Does hospital productivity grow at the same rate as productivity in the rest of the economy?

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Abstract

Each year the Medicare Payment Advisory Commission (MedPAC) makes a recommendation to Congress on the Medicare payment update to hospitals. In making this recommendation, MedPAC considers payment adequacy, cost trends, technological advances, and changes in productivity. In 2003, MedPAC recommended a downward adjustment to this update factor for productivity, basing this recommendation on the simplifying assumption that hospital productivity should grow at the average rate of productivity growth for the economy as a whole. In this paper, I argue that there are good reasons to believe that the true rate of hospital productivity growth is lower than the average rate of productivity growth in the economy as a whole. First, estimates of labor productivity growth based on official government statistics indicate that the rate of hospital productivity growth is significantly lower than the average rate of productivity growth in the economy as a whole. Second, the hospital sector has several characteristics that previous studies have shown to be associated with low productivity growth: (1) the hospital sector is relatively labor-intensive; (2) the hospital sector has relatively low investment in computers, software, and communications equipment; and (3) the hospital sector has relatively low investment in research and development.

To set an appropriate output price increase, MedPAC must make a reasonable estimate of hospital productivity growth. In 2003 MedPAC adopted the assumption that the rate of hospital productivity growth should be equal to the rate of productivity growth in the economy as a whole. In this article, I will argue that there are good reasons to believe that the true rate of hospital productivity growth is lower than the average rate of productivity growth in the economy as a whole. First, estimates of labor productivity growth based on official government statistics indicate that the rate of hospital productivity growth is significantly lower than the average rate of productivity growth in the economy as a whole. Second, the hospital sector has several characteristics that are associated with low productivity growth: (1) the hospital sector is relatively labor-intensive; (2) the hospital sector has relatively low investment in computers, software, and communications equipment; and (3) the hospital sector has relatively low investment in research and development (R&D).

1. Hospital productivity growth estimates based on BEA real output data and AHA employment data

The U.S. Bureau of Economic Analysis (BEA), a division of the Department of Commerce, publishes current- and constant-dollar estimates of gross output by detailed industry. (http://www.bea.gov/bea/dn2/gpo.htm). One of the detailed industries is Hospitals (code 806). AHA publishes data on the number of full-time equivalent (FTE) employees working in hospitals (American Hospital Association (2003, Table 5.3)). Hence we can compute estimates of (the growth of) labor productivity—real output per FTE employee in the hospital industry—and compare them to measures of labor productivity growth for the economy as a whole constructed by the Bureau of Labor Statistics.

These calculations are shown in Table 1 and in Figure 1. In every year except 2001, the hospital labor productivity growth rate was lower than the labor productivity growth rate of the nonfarm business sector. ***The average annual rate of labor productivity growth of hospitals during the period 1987-2001 was less than half that of the nonfarm business sector.***

The last column of Table 1 shows the growth in private business sector *multifactor* productivity, i.e. output per combined unit of capital and labor. Due to lack of data on hospital capital, it is not feasible to calculate multifactor productivity (MFP) for hospitals. However there is a strong positive correlation across industries between the long-run rate of MFP growth and the rate of labor productivity growth: industries with low rates of labor productivity growth also tend to have low rates of MFP growth. This correlation is documented by Figure 2, which shows the relationship between labor productivity growth rate and MFP growth rate among 453 manufacturing industries over the period 1958-1996.[1] This relationship suggests that the difference between the MFP growth rates of two industries tends to be about half as great as the difference between their labor productivity growth rates. Since the difference between the labor productivity growth rates of hospitals and the private business sector is -1.0%, this would imply that the difference between their MFP growth rates is about -0.5%.

2. The hospital sector has several characteristics that are associated with low productivity growth

a. The hospital sector is relatively labor-intensive

Baumol (1967) argued that "economic activities can, not entirely arbitrarily, be grouped into two types: technologically progressive activities in which innovations, capital accumulation, and economies of large scale all make for a cumulative rise in output per manhour and activities which, by their very nature, permit only sporadic increases in productivity." He also argued that "the basic source of differentiation resides in the role played by labor in the activity". His theory suggests that the productivity growth rates of labor-intensive industries—those with a relatively high ratio of labor cost to total cost—would tend to be lower than the productivity growth rates of other (more capital-intensive) industries. If this is the case, and if the hospital industry's labor intensity is significantly greater than the average labor intensity of all industries, then it provides one possible explanation for the hospital industry's below-average rate of productivity growth.

[1] The productivity growth rates were computed from the NBER-CES Manufacturing Industry Database described in the next section.

We can test the hypothesis that productivity growth is inversely related to labor intensity using the NBER-CES Manufacturing Industry Database (http://www.nber.org/nberces/nbprod96.htm). This database, produced by the National Bureau of Economic Research (NBER) and the U.S. Census Bureau's Center for Economic Studies (CES), contains annual industry-level data on output, employment, payroll and other input costs, investment, capital stocks, multifactor productivity (MFP), and various industry-specific price indexes. The database covers all 4-digit manufacturing industries from 1958-1996. From this database, I calculated for each industry (a) the average share of labor cost in both total cost and in value added (total cost minus cost of purchased materials and services), and (b) the average annual rate of MFP growth. ***Consistent with Baumol's theory, there was a highly statistically significant inverse relationship between labor intensity and productivity growth.***

To illustrate this, we ranked the 453 industries by their average ratio of labor cost to value added, and grouped them into four quartiles, from least to most labor-intensive. (There were 113 or 114 industries in each quartile.) We then calculated the average MFP growth rate of the industries in each quartile. The results are shown in the following table, and in Figure 3.

labor-intensity quartile	**mean ratio of labor cost to value added**	**MFP growth rate**
lowest	29.3%	0.65%
second	43.5%	0.53%
third	49.1%	0.47%
highest	55.2%	0.40%

The average MFP growth rate of the industries in the highest labor-intensity quartile was 62% as high as the average MFP growth rate of the industries in the lowest labor-intensity quartile.[2]

[2] I excluded a handful of industries with annual rates of productivity growth lower than -5% or greater than +5%. I also calculated both ordinary (Pearson) correlations and rank (Spearman) correlations between MFP growth and both measures of labor intensity. The correlations between MFP growth and each measure of labor intensity were as follows:

Measure of labor intensity	**Pearson correlation**	**p-value**
labor cost/value added	-0.104	0.027
labor cost/gross output	-0.069	0.145

Hospitals and other health services industries are significantly more labor intensive than other industries. As Figure 4 indicates, the ratio of employee compensation to value added is 78.4% in health services, and 57.4% in the economy as a whole.[3]

Since hospitals are evidently more labor intensive than the average industry, and industry productivity growth is inversely related to labor intensity, our finding in the previous section that hospital productivity growth is significantly lower than average productivity growth is not surprising.

b. The hospital sector has relatively low investment in computers, software, and communications equipment

During the last decade, there has been a significant acceleration in productivity in the economy as a whole (Figure 5). Many analysts believe that investments in information technology have played a major role in the recent acceleration of productivity.[4] For example, Jorgenson, Ho, and Stiroh (2002) argue that "investments in information technology and higher education stand out as the most important sources of growth at both industry and economy-wide levels."

As indicated by Table 2 and Figure 6, which are based on 1997 BEA data, the hospital sector has relatively low investment in computers, software, and communications equipment. Hospital investment in computers, software, and communication equipment, amounted to only 1.9% of gross output, whereas in the economy as a whole, this kind of investment amounted to 3.1% of gross output. Virtually all of this difference is attributable to the fact that hospitals are generally less capital-intensive than other industries. Hospitals have devoted about the same percentage of their investment expenditure to computers, software, and communication equipment as other industries have, but they have lower average ratios of investment to output.

	Spearman correlation	**p-value**
labor cost/value added	-0.135	0.004
labor cost/gross output	-0.123	0.009

All four correlations are negative, and three of the four are significantly different from zero (p-value < .03).

[3] BEA does not provide data on the components of Gross Domestic Income (e.g., employee compensation) for hospitals.

[4] See, for example, Lichtenberg (1995, 1998), Lichtenberg and Lehr (1998, 1999).

c. The hospital sector has relatively low investment in research and development (R&D)

Numerous studies at the firm, industry, and national level have provided evidence that productivity growth is positively related to R&D-intensity—the ratio of R&D investment to revenue.[5] R&D-intensive industries tend to have higher rates of multifactor productivity growth than non-R&D-intensive industries. Griliches and Lichtenberg (1984b) ranked industries by privately-funded R&D intensity, and grouped them into four quartiles, from least to most R&D-intensive. They then calculated the average rate of MFP growth during the period 1969-1976 of the industries in each quartile. The results are shown in Figure 7. The average rate of productivity growth of industries in the bottom two quartiles was *negative*. By a large margin, the highest rate of productivity growth was for industries in the top quartile of the R&D-intensity distribution.

Hospitals tend to be far less R&D-intensive than other industries. According to the National Science Foundation, nonprofit hospitals performed $1.428 billion worth of R&D in 1997.[6] According to the AHA annual survey, total net revenue of nonprofit hospitals in that year was $240.2 billion. Hence nonprofit hospital R&D-intensity—the ratio of nonprofit hospital R&D expenditure to nonprofit hospital revenue—was 0.59%. As Figure 8 shows, this is considerably lower than both the ratio of national R&D expenditure to GDP (2.55%) and the ratio of R&D to sales of R&D-performing companies (3.40%) in 1997.

I hypothesize that the main reason that hospital R&D intensity is below average is lower technological opportunity, or expected returns to investment in R&D. Firm size may also play a role. As Figure 9 indicates, nonprofit hospitals tend to be smaller than firms in the pharmaceutical industry, the most R&D-intensive sector of the economy. The average revenue of the 4 or 8 largest pharmaceutical firms is over twice as great as the average revenue of the 4 or 8 largest nonprofit hospitals. As Cohen and Klepper (1996) observe, the likelihood of a firm reporting positive R&D effort rises with firm size and approaches one for firms in the largest size ranges. They developed a simple model

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[5] See, for example, R&D: Griliches and Lichtenberg (1984a, 1984b), Lichtenberg and Siegel (1991), Lichtenberg (1993), Lichtenberg and van Pottelsberghe de la Potterie (1998).

[6] http://www.nsf.gov/sbe/srs/nsf02303/pdf/taba5.pdf

based on the idea of R&D cost-spreading that can explain this and additional features of the R&D-firm size relationship, and that implies an advantage to large size in R&D.

Since hospitals are evidently less R&D-intensive than the average industry, and industry productivity growth is positively related to R&D-intensity, our finding in section 1 that hospital productivity growth is significantly lower than average productivity growth is not surprising.

Conclusion

In order to decide how much to increase Medicare payments to hospitals from one year to the next, the Medicare Payment Advisory Commission (MEDPAC) needs to estimate hospital productivity growth. A simplifying assumption made in the past has been to assume that the rate of hospital productivity growth is equal to the rate of productivity growth in the economy as a whole. I have argued that there are good reasons to believe that the true rate of hospital productivity growth is lower than the average rate of productivity growth in the economy as a whole. First, estimates of labor productivity growth based on official government statistics indicate that the rate of hospital productivity growth is significantly lower than the average rate of productivity growth in the economy as a whole. Second, the hospital sector has several characteristics that previous studies have shown to be associated with low productivity growth: (1) the hospital sector is relatively labor-intensive; (2) the hospital sector has relatively low investment in computers, software, and communications equipment; and (3) the hospital sector has relatively low investment in research and development (R&D).

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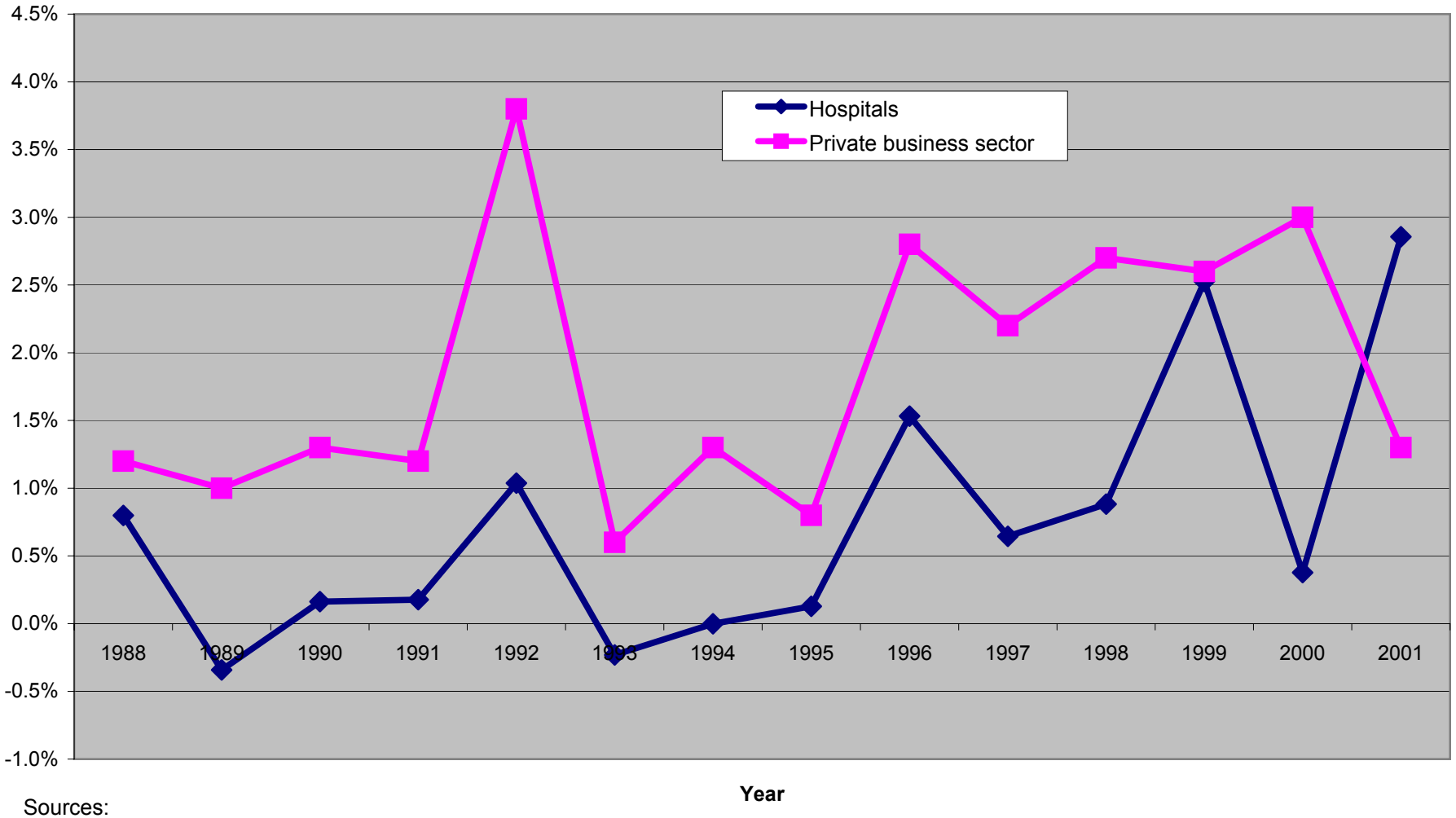
Table 1
Real output, employment, and productivity of hospitals, 1987-2001

Column	1	2	3	4	5	6	7	8
Year	Real output, current dollars	Real output, constant 1996 dollars	Implicit price deflator (1996=100)	FTE Personnel	Hospital labor productivity (Real output/FTE)	Hospital labor productivity growth	Private business sector labor productivity growth	Private business sector multifactor productivity growth
Source	BEA	BEA	BEA	AHA	(2)/(4)		BLS	BLS
1987	$138,526	$212,452	65.203	3,106,082	$68,399			
1988	$153,680	$220,298	69.760	3,195,168	$68,947	0.8%	1.2%	0.7%
1989	$169,394	$226,608	74.752	3,297,947	$68,712	-0.3%	1.0%	0.6%
1990	$186,869	$235,076	79.493	3,415,622	$68,824	0.2%	1.3%	0.1%
1991	$205,616	$243,421	84.470	3,530,623	$68,946	0.2%	1.2%	-1.0%
1992	$223,269	$251,848	88.652	3,615,145	$69,665	1.0%	3.8%	2.3%
1993	$235,320	$255,375	92.147	3,674,250	$69,504	-0.2%	0.6%	0.5%
1994	$243,469	$256,530	94.909	3,690,905	$69,503	0.0%	1.3%	1.1%
1995	$251,781	$258,045	97.572	3,707,958	$69,592	0.1%	0.8%	0.3%
1996	$263,223	$263,223	100.000	3,724,843	$70,667	1.5%	2.8%	1.6%
1997	$274,479	$269,542	101.831	3,789,752	$71,124	0.6%	2.2%	1.2%
1998	$286,576	$274,895	104.249	3,831,068	$71,754	0.9%	2.7%	1.3%
1999	$300,562	$282,435	106.418	3,837,964	$73,590	2.5%	2.6%	0.9%
2000	$317,444	$288,928	109.870	3,911,412	$73,868	0.4%	3.0%	1.5%
2001	$345,981	$303,066	114.160	3,987,274	$76,008	2.9%	1.3%	-1.0%
average, 1987-2001						0.8%	1.8%	0.7%

-Hospital labor productivity growth is less than half of that for the private business sector (40.9%).
-Labor productivity growth is consistently higher than TFP productivity growth, the measure used by MedPAC (see Figure 2 for relationship across industries).
-These relationships imply hospital TFP growth would be expected to be 0.5 percentage points lower than private business sector MFP growth.

http://www.bls.gov/news.release/prod3.t03.htm

Figure 1
Annual labor productivity growth rates: hospitals vs. private business sector



Sources:
Hospitals: Author's calculations based on Bureau of Economic Analysis real output data, and American Hospital Association employment data
Private business sector: Bureau of Labor Statistics

Figure 2
Relationship between labor productivity growth rate and MFP growth rate among 453 manufacturing industries, 1958-1996

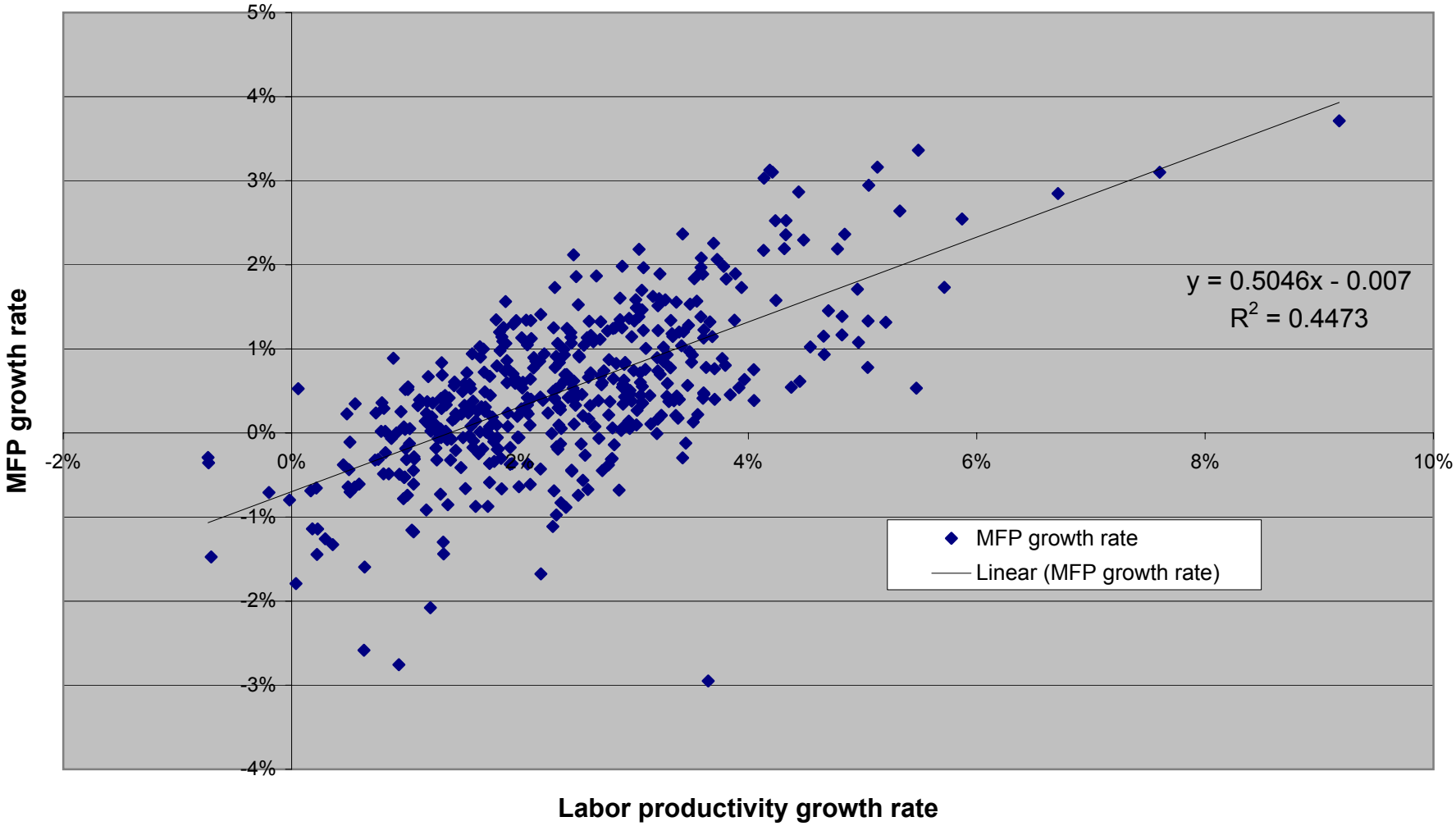
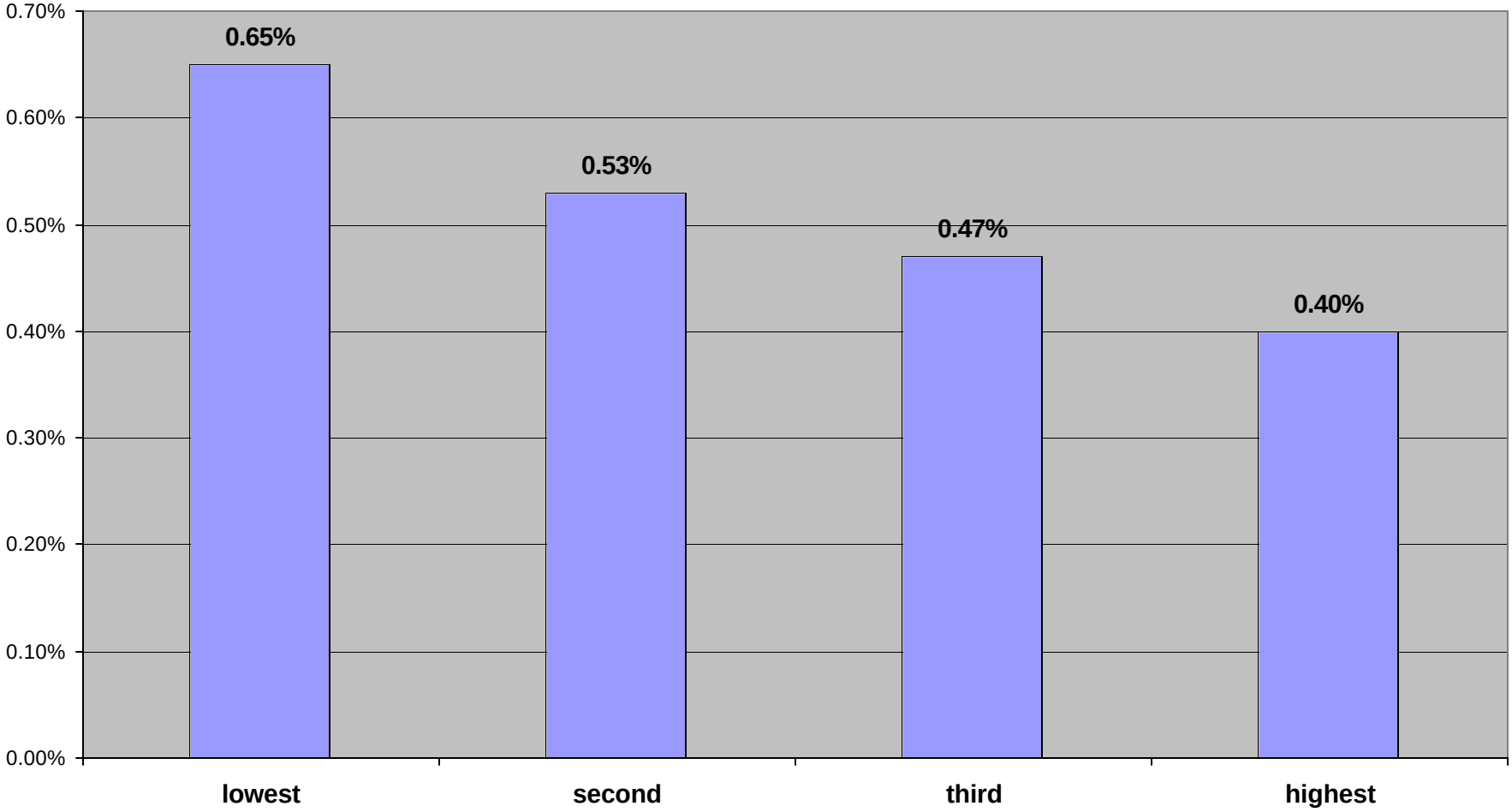
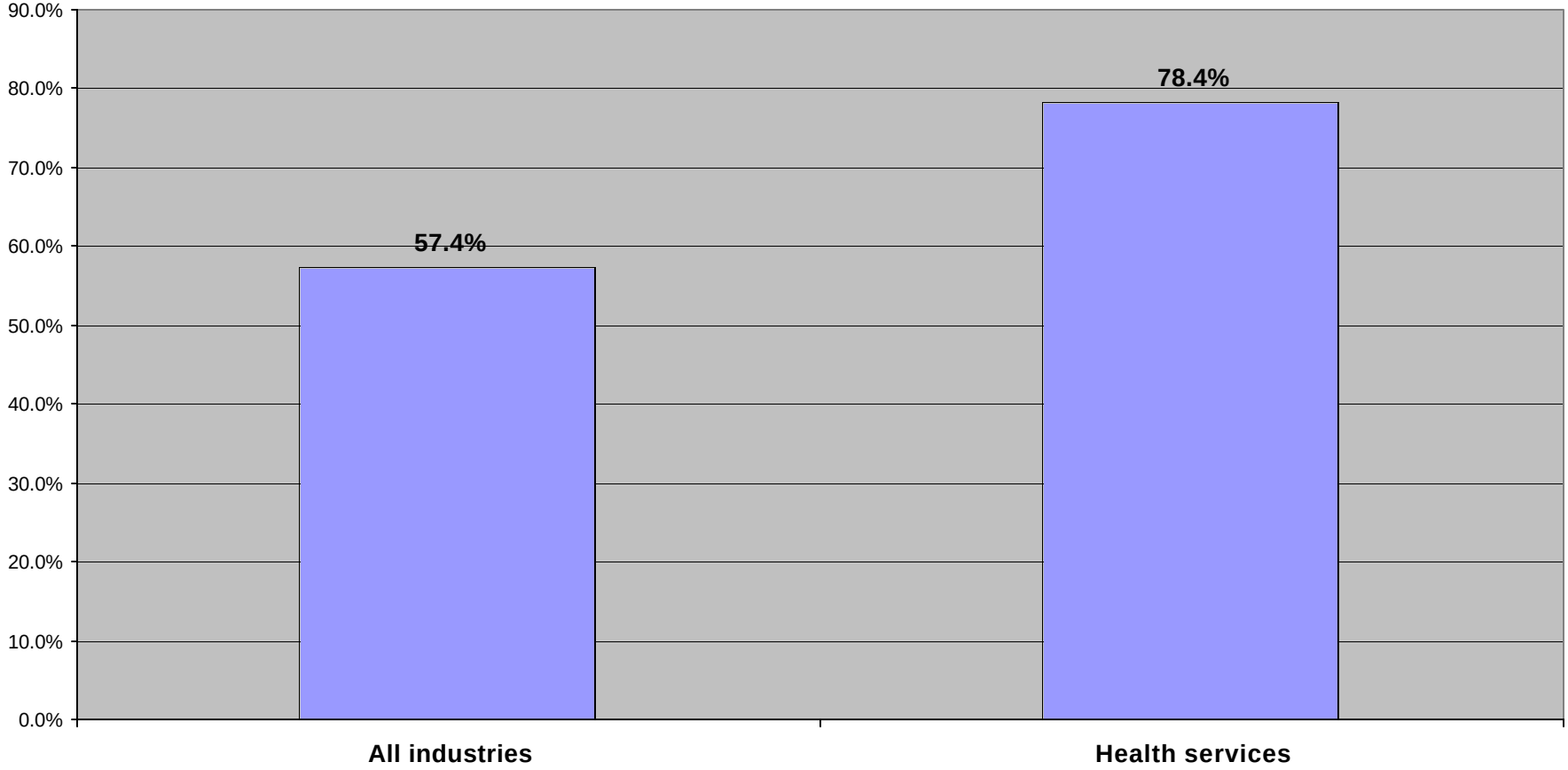


Figure 3
Average annual rate of MFP growth, by quartile of labor-intensity distribution



Note: based on data for 453 manufacturing industries contained in the NBER-CES Manufacturing Industry Database.

Figure 4
Labor-intensity of health services vs. all industries



Note: Labor intensity is defined as the ratio of employee compensation to value added (gross domestic product).

Figure 5
Growth rate of nonfarm business output per hour worked

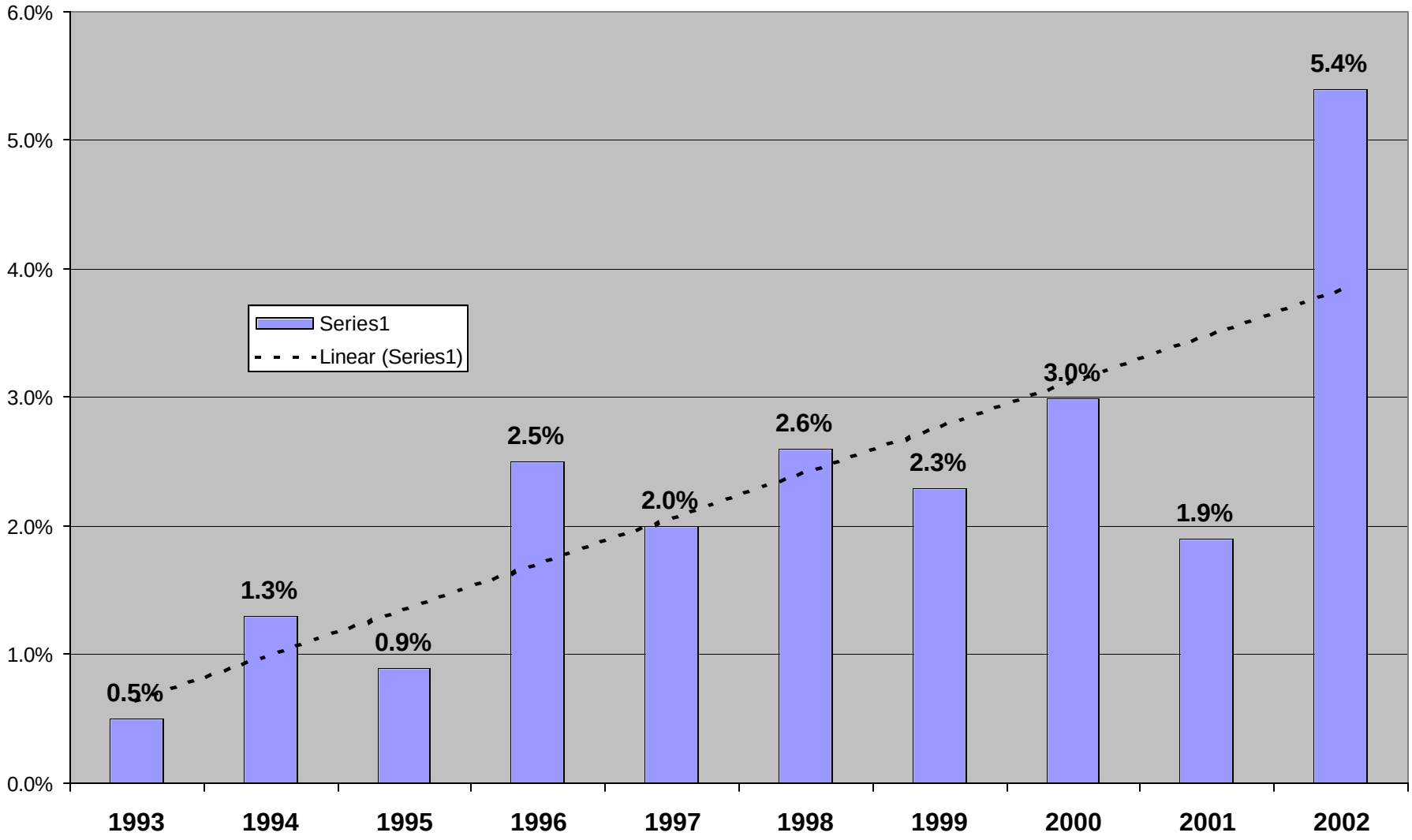


Table 2
Investment in computers, software, and communication equipment in 1997:
Hospitals vs. all industries

	Hospitals	All industries
Computers and peripheral equipment	$2,277	$81,598
Office and accounting equipment	$59	$5,721
Software	$2,034	$97,988
Communication equipment	$735	$80,154
Total	$5,105	$265,461
Gross output	$274,479	$8,431,659
Investment in computers, etc. as a percentage of gross output	1.90%	3.10%

Note: dollar figures are in millions.
Source: BEA Capital flow table for 1997
http://www.bea.gov/bea/newsrel/flow1997.xls

Figure 6
Expenditure on computers, software, and communication equipment as a percentage of gross output in 1997

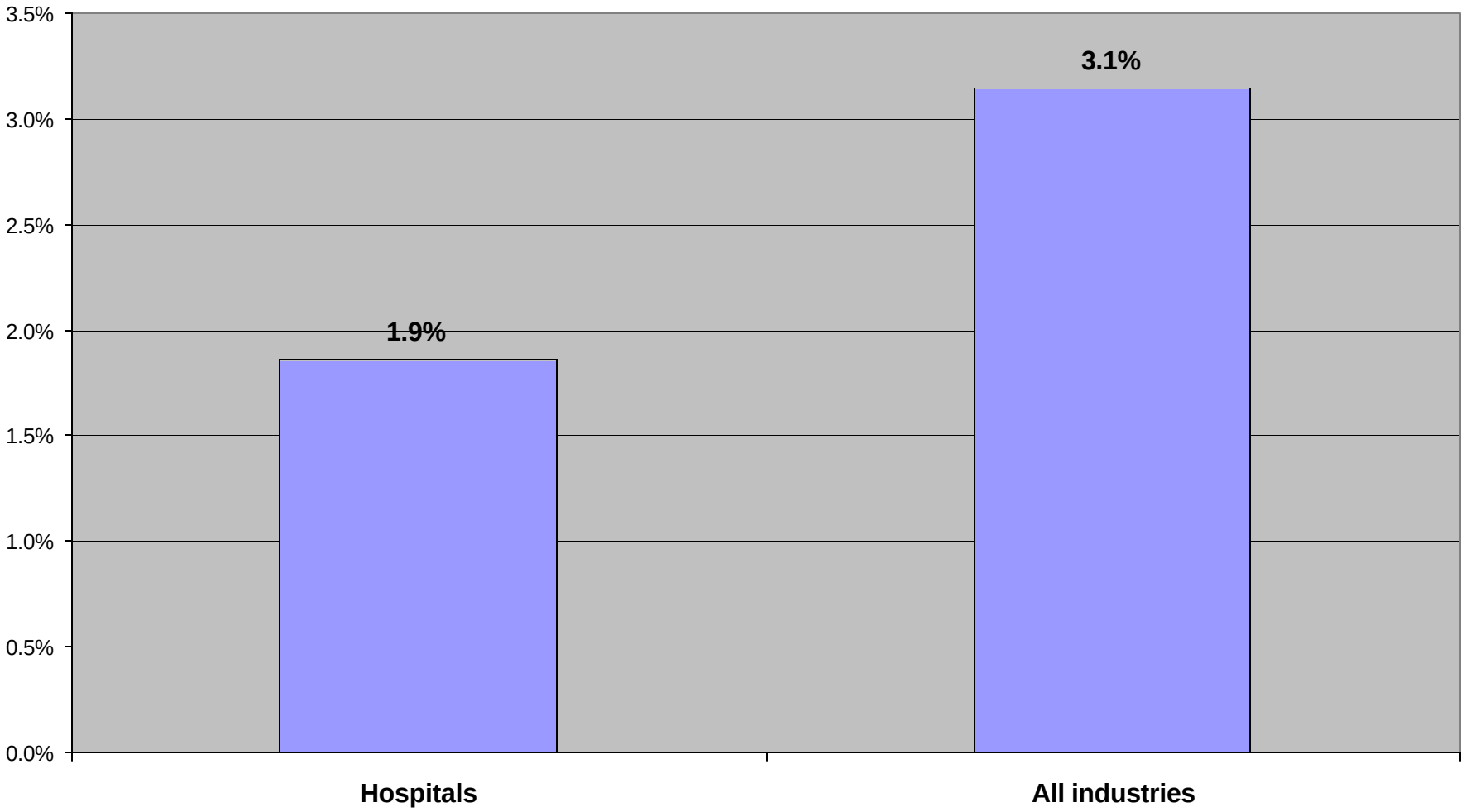
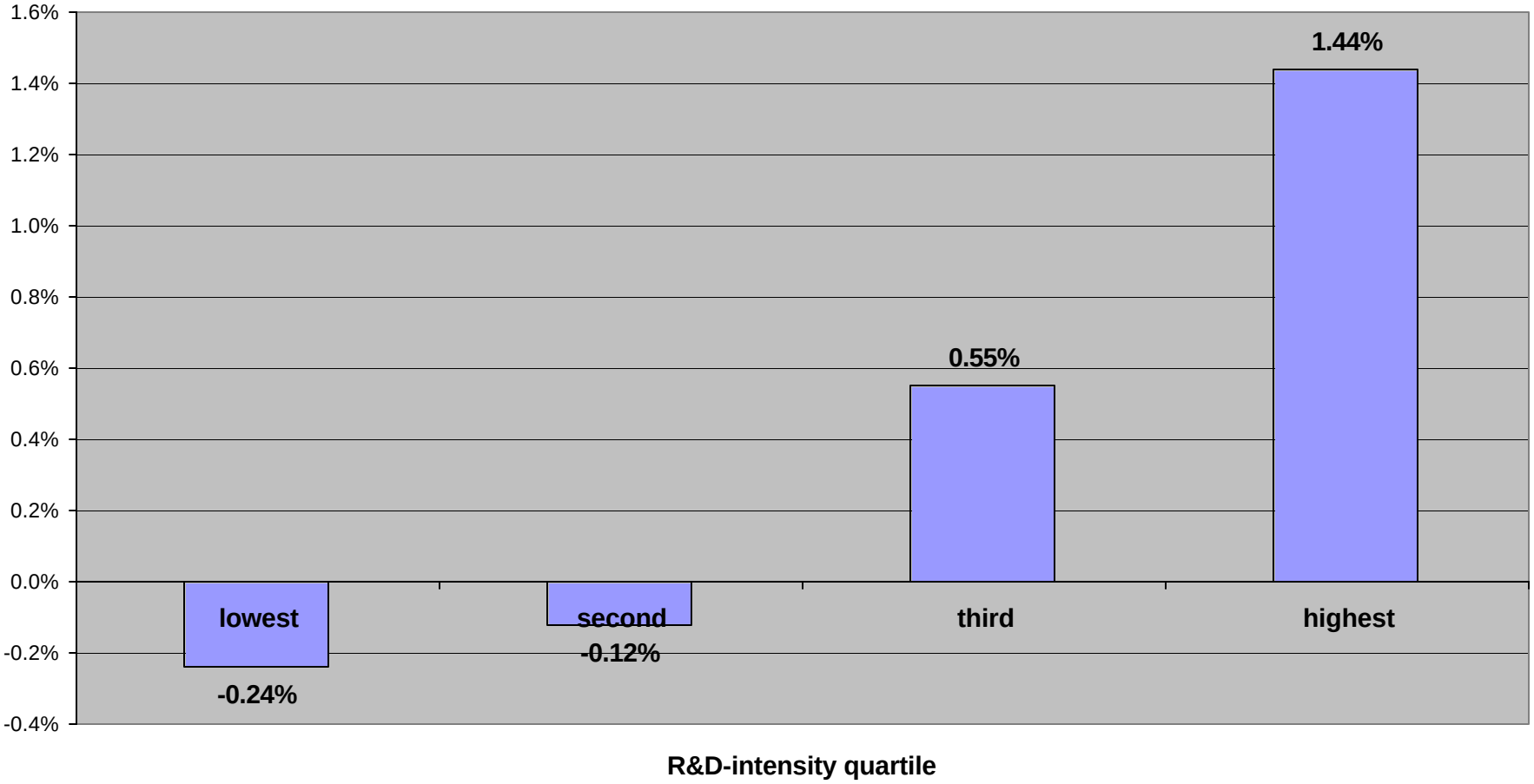
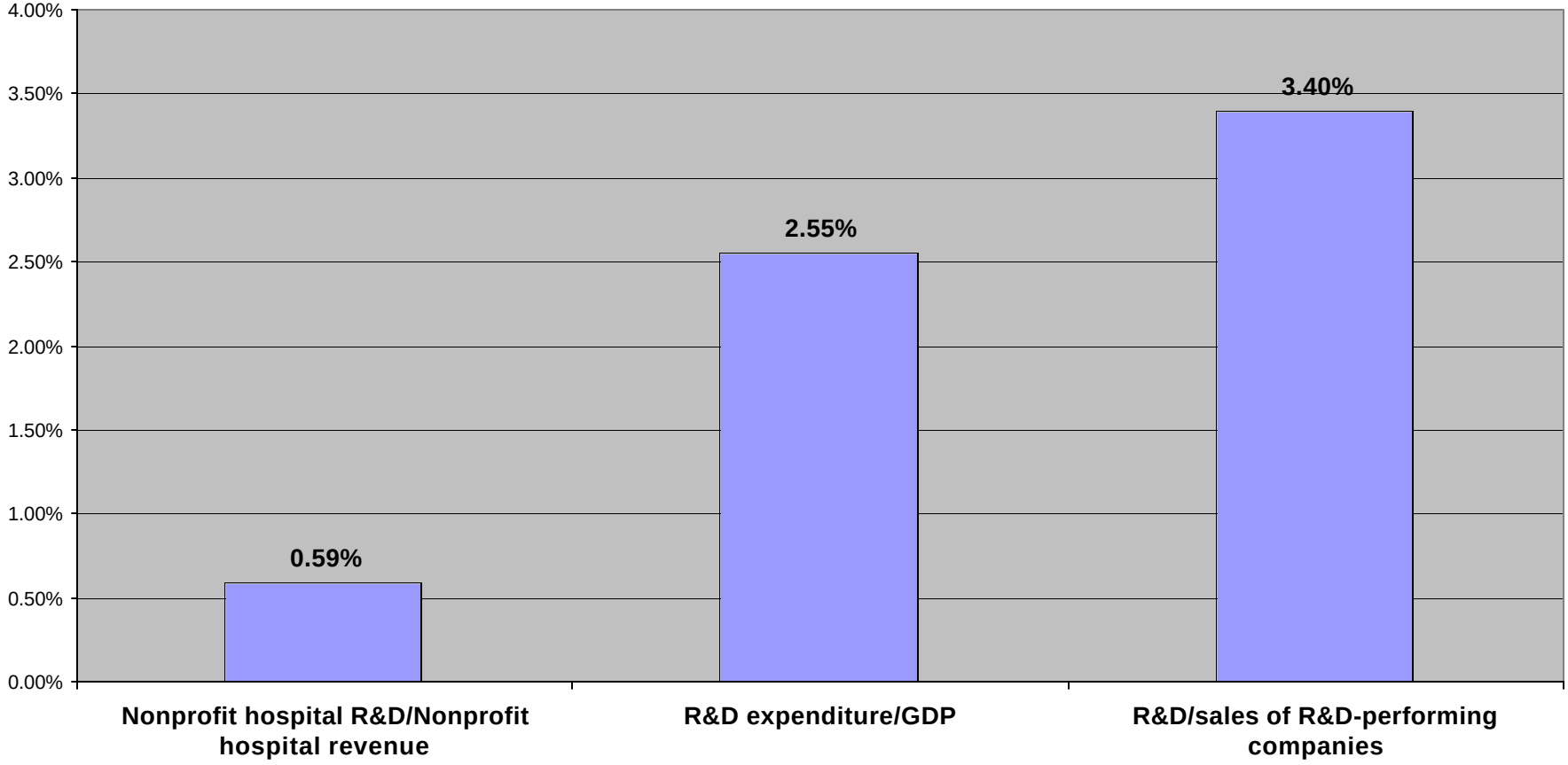


Figure 7
Average 1969-1976 MFP growth rate of industries,
by quartile of R&D-intensity distribution



Note: Based on data for 27 manufacturing industries reported in Griliches and Lichtenberg (1984b).

Figure 8
R&D intensity of hospitals vs. other industries, 1997



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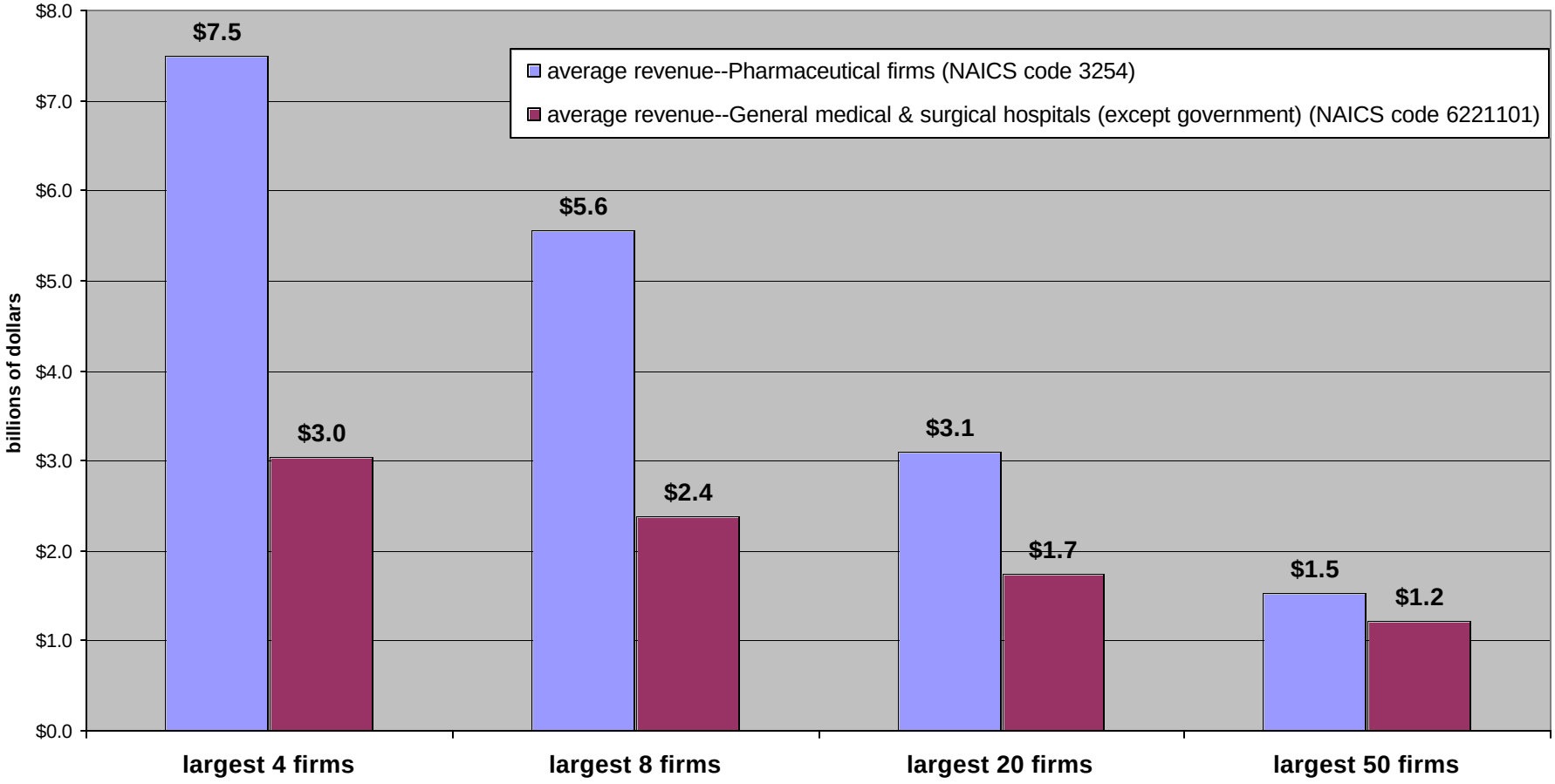
http://www.nsf.gov/sbe/srs/nsf01305/tables/taba21.xls

Figure 9
Average revenue in 1997 of largest firms:
Nonprofit hospitals vs. pharmaceutical companies



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