Multifactor Productivity in Physicians' Offices: An Exploratory Analysis

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This article constructs measures of multifactor productivity (MFP) for physicians' offices using a variation of the productivity methodology developed by the U.S. Bureau of Labor Statistics (BLS) for other industries. Two alternatives measures are presented and both yield positive gains in physicians' office MFP over the study period. These increases lie below MFP rates for the general economy (private non-farm business sector). During 1983-1992, physicians' office MFP growth exceeded general economy MFP. For 1993-2000, physicians' office MFP growth was both negative and below general economy rates. For the most recent period analyzed, 2001-2004, physician's office MFP grew nearly as quickly as the general economy.

INTRODUCTION

The Medicare Economic Index (MEI) is one component that contributes to the yearly update of the Medicare physician fee schedule and is intended to measure year-to-year changes in input prices faced by physicians. The MEI is adjusted for MFP to avoid double counting gains in earnings that result from growth in productivity. Without this adjustment, the MEI would be based only on the inputs used in providing services (input prices, volume, and intensity of services) and would not reflect increases in the efficiency with which those services could be provided.

The author is an independent consultant. The statements in this article are those of the author and do not necessarily reflect the views or policies of the author or the Centers for Medicare & Medicaid Services (CMS).

BLS publishes productivity estimates for various industries, however; there is no readily accessible measure that is specific to physicians' offices. As a result, CMS, the agency responsible for the construction of the updates, uses an economywide measure of MFP from the private non-farm business sector as a proxy for physicians' MFP. To determine if this economywide MFP index represents the best available proxy for use in the MEI, this study constructs alternative estimates of MFP for physicians' offices.

METHODOLOGY

This research begins with the MFP methodology used by BLS (1997) for other industries, but deviates from that method when necessary. The underlying economic theory of production leads to the derivation of a logarithmic formula for a technical change index as the residual that is left when the effects on output from specific inputs are netted out:

MFP=

$$\ln\left(\frac{A_t}{A_{t-1}}\right) = \ln\left(\frac{Q_t}{Q_{t-1}}\right) - \left[w_k\left(\ln\frac{K_t}{K_{t-1}}\right) + w_l\left(\ln\frac{L_t}{L_{t-1}}\right) + w_{ip}\left(\ln\frac{IP_t}{IP_{t-1}}\right)\right]$$

where:

A_t = multifactor productivity in time t
Q_t = quantity of output in time t
K_t = quantity of capital input in time t
L_t = quantity of labor input in time t

IP_t = quantity of intermediate input in time t

w_k, w_l, w_{ip} = cost share weights for the inputs

According to this model, the logarithm of the change in MFP is represented by the logarithm of changes in real output, less logarithms of changes in capital, real inputs for labor, and intermediate inputs (goods and services purchased by an industry from other industries). Cost shares for each input are computed from observed input price and quantity data. The cost share weights appearing in the technical change formula used by BLS are the means of the cost shares for each input computed in two adjoining periods:

$$w_i = \frac{(s_{i,t} + s_{i,t-1})}{2} \quad s_{i,t} = \frac{P_{i,t} x_{i,t}}{\sum (P_{i,t} x_{i,t})}$$

where: $P_{i,t}$ = price of input i in period t
$x_{i,t}$ = quantity of input i, in period t
i = *K, L, IP*

Results from this study are dictated by both the MFP methodology and the strength of available data. Oftentimes, approximations are required because the physicians' office industry is marked by a lack of information from sources typically used to construct MFP for other industries.

Another deviation from the MFP methodology used by BLS for other industries includes the absence of the use of labor hours to account for changes in labor quality. Labor hours in the BLS formulation are not homogeneous, as these hours are a function of skill mix which varies among industries and across time within industries. To deal with this, BLS and others within the research community, specifically Jorgenson, Mun, and Stiroh (2005), use variations in worker characteristics to construct indexes that reflect differences in labor quality. Unfortunately, information required to construct a skill mix index for physicians' offices is not available.

This model further departs from BLS methodology with respect to opportunity costs of self-employed persons, a significant portion of total physician office personnel. BLS treats labor compensation paid to a self-employed person as equal to the labor compensation for an employee in the same industry and in the same age/sex/educational attainment class. For example, a female self-employed physician is assigned compensation equal to a female physicians' office employee in the same age range with an educational level more than a college degree. This attaches an opportunity cost to physicians that is substantially lower than what is consistent with actual educational attainment and experience. This model abandons this procedure for an alternative that includes separate labor compensation estimates for physicians and for non-physician employees in physicians' offices.

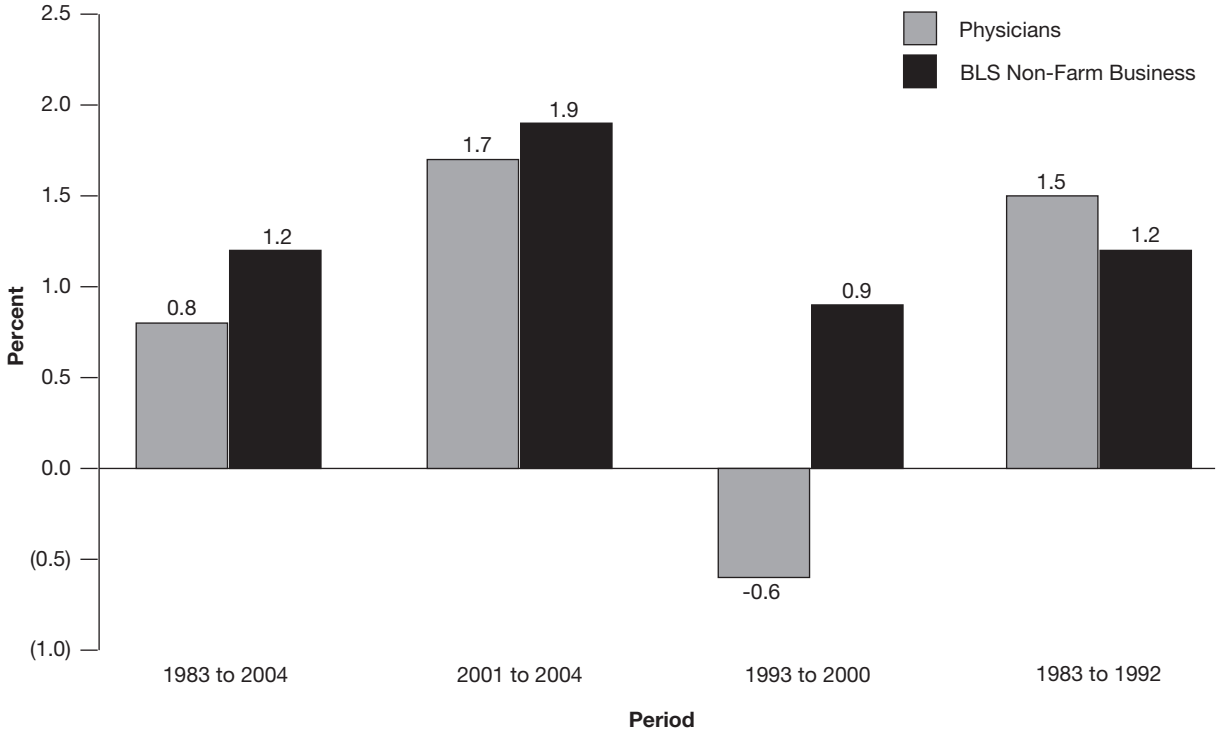
In order to merge data for input categories into an input index, the BLS methodology uses 2-year moving averages of annual weights. These are applied to logarithms of changes in input quantities. However, in this model an input index is derived by applying annual weights to changes in input quantities, because it is simpler to explain and there are no significant differences in results.

To highlight key trends in average annual rates, this study is divided into three periods: 1983-1992, 1993-2000, and 2001-2004 (Figure 1).

The article begins by constructing an index for the quantity of inputs followed by how the indexes for quantities of outputs are created, and how the output and input indexes are merged to provide an estimate of physicians' office MFP. Then that is compared to economywide MFP and various conclusions are offered.

Figure 1

Average Percent Changes in Physicians and Non-Farm Business Multifactor Productivity, by Selected Periods



NOTES: BLS is U.S. Bureau of Labor Statistics. Additional information available on request from the author.

SOURCE: Fisher, C., 2007.

PHYSICIANS' OFFICE INPUT INDEX

The physicians' office input index includes both cost shares and changes in quantities for each major category of input. To establish cost shares, physicians' office expenditures are organized into income statement form to identify major expense categories. This income statement consists of three areas:

(1) Non-physician employee labor compensation expenditures, labor compensation rates, and quantities of labor hours.
(2) Physician office depreciation and business taxes.
(3) Intermediate input expenses and physician incomes.

Physician office expenditures not accounted for by previously mentioned items 1 and 2 are represented by item 3, intermediate input expenses and physician incomes. This requires various time series for physician-related variables including number of physicians, work-hours, income per physician, labor compensation, returns on equity (ROE), and intermediate input prices and quantities. Cost shares for non-physician labor compensation, physician labor compensation (physician incomes, less ROE), intermediate inputs (intermediate input expenses, plus business taxes), and capital (depreciation, plus return-on-capital) are then computed. Changes in input quantities are determined by changes in labor hours of physicians and non-physician employees, real intermediate input expenses (nominal expenses, deflated by an appropriate input price index), and changes in capital services. The sum of

the products of the weights and quantities form the input index.

Annual Work-Hours and Labor Compensation

Annual work-hours of non-physician employees are the product of the number of employees, their average work-hours per week, and their average annual work weeks. Annual labor compensation is the product of annual work-hours, and average earnings and fringe benefits per hour (Table 1). Outpatient surgical and health maintenance organization centers are included with physicians' offices because these categories are grouped with physician expenditures in the Bureau of Economic Analysis (BEA) National Income and Product Accounts.

The production worker grouping in the BLS Current Employment Survey (CES) includes the number of non-physician, non-supervisory employees in physicians' offices. Although BLS states that an unknown number of these production workers may be employed physicians who are not corporate officers or who have no supervisory responsibility, their number is small. Further, the BLS Occupational Employment Survey points out that by omitting employed physicians, average earnings per hour for non-physician employees is roughly the same as those for production workers in the CES. The CES also publishes average hours per week and average earnings per hour for production workers (Table 1).

Data for the number of non-physician employees in physicians' offices are also available from the Decennial Census for 1980, 1990, and 2000, the Census Bureau's American Community Survey (ACS) for 2001-2004, and the Current Population Survey (CPS) for all years through 1993. The Decennial Census and the ACS data are very similar to the CES data; however the CPS data contains considerably fewer non-physician employees. The CES data is the preferred source, because it is corroborated by the Decennial Census data, is more timely, and is stable.

The CES also reports from the North American Industry Classification System the number of outpatient surgical and health maintenance organization center employees, but excludes the number of production workers, work-hours, and earnings. Therefore, data for the number of production workers are based on the proportion of employees who are production workers in physicians' offices. In addition, in the previously mentioned centers, average hours per week and earnings per hour are based on data for non-mental health outpatient facilities (Table 1). Average annual work weeks for non-physician employees are reported in the CPS.

Data for fringe benefits per hour are not available for physicians' offices. Therefore, ratios of fringe benefits to hourly earnings from the BLS Employer Cost for Employee Compensation Survey are used to compute fringe benefits. The survey also reports employer costs for earnings and fringe benefits for all health services and hospitals, though not for physicians' offices. In estimating fringe benefits for physicians' offices, an employment-weighted estimate of hospital's contribution is backed out of the total. Although the remaining residual includes data specific to both ambulatory care and nursing homes, it is the closest wage supplement available. These data are then merged to form annual work hour and labor compensation estimates for non-physician employees. Annual work hours estimate the labor input. Labor compensation is used to compute the non-physician weight.

Table 1

Non-Physician Employee Labor Hours and Earnings: 1982-2004

	Physician's Office					Surgical Outpatient and HMO Centers			
Year	Total Employees[1]	Production Workers[1]	Production Workers to Total Employees	Hours Per Week	Earnings Per Hour	Employees Workers[1]	Production Workers[1]	Hours Per Week	Earnings Per Hour
2004	2,047.8	1,703.5	0.832	33.5	$18.95	54.5	45.3	35.2	$19.27
2003	2,002.5	1,659.7	0.829	33.4	18.41	50.7	42.0	32.3	18.40
2002	1,967.8	1,638.5	0.833	33.1	17.91	48.2	40.2	31.5	16.72
2001	1,911.2	1,636.2	0.856	33.1	17.05	47.7	40.8	31.4	16.28
2000	1,839.9	1,601.4	0.870	32.7	16.26	46.9	40.8	31.3	15.60
1999	1,786.6	1,545.4	0.865	32.4	15.65	46.2	39.9	31.4	14.78
1998	1,723.6	1,495.5	0.868	32.5	15.05	45.8	39.7	31.5	14.27
1997	1,660.5	1,445.4	0.870	32.6	14.51	45.1	39.2	31.3	13.79
1996	1,603.8	1,387.6	0.865	32.8	13.99	44.5	38.5	31.2	13.26
1995	1,540.4	1,339.3	0.869	32.5	13.36	44.2	38.5	31.6	12.63
1994	1,480.9	1,281.2	0.865	32.1	12.72	44.2	38.2	31.8	12.36
1993	1,442.0	1,231.3	0.854	32.0	12.43	43.9	37.5	31.8	12.11
1992	1,401.1	1,200.0	0.856	31.8	12.05	43.5	37.3	31.9	11.60
1991	1,345.2	1,171.5	0.871	31.7	11.56	42.9	37.4	31.7	11.21
1990	1,278.0	1,126.6	0.882	31.5	11.26	43.0	37.9	32.0	10.95
1989	1,206.6	1,073.8	0.890	31.3	10.69	40.8	36.3	32.0	10.69
1988	1,143.2	1,020.5	0.893	31.3	9.99	40.1	35.8	32.0	9.99
1987	1,085.8	967.6	0.891	31.0	9.30	39.3	35.0	32.0	9.30
1986	1,031.5	925.9	0.898	30.5	8.85	38.6	34.6	32.0	8.85
1985	980.9	885.1	0.902	30.6	8.60	37.8	34.1	32.0	8.60
1984	933.1	846.0	0.907	30.3	8.27	37.1	33.6	32.0	8.27
1983	891.6	812.5	0.911	30.3	7.95	36.3	33.1	32.0	7.95
1982	847.4	785.0	0.926	30.9	7.68	35.6	33.0	32.0	7.68

Refer to footnotes at the end of the table.

Table 1—Continued

Non-Physician Employee Labor Hours and Earnings: 1982-2004

Year	Non-Physician Supervisors					All Employees			
	Ratio to Production Workers							Work Hours	
	Number Employees[1]	Mean Hourly Wage	Number[1]	Hours Per Week	Mean Hourly Earnings	Number[1]	Average Work Weeks	Annual Amount[1]	Ratio Change
2004	0.030	1.943	51.9	33.5	$36.81	1,810	47.4	2,864,754	1.033
2003	0.030	1.943	50.4	33.4	35.77	1,761	47.4	2,773,469	1.022
2002	0.030	1.943	49.8	33.1	34.79	1,736	47.5	2,714,454	0.991
2001	0.036	1.943	58.1	33.1	33.12	1,742	47.8	2,739,124	1.018
2000	0.039	1.943	62.9	32.7	31.59	1,711	48.3	2,692,005	1.067
1999	0.041	1.943	64.1	32.4	30.40	1,656	47.2	2,522,688	1.033
1998	0.041	1.943	62.0	32.5	29.24	1,603	47.1	2,442,565	1.022
1997	0.041	1.943	59.9	32.6	28.19	1,550	47.5	2,390,372	1.029
1996	0.041	1.943	57.5	32.8	27.18	1,490	47.8	2,324,087	1.086
1995	0.041	1.943	55.5	32.5	25.96	1,439	46.0	2,139,783	1.075
1994	0.041	1.943	53.1	32.1	24.71	1,378	45.2	1,990,035	1.018
1993	0.041	1.943	51.1	32.0	24.15	1,326	46.3	1,954,301	1.035
1992	0.041	1.943	49.8	31.8	23.41	1,293	46.1	1,887,731	1.066
1991	0.041	1.943	48.6	31.7	22.46	1,263	44.4	1,770,629	1.019
1990	0.041	1.943	46.7	31.5	21.88	1,216	45.5	1,736,783	1.063
1989	0.041	1.943	44.5	31.3	20.77	1,159	45.2	1,633,270	1.073
1988	0.041	1.943	42.3	31.3	19.41	1,103	44.3	1,522,688	1.069
1987	0.041	1.943	40.1	31.0	18.07	1,047	44.0	1,423,885	1.050
1986	0.041	1.943	38.4	30.5	17.19	1,003	44.5	1,356,581	1.040
1985	0.041	1.943	36.7	30.6	16.71	960	44.5	1,304,422	1.072
1984	0.041	1.943	35.1	30.3	16.07	918	43.8	1,217,005	1.081
1983	0.041	1.943	33.7	30.3	15.44	883	42.2	1,125,379	1.002
1982	0.041	1.943	32.6	30.9	14.92	853	42.7	1,123,231	—

NOTE: HMO is health maintenance organization. Additional information is availlable on request from the author.

[1] Numbers in thousands.

SOURCE: Fisher, C., 2007.

Recently, as average compensation for non-physician employees accelerated, non-physician employees' annual hours decelerated. Beginning in the early 1990s, the share of total expenditures accounted for by non-physician employee compensation increased steadily from 18.2 percent in 1987 to a peak of 25.2 percent in 2000. This share began to decline around 2001.

Depreciation and Business Taxes

Reliable historical depreciation data for physicians' offices are not available. Instead, for ambulatory health services depreciation data from BEA are utilized. Physicians' office spending represents approximately one-half of ambulatory health services spending. Physicians' office depreciation then is the ratio of depreciation to gross output for ambulatory health services, multiplied by physicians' office spending. Business taxes are estimated from BEA's gross domestic product by industry series for ambulatory health services.

Physician Income and Intermediate Input Expenses

Physicians' office input costs not only include non-physician labor compensation, depreciation, and business taxes, but intermediate expenses and physicians' income, as well. Intermediate expenses, plus physicians' income form the residual.[1] Intermediate inputs consist of goods and services purchased from other industries. These include medical non-durables, such as syringes. Physician income has two components: (1) labor compensation for work performed and (2) returns on physicians' office equity.

[1] Equivalently, the residual is physicians' office expenditures, less non-physician labor compensation, depreciation, and business taxes.

Unfortunately, no time series exists for intermediate input costs or physicians' income. To construct this time series, data for the number of physicians and their work-hours are merged with physicians' average annual income and data for physicians' office intermediate input costs. Physician work-hours are the product of the number of office-based physicians, average hours per week, and average work weeks per year (Table 2). There is no official government source for the number of office-based physicians, therefore the annual allopathic and osteopathic physician censuses by the American Medical Association (AMA) and the American Association of Colleges of Osteopathic Medicine are used. Annual physician work-hours are computed from CPS data for weeks worked and hours worked per week. Annual work-hours computed from these data are similar to AMA estimates for overlapping years (1987-1999).

Physician average weekly hours remained fairly steady through the 1980s and early 1990s. After reaching a peak of nearly 55.7 hours in 2001, hours per week dropped to an average of 51.5. Despite this, annual work weeks remained steady, leading to a decline in annual hours. A recent study by Tu and Ginsburg (2006) and annual surveys conducted by *Medical Economics* (1999-2006) seem to support this finding.

Tu and Ginsburg (2006) also report annual average income per physician for 1995, 1999, and 2003. These data are multiplied by the number of physicians to yield total physician income. Merging annual physician income and BEA input-output intermediate input expense data for physicians' and dentists' offices for 1987 and 1992 creates a time series for splitting the residual data into physicians' income and intermediate input expenses.

Table 2

Annual Physician Income and Compensation Rates, by Number of Physicians, Work Weeks, Hours Worked Per Week, and Annual Hours: 1982-2004

Year	Number of Physicians			Weeks Per Year	Hours Per Week	Annual Hours Per Physician		Total Annual Hours		Physician Income	
	Total	Allopathic Office-Based	Osteopathic	Reported Amounts		CPS	AMA	Amount	Ratio Change	Amounts per Physician	Total
		(In Thousands)						(In Millions)		(In Thousands)	(In Billions)
2004	584.7	542.7[1]	42.0[1]	49.4	51.5	2,547	—	1,489.3	1.010	—	—
2003	571.8	529.8	42.0[1]	50.1	51.5	2,578	—	1,473.9	0.975	$203	$116.1
2002	558.2	516.2	42.0[1]	50.8	53.3	2,708	—	1,511.4	0.993	—	—
2001	555.6	514.0	41.6	50.1	54.7	2,740	—	1,522.1	1.004	—	—
2000	535.0	490.4	44.6	50.1	56.6	2,834	—	1,516.3	1.078	—	—
1999	515.7	473.2[1]	42.5[1]	49.9	54.7	2,727	—	1,406.2	0.998	187	96.4
1998	509.3	468.8	40.5[1]	50.0	55.4	2,767	2,810	1,409.3	1.025	—	—
1997	496.6	458.2	38.4	50.7	54.7	2,770	2,874	1,375.4	1.015	—	—
1996	482.2	445.8	36.4	50.3	56.0	2,811	2,888	1,355.6	1.084	—	—
1995	471.6	437.3	34.3	49.9	53.1	2,651	2,820	1,250.4	1.063	181	85.4
1994	440.1	407.3	32.8	48.9	54.7	2,673	2,881	1,176.4	1.015	—	—
1993	430.0	398.8	31.2[1]	49.8	54.1	2,695	2,914	1,158.9	1.060	—	—
1992	416.6	387.0	29.6[1]	48.9	53.7	2,626	2,895	1,093.7	1.050	—	—
1991	401.4	373.5	28.0[1]	48.1	54.0	2,596	2,906	1,042.1	1.007	—	—
1990	386.3	359.9	26.4	49.0	54.7	2,679	2,862	1,034.9	1.039	—	—
1989	375.6	350.1	25.5[1]	49.6	53.5	2,652	2,869	996.0	1.008	—	—
1988	362.1	337.5	24.6[1]	50.3	54.3	2,729	2,820	988.1	1.034	—	—
1987	355.3	331.7	23.7[1]	50.2	53.7	2,691	2,740	956.0	1.026	—	—
1986	348.6	325.8[1]	22.8[1]	49.3	54.2	2,674	—	932.0	0.995	—	—
1985	350.9	329.0	21.9	49.0	54.5	2,671	—	937.1	1.009	—	—
1984	339.4	318.7	20.7[1]	49.3	55.6	2,736	—	928.6	1.083	—	—
1983	327.9	308.3	19.6[1]	49.2	53.2	2,616	—	857.6	1.038	—	—
1982	315.9	297.5[1]	18.4[1]	49.2	53.2	2,616	—	826.3	—	—	—

NOTES: CPS is Current Population Survey. AMA is American Medical Association. Additional information is availlable on request from the author.

[1] Estimated.

SOURCES: Census Bureau, U.S. Bureau of Labor Statistics, American Medical Association, and Fisher, C., 2007.

Physician income as a percent of total physician office expenditures for 1995, 1999, and 2003 is shown on Table 3. The intermediate input percentage is the difference between the residual and the physician income percentages. For 1987 and 1992, the physicians' income percentage is the difference between the residual and the intermediate inputs percentage. Data are interpolated and extrapolated for other years. Results show physician income as a proportion of total physician office spending declined since 1994, while the intermediate inputs steadily increased since 1995. In 2004, the share of input costs dedicated to physician income was only 4.2 percentage points higher than that dedicated to intermediate input expenses. In contrast, the difference was 19.2 percentage points in 1987.

Physician income consists of labor compensation (which is the opportunity cost of physician labor) and ROE. The data do not distinguish between the two. This ambiguity is reflected in the Internal Revenue Service's (2006) Statistics of Income data, which shows net profits vary substantially by physicians' office's legal arrangement whereby a portion of sole proprietor and partnership net income is reported by physicians as labor compensation rather than ROE. Similarly, business income (distinguished from wage income) as reported in the Decennial Census, the ACS, and the CPS, is not separated into labor compensation and ROE.

Here, we split physician income into labor compensation and ROE. Theoretically, all corporate physicians should be paid wages commensurate with their contributions to marginal product as physicians or corporate officers. Thus, any corporate net profit represents ROE. The same ROE rate is assumed for sole proprietors and partnerships. This rate is applied to physician income, thus separating physician income into labor compensation and ROE. Physician labor compensation is used later to compute the physician portion of the labor input cost share. Similarly, ROE, along with depreciation, is used to compute the capital services weight. Undoubtedly, this ROE measure is imprecise. An alternative method equates physician labor compensation with the average compensation for their employees in the same demographic class. Unfortunately, this measure assigns far too little opportunity costs to physicians and far too much to ROE. Neither method is without fault, but the former is less problematic.

Throughout the 1980s, physician labor compensation (their opportunity costs) as a proportion of physicians' office revenues remained fairly stable. Since the early 1990s, however, physicians took home an ever-shrinking portion of office revenues, dropping from 45.1 percent in 1992 to 33.0 percent in 2004. This is reflected in the deceleration of labor compensation rates since 1992. As a percent of office revenues, ROE grew slowly throughout the mid-1990s, a trend that continued into the 2000s.

Intermediate inputs make up the other part of the residual. Real intermediate inputs are nominal intermediate inputs deflated by the MEI price index. CMS considered the BEA index for ambulatory health services intermediate inputs as an alternative to the MEI because it implies higher real inputs. However, unlike the MEI, the BEA index did not accelerate from the 1993-2000 to 2001-2004 period, despite accelerations in intermediate input expenses, particularly liability insurance payments. The MEI price index is preferable to the BEA alternative because it is specific to physicians' offices and displays expected rates of change.

Table 3

Physician Income and Intermediate Input Expenses: 1982-2004

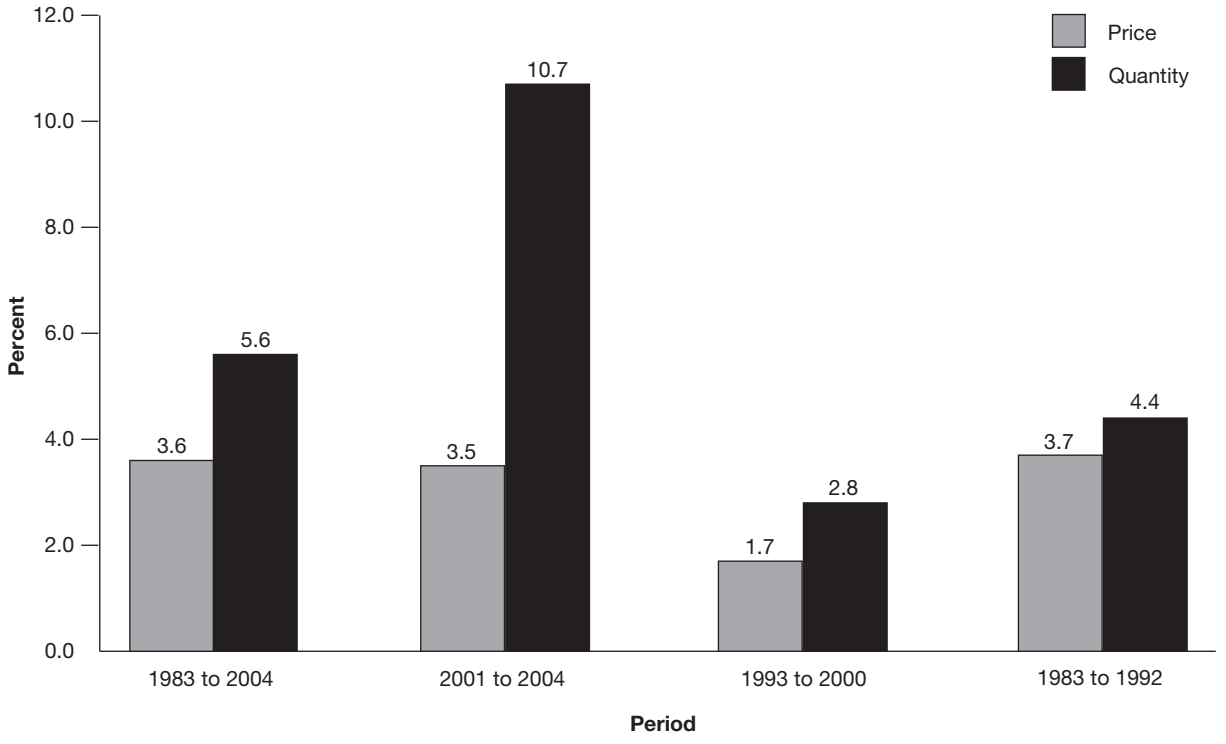
Year	Physician Office Expenditures	Residual Expenses		Pysicians Income		Intermediate Inputs	Implied Expenses-Percents		Implied Expenses-Amounts	
		Amount	Percent of Total Expenditures	Amount Total	Percent of Expenditures	Percent of Expenditures	Physician Percent of Office	Intermediate Inputs Expenditures	Physician	Intermediate Inputs
2004	$323.3	$236.1	73.0	—	—	—	37.3	35.7	$120.5	$115.6
2003	301.1	219.6	72.9	$116.1	38.6	34.4	38.6	34.4	116.1	103.5
2002	277.2	199.7	72.0	—	—	—	39.8	32.2	110.4	89.3
2001	256.8	182.4	71.0	—	—	—	41.1	29.9	105.6	76.8
2000	236.8	167.6	70.8	—	—	—	42.4	28.4	100.4	67.2
1999	220.8	159.1	72.0	96.4	43.7	28.4	43.7	28.4	96.4	62.6
1998	210.3	152.2	72.4	—	—	—	44.3	28.1	93.2	59.0
1997	198.2	143.3	72.3	—	—	—	45.0	27.4	89.1	54.2
1996	190.4	138.2	72.6	—	—	—	45.6	27.0	86.8	51.4
1995	184.6	137.9	74.7	85.3	46.2	28.4	46.2	28.4	85.3	52.5
1994	174.4	132.1	75.7	—	—	—	47.1	28.6	82.2	49.9
1993	167.7	127.1	75.8	—	—	—	47.0	28.8	78.9	48.2
1992	163.6	125.4	76.6	—	47.7	28.9	47.7	28.9	78.1	47.3
1991	149.2	114.3	76.6	—	—	—	47.6	29.0	71.1	43.2
1990	138.6	105.4	76.0	—	—	—	47.0	29.0	65.2	40.2
1989	125.1	95.3	76.2	—	—	—	47.1	29.0	58.9	36.3
1988	115.3	89.1	77.3	—	—	—	48.2	29.1	55.6	33.5
1987	101.5	78.6	77.5	—	48.3	29.1	48.3	29.1	49.1	29.5
1986	87.2	66.5	76.3	—	—	—	47.2	29.1	41.2	25.4
1985	78.8	59.6	75.7	—	—	—	46.6	29.1	36.7	22.9
1984	70.9	53.7	75.8	—	—	—	46.7	29.1	33.1	20.6
1983	63.5	48.3	76.0	—	—	—	46.9	29.1	29.8	18.5
1982	56.2	41.8	74.4	—	—	—	45.3	29.1	25.5	16.4

NOTES: Dollar amounts in billions. Additional information is availlable on request from the author.

SOURCE: Fisher, C., 2007.

Figure 2

Average Annual Percent Change in Intermediate Input Price and Quantity, by Selected Periods



SOURCES: U.S. Bureau of Economic Analysis and Fisher, C., 2007.

Intermediate input expenses as a share of physician office revenues, though stable during the earlier periods, has increased markedly beginning in 2001. This was primarily due to increases in quantities of intermediate inputs (Figure 2).

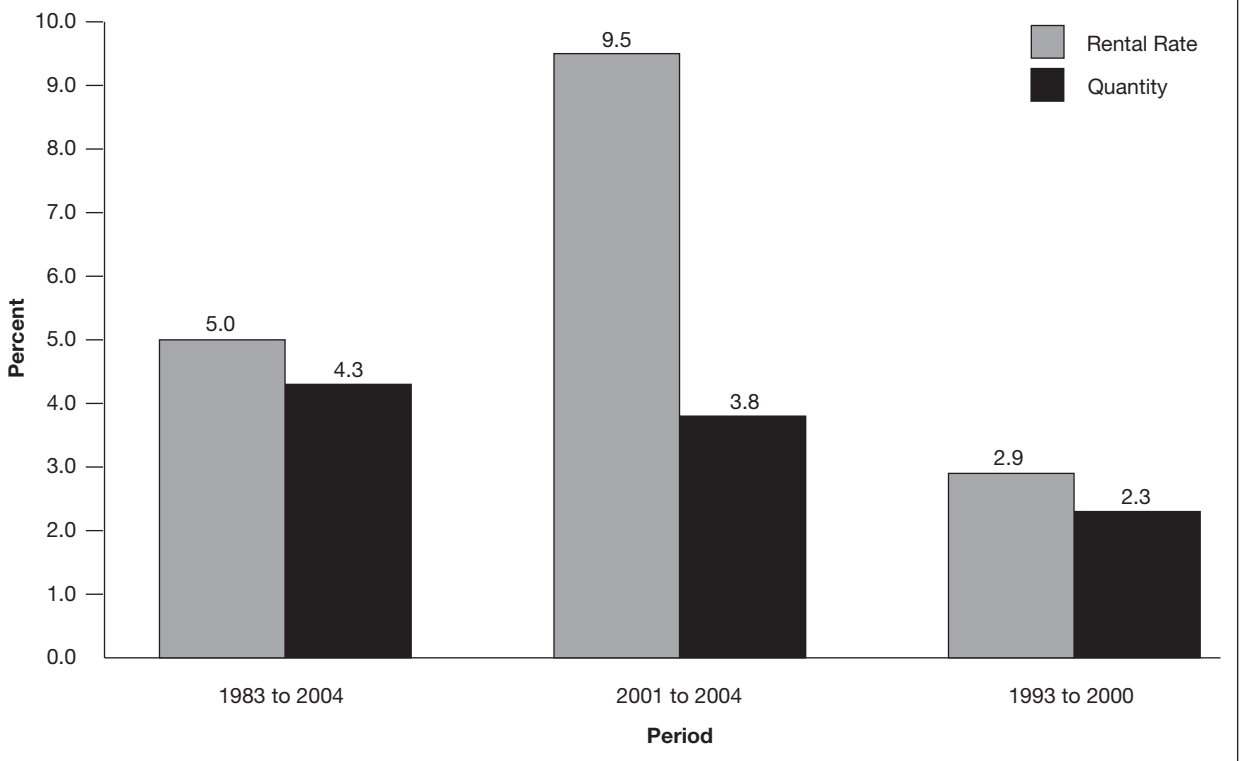
The story that emerges is that fluctuations in annual physician incomes and physician labor compensation per hour result from a combination of factors. First, the deceleration in physician revenues, coupled with a smaller deceleration in expenses forced physicians to absorb most of the drop in office revenues during the early 1990s. Second, labor hourly compensation rates for non-physician employees and intermediate input prices decelerated slightly after 1992 as well, but not nearly as much as physician labor compensation rates. Third, after 1999, non-physician employee compensation rates accelerated slightly, but intermediate input price changes increased somewhat as physician incomes and labor compensation rates grew along with physician office revenues.

Capital Services and Rental Rates

Capital stocks, represented by buildings and equipment, and the annual services from which they flow (or equivalently depreciation), are another input in the production of physician services. Ideally, an MFP calculation would include an index for capital services of constant quality (Jorgenson, Mun, and Stiroh, 2005). The flow of capital services during the year is assumed to be proportional to the average of current and lagged capital stock (Jorgenson, Mun, and Stiroh, 2005). Thus, an

Figure 3

Average Annual Percent Change in Capital Service Price and Quantity, by Selected Periods



NOTE: Additional information available on request from author.

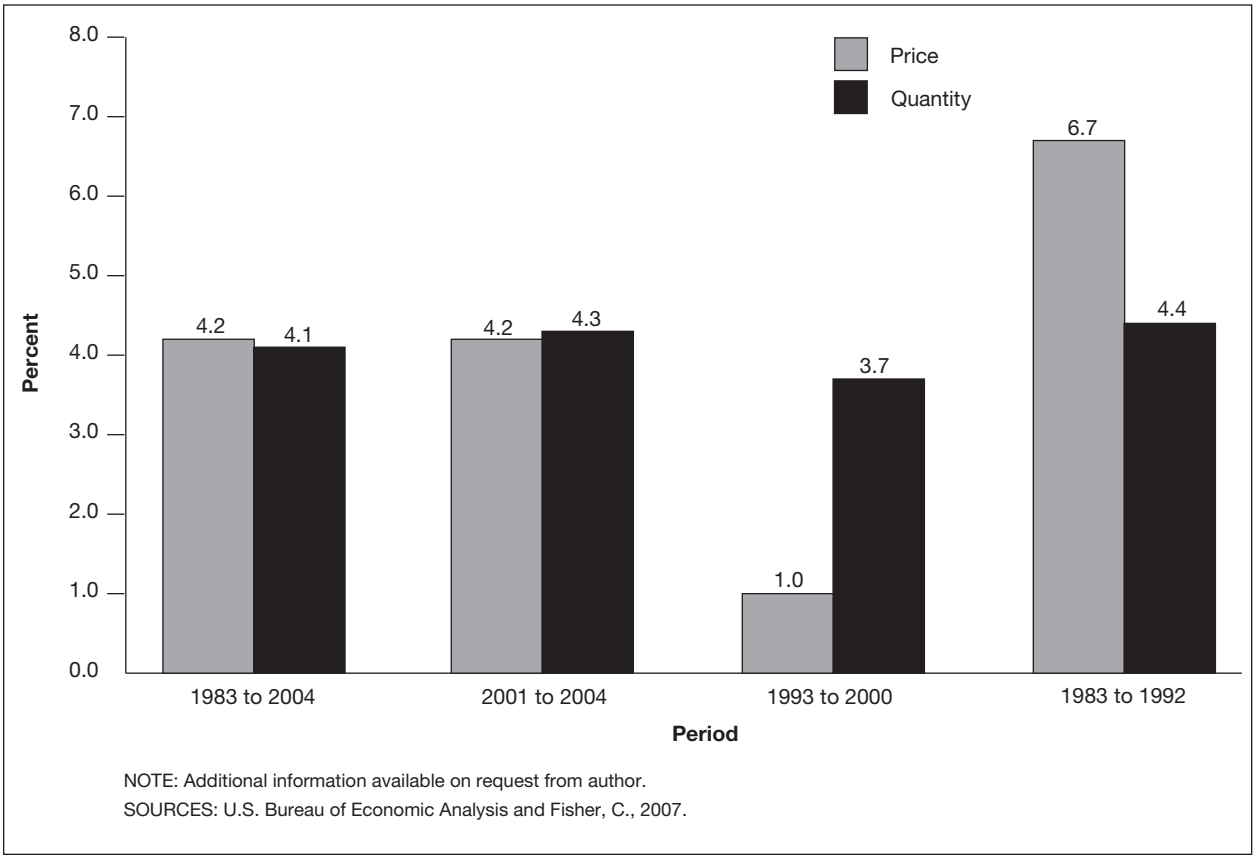
SOURCES: U.S. Bureau of Economic Analysis and Fisher, C., 2007.

estimate of physicians' office MFP would ideally contain a constant-quality, 2-year moving average of capital stock. Unfortunately, a constant-quality measure is not available.

A proxy for changes in physicians' office capital stock is changes in the ambulatory health services sector indexes for structures and equipment. These are found in the BEA fixed-asset data. Changes in capital stock represent changes in capital services, without accounting for any lagged effect of changes in capital stock on capital services; a procedure which may introduce some error in the growth of capital services in the MFP calculation. However, whatever error may exist is minimized by the relatively small weight associated with capital service growth. In the BLS MFP formulation, the cost share for capital services is not included in physician and non-physician employee labor compensation, intermediate input expenditures, and business taxes. The capital services cost share is the sum of ROE and depreciation. Changes in the capital service rental rate are represented by changes in the total capital service rentals divided by changes in the quantity of capital services. It is possible that growth estimates in physicians' office capital services may be underestimated substantially due to large, but unknown, capital services made available by institutions, particularly hospitals, which do not appear as expense items in physicians' office ledgers.[2]

[2] The effect, if any, on rates of change in capital services used in the MFP calculations is unknown. Any error in MFP due to this omission may be mitigated by the relatively small share of capital services.

Figure 4
Average Annual Percent Change in Physicians' Office Input Price and Quantity, by Selected Periods



NOTE: Additional information available on request from author.
SOURCES: U.S. Bureau of Economic Analysis and Fisher, C., 2007.

Capital service rentals as a proportion of physician office revenue, stable for many years, increased sharply beginning in 1998. This is primarily a result of rapidly increasing capital rental rates per unit of capital (Figure 3).

Total Input Expenditures, Quantities, and Prices

Total input costs is the sum of the various input costs as previously described. The cost shares for the major inputs are computed by converting each to dollars (Table 4). Capital services are represented by ROE and depreciation. To simplify computations, annual weighted averages of the inputs are used in place of the Tornqvist-weighted MFP formulation used by BLS. Cost shares are multiplied by their respective inputs and summed to obtain a rate of change in total inputs. A similar computation for input prices yields changes in total input prices. These calculations show rapid accelerations in both input prices and quantities for 1983-1992, followed by rapid deceleration for input prices and moderate deceleration for input quantities over 1993-2000. For 2001-2004, input prices and quantities resumed their acceleration, at average annual rates of 4.2 and 4.3 percent, respectively (Figure 4).

Output Expenditures, Prices, and Quantities

The quantity of physicians' office outputs is derived by deflating physicians' office revenue using an appropriate transaction price index. The only existing price

Table 4

Physician's Office Input Cost Weights: 1982-2004

Intermediate Year	Physician Office Spending	Labor Compensation		Intermediate Inputs			Capital Services	Percent Distribution				
									Labor Compensation			
		Physicians	Non-Physician Employees	Total	Inputs	Business Taxes		Total	Physicians	Non-Physician Employees	Intermediate Inputs	Capital Services
2004	$323.3	$106.6	$74.0	$117.6	$115.6	$2.0	$25.1	1.0000	0.3298	0.2289	0.3638	0.0775
2003	301.1	103.2	69.6	105.4	103.5	1.9	22.9	1.0000	0.3426	0.2310	0.3501	0.0762
2002	277.2	98.5	66.6	91.1	89.3	1.8	20.9	1.0000	0.3489	0.2404	0.3353	0.0754
2001	256.8	95.8	64.5	78.5	76.8	1.7	18.0	1.0000	0.3586	0.2510	0.3202	0.0702
2000	236.8	93.2	59.7	68.8	67.2	1.6	15.1	1.0000	0.3786	0.2522	0.3053	0.0638
1999	220.8	90.2	52.7	64.1	62.6	1.5	13.7	1.0000	0.4087	0.2388	0.2904	0.0621
1998	210.3	88.0	49.6	60.4	59.0	1.4	12.2	1.0000	0.4156	0.2359	0.2903	0.0582
1997	198.2	83.8	46.8	55.6	54.2	1.3	12.0	1.0000	0.4128	0.2361	0.2903	0.0608
1996	190.4	82.0	44.3	52.7	51.4	1.3	11.4	1.0000	0.4172	0.2328	0.2903	0.0597
1995	184.6	80.4	39.0	53.7	52.5	1.2	11.4	1.0000	0.4358	0.2115	0.2910	0.0617
1994	174.4	77.6	34.8	51.0	49.9	1.2	10.9	1.0000	0.4466	0.1997	0.2910	0.0627
1993	167.7	74.4	33.4	49.3	48.2	1.1	10.5	1.0000	0.4472	0.1991	0.2910	0.0627
1992	163.6	73.8	31.3	48.4	47.3	1.1	10.1	1.0000	0.4557	0.1914	0.2910	0.0618
1991	149.2	67.1	28.6	44.2	43.2	1.0	9.3	1.0000	0.4552	0.1916	0.2910	0.0621
1990	138.6	61.5	27.3	41.1	40.2	0.9	8.6	1.0000	0.4496	0.1971	0.2910	0.0623
1989	125.1	55.7	24.4	37.2	36.3	0.8	7.9	1.0000	0.4509	0.1951	0.2910	0.0630
1988	115.3	52.5	21.3	34.3	33.5	0.8	7.2	1.0000	0.4621	0.1844	0.2910	0.0625
1987	101.5	46.4	18.5	30.2	29.5	0.7	6.4	1.0000	0.4639	0.1823	0.2910	0.0627
1986	87.2	38.9	16.8	26.0	25.4	0.6	5.6	1.0000	0.4525	0.1924	0.2910	0.0641
1985	78.8	34.6	15.7	23.5	22.9	0.5	5.0	1.0000	0.4462	0.1990	0.2910	0.0638
1984	70.9	31.2	14.1	21.1	20.6	0.5	4.5	1.0000	0.4473	0.1984	0.2910	0.0633
1983	63.5	28.1	12.5	18.9	18.5	0.4	4.0	1.0000	0.4499	0.1969	0.2910	0.0622
1982	56.2	24.0	12.1	16.7	16.4	0.4	3.4	1.0000	0.4336	0.2145	0.2910	0.0609

NOTES: Dollar amounts in billions. Additional information is availlable on request from the author.

SOURCE: Fisher, C., 2007.

measures for physicians' offices are the BLS producer price inconsumer price index (CPI). The PPI is a transaction price index that presents prices after deductions for discounts. A published rate of change in the PPI was first made available in 1998. The CPI is a list price that portrays prices before deductions for discounts and is available for all study years. Because the CPI overstates the growth in actual prices, it understates the growth in the quantity of outputs when used as a deflator. Therefore, a backcasted PPI is required for periods prior to 1998.

Two methods of backcasting the PPI are presented here. In the first, a discount history is constructed for industrywide physician services. The discount history is then applied to the CPI for physicians to construct a transaction price, or essentially a PPI for physicians. The second method uses Medicare Payment Advisory Commission (MedPAC) data on the ratio of Medicare prices to private health insurance prices to construct a Medicare-private health insurance price index. This index is used to backcast the PPI for periods before 1998.

Backcasted PPI Alternative 1

To convert historic CPIs into a transaction price index similar to the PPI, an allowance rate history (one, minus the discount rate) for general population physician billings is needed. Although an allowance rate history exists for Medicare physician billings, none is available for the general population billings. To approximate such a history, a Medicare allowance history is constructed from Medicare Part B carrier workload reports. Based on this, a discount history for the general population is created based on the following assumptions:

- The general population allowance rate was the same as Medicare's at the earliest point in time when the Medicare allowance data first became available, 1975. At that time, Medicare's discount rate was negligible.
- The general population allowance rate was the same as that reported for all physician billings in the Medical Expenditure Panel Survey for 1996, the first year it became available. That rate was 66 percent (Agency for Health Care Research and Quality, 1996).
- Between 1975 and 1996, the general population allowance rate followed a theoretical curve that paralleled the Medicare experience. A quadratic equation provided the best fit for the Medicare data. The same functional form is applied to the general population data. The parameters of the general population curve are determined by data for the two end points, 1975 and 1996, and by the derivative of the Medicare curve.

The general population allowance rates were then merged with the physicians' CPI to obtain a deflated transaction price index for physicians. The data show Medicare began to diverge significantly from the industrywide curve in the early 1980s.

To backcast the PPI from 1996, the National Income and Product Accounts transition change for 1997, and the PPI for 1998 forward were used to deflate physician expenditures. Results show output decelerated during 1993-2000. The period after 2000 exhibits a rapid acceleration in output.

Backcasted PPI Alternative 2

Direct Research, LLC (2003) publishes a combined Medicare-private health insurance index, which is the ratio of the Medicare fee-for-service (FFS) payment rate to the private health insurance payment rate. This ratio is available for all years 1989-

Table 5

Output Price and Quantity Changes: 1989-2004

Year	Proportion of Physician Spending			Ratio Medicare Price to Private Insurance Price		Physician Output Prices: Ratio Change				Nominal Physician Expenditures	Real Physician Expenditures
	Private Consumers	Payers Insurance	Medicare	Level	Ratio Change	Medicare Fee-for-Service	Private Insurance	Combined-Medicare Private Insurance	PPI		
2004	0.585	0.485	0.205	0.83	1.025	1.038	1.013	1.020	1.021	1.074	1.052
2003	0.586	0.484	0.201	0.81	1.000	1.014	1.014	1.014	1.015	1.086	1.070
2002	0.586	0.482	0.200	0.81	0.976	0.958	0.982	0.975	0.999	1.079	1.080
2001	0.583	0.476	0.203	0.83	1.012	1.053	1.040	1.044	1.028	1.084	1.054
2000	0.586	0.474	0.202	0.82	1.051	1.059	1.007	1.023	1.018	1.072	1.054
1999	0.588	0.474	0.197	0.78	1.024	1.026	1.002	1.009	1.022	1.050	1.027
1998	0.593	0.476	0.192	0.76	1.022	1.028	1.006	1.012	1.021	1.061	1.039
1997	0.595	0.477	0.192	0.74	1.049	1.006	0.959	0.972	1.001	1.041	1.040
1996	0.598	0.481	0.190	0.71	1.014	1.008	0.994	0.998	1.011	1.031	1.020
1995	0.599	0.481	0.188	0.70	1.061	1.073	1.012	1.029	1.024	1.058	1.034
1994	0.608	0.477	0.181	0.66	1.065	1.068	1.003	1.021	1.021	1.040	1.019
1993	0.616	0.470	0.172	0.62	1.016	1.014	0.998	1.002	1.013	1.025	1.012
1992	0.616	0.457	0.174	0.61	0.953	1.019	1.069	1.055	1.034	1.097	1.060
1991	0.618	0.443	0.180	0.64	0.941	0.985	1.047	1.029	1.024	1.076	1.051
1990	0.619	0.427	0.186	0.68	0.971	1.010	1.040	1.031	1.025	1.108	1.081
1989	0.623	0.412	0.189	0.70	—	—	—	—	—	—	—

NOTES: PPI is producer price index. Additional information is availlable on request from the author.

SOURCE: Fisher, C., 2007.

2004, with the exception of 1997 and 1998, which are interpolated (Table 5).

To create this combined price, the rate of change in Medicare FFS prices (Table 5) is first divided by the rate of change in the MedPAC ratio for Medicare prices to private health insurance prices. This yields a rate of change in private health insurance prices. The rates of change in Medicare and private health insurance prices are then weighted by their respective expenditures, found in the National Health Expenditure Accounts. The result represents a rate of change in combined Medicare-private health insurance prices.

Although the Medicare-private health insurance index does not entirely reflect the total physician payment universe, it still appears to be the main driver of changes to the PPI. The high correlation coefficient between the index and the PPI for 1998-2004 (r = 0.93) justifies using a regression line to backcast the PPI rate of change to 1990 (Table 5). Much like Alternative 1, the results show a deceleration in the quantity of outputs during 1993-2000, followed by a rapid acceleration beginning in 2001.

For 1990-2004, changes in the quantity of outputs are about the same for the two alternative prices, but are greater than the changes in the CPI. Despite their similarities, the quantities of output generated by the two alternative PPIs differ in some respects. Alternative 1's comparatively higher prices generate smaller rates of output change than Alternative 2's prior to 1993, but their slightly lower prices produce somewhat higher rates of output change for 1993-2000. In all periods, the rates of change in the ratio of Medicare fees to this constructed PPI and the rates of change in the ratio of Medicare fees to private health insurance fees are similar.

Physician output studies have documented rapid increases in Medicare physician measures of real output (represented by volume and intensity of services). For example, MedPAC (2006) reports rapid increases in volume and intensity of physician services since 1999, particularly for imaging and testing procedures. The volume of services per Medicare beneficiary grew at an average annual rate of 5.4 percent for 1999-2003, and 6.2 percent for 2003-2004. The volume of service is measured by weighting the number of procedures by their relative value unit. Further, CMS reports that volume and intensity of physicians' services per Medicare beneficiary increased about 1 percent per year during the 1990s and has increased more rapidly since (Shatto, 2006).

Some economists (Triplett and Bosworth, 2004; Cutler, 2001) reject health sector price measures produced by BLS because they are measured in producer prices rather than prices which reflect changes in health care quality (Nordhaus, 2005). This article does not account for quality changes because comparisons between physician and general economy MFP are required for evaluating the MEI and general economy MFP data from BLS use producer prices, not quality adjusted prices.

Physician Office MFP

The percentage change in real outputs not explained by the percentage change in real inputs represents the growth in physicians' office MFP. The approximations offered in this exploratory analysis indicate that from 1983-1992, average growth in physicians' office MFP (1.5 percent) grew somewhat more quickly than economywide MFP (1.2 percent). Beginning in 1993 and continuing through 2000, a period often referred to as the managed care era,

physicians' office MFP averaged negative annual growth at -0.6 percent; considerably lower than the 0.9 percent growth observed in the private non-farm business sector. Finally, from 2001 up through and including 2004, average annual growth in physicians' office MFP was just two-tenths of a percentage point lower than economywide growth (1.7 versus 1.9, respectively).

It is important to note that the preceding analysis represents a good faith effort to approximate annual growth rates in physicians' office MFP and compare those estimates to the economywide measure currently used to adjust the MEI. Due to data limitations throughout the estimation process, many assumptions were incorporated and various proxies were used. Consequently, the results presented here are not suitable for use in adjusting actual payments.

REFERENCES

Agency for Health Care Research and Quality: *Medical Expenditure Panel Survey.* U.S. Department of Health and Human Services. 1996. Internet address: http://www.meps.ahrq.gov (Accessed 2007.)

Direct Research, LLC: *Medicare Physician Payment Rates Compared to Rates Paid by the Average Private Insurer, 1999-2001.* Research conducted for the Medicare Payment Advisory Commission. August 2003.

Internal Revenue Service: *2006 Statistics of Income*. U.S. Department of the Treasury. Internet address: http://www.irs.gov/taxstats/index.html (Accessed 2007.)

Jorgenson, D.W., Mun S.H, and Stiroh, K.J.: Information Technology and the American Growth Resurgence. *Productivity* Vol. 3. MIT Press. Cambridge, MA. 2005.

Medical Economics: 1999-2005 Surveys. Internet address: http://www.memag.com/memag/static/staticHtml.jsp?id=114288 (Accessed 2007.)

Medicare Payment Advisory Commission: *Report to Congress: Medicare Payment Policy*. Washington, DC. March 2006.

Nordhaus, W.D.: Irving Fisher and the Contribution of Improved Longevity to Living Standards. *American Journal of Economics and Sociology* 64(1): 367-392, January 2005.

Shatto, J.: Personal Communication with John Poisal, Office of the Actuary, Centers for Medicare and Medicaid Services. June 27, 2006.

Triplett, J.E. and Bosworth, B.P.: *Productivity in the U.S. Services Sector*. Brookings Institute. Washington, DC. 2004.

Tu, H.T. and Ginsburg, P. 2006: *Losing Ground: Physician Income, 1995-2003*. Center for Studying Health System Change. 2006 Tracking Report No. 15. June 2006.

U.S. Bureau of Labor Statistics: *BLS Handbook of Methods* Bulletin 2490. April 1997. Internet address: http://www.bls.gov/opub/hom/home.htm (Accessed 2007.)

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