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"Medical Care Price Indexes for Patients with Employer-Provided Insurance: Nationally-Representative Estimates from MarketScan Data"[1]

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I. INTRODUCTION

In recent years, healthcare service utilization has undergone several shifts, having potentially important implications for the cost of medical care. For example, while inpatient care has been declining, surgeries at outpatient departments and other venues not requiring a costly overnight stay have been rising.[2] These shifts in medical care are not reflected in official price indexes reported by the Bureau of Labor Statistics (BLS). The official price indexes capture the provider prices for a fixed basket of goods or services, which do not allow for shifts in treatment.[3] This type of index is referred to as a "service price index" or SPI in the literature. Alternative indexes have been proposed that would capture the effect of service shifts on costs (Schultze and Mackie (2002)). In fact, many health economists have advocated an index that tracks the actual expenditures associated with an episode of care, without holding the service mix fixed. For example, if depression is now treated with drug therapy, rather than more expensive talk therapy, the alternative index figures would show cost reductions associated with this switch. This alternative index is referred to as a "medical care expenditure index," or MCE.

Aizcorbe and Nestoriak (2010) (henceforth referred to as AN) have made a recent contribution to the MCE literature. Unlike the prior work on MCE indexes that primarily

[2] In addition, anecdotal reports suggest that innovations in prescription drugs have brought about a transition away from utilization of non-drug care; recent studies suggest that cost-offsetting effects do result from these transitions (See Chernew and Fendrick (2009) for a recent review). There are several other examples of these observed shifts in medical care toward potentially lower-cost treatments leading to lower costs of care. See Winter (2003) on the growth of outpatient surgery settings. There are many other examples. In the case of home care, advances in medical equipment have minimized the need for professional administration and monitoring, allowing home care to be a more viable alternative to hospital care for some conditions (See, for example, http://aappolicy.aappublications.org/cgi/reprint/pediatrics;118/2/834.pdf for pediatric home care). Among patients with private insurance, the mix of medical care shifted towards outpatient services and pharmaceuticals over the period from 2001 to 2006 (Bundorf et al. 2009).

[3] See Berndt et al. (2000) and Schultze et al. (2002) for a full discussion of the issues.

focus on case studies, they contribute to this literature by carefully documenting expenditure shifts across a broad range of conditions. They find that an MCE index that accounts for these shifts grows at an annual rate of 4 percent over the period 2003-2005, which is 2 percent slower than an SPI index. These results are important, as they suggest that current inflation may be significantly overstated and real GDP growth may be understated by a similar amount.

While the AN paper presents a potentially important finding, there are a number of limitations to their study. First, the sample used in their analysis is from the Pharmetrics claims data, which only includes commercially insured patients (i.e. not Medicare, Medicaid or uninsured). Second, although their dataset is large (over 9 million patients with claims in each year), it is unclear whether the sample is representative of the entire U.S. commercially insured population. Third, they examine a limited time period from 2003 to 2005.

The goal of this study is to assess the robustness of the AN results to gain further insight into the medical utilization shifts and trends. To do this we replicate their analysis using Thomson/Reuters' MarketScan data that has a different sample of enrollees including data from both large employers and insurers. We provide a comparison of the trends in both datasets for the years 2003 to 2005, as well as the period 2003 to 2007 to see if their results can be generalized over an extended period of time. While neither the MarketScan data nor the Pharmetrics database is representative of the commercially insured or national populations, a panel of health experts at the National Academy of

Sciences (NAS) suggests that using a subgroup of the national population is a good first step in "demonstrat[ing] that dollars spent in the economy on medical care can be allocated into disease categories in a fashion that yields meaningful information."[4] Although the underlying data in both studies is based on convenience samples, in this paper we take an additional step of applying weights based on region, age and sex to make the analysis representative of the commercially-insured population and examine how these weights affect our results.[5]

Overall we find results that are qualitatively similar to AN. Over the 2003:1 to 2005:1 period, we find that the MCE index grew at a compound annual rate (CAGR) of about 3.6 percent per year, which is 0.9 percentage points slower than the SPI index. As noted in AN, a literal interpretation of this result is that the expenditure growth in our sample would have been even higher in the absence of service shifts. While the qualitative finding is similar, we find a smaller difference between the MCE and SPI indexes, implying a smaller inflation bias. Compared to our finding of a 0.9 percent difference, the AN study finds that the MCE index grew at a CAGR that is 1.5 percentage points slower than the SPI index. Although our measure of bias is smaller, the health sector of the economy is large enough (16 percent of GDP) [6] that the bias could cause economy-wide inflation to be overstated. Even our more conservative estimates suggest an

[4] It is also important to note that the commercially insured are about 61.6 percent of the population (See Health United States (2009)).
[5] More generally, another contribution of this paper is that it follows the advice of the NAS that has determined that the Bureau of Economic Analysis should "investigate the impact of different expenditure allocation approaches . . . on price index construction and performance."
[6] This calculation is based on the Bureau of Economic Analysis estimate that healthcare comprises 16 percent of GDP.

inflation bias of about 0.1 percentage points per year, with an understatement of real GDP growth of the same amount.

The paper is organized as follows: Section II provides additional background discussion. Section III discusses methodological issues and the MarketScan data. Section IV discusses the results and Section V concludes.

II. BACKGROUND

Much of the literature associated with the examination of an MCE index has focused on case studies that attempt to control for the quality of treatments, or a quality-adjusted MCE. Generally, these empirical studies have found that the SPI indexes significantly overstate the rate of price growth for medical care. This has been shown in the seminal work by Cutler et al. (1998) examining the effects of heart attacks. Other examples of case studies with similar findings look at cataracts (Shapiro et al. (2001)) and depression (Berndt et al. (2001)).[7]

Aizcorbe and Nestoriak focus on a different aspect of MCE indexes. Instead of focusing on creating "ideal" measures for price growth, they focus on how expenditure shifts impact the MCE index relative to an SPI index across a broad range of conditions. They contribute to the literature by providing empirical evidence that: (1) service shifts across industry lines have occurred in a broad range of conditions (i.e. they go well beyond the

[7] Also see Cutler and McClelland (2001) who discuss five distinct disease areas.

conditions covered in the literature);[8] (2) that these changes in the way that medical care is provided have worked to hold down spending growth for patients in their sample; (3) to the extent similar shifts have occurred across a broader patient population, these shifts could cause a significant upward bias in official price indexes; and (4) they also provide evidence on several specific service shifts, including reduced reliance on inpatient care in favor of care at outpatient departments and venues that do not require an overnight stay, increased use of home care, and increased use of prescription drugs.

III. METHODOLOGY

This paper precisely follows the methodology of AN so that we are able to directly compare results between their paper and ours and isolate the factors that affect any divergence between our results. In particular, the differences we focus on include: (1) differences in the sample used (MarketScan vs. Pharmetrics); (2) differences in the use of weights (weighted versus unweighted); and (3) differences in the years examined (2003-2005 vs 2003-2007). This section provides a brief review of the methodology used in this paper, which closely follows that presented in AN.

A. MCE and SPI Indexes

This section describes the construction of MCE and SPI indexes. In detailing the MCE index, there are two critical steps that must be taken. First, each observation must be

[8] Services were defined by industry because it is consistent with the BLS classification system for the official price indexes: hospitals (inpatient and outpatient), ambulatory care, and prescription drugs. Any shifts within these industries will have implications for how prices are measured for those industries.

linked to a particular condition. To do this we link each observation in the data to a claim using a "grouper" algorithm that was also applied in AN's work; this method is discussed in greater detail in the following section. Second, following AN, we choose a fixed time period (a quarter) over which to measure expenditures.

The MCE index is the average cost of treating a specific disease in the base period for a given patient, compared with the cost of treating a disease for a given patient in the current period. More precisely, let the expenditures for the services used to treat disease d in period 2 be denoted c_d.[9] To calculate c_d, we sum the number of encounters of a particular service used to treat the disease, multiply it by the price of the service (e.g. outpatient visit for treating a particular disease), and divide it by the number of people with that disease. Formally, using superscripts to represent period 2, this is calculated as $\Sigma_s c_{d,s}^{\ 2}\, x_{d,s}^{\ 2} / N_d^{\ 2}$, where $c_{d,s}$ is the price of service s for treating disease d and is calculated by summing up expenditures for disease d and dividing by the number of encounters; $x_{d,s}$ is the number of encounters for service s performed for disease d; and N_d is the number of people with disease d in period 2. The MCE index is the ratio of period 1 prices to treat the disease, divided by period 2 prices:

$$(1) \qquad MCE_d = c_d^{\ 2} / c_d^{\ 1} = \frac{\Sigma_s (c_{d,s}^{\ 2}\, x_{d,s}^{\ 2}) / N_d^{\ 2}}{\Sigma_s (c_{d,s}^{\ 1}\, x_{d,s}^{\ 1}) / N_d^{\ 1}}$$

[9] For inpatient stays, we define the service as the medical confinement.

The MCE measure allows for shifts in both the type and number of services performed for a given patient. In contrast, the SPI represents an index similar to those used traditionally that holds fixed the basket of services performed across time periods. Specifically, the price change from period 1 to period 2 is:

$$(2) \qquad SPI_d = \frac{\Sigma_s (c_{d,s}^{2} x_{d,s}^{1}) / N_d^{1}}{\Sigma_s (c_{d,s}^{1} x_{d,s}^{1}) / N_d^{1}}$$

That is, for the SPI index, the x's and the N's are held fixed from period 1 to period 2. The idea here is to track the amount of dollars needed to compensate a patient for any change in the price of a service given that she consumes the same service mix between periods. AN show that the MCE_d index may be decomposed into several components; it can be decomposed into a component that is due to service prices changing, SPI_d, or a change in the amount of services used per condition, $dU_{d,s} = (x_{d,s}^{2}/ N_d^{2})/ (x_{d,s}^{1}/ N_d^{1})$. The full decomposition of the MCE_d index is:

$$(3) \qquad MCE_d = SPI_d + \Sigma_s \{ SPI_{d,s} (dU_{d,s} - 1) \} ,$$

The additional term $SPI_{d,s}$ is the contribution of service s to the SPI index and is calculated as: $SPI_{d,s} = (c_{d,s}^{2} x_{d,s}^{1}) / \Sigma_s (c_{d,s}^{1} x_{d,s}^{1})$. Note that if there is no shift in

utilization then $dU_{d,s}=1$ and the two price measures are identical. For additional details regarding the decomposition, see AN.

The overall MCE and SPI indexes may be constructed from the disease specific indexes by weighing each diseases contribution to the total.

B. Measuring Spending by Disease

To construct the above price indexes, it is necessary to classify spending by disease. There are a number of methods that may be used to classify spending, which is discussed more extensively in AN. Here, similar to the original AN work, we classify disease spending using a commercial algorithm called a grouper; both studies use the ETG grouper from Symmetry. A grouper applies an algorithm to the data to assign each record to an episode. An important advantage of this approach is that it does not require medical expertise. However, these algorithms are also a "black box" in the sense that they rely entirely on the expertise of those that developed the grouper software.

The ETG grouper, developed by Symmetry, allocates each record into one of over 500 disease groups called "episode treatment groups" (ETGs). Although the price indices are constructed at the ETG level, the results will be presented at a higher level of aggregation that Symmetry calls "major practice categories," or MPCs.

IV. DATA

We use a sample of enrollees that are not in capitated plans from the MarketScan database.[10] We also limit our sample to enrollees with drug benefits, since drug purchases will not be observed for individuals without drug coverage. The MarketScan database tracks claims from all providers using a nationwide convenience sample of patients and is therefore not representative of all commercially insured patients. MarketScan collects data from employers, health plans, and state-level Medicaid agencies; all claims have been paid and adjudicated. Each enrollee has a unique identifier and can be identified at the three-digit zip code level.[11] This paper uses the Commercial Claims and Encounters Database portion of the MarketScan Databases, which includes healthcare utilization and cost records at the encounter level. This portion of the database provides patient identifiers that may be used to sum expenditures to the patient level. In this study we use data from 2003 to 2007.

The Commercial Claims and Encounters Database contains data from employer and health plan sources concerning medical and drug data for several million employer-sponsored insurance (ESI)-covered individuals, including employees, their spouses, and dependents. These enrollees obtain healthcare under fee-for-service plans, full and partially capitated plans, preferred and exclusive provider organizations, point of service plans, indemnity plans, health maintenance organizations, and consumer-directed health plans (Adamson, Chang and Hansen (2008)). Each observation in the data corresponds

[10] Plans that pay providers based on capitation are not used here because payments are often not observed for capitated claims and cannot be associated with particular services.
[11] MarketScan User Guide: National Weights (White Paper)

to a line item in an "explanation of benefits" form; therefore each claim can consist of many records and each encounter can consist of many claims. To obtain the numbers of services and treated patients ("x" and "N" respectively throughout this paper), we aggregate the individual records assigned to a specific condition. For services that last only one day (e.g. pharmacy visit, office visit), we define the service as a day of care from the provider for a particular disease. For inpatient stays, we define the service as the medical confinement.[12] We group providers by industry (using an identifier for the place of service), by the medical disease (using the ETG code assigned by the Symmetry grouper), and by day (using the date). We measure the number of patients treated as the number of people that received treatment for a disease, d, in a given period. Expenditures are measured as the amount received by all providers of the services (including both out-of-pocket payments and amounts paid by insurance firms).

Claims datasets such as Pharmetrics and MarketScan have been used in some other studies that explored problems in medical care price indexes (Berndt et al. (2001) and Song et al. (2009)) and in other studies that document shifts in utilization (Bundorff et al. (2009) and Chernew and Fendrick (2009)). Although these indexes are not nationally representative, their advantage is that the large number of observations provides a better representation of spending at the high end of the distribution and the use of administrative records avoids undercount issues typical of household expenditure surveys (Aizcorbe et al. 2010).

[12] Because our data begin in 2003:1, we will understate the cost of confinements that were in progress over the turn of that year. However, to the extent that our goal is to compare results from the two types of indexes, and that the understatement is the same in both of the indexes, our inferences about treatment shifts and their effect on cost savings should be valid.

A. Descriptive Statistics

Table 1 below provides some basic descriptive statistics of the enrollees in both samples. Looking at the age and sex of the two populations, the samples are relatively similar. However, there are some other notable differences. First, the population in the MarketScan data grows substantially over the study period, starting with a population of 9.9 million (10 percent smaller than the Pharmetrics data), and nearly doubling in size to 19.1 million. This growth is from two sources: (1) the incorporation of insurance claims data starting in 2003 and expanding over the entire sample period and (2) an expansion in the number of enrollees from employers.[13] In contrast, the Pharmetrics sample experienced relatively minor growth. Another important difference is that the MarketScan data draws disproportionately from the southern region of the United States.[14] This difference from the true nationwide distribution of the population implies that it may be important to apply weights that control for the enrollment distribution across geographic areas.

[13] The number of visits from the sample of enrollees associated with large employers rose by 72 percent over this period, while the share of visits from enrollees associated with insurers rose by 256 percent. As a percent of overall visits, insurance claims accounted for just 33 percent of claims in 2003, and increased to 49 percent by 2007.

[14] The actual population distribution as of July 2006 was Northeast (18 percent), Midwest (22 percent), South (36 percent), and West (23 percent). While the MarketScan data undersamples the south the Pharmetrics data over-samples this region.

Table 1. Descriptive Statistics for MarketScan and Pharmetrics Samples

		MarketScan			Pharmetrics	
		2003	2005	2007	2003	2005
Number of plans		-	-	-	21	21
Number of enrollees (mil)		9.9	15.2	19.1	10.9	11.3
Gender						
	Female	51.7%	51.6%	51.2%	54.5%	53.9%
	Male	48.3%	48.4%	48.8%	45.5%	46.1%
Age						
	0 to 18	26.6%	27.3%	27.6%	29.7%	28.0%
	19 to 24	8.5%	8.2%	8.5%	6.6%	6.7%
	25 to 34	14.0%	14.0%	14.2%	13.9%	13.7%
	35 to 54	35.9%	35.4%	35.1%	37.1%	37.1%
	55 and over	14.9%	15.2%	14.7%	12.7%	14.6%
Region						
	NE	11.3%	11.2%	11.6%	22.5%	24.3%
	MW	28.0%	26.8%	23.0%	26.1%	27.8%
	S	46.2%	45.8%	49.6%	31.5%	30.4%
	W	14.5%	16.2%	15.7%	19.8%	17.4%

There are also dissimilarities in spending across the two samples shown. Table 2 shows spending by service categories for both the Pharmetrics and MarketScan datasets for the first quarter of 2003 (2003:1). For many of the services the spending appears to be a bit higher in the MarketScan data. This is especially true for inpatient and outpatient hospital services that are 37 percent and 67 percent more expensive per visit in the MarketScan data relative to the Pharmetrics data. Despite having fewer enrollees, overall spending is larger for 2003:1 in the MarketScan sample. This finding may be due to numerous differences across the two samples, such as the geographic location of

enrollees, the generosity of coverage, the health state of the population in different samples, and how records are gathered and maintained across the two data providers.

Table 2. Spending by Place of Service, 2003: 1

	MarketScan		Pharmetrics	
Place of Service	Spending/ Encounter	Total Spending (millions)	Spending/ Encounter	Total Spending (millions)
Inpatient Hospital	$5,807	$1,837.1	$4,332	$1,488
Office Visits	$108	$1,342.6	$105	$1,461
Pharmacy	$73	$1,382.5	$87	$1,326
Outpatient Hospital	$527	$1,543.7	$314	$306
Emergency Room-Hospital	$365	$145.1	$370	$181
Ambulatory Surgical Center	$1,703	$123.2	$1,079	$92
Home Care	$312	$109.3	$281	$84
Other inpatient hospital care	$417	$79.6	$432	$81
Independent Lab	$52	$46.2	$54	$63
Other	$276	$167.4	$211	$40
Total Spending		**$6,776.6**		**$5,122**

Table 3 shows the allocation of spending by disease type for the MarketScan data, with the last column showing the percentage share of total spending for each disease in the Pharmetrics data. Of the $6.7 billion of total spending reported in the MarketScan data for 2003:1, about 97 percent is allocated to disease classes (MPC 1 to 19), and just over 1 percent is allocated to non-disease MPCs (preventative and administrative care). Similar to AN, we find that most of these allocations (96 percent) are done using some combination of diagnosis (ICD-9) and procedure codes (CPT-4) on the claim record or in the patients' histories (column 1). The remainder of the expenditures are allocated using NDC drug codes (column2) —this represents spending by patients with ongoing prescriptions with no other medical encounters (hence, no diagnosis or procedure codes). Comparing the percentage of disease allocation across the MarketScan and Pharmetrics

data, we find that these two distinct samples have similar allocations of disease spending. This is expected because identical grouper algorithms were applied to both samples to classify diseases; furthermore, the age distribution of the population is similar across datasets. Orthopedics and rheumatology is the largest share for both samples, at almost 15 percent each. Although the allocation of spending is similar in both datasets, some interesting differences do exist. Cardiology has the largest difference, with its share being 3.5 percent larger in the MarketScan data; cardiology has the second largest share of total spending in each sample. In general, MarketScan allocates more spending to specific categories, as reflected in the smaller share of expenditures in the "other" category.

Table 3. Allocation of Spending by Disease, 2003: 1
(million dollars)

	MarketScan				Pharmetrics
	SPENDING ALLOCATED USING				
MAJOR PRACTICE CATEGORY	Diagnoses and Procedure Codes	Drug Codes (NDC)	Total Spending millions	percent	Total Spending percent
1 INFECTIOUS DISEASES	$72.4	$8.1	$80.5	1.2%	1.0%
2 ENDOCRINOLOGY	$414.5	$36.7	$451.2	6.7%	6.0%
3 HEMATOLOGY	$139.9	$2.0	$141.9	2.1%	2.3%
4 PSYCHIATRY	$254.2	$36.8	$291.1	4.4%	5.3%
5 CHEMICAL DEPENDENCY	$27.9		$27.9	0.4%	0.6%
6 NEUROLOGY	$353.0	$20.8	$373.8	5.6%	5.5%
7 OPHTHALMOLOGY	$91.4	$0.3	$91.7	1.4%	1.7%
8 CARDIOLOGY	$847.6	$11.3	$858.9	12.8%	9.3%
9 OTOLARYNGOLOGY	$404.0	$24.4	$428.4	6.4%	7.6%
10 PULMONOLOGY	$365.9	$13.5	$379.4	5.7%	4.8%
11 GASTROENTEROLOGY	$559.6		$592.3	8.9%	8.5%
12 HEPATOLOGY	$158.7		$158.7	2.4%	2.3%
13 NEPHROLOGY	$99.1		$99.1	1.5%	1.0%
14 UROLOGY	$215.1	$3.0	$218.1	3.3%	2.9%
15 OBSTETRICS	$242.0		$242.0	3.6%	4.4%
16 GYNECOLOGY	$442.0	$0.4	$442.4	6.6%	6.5%
17 DERMATOLOGY	$225.7	$6.7	$232.4	3.5%	3.9%
18 ORTHOPEDICS & RHEUMATOLOGY	$980.6	$8.9	$989.5	14.8%	14.7%
19 NEONATOLOGY	$103.9		$103.9	1.6%	1.9%
20 PREVENTIVE AND ADMINISTRATIVE	$126.5	$45.3	$171.8	2.6%	3.7%
21 LATE EFFECTS, ENVIRONMENTAL TRAUMA AND POISONINGS	$32.8		$32.8	0.5%	0.5%
22 ISOLATED SIGNS & SYMPTOMS	$73.7	$8.3	$82.1	1.2%	1.5%
OTHER	$195.4		$195.4	2.9%	4.1%
Total	**$6,426.0**	**$259.3**	**$6,685.3**	**100.0%**	**100.0%**

Tables 1 through 3 provide some basic descriptive statistics to compare the two samples, but there are other key differences between the MarketScan and Pharmetrics data. While both are convenience samples, they draw from distinct data sources. MarketScan primarily obtains information from large employers, although it has gained additional data from commercial insurers since 2002; Pharmetrics only gathers data from insurers.[15] Both datasets only include claims from enrollees in non-capitated plans. Unfortunately the plan types appear to be different across the two datasets. In the Pharmetrics data it seems that a plan is categorized as an HMO plan if it is marketed as an HMO. MarketScan, according to its documentation, defines a plan as an HMO based on several criteria; these include incentives to use certain providers, no out-of-network service coverage, mandatory referrals to specialists, assigned primary care physicians, and some capitated payments to providers. Therefore, no HMOs, as defined by MarketScan, are included in the sample.[16] In contrast, over one fourth of the Pharmetrics sample is characterized as HMO.

The many differences between the MarketScan and Pharmetrics samples, and how data is gathered, add to the usefulness of this study. In particular, given that the two databases draw upon unique samples, if the trends across the two samples agree, they are more likely to be representative of the larger population. Conversely, if the samples drew from similar populations, then little may be learned from using an alternative data source.

[15] An important difference between data coming from large insurers and employers is that the amount of turnover in the sample. Data sets from insurers typically have higher turnover in the sample because it is more common for individuals to change insurers than change jobs.

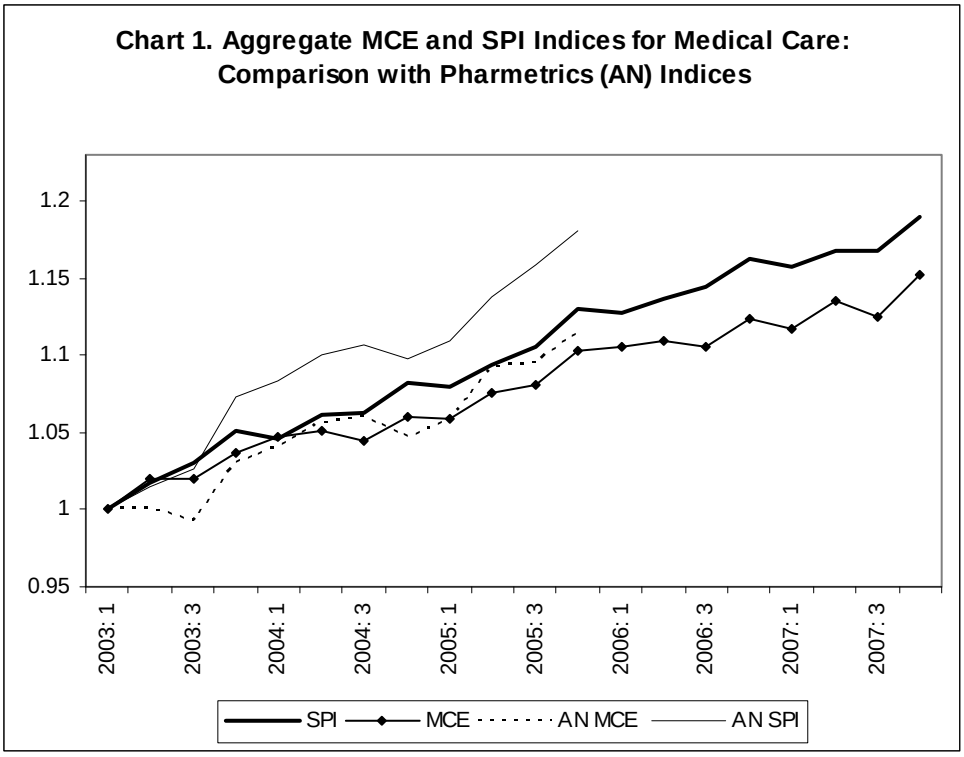
[16] While this is stated in the MarketScan documentation, the Thomson/Rueters staff suggested that this definition was not so clear. However, they stated that because they do not have a clear identifier for which plans are capitated (until 2008), they commonly recommended dropping HMO plans to remove capitation. In the future we may want to examine whether results are different if HMOs are left in the sample.

V. RESULTS

Chart 1 illustrates a comparison of the SPI, which measures the prices of the underlying treatments, and the MCE, which measures the cost of treating diseases, from both the Pharmetrics and MarketScan datasets. Using the Marketscan data, the quarterly indexes are constructed for 2003:1 through 2007:4, with 2003:1 being the baseline of 1.0; the Pharmetrics indexes are shown from 2003:1 through 2005:4. Based on the MarketScan results for the period 2003:1 to 2007:4, the MCE exhibits slower growth than the SPI: the difference between the two indexes is notable, with the SPI growing 18.9 percent over the three-year period and the MCE growing at a markedly slower 15.3 percent. There is a difference of about 0.7 percentage points between the compound annual growth rates, with the MCE compound annual growth rate (CAGR) being 3.0 percentage points and the SPI CAGR being 3.7 percentage points.

Overall, our findings are similar to those of AN. Similar to the MarketScan results, they find that the MCE grows slower than the SPI. However, there are two key differences. First, the overall growth rate using the Pharmetrics sample is faster for both types of indexes, with compound annual growth rates of 6.1 percentage points for the SPI versus 4.4 percentage points for the MCE. Second, the difference between the MCE and SPI is notably smaller in the MarketScan data even when focusing on the same 2003:1 to 2005:4 period. The difference in the CAGR between in MCE and SPI indexes is 0.9 percentage points over this three year period, compared to a difference of 1.5 percentage

points found using the Pharmetrics data. The results from both datasets suggest that the SPI index overstates inflation and understates real GDP, but the results using the MarketScan data suggest that this bias may be smaller than that implied by the Pharmetrics data.



Using the additional years of data from the MarketScan study that extends to the fourth quarter of 2007, we find that the difference between the MCE and SPI index continues to grow during the post 2005 period. From the first quarter of 2006 to the fourth quarter of 2007 the SPI grows at a CAGR of 3.1 percentage points while the MCE has a CAGR of 2.4 percentage points, a difference of 0.7 percentage points.

The results presented in Chart 1 are for an unweighted population. Next, we apply population weights so that the MarketScan population is nationally representative of the commercially insured population;[17] the weighted results are nearly identical to the unweighted results. Although both the SPI and MCE grow at slightly faster rates using the weighted results, the difference in levels between the SPI and MCE indexes is quite similar using the weighted or unweighted results. Therefore, even when population weights are applied, the implied bias of using an MCE index relative to an SPI index remains unchanged.

Table 4. Comparison of Weighted and Unweighted Price Indices with AN Unweighted Results

			MarketScan			
	AN results		Unweighted		Weighted	
Year: Quarter	SPI	MCE	SPI	MCE	SPI	MCE
2003: 1	1.00	1.00	1.00	1.00	1.00	1.00
2003: 2	1.02	1.00	1.02	1.02	1.02	1.02
2003: 3	1.03	0.99	1.03	1.02	1.03	1.02
2003: 4	1.07	1.03	1.05	1.04	1.05	1.04
2004: 1	1.08	1.04	1.05	1.05	1.05	1.05
2004: 2	1.10	1.06	1.06	1.05	1.06	1.05
2004: 3	1.11	1.06	1.06	1.05	1.06	1.04
2004: 4	1.10	1.05	1.08	1.06	1.09	1.06
2005: 1	1.11	1.06	1.08	1.06	1.09	1.06
2005: 2	1.14	1.09	1.09	1.08	1.10	1.08
2005: 3	1.16	1.10	1.11	1.08	1.11	1.09
2005: 4	1.18	1.11	1.13	1.10	1.14	1.11
2006: 1			1.13	1.11	1.14	1.12
2006: 2			1.14	1.11	1.15	1.13
2006: 3			1.14	1.11	1.16	1.12
2006: 4			1.16	1.12	1.18	1.14
2007: 1			1.16	1.12	1.17	1.14
2007: 2			1.17	1.13	1.19	1.16
2007: 3			1.17	1.12	1.19	1.15
2007: 4			1.19	1.15	1.21	1.18

[17] The weights applied are constructed based on the age, sex and region of the population.

Next we turn to the decomposition to examine what factors are causing the differences between the MCE and SPI indexes. For comparison, we include results from both the unweighted MarketScan data and the Pharmetrics data over the same time period 2003:1 to 2005:4. The left panel of Table 5 compares the growth of the two indexes across 19 major disease categories, providing a look into the sources of differences between the two indexes. Growth rates for the MCE and SPI indexes indicate that expenditures per patient as well as the average price of services increased for many of the major categories. The third column shows the difference between the two indexes. As indicated by the negative numbers, for most conditions expenditures per patient did not grow as fast as they would have if patients had received the same bundle of services in 2005 that patients received in 2003. There are three exceptions in the MarketScan data: 1) ophthalmology, 2) obstetrics, and 3) orthopedics & rheumatology. The exceptions in the Pharmetrics analysis were chemical dependency and obstetrics. Combined, the three exceptions we found in the MarketScan data comprise about 19 percent of total spending, and the Pharmetrics exceptions comprised a total of about 10 percent of total spending. While the exceptions represent a relatively small share in spending in both datasets, they are still examples where the cost of treating entire diseases rose faster than the cost of the individual treatments, owing to increases in utilization.

Table 5. AN Comparison of Price Indexes and Sources of Differences, 2003: 1 - 2005: 4

MarketScan Decomposition Results Unweighted

					Hospital		Office		
	Major Practice Category	MCE	SPI	MCE-SPI	Inpatient	Outpatient	Visits	Pharmacy	Other
1	INFECTIOUS DISEASES	1.15	1.17	-0.02	0.01	0.00	-0.01	-0.02	0.00
2	ENDOCRINOLOGY	1.10	1.16	-0.07	-0.04	0.00	-0.01	-0.02	-0.01
3	HEMATOLOGY	1.16	1.19	-0.04	-0.03	0.00	0.00	0.00	0.00
4	PSYCHIATRY	1.04	1.11	-0.08	0.00	0.00	-0.03	-0.02	-0.01
5	CHEMICAL DEPENDENCY	1.03	1.06	-0.03	-0.05	0.06	-0.02	0.01	-0.03
6	NEUROLOGY	1.10	1.17	-0.06	-0.03	-0.01	0.00	-0.01	-0.01
7	OPHTHALMOLOGY	1.09	1.08	0.01	0.00	0.00	0.01	-0.01	0.02
8	CARDIOLOGY	1.01	1.12	-0.11	-0.08	-0.01	0.00	-0.02	-0.01
9	OTOLARYNGOLOGY	1.12	1.13	-0.01	0.00	0.00	0.00	-0.02	0.02
10	PULMONOLOGY	1.06	1.09	-0.03	-0.01	0.00	0.00	-0.01	0.00
11	GASTROENTEROLOGY	1.15	1.14	0.00	-0.01	0.00	0.00	-0.01	0.02
12	HEPATOLOGY	1.04	1.07	-0.04	-0.02	-0.01	0.00	-0.01	0.00
13	NEPHROLOGY	1.06	1.14	-0.08	-0.02	-0.05	0.00	-0.01	0.00
14	UROLOGY	1.08	1.10	-0.02	-0.02	0.00	0.00	0.00	0.00
15	OBSTETRICS	1.16	1.09	0.07	0.06	0.01	0.00	0.00	0.00
16	GYNECOLOGY	1.13	1.13	0.00	0.00	0.01	0.00	-0.01	0.00
17	DERMATOLOGY	1.15	1.17	-0.02	-0.01	0.00	-0.01	-0.01	0.00
18	ORTHOPEDICS & RHEUMATOLOGY	1.16	1.14	0.02	0.01	-0.01	0.02	-0.01	0.01
19	NEONATOLOGY	1.16	1.19	-0.03	-0.03	0.00	0.00	0.00	-0.01

AN Decomposition Results using Pharmetrics

					Hospital		Office		
	Major Practice Category	MCE	SPI	MCE-SPI	Inpatient	Outpatient	Visits	Pharmacy	Other
1	INFECTIOUS DISEASES	1.36	1.37	0.00	-0.02	-0.01	-0.01	0.01	0.01
2	ENDOCRINOLOGY	1.11	1.15	-0.04	-0.04	-0.01	-0.02	0.03	0.00
3	HEMATOLOGY	1.18	1.24	-0.06	-0.04	-0.02	-0.01	0.00	0.02
4	PSYCHIATRY	1.02	1.08	-0.06	-0.02	0.00	-0.05	0.02	-0.01
5	CHEMICAL DEPENDENCY	1.16	1.12	0.04	0.00	-0.02	-0.02	0.03	0.05
6	NEUROLOGY	1.12	1.21	-0.09	-0.04	-0.02	-0.03	0.01	-0.01
7	OPHTHALMOLOGY	1.08	1.11	-0.03	0.00	-0.02	-0.01	0.00	0.01
8	CARDIOLOGY	1.00	1.19	-0.19	-0.15	-0.02	-0.01	0.00	-0.01
9	OTOLARYNGOLOGY	1.09	1.15	-0.06	0.00	-0.03	-0.02	-0.01	0.00
10	PULMONOLOGY	1.15	1.21	-0.05	-0.03	-0.02	-0.02	0.00	0.00
11	GASTROENTEROLOGY	1.16	1.23	-0.07	-0.03	-0.03	-0.02	0.00	0.01
12	HEPATOLOGY	1.08	1.14	-0.05	-0.03	-0.01	-0.01	-0.02	0.01
13	NEPHROLOGY	1.02	1.10	-0.08	-0.02	-0.05	0.00	0.00	0.00
14	UROLOGY	1.07	1.17	-0.10	-0.04	-0.03	-0.02	0.00	-0.01
15	OBSTETRICS	1.17	1.16	0.01	0.01	0.00	0.00	0.00	0.01
16	GYNECOLOGY	1.11	1.21	-0.10	-0.04	-0.03	-0.03	-0.01	0.00
17	DERMATOLOGY	1.16	1.20	-0.04	-0.01	-0.01	-0.02	-0.01	0.00
18	ORTHOPEDICS & RHEUMATOLOGY	1.11	1.18	-0.08	-0.02	-0.03	-0.01	0.00	-0.01
19	NEONATOLOGY	1.17	1.18	-0.01	-0.01	0.00	0.01	0.00	0.00

The evidence presented in Table 5 suggests that shifts in the bundle of services are pervasive. To explore the sources of those shifts, the right panel of Table 5 uses the decomposition from equation (3) to link the differences in the price indexes to shifts in the underlying services. More precisely, these are the shifts in service as measured by $dU_{d,s}\text{-}1= (x_{d,s}^{2}/ N_d^{2})/ (x_{d,s}^{1}/ N_d^{1})\text{-}1$. Recall that a value of $(dU_{d,s}\text{-}1)$ below 0 indicates a decline in the MCE_d relative to the SPI_d caused by a shift in service s, while a value above 0 indicates a service shift causing an increase in price relative to the SPI. As

discussed above, a positive sign reflects an increase in service intensity while a negative sign reflects a decrease. In line with Aizcorbe and Nestoriak's findings, our results suggest that many of the shifts in services seem to be related to declining utilization at inpatient hospitals, possibly due to surgeries being performed elsewhere (e.g. ambulatory surgical centers).

The additional columns in Table 5 show movements in MCE prices caused by the shifts in services, relative to shifts in the price of underlying services. Endocrinology (including diabetes) shifted away from hospitals visits, doctors' offices and drugs; the shift held expenditures down by 7 percentage points. Similarly, psychiatry, which includes anxiety and depression (line 4), experienced a shift from inpatient stays, office visits and drugs. Finally, in both samples, cardiology exhibited a large decline in expenditures (11 percentage points and 19 percentage points in MarketScan and Pharmetrics, respectively). Consistent with the Pharmetrics analysis, we observe a general shift away from inpatient hospital services across many of the diseases in the MarketScan data. However, in contrast to the AN study, we observe less of a shift toward drugs, with the exception of chemical dependence.

The above decomposition provides evidence that many of the results are similar across the unweighted MarketScan and Pharmetrics samples. To check the robustness of these results we examine these decompositions using alternative time periods and also applying population weights. Table 6 shows the MCE and SPI prices across diseases for two alternative samples of the data. Estimate 1, shown in the first 3 columns, are for the

unweighted sample from 2003:1 to 2005:4; these are the same results reported in Table 5. The results for Estimate 2, shown in the next three columns, are for the same time period, but have population weights applied to the sample. Looking at these results, we find that they are quite similar across all disease categories, except for neonatology, which reports a price increase that is 15 percent faster relative to the unweighted sample. (Currently, the cause of the large gap between the weighted and unweighted results for neonatology is unclear.)

Table 6. Comparison of Price Indices and Sources of Differences

		Estimate 1			Estimate 2			Estimate 3			Estimate 4		
		Unweighted 2003: 1 - 2005: 4			Weighted 2003: 1 - 2005: 4			Weighted 2003: 1 - 2007: 4			Weighted 2003: 1 - 2007: 1		
	Major Practice Category	MCE	SPI	MCE-SPI	MCE	SPI	MCE-SPI	MCE	SPI	MCE-SPI	MCE	SPI	MCE-SPI
1	INFECTIOUS DISEASES	1.15	1.17	-0.02	1.19	1.21	-0.02	1.34	1.39	-0.05	1.25	1.33	-0.07
2	ENDOCRINOLOGY	1.10	1.16	-0.07	1.09	1.16	-0.07	1.09	1.18	-0.09	1.06	1.15	-0.09
3	HEMATOLOGY	1.16	1.19	-0.04	1.14	1.19	-0.05	1.24	1.28	-0.04	1.24	1.27	-0.03
4	PSYCHIATRY	1.04	1.11	-0.08	1.04	1.11	-0.08	1.05	1.15	-0.11	1.07	1.14	-0.07
5	CHEMICAL DEPENDENCY	1.03	1.06	-0.03	1.03	1.07	-0.03	1.05	1.17	-0.12	1.04	1.08	-0.04
6	NEUROLOGY	1.10	1.17	-0.06	1.11	1.18	-0.07	1.22	1.31	-0.08	1.13	1.20	-0.07
7	OPHTHALMOLOGY	1.09	1.08	0.01	1.08	1.07	0.01	1.13	1.18	-0.05	1.07	1.13	-0.06
8	CARDIOLOGY	1.01	1.12	-0.11	1.01	1.12	-0.11	1.03	1.17	-0.14	1.02	1.12	-0.10
9	OTOLARYNGOLOGY	1.12	1.13	-0.01	1.12	1.13	-0.01	1.18	1.19	-0.01	1.11	1.13	-0.02
10	PULMONOLOGY	1.06	1.09	-0.03	1.08	1.10	-0.02	1.15	1.22	-0.06	1.10	1.17	-0.07
11	GASTROENTEROLOGY	1.15	1.14	0.00	1.15	1.16	0.00	1.25	1.25	0.01	1.17	1.16	0.01
12	HEPATOLOGY	1.04	1.07	-0.04	1.04	1.08	-0.04	1.11	1.16	-0.05	1.03	1.07	-0.04
13	NEPHROLOGY	1.06	1.14	-0.08	1.05	1.10	-0.05	0.94	0.99	-0.05	0.97	1.10	-0.13
14	UROLOGY	1.08	1.10	-0.02	1.07	1.10	-0.03	1.17	1.21	-0.04	1.12	1.15	-0.03
15	OBSTETRICS	1.16	1.09	0.07	1.17	1.10	0.07	1.28	1.20	0.08	1.14	1.13	0.01
16	GYNECOLOGY	1.13	1.13	0.00	1.13	1.13	0.00	1.23	1.23	0.00	1.16	1.17	0.00
17	DERMATOLOGY	1.15	1.17	-0.02	1.15	1.17	-0.02	1.23	1.27	-0.04	1.21	1.24	-0.03
18	ORTHOPEDICS & RHEUMATOLOGY	1.16	1.14	0.02	1.15	1.15	0.01	1.22	1.21	0.01	1.15	1.15	0.00
19	NEONATOLOGY	1.16	1.19	-0.03	1.34	1.39	-0.05	1.49	1.50	0.00	1.18	1.20	-0.02

The third set of results shows the decomposition of the weighted results for the full time period, 2003:1 through 2007:4. The results are quite similar to those for the weighted period, although the difference between the MCE and SPI indexes tends to be slightly

more negative in many instances. In fact, ophthalmology moves from a price increase due to shifts in utilization to a price decline. The final set of estimates, Estimate 4, removes seasonality effects by reporting estimates on the first quarter of 2007, rather than the fourth quarter, to correspond to the 2003:1 base period. Comparing Estimates 3 and 4, it appears that seasonality may be a factor causing positive shifts in price from changes in utilization. After removing seasonality effects, only obstetrics and gastroenterology show slightly positive shifts in price due to service shifts (a 1 percent increase in both disease categories). Here we see that the shifts that cause the MCE index to be higher than the SPI are less pronounced for both Obstetrics and Orthopedics & Rheumatology. A likely cause of the seasonality effect is that certain services have seasonal variation, such as births, and the high cost of the birth occurs during delivery. For future analysis, this seasonality effect may be accounted for in a number of additional ways, including focusing on annual expenditures or changing the time-frame to focus on completed episodes.

Although the MarketScan data is not representative,[18] the result still provides insight into the potential importance of the measurement differences. In 2009, healthcare spending comprised 16 percent of GDP; therefore, if a difference of a similar magnitude was true across patient types (i.e. including the publicly insured and the uninsured), a transition to the MCE price deflator in BEA's National Accounts would result in a sizeable increase of measured real GDP growth by about 0.1 percentage points per year. This result is based on the more conservative estimates from the MarketScan results presented here (the AN study suggesting that this bias could be as high as 0.25 percent a year).

[18] Our data does not include the publicly insured or the uninsured.

A. Robustness Checks

Some additional robustness checks were conducted using the MarketScan data. As mentioned previously, the MarketScan data is a combination of employer and insurer data. To check if the mix of employer and insurer data has a measurable impact on our results, we examine results on employers only and find qualitatively similar results to those reported above.

Another concern with the results above is the growing sample of enrollees across each period. This creates a number of potential problems. One problem is that for those individuals newly added to the data, there may be a truncation problem because the previous year's medical records are not used for disease classification, potentially leading to inaccuracies in the grouper. To correct for this potential problem, we remove the first year observation from individuals in the sample allowing a sufficient history to exist in order to classify diseases; this approach produces very similar results to those reported above.

VI. CONCLUSION

AN find that the cost of disease treatment as measured using an MCE index is measurably lower than an SPI index. This finding has potentially important implications for the inflation and productivity of the health sector. However, a limitation of the AN

study is that it uses commercial claims data from Pharmetrics that is a convenience sample, which may not be representative.

This paper builds on the work of AN by investigating whether their findings hold more generally. To do this, we apply the identical methodology of AN using an alternative claims database, MarketScan. Similar to the Pharmetrics data, the MarketScan data is a convenience sample that is not representative; however, it is a distinct dataset that covers a large segment of the commercially insured population, and we use population weights to make the data representative at the national level.

Applying the AN methodology for constructing MCE and SPI indexes, we find qualitatively similar results to those of AN for the 2003:1 to 2005:4 period. Namely, the growth in the MCE index is lower than the SPI index. Similar to their finding, it appears that an important reason for the gap between the MCE and SPI indexes is a shift away from inpatient hospital services. This result is robust to whether population weights are applied to the sample or not. In addition, there is some evidence that this trend continues into the 2005 to 2007 period. Although this paper generally supports the key findings in the AN paper, we find that the magnitude of the difference between the MCE and SPI index is smaller using the MarketScan data. While they find that the difference between the MCE and SPI indexes to be 7 percentage points over the 2003 to 2005 time period, we find this difference is only about 3 percentage points.

There are a number of extensions to this current paper that may provide greater insight into the trend in health expenditures in the United States. First, in addition to a national price index by disease, it would be useful to produce a similarly constructed index at the regional level. This would help inform policy-makers of local trends and help explain factors leading to cost growth. Second, the current paper focuses on the cost of disease per quarter, but it may be informative to analyze the cost of disease per episode of treatment to obtain a more precise measure of the full cost of disease treatment.

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