Hospital Costs and the Medicare Program

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Several causes may explain the rapid acceleration in hospital costs with the advent of Medicare and Medicaid. To sort out the influence of these separate factors, this article presents certain types of evidence of hospital cost inflation in the first 2 years of Medicare: overall trends in hospital revenues and expenses, labor and capital components of cost inflation, trends in individual hospital services, and the simultaneous influence of a number of sources of cost increase.

The study findings reveal that many characteristics of hospital inflation in the pre-Medicare period continued with greater intensity in the first 2 years of Medicare. Capital expenses continued to grow faster than labor expenses. Most of the rise in expenses has occurred in ancillary services rather than in basic room and board. The findings tend to support the demand-pull view of hospital inflation and the views that emphasize changes in technology and expansion of the hospital's role. The labor-cost-push model does not fully explain hospital inflation, as costs per patient day would have risen at a 6-percent annual rate even if wages had remained constant. Econometric estimation of hospital costs over the pre-Medicare and Medicare period indicates that Medicare affected hospital costs in much the same way as the growth of private insurance in the earlier period.

THE RAPID INCREASE in hospital costs following the introduction of the Medicare and Medicaid programs in 1966 is well known. The nature of the cost inflation and the reasons for its concurrence, however, are not well understood. Several explanations of the rapid acceleration of hospital costs with the advent of Medicare and Medicaid are plausible:

- as government financing programs expanded, hospitals were able to increase charges for hospital care without risking any reduction in demand for their services; with additional revenues from private patients and from public programs, hospitals improved the quality (and cost) of care provided
- hospitals responded to the increase in demand for hospital care on the part of beneficiaries of public programs by raising prices to private patients in order to ration limited bed availability
- with a greater growth of guaranteed reimbursement for costs generated in providing medical services, hospitals became increasingly inefficient and increased expenses unnecessarily
- with improvement in the financial position of hospitals, hospital workers demanded "inordinate" increases in wages, and hospitals were increasingly willing (and able) to grant these demands
- application of minimum wage legislation to hospitals at the same time made it necessary for hospitals to increase both the wages of employees falling below the minimum wage and the wages of higher-paid employees in order to maintain "appropriate" wage differentials
- implementation of the Medicare and Medicaid programs coincided with rising prices and wage levels generally in the economy, and hospitals were forced to pass along increases in the prices they paid for materials, supplies, and labor
- public programs caused a radical shift in the case-mix of hospital patients towards those patients (the elderly and poor) for whom treating is very costly.

Undoubtedly, the "true" explanation of rising costs is no single one of the explanations but some combination of these factors. To sort out the role or influence of the separate causes to the greatest degree possible, this article presents several types of evidence of hospital cost inflation in the first 2 years of the Medicare program.

First, the rates of increase in hospital revenues and expenses are examined and the resulting changes in net income and cash flow determined. Second, overall increases in costs are decomposed into those resulting from increases in (a) wages paid hospital employees, (b) number of employees, (c) prices of nonlabor inputs, and (d) quantities of nonlabor inputs. Examination of the portion of overall inflation that may be traced to a single factor such as wage increases is thus possible. Third, the composition of hospital expenses and revenues, by department, are examined to determine if cost increases have been primarily in administrative services, nursing

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services, ancillary services, or outpatient services. This step should provide some indication of the relevance of charges of inefficiency, case-mix change, etc. Finally, regression analysis of individual hospital costs for the period from 1962 to 1968 considers the simultaneous influence of a number of sources of cost increases.

Data reported here are based on a nationwide sample survey—the Hospital Economic Survey. Pre-Medicare data were collected by the American Hospital Association for the Social Security Administration. Data for 1967 and 1968 are based on the same sample of hospitals but they were submitted directly to the Social Security Administration under the Medicare program.[1]

OVERALL TRENDS IN HOSPITAL REVENUES AND EXPENSES

It was widely feared by hospitals that the Medicare program would result in losses to hospital operations. In fact, hospital revenues have risen slightly faster than expenses since the introduction of Medicare, and a fairly substantial increase in hospital net incomes has resulted. Net incomes of community hospitals went from $198 million in fiscal year 1966 to $280 million in fiscal year 1968 (table 1). Cash flows of community hospitals (net incomes plus depreciation expenses) also rose considerably—from $625 million in 1966 to $1.0 billion in 1968.

Since hospitals are primarily nonprofit organizations and since much of hospital capital is financed by public grants or private philanthropic contributions, the most appropriate measure of "profitability" is somewhat arbitrary. If all capital were financed by grants, cash flow (net income plus depreciation expenses) would provide a measure of "free" funds available for discretionary use by the hospital. If hospitals must use internal funds to replenish depreciating capital, net income reflects the surplus available for net addition to capital stock or discretionary use. If some capital investment is financed by borrowing, net income understates the total return to capital. The appropriate measure of "profitability" in that case is net income as a proportion of equity capital or net income plus interest expenses (referred to as capital return in table 2) as a percentage of equity and borrowed capital. Trends in all three measures of "profitability" as a percent of plant assets and of total revenues are presented in table 2.

Net income as a percent of total revenue went from 2.01 in 1966 to 2.11 in 1968. Increases with respect to plant assets were somewhat more substantial with net income as a percent of plant assets rising from 1.52 in 1966 to 1.97 in 1968. Cash flow as a percent of plant asssets averaged

TABLE 1.—Revenue, expenses, net income, and cash flow of community hospitals, 1962–68

Year	Total revenues	Total expenses	Net income	Cash flow [1]
	Total amount (in millions)			
1962	$6,584	$6,456	$127	$388
1966	9,859	9,661	198	625
1967	11,679	11,585	94	728
1968	13,275	12,995	280	990
Percentage increase, average annual:				
1962–66	10.6	10.6	11.8	12.7
1966–68	16.1	16.0	18.9	25.9
	Amount per patient day			
1962	$35.62	$34.93	$0.69	$2.10
1966	46.40	45.47	.93	2.95
1967	53.66	53.23	.43	3.35
1968	58.40	57.17	1.23	4.35
Percentage increase, average annual:				
1962–66	6.8	6.8	7.8	8.9
1966–68	12.2	12.1	15.0	21.4

[1] Net income plus depreciation expenses.

TABLE 2.—Net income, cash flow, and capital return ratios, 1962–68

Year	Net income ratio		Cash flow ratio [1]		Capital return ratio [2]	
	Total revenue	Plant assets	Total revenue	Plant assets	Total revenue	Plant assets
1962	1.93	1.42	5.89	4.33	2.34	1.72
1966	2.01	1.52	6.34	4.81	2.65	2.01
1967	.80	.69	6.24	5.41	1.67	1.45
1968	2.11	1.97	7.46	6.94	2.95	2.75
Average annual:						
1962–66	2.00	1.49	6.11	4.54	2.50	1.86
1967–68	1.46	1.33	6.85	6.18	2.31	2.10

[1] Net income plus depreciation expenses.
[2] Net income plus interest expenses.

[1] For a description of the sample design and estimation procedures, as well as detailed results for the pre-Medicare period, see Karen Davis, "Community Hospital Expenses and Revenues: Pre-Medicare Inflation," *Social Security Bulletin*, October 1972. For a more complete breakdown of hospital expenses and revenues in the pre-Medicare period by type of hospital ownership and by bed size, see Karen Davis and Richard W. Foster, *Community Hospitals: Inflation in the Pre-Medicare Period* (Research Report No. 41), Social Security Administration, Office of Research and Statistics, 1972.

6.18 in the Medicare period, while capital return (net income plus interest expenses) increased from 2.01 percent in 1966 to 2.75 percent in 1968.

The sample data also confirm the marked acceleration in hospital expenses and revenues during the Medicare period that has been noted in other studies.[2] Expenses per patient day in community hospitals increased at an annual rate of 12.2 percent in the first 2 years of the Medicare program, compared with 6.8 percent in the pre-Medicare period. Although this was a time of accelerating price inflation in the economy as a whole, all of the increase in hospital costs cannot be attributed to that source. The consumer price index rose at an annual rate of 3.5 during the period.

The rapid rise in hospital costs, as well as hospital revenues, disputes one possible explanation of the Medicare experience—that prices were raised simply to ration available space. If this had been the only factor influencing hospitals, revenues could have been expected to rise substantially, but expenses would not also have followed at approximately the same rate.

LABOR AND CAPITAL COMPONENTS OF HOSPITAL INFLATION

Following the introduction of Medicare, early analysis of hospital cost inflation focused on the role of wage increases.[3] Some proponents of the "wage-push" view of hospital inflation noted the application of minimum wage legislation to hospitals shortly after Medicare began and felt that the impact of minimum wage standards was responsible for the increase, rather than Medicare itself. Others argued that the program improved the financial position of hospitals and made it possible for them to grant more generous wage increases. Still others pointed to the generally tight labor-market conditions of that period as responsible for most of the increase in hospital labor cost.

[2] See, for example, Karen Davis, *Net Income of Hospitals, 1961–1969* (Staff Paper No. 6), Social Security Administration, Office of Research and Statistics, 1970, and Saul Waldman, *The Effect of Changing Technology on Hospital Costs* (Research and Statistics Note No. 4), Social Security Administration, Office of Research and Statistics, 1972.

[3] For a further discussion of these views, see Karen Davis and Richard W. Foster, *op. cit.*

More recently, increases in capital equipment and specialized facilities have been isolated as a source of hospital cost inflation. Evidence of duplication of facilities among hospitals in a given area is blamed for much of the higher cost of hospital care.

To determine the validity of these contending claims about the nature of hospital cost inflation, it is instructive to decompose hospital expenses into quantities and prices of factor inputs. Investigation of these labor and capital components of hospital costs in the first 2 years of the Medicare period reveals several important findings:

- Increases in prices of factor inputs were more marked in the Medicare period than in earlier periods, but a significant part of the growth in hospital costs continued to result from an increase in the quantity of inputs used to provide a day of hospital care. The price of hospital inputs increased at an annual rate of 8.5 percent from 1966 to 1968 while inputs per day of care increased by 3.7 percent annually.
- Capital expenses have risen more rapidly than other types of expenses so that the share of operating expenses going for depreciation and interest expenses has increased from 5.1 percent in 1966 to 6.4 percent in 1968.
- About nine-tenths of the increase in labor expenses in the Medicare period is accounted for by increases in average earnings of employees, and about one-tenth of the rise represents an increase in number of employees per day of care.
- Major-equipment plant assets per patient day have continued to grow more rapidly than the overall rate of increase in plant assets in the Medicare period, while the share of building plant assets per day of care has fallen from 61.5 percent in 1966 to 60.5 percent in 1968.

Major Labor and Capital Components of Hospital Expenses

With the data available from the Medicare program, hospital operating expenses may be split into payroll expenses, depreciation and interest expenses, and all other expenses. Rent expenses are not itemized separately in the Medicare data. As table 3 shows, capital expenses continued to mount rapidly in the Medicare period, with depreciation and interest expenses per patient day increasing at an annual rate of 25.0 percent in the first 2 years of the program. By 1968, depreciation and interest expenses accounted for 6.4 percent of all operating expenses. Payroll expenses also increased somewhat faster than

TABLE 3.—Labor and capital components of hospital operating expenses, 1962–68 [1]

Year	Total operating expenses	Payroll	Depreciation and interest	Other
	Total amount (in millions)			
1962	$6,365	$3,949	$288	$2,128
1966	9,517	5,797	489	3,231
1967	11,427	6,946	737	3,744
1968	12,895	7,854	820	4,221
Percentage increase, average annual:				
1962–66	10.6	10.1	14.1	10.6
1966–68	16.4	16.4	29.5	14.3
	Amount per patient day			
1962	$34.44	$21.36	$1.56	$11.67
1966	44.79	27.28	2.31	15.21
1967	52.50	31.91	3.39	17.20
1968	56.73	34.55	3.61	18.57
Percentage increase, average annual:				
1962–66	6.8	6.3	10.2	6.8
1966–68	12.6	12.5	25.0	10.5
	Percentage distribution			
1962	100.0	62.0	4.5	33.4
1966	100.0	60.9	5.1	34.0
1967	100.0	60.8	6.4	32.8
1968	100.0	60.9	6.4	32.7

[1] Operating expenses differ slightly from total expenses reported in table 1 because they exclude expenses incurred in fund drives and other nonoperating expenses.

all expenses, with other expenses declining from 34 percent of all expenses in 1966 to 33 percent in 1968.

The increase in payroll expenses reflects both an increase in personnel per day of hospital care and increases in average annual earnings. The number of employees per daily census increased from 2.61 in 1966 to 2.66 in 1968 (table 4). Average annual earnings, though still at a relatively low level, went up 11.2 percent annually. By 1968, hospital employees earned on the average $4,717 annually. Increases in average earnings of employees account for about 90 percent of the increase in payroll expenses per patient day. Even if hospital earnings had remained unchanged, however, all hospital expenses per patient day would have continued to rise by 6 percent annually. Although labor expenses are an important component of hospital inflation, they cannot be held fully responsible for all cost increases.

TABLE 4.—Labor and capital hospital inputs, 1962–68

Year	Number of full-time equivalent employees		Average annual earnings [1]	Plant assets	
	Total (in thousands)	Per daily census		Total (in millions)	Per daily census
1962	1,243	2.46	$3,176	$8,971	$17,716
1966	1,519	2.61	3,816	12,985	22,308
1967	1,563	2.63	4,445	13,423	22,511
1968	1,665	2.66	4,717	14,222	22,838
Percentage increase, average annual:					
1962–66	5.1	1.5	4.7	9.7	5.9
1966–68	4.7	1.0	11.2	4.7	1.2

[1] Total annual payroll expenses per full-time equivalent employee.

Not only have labor inputs per day of hospital care increased over time, but other inputs (such as supplies, food, linens, utilities, drugs) have multiplied. As table 5 indicates, both capital and other nonlabor inputs per day of hospital care increased in the Medicare period. Real nonlabor inputs are estimated by deflating other expenses by the consumer price index. This step yields an increase in "real" supplies and other inputs of 6.8 percent annually.

Unfortunately, a good measure of physical capital is not available. While total depreciation and interest expenses rose at an annual rate of 30 percent in the Medicare period, plant assets increased by 4.7 percent annually. The large increase in capital expenses, without any major changes in capital stock, suggests that Medicare caused a change in accounting methods of measuring depreciation. True growth in capital expenses, therefore, is undoubtedly overstated by the trend in depreciation expenses. Similarly, overstatement of depreciation expense growth leads to an underestimate of the growth in capital stock as

TABLE 5.—Hospital operating expenses per patient day, average annual rate of increase and percentage distribution of increase, 1962–66 and 1966–68

Item	Percentage increase, average annual		Percentage distribution	
	1962–66	1966–68	1962–66	1966–68
Total	6.8	12.6	100.0	100.0
Increase in wages and input prices [1]	3.8	8.5	55.9	67.5
Wage rates	4.7	11.2	42.5	54.7
Price of capital	4.7	8.4	3.4	3.3
Consumer price index	1.8	3.5	8.8	9.4
Increase in inputs [2]	2.9	3.7	42.7	29.4
Labor	1.5	1.0	13.6	4.9
Capital	5.1	15.5	3.7	6.0
Other	5.0	6.8	24.7	18.1
Interaction term	.1	.4	1.4	3.1

[1] Increase in wages and input prices is a weighted average of price increases of inputs. Weights are the share of expenses represented by each input in 1964: .615 for labor, .049 for capital, and .336 for other inputs—that is, 8.5 = (.615) × 11.2 + (.049) × 8.4 + (.336) × 3.5.

[2] Increase in inputs is a weighted average of real increases in each input—that is, 3.7 = (.615) × 1.0 + (.049) × 15.5 + (.336) × 6.8.

TABLE 6.—Composition of plant assets, by type, 1962–68

Year	Total plant assets	Land and land improvements	Buildings	Major equipment	Minor equipment	Other
	Total amount (in millions)					
1962	$8,971	$343	$5,734	$1,819	$37	$1,038
1966	12,985	525	7,987	2,972	65	1,435
1967	13,423	622	8,149	3,077	92	1,483
1968	14,222	685	8,601	3,525	49	1,361
Percentage increase, average annual:						
1962–66	9.7	11.3	8.6	13.1	15.0	9.8
1966–68	4.7	14.2	3.8	8.9	−11.6	−2.6
	Amount per daily census					
1962	$17,716	$677	$11,324	$3,591	$73	$1,981
1966	22,308	902	13,722	5,106	112	2,458
1967	22,511	1,043	13,666	5,160	154	2,487
1968	22,838	1,100	13,812	5,661	78	2,186
Percentage increase, average annual:						
1962–66	5.9	7.4	4.9	9.2	11.3	6.3
1966–68	1.2	10.5	.3	5.3	−14.2	−5.4
	Percentage distribution					
1962	100.0	3.8	63.9	20.3	0.4	11.6
1966	100.0	4.0	61.5	22.9	.5	11.0
1967	100.0	4.6	60.7	22.9	.7	11.0
1968	100.0	4.8	60.5	24.8	.3	9.6

measured by plant assets (net of accumulated depreciation). Deflating capital expenses by an index of the interest rate for high-grade municipal bonds yields an increase in "real" capital inputs of 15.5 percent annually. Since increases in depreciation expenses are overstated, however, this measure of real inputs is also overstated.

These trends in physical inputs and prices of inputs are summarized in table 5. An aggregate price index is constructed by weighting the prices of each of the factor inputs by the proportion of expenses represented by that factor in 1964.[4] An aggregate physical input index per patient day is also constructed using the same weights. The overall annual increase of 12.6 percent in operating expenses per patient day may then be decomposed into an annual increase of 8.5 percent in the prices of hospital inputs and an annual increase of 3.7 percent in the quantities of inputs used in the provision of a day of hospital care (with an interaction term accounting for the remaining 0.4 percent).

Table 6 reveals the trends in the composition of plant assets occurring in the Medicare period. Major-equipment plant assets continued to increase as a proportion of all plant assets—from 22.9 percent in 1966 to 24.8 percent in 1968. Building assets, still the largest component of hospital plant assets and still growing in absolute magnitude, showed an average annual increase of 0.3 percent per day of care in the Medicare period. "Other" plant assets (including assets for plant under construction) declined, however, by 5.4 percent per patient day. The rate of increase in land assets was the greatest of all component increases; minor equipment showed a substantial rate of decline. Together, land and minor equipment still account for a smaller proportion of all assets than any of the other components, so the effect of these changes is not very significant.

TRENDS IN REVENUES AND EXPENSES OF INDIVIDUAL HOSPITAL SERVICES

Additional insight into the nature of hospital cost inflation may be gained by examining trends in the departmental components of hospital revenues and expenses. Such an approach reveals whether the major sources of increases were incurred in providing standard room-and-board

[4] The year 1964 is used as a base for systematic comparison with increases in the pre-Medicare period, which were calculated as of that year. Using 1966 weights, however, yields virtually identical rates of increase.

services or in providing specialized ancillary services. This information is relevant to a number of different views of hospital inflation. It indicates whether cost increases have been in response to patient demands for more amenities—such as better food or more pleasant surroundings—or whether they have been the result of administrative expenses caused by additional paperwork.

Two views of hospital inflation stress (a) the expanded role of the community hospital (tests formerly not performed at all or performed in a physician's office are conducted in the hospital, outpatient care may replace physician visits to the home, etc.) and (b) advances in scientific technology that have made it possible to undertake more sophisticated (and expensive) forms of treatment. Neither of these views predicts a sudden, rapid increase in costs at the onset of the Medicare program, but they both predict that increases will be more likely to occur in certain departments (such as ancillary services or outpatient department) than others. Examination of these components of costs should indicate whether these views of inflation may explain at least some of the growth in overall hospital expenses.

Experience with the first 2 years of Medicare reveals that many of the same types of major cost increases in the pre-Medicare period continued, with greater intensity, after Medicare began. Major findings on trends in individual departmental expenses and revenues include the following:

- Increases in expenses of standard routine services such as dietary and plant engineering have been moderate in the Medicare period, but increases in individual ancillary service expenses (particularly laboratory expenses) have been quite marked. Unlike the situation in the pre-Medicare period, nursing-service expenses rose much more rapidly than all hospital costs.
- Philanthropic contributions and other nonpatient revenues to hospitals declined as a share of revenue from 11 percent in 1966 to 10 percent in 1968.
- Revenues from room-and-board services went up more rapidly than ancillary revenues in the first 2 years of the Medicare program—a reversal of what happened in the pre-Medicare period, undoubtedly reflecting a change in hospital rate structures towards relatively greater reliance on the room-and-board charge.
- In spite of the relatively faster growth in room-and-board revenues, hospitals had higher revenue-direct cost ratios on most ancillary services—an indication that prices of these services have kept ahead of the direct cost of providing them. Revenue-cost margins on ancillary services ranged from 0.97 on delivery room services to 2.07 on pharmacy services in the first 2 years of Medicare.

Departmental Operating Expenses

Table 7 depicts the growth in various departmental costs in the Medicare period. Unfortunately the definition of departmental cost is not the same as that for the pre-Medicare period so that strict comparisons of trends in the two periods cannot be made. Medicare cost figures are adjusted for nonallowable costs, such as dietary expenses incurred in cafeteria operations, sale of drugs to nonpatients, fees of radiologists, pathologists, and anethesiologists who are reimbursed separately, and so forth. Rates of increase over the 2-year period are therefore understated in a number of departments.

The adjusted departmental expenses reflect some of the same pattern of increase observed in the pre-Medicare period. Standard services such as dietary expenses and plant engineering expenses per patient day rose 1.8 percent and 0.5 percent, respectively, in the Medicare period, compared with a 12.6-percent increase in all operating expenses per patient day from 1966 to 1968. Ancillary service expenses such as laboratory expenses continued to be the major type of inpatient cost inflation.

Outpatient expenses increased rapidly over the period. Part of this increase, however, may be the result of a change in methods of allocating costs between inpatient and outpatient departments. Before the introduction of Medicare, many hospitals failed to separate outpatient expenses in the laboratory and radiology departments from inpatient expenses.

One major difference between the pre-Medicare and Medicare periods is the trend in nursing service. In the pre-Medicare period, nursing-service expenses per patient day rose 6.1 percent annually. Between 1966 and 1968, nursing service expenses per patient day jumped 13.7 percent—perhaps registering some impact of the minimum wage legislation. Part of the increase in nursing-service expenses may reflect the greater nursing needs of Medicare patients. Intern-resident service expenses—which one might expect to increase

TABLE 7.—Departmental operating expenses, by type, 1962–68

Year	Total operating expenses	Administrative	Dietary	Plant operation and maintenance [1]	Nursing service	Medical service [2]	Operating and delivery room	Radiology	Laboratory	Pharmacy	Outpatient [3]	Depreciation and interest [4]	Other [5]
	Total amount (in millions)												
1962	$6,365	$725	$660	$431	$1,527	$310	$441	$305	$367	$274	$96	$288	$941
1966	9,517	1,110	874	610	2,221	464	651	503	603	387	154	489	1,450
1967	11,427	1,123	912	615	2,591	185	747	384	643	435	336	737	2,720
1968	12,895	1,270	971	659	3,070	194	811	446	768	491	394	820	3,000
Percentage increase, average, annual:													
1962–66	10.6	11.2	7.3	9.1	9.8	10.6	10.2	13.3	13.2	9.0	12.5	14.1	11.4
1966–68	16.4	7.0	5.4	3.9	17.6	----------	11.6	(6)	12.9	12.6	59.9	29.5	43.8
	Amount per patient day												
1962	$34.44	$3.92	$3.57	$2.33	$8.26	$1.68	$2.39	$1.65	$1.99	$1.48	$0.52	$1.56	$5.09
1966	44.79	5.22	4.12	2.87	10.45	2.18	3.06	2.37	2.84	1.82	.73	2.31	6.82
1967	52.50	5.16	4.19	2.82	11.90	.85	3.43	1.76	2.95	2.00	1.54	3.39	12.50
1968	56.73	5.59	4.27	2.90	13.51	.86	3.57	1.96	3.38	2.16	1.13	3.61	13.20
Percentage increase, average annual:													
1962–66	6.8	7.4	3.6	5.4	6.1	6.7	6.4	9.5	9.3	5.3	8.8	10.2	7.6
1966–68	12.6	3.5	1.8	.5	13.7	----------	8.0	(6)	9.1	8.9	53.9	25.0	39.1
	Percentage distribution												
1962	100.0	11.4	10.4	6.8	24.0	4.9	6.9	4.8	5.8	4.3	1.5	4.5	14.8
1966	100.0	11.7	9.2	6.4	23.3	4.9	6.8	5.3	6.3	4.1	1.6	5.2	15.2
1967	100.0	9.8	8.0	5.4	22.7	1.6	6.5	3.4	5.6	3.8	2.9	6.5	23.8
1968	100.0	9.9	7.5	5.1	23.8	1.5	6.3	3.5	6.0	3.8	3.1	6.4	23.3

[1] Excludes expenses for housekeeping, laundry, linen, or maintenance of personnel.
[2] Data for 1967 and 1968 include only intern-resident service expenses.
[3] Excludes emergency department expenses.
[4] Excludes rent expenses.
[5] Includes expenses for housekeeping, laundry, linen, maintenance of personnel, medical and surgical service other than intern-resident service, medical records and library, social service department, blood bank, oxygen-therapy, physical therapy, ambulance service, emergency room, rent, medical supplies, and, for 1967 and 1968, all Medicare nonallowable costs for other departments.
[6] Excludes radiologists fees in Medicare period.

for reasons similar to those for nursing-expense increases—did not, however, change significantly from 1967 to 1968. A comparison with the previous trend in this category is difficult because intern-resident expenses are not available separately in the pre-Medicare period.

These patterns of departmental cost increases verify many of the conclusions about the nature of hospital cost inflation that could be made on the basis of pre-Medicare data. There is no evidence to support claims that demand for amenities or added complexity of administrative tasks are primarily responsible for hospital inflation. Instead, theories of hospital inflation that emphasize the role of specialized services, the expanded role of the community hospital, and advances in technology all are consistent with observed phenomena. The rapid increase in costs concomitant with the start of Medicare lends substantial credence to the view that hospitals respond to increased insurance coverage (either public or private) by changing the style (and expensiveness) of hospital care provided, particularly in the areas of specialized services.

Sources of Hospital Revenues

Hospitals, because of their predominantly nonprofit ownership, have commonly been characterized as dependent upon philanthropic contributions for survival. Such sources of hospital revenues, however, are small and have been declining in importance. Data for the pre-Medicare period indicate that contributions accounted for only 2 percent of hospital revenues in 1966, and other nonpatient income (such as cafeteria sales) represented an additional 9 percent of revenue. As table 8 shows, contributions and other nonpatient income have increased only slightly in the Medicare period, so that they jointly contributed only 10 percent of all hospital revenues in 1968.[5]

The composition of patient revenue has also

[5] Separate breakdowns of philanthropic and other income are not available for the Medicare period.

TABLE 8.—Sources of hospital revenues, 1962–68

Year	Total revenue	Net patient revenue	Other
	Total amount (in millions)		
1962	$6,584	$5,768	$816
1966	9,859	8,757	1,102
1967	11,679	10,707	973
1968	13,275	12,007	1,268
Percentage increase, average annual:			
1962–66	10.6	11.0	7.8
1966–68	16.1	17.1	7.3
	Amount per patient day		
1962	$35.62	$31.20	$4.42
1966	46.40	41.22	5.19
1967	53.66	49.19	4.47
1968	58.40	52.82	5.58
Percentage increase, average annual.			
1962–66	6.8	7.2	4.1
1966–68	12.2	13.2	3.7
	Percentage distribution		
1962	100.0	87.6	12.4
1966	100.0	88.8	11.1
1967	100.0	91.7	8.3
1968	100.0	90.4	9.6

undergone substantial change in the early Medicare period. In the 5 years preceding the implementation of Medicare, room-and-board revenues declined relatively as a source of patient revenue (from 47 percent of revenues in 1962 to 46 percent in 1966). In the first 2 years of Medicare, room-and-board revenues increased much faster than other types of revenue so that their share of revenue had risen to 51 percent by 1968 (table 9).

Increase in room-and-board revenues may reflect a decision on the part of hospitals to aline charges more closely with the costs of providing different types of services. Greater attention to accounting systems, induced by the Medicare program, would have made such a reappraisal of rate structure possible. Since room-and-board charges have traditionally been set rather low in relation to costs, a move toward greater equality would require higher charges for room-and-board services. As indicated in table 10, however, hospitals also raised the charges on ancillary services enough to raise the ratios of revenues to costs on those services as well. Therefore, the increase in room-and-board charges would not seem to be part of consistent policy to equate charges of each type of hospital service (including ancillary services) with costs.

Another explanation of the relatively greater growth in room-and-board revenues involves the sensitivity of demand for hospital care to the basic room charge. If the major price that influences patient and physician decisions regard-

TABLE 9.—Departmental patient revenue per patient day, 1962–68

Year	Gross patient revenue	Inpatient revenue						Outpatient revenue
		Room and board	Operating room	Radiology	Laboratory	Pharmacy	Other	
	Total amount (in millions)							
1962	$6,468	$3,049	$602	$418	$623	$580	$678	$518
1966	9,800	4,547	836	644	984	784	1,169	836
1967	12,024	5,845	1,054	714	1,272	926	1,241	971
1968	13,276	6,824	1,122	713	1,337	988	1,293	999
Percentage increase, average annual.								
1962–66	10.9	10.5	8.6	11.4	12.1	7.8	14.6	12.7
1966–68	16.4	22.5	15.8	5.2	16.6	12.2	5.2	9.3
	Amount per patient day							
1962	$34.99	$16.50	$3.26	$2.26	$3.37	$3.14	$3.67	$2.80
1966	46.13	21.40	3.93	3.03	4.63	3.69	5.51	3.94
1967	55.24	26.86	4.84	3.28	5.84	4.25	5.70	4.46
1968	58.41	30.02	4.94	3.14	5.88	4.35	5.69	4.39
Percentage increase, average annual:								
1962–66	7.1	6.7	4.8	7.6	8.3	4.1	10.7	8.9
1966–68	12.5	18.4	12.1	1.8	12.7	8.6	1.6	5.5
	Percentage distribution							
1962	100.0	47.2	9.3	6.5	9.6	9.0	10.5	8.0
1966	100.0	46.4	8.5	6.6	10.0	8.0	11.9	8.5
1967	100.0	48.6	8.8	5.9	10.6	7.7	10.3	8.1
1968	100.0	51.4	8.5	5.4	10.1	7.4	9.7	7.5

TABLE 10.—Ratio of patient revenue to direct costs of selected ancillary services, 1962–68

Year	Revenue/direct-cost ratios						
	Operating room	Delivery room	Anesthesiology	Radiology	Laboratory	Physical therapy	Pharmacy
1962	1.43	0.97	1.62	1.37	1.70	1.27	2.12
1966	1.37	.81	1.50	1.28	1.63	1.28	2.02
1967	1.39	.95	1.89	1.86	1.98	1.21	2.13
1968	1.37	.99	1.81	1.60	1.74	1.30	2.01
Average annual:							
1962–66	1.40	.89	1.55	1.34	1.66	1.26	2.05
1967–68	1.38	.97	1.85	1.73	1.86	1.26	2.07

ing hospitalization were not the overall cost of hospital care but the more visible daily room charge,[6] hospitals would have an incentive to keep this charge down in normal periods. With the introduction of Medicare and an assured additional source of demand for hospitalization, however, hospitals could raise the room charge without incurring reductions in overall use (since the increase from elderly patients could be counted upon to offset any reduction in demand by younger patients). If the hospital were already operating at near-capacity levels, it might welcome a reduction in demand by younger patients.

Ancillary service revenues, which increased rather markedly from 1966 to 1968, include operating-room revenues and laboratory revenues. An earlier study has indicated that surgery on elderly patients increased with Medicare.[7]

Some of the increase in operating-room revenues, therefore, may reflect both a change in composition of patients toward more elderly patients and a greater incidence of surgery among the elderly.

Radiology revenues, which had increased slightly faster than all revenues in the pre-Medicare period, had only moderate increases in the Medicare period. This slowing of the rate of increase may reflect a greater tendency in the Medicare period for hospital radiologists to bill patients separately for services so that these charges are not counted as part of hospital revenues.

[6] See Karen Davis and Louise B. Russell, "Substitution of Hospital Outpatient Care for Inpatient Care," *Review of Economics and Statistics*, May 1972, pages 109–120, for econometric evidence that demand is more elastic with respect to the room charge than either revenue per patient day or revenue per hospital admission.

[7] Regina Lowenstein, "Early Effects of Medicare on the Health Care of the Aged," *Social Security Bulletin*, April 1971.

Departmental Revenue-Direct Cost Ratios

In the pre-Medicare period, ancillary service revenues tended to be much higher in relation to direct costs on those services for which demand might be expected to be relatively inelastic. For example, since prescription drugs retail at high prices in relation to costs, hospitals can charge fairly high prices for medication without complaints from patients or without patients attempting to obtain drugs from other sources. In fact, hospitals have a higher ratio of revenues to direct costs on pharmacy services than on any other ancillary services. The lowest ratio of revenue to direct cost in the pre-Medicare period was on delivery-room services, a service that is generally less well-covered by insurance and for which sufficient time exists for the patient to obtain information on charges at different hospitals in the area.

As table 10 indicates, the same general pattern of revenue-cost ratios was evident in the Medicare period, with delivery-room services having the lowest ratio (average of 0.97 in 1967 and 1968) and pharmacy services having the highest (average of 2.07 in 1967 and 1968). The levels on all services, however, tended to be higher in the Medicare period. For example, radiology revenues were 1.7 times as high as direct costs in the Medicare period and only 1.3 times as high in the pre-Medicare period.

MULTIVARIATE REGRESSION ANALYSIS OF HOSPITAL COSTS

Although examination of components of hospital costs by type of service provided and by type of factor inputs may suggest the underlying causes of hospital inflation, it is not possible in such an analysis to hold constant for all of the

factors that may possibly affect costs. Nor is it possible to determine by examination of the components of costs whether increases in real nonlabor inputs, for example, are a response to changes in demand for hospital care, changes in composition of patients treated, or technological progress. This section, therefore, presents the results of an econometric regression analysis of hospital costs using individual nonprofit hospital data for the period from 1962 to 1968.

The regression analysis focuses on movements over time and differences among hospitals in total expenses per hospital admission. Hospital admissions are used here as a measure of output because of the particular interest in examining the impact of Medicare both on the length of hospital stay and on expenses per day of care. To the extent that Medicare—or public and private insurance generally—leads to a prolongation of hospital stay, the social costs of caring for patients are increased even if costs per patient day do not change. Any increase in cost per admission induced by a lengthening of hospital stay may be desirable if there are concomitant benefits of prolonged hospitalization. The purpose of the analysis here is not to render a judgment on the undesirability of higher costs but only to summarize the impact of Medicare on total costs—both through its effect on costs per day of care and on length of hospital stays. For purposes of brevity, most of the analysis focuses on expenses per hospital admission. Some overall regressions on expenses per patient day and mean stay are presented, however, and their relationship to the regressions on expenses per admission explained.

Included in the regression equations are all of the factors that can be expected to affect costs directly, or indirectly by affecting the quantity of services provided by the hospital. Demand factors such as insurance and income, for example, may affect costs directly as hospitals respond to additional insurance coverage by providing a higher quality, or at least more expensive, type of hospital care. Demand factors may also affect costs indirectly by affecting prices charged for hospital care, which in turn may influence hospital occupancy levels. Finally, to the degree that more extensive insurance or higher income lengthens hospital stays, hospital expenses per admission can be expected to increase. Including demand factors in a regression of expenses per admission therefore allows for all these direct and indirect effects.

Five types of factors that might be expected to have either direct or indirect effects on hospital costs are included in the analysis: demand factors, case-mix factors, hospital wage rates, changes over time unexplained by other factors, and proportion of hospital patients who are Medicare patients. These sets of factors are used to explain both overall hospital costs per admission and quantities of factor inputs per hospital admission. In addition, the impact of demand, case-mix, time, and Medicare patients on hospital wage rates is examined.

Definition of Regression Variables and Data Sources

The major variables to be explained in the model include: total hospital expenses per admission, hospital wage rates, personnel per hospital admission, and real nonlabor inputs per hospital admission. Increases in hospital costs attributable to increases in economy-wide price levels are eliminated by deflating hospital expenses by the consumer price index. Real nonlabor inputs per hospital admission are calculated by first subtracting payroll expenses from all operating expenses, dividing these other expenses by the consumer price index, and, finally, dividing real other expenses by hospital admissions.

Demand variables included in the regression model include: insurance, income, available physicians per capita, types of physicians available, available hospital beds per capita, population density, educational level, age composition, and racial composition of the population.[8] Instead of including a direct measure of insurance, the model follows the earlier work by Martin Feldstein and includes a measure of noninsured expenses in the regression. This measure is derived from both national data on net and total expenditures on short-term hospital services and from State data on enrollment in hospital insurance plans. These data are combined, according to the

[8] For hospital demand studies based on these variables, see Martin S. Feldstein, "Hospital Cost Inflation: A Study of Nonprofit Price Dynamics," *American Economic Review*, December 1971, pages 853–872, and Karen Davis and Louise B. Russell, *op. cit.*

formula developed by Feldstein, to derive an estimate of the proportion of hospital charges paid directly by patients.[9] An increase in government programs such as Medicare and Medicaid hence will result in a reduction in noninsured expenses (that is, a reduction in the proportion of the hospital bill paid out of pocket).

Income is defined as disposable income per capita deflated by the consumer price index. Data on income for each year for the county in which the sample hospital is located are from annual American Medical Association publications.[10] Two measures of physician availability are included in the model: patient-care physicians per capita in the county and the ratio of general practitioners to patient-care physicians. Hospital bed availability is measured by hospital beds per capita in the county in which the hospital is located. Again, data are from the annual American Medical Association reports.

Other demand variables included in the regressions are population density, racial composition, age composition, and education. Population data in the county for each year are from the American Medical Association reports. Density is simply the ratio of persons per square mile area in the county. Racial composition, defined as the ratio of white population to all persons in the county, are for the year 1960 and are from the 1960 Census.[11] Similarly, age composition (percent of the county population under age 65) and education (median school years completed for adults aged 25 and over) are from the 1960 Census. Since these variables are held constant over the period, they can explain differences in costs for different hospitals but do not account for any of the increase in costs over time.

Proxies for case-mix include hospital bed size, plant assets per bed, affiliation with a medical school, composition of personnel, and physicians on the hospital medical staff per bed. The expected effects of each of these variables is discussed in the next section. Data on bed size, plant assets per bed, and affiliation with a medical school are from annual reports of sample hospitals. Composition of personnel is represented by the following variables: ratio of interns and residents to all hospital personnel, ratio of registered nurses to all personnel, and ratio of licensed practical nurses to all personnel. Data on composition of personnel and physicians on the hospital's medical staff are available only from Social Security Administration records for the two Medicare years, 1967 and 1968. Data for 1967, therefore, are used for the sample hospitals in earlier years.

The residual effect of systematic changes over time, including for example changes in technology, is captured in the regressions with time variables. These variables take on a value of one in 1962, increasing to seven in 1968. The overall time variable is also split into two time variables: the pre-Medicare time variable has zero values in 1967 and 1968, and it increases from a value of one in 1962 to a value of five in 1966. The Medicare time variable has zero values from 1962 to 1966 and increases from a value of six in 1967 to seven in 1968.

The separate effect of Medicare admissions over and above all other variables included in the regression is investigated with a variable on the ratio of Medicare hospital admissions to total hospital admissions for each hospital in the sample. This variable has a value of zero in all pre-Medicare years in all hospitals.

Expected Effects of Demand, Case-Mix, Wage, and Time Variables

In the model developed by Martin Feldstein,[12] hospitals react to expansion in insurance coverage—whether from private health insurance or from public programs such as Medicare and Medicaid—by providing a more expensive style of hospital care. Essentially, as hospitals find it possible to generate higher revenues, they also find ways to spend those revenues, perhaps by providing higher quality care or by adding new specialized services. In addition, insurance coverage may remove financial constraints on patients and physicians and lead to a decision to lengthen hospital stay. Hospital costs per admission are thus increased. To investigate the effects of private insurance and public programs on hospital costs per admission, the proportion of non-

[9] Martin S. Feldstein, *op. cit.*, page 860.

[10] American Medical Association, *Distribution of Physicians, Hospitals and Hospital Beds in the U.S.*, annual issues.

[11] Bureau of the Census, *County and City Data Book, 1967*, 1967.

[12] *Op. cit.*

insured expenses is included in the regression. Hospitals with a higher level of noninsured expenses are expected to have lower costs. As the proportion of noninsured expenses declines over time, hospital costs are expected to rise. The sign on the coefficient of the noninsured expenses variable, therefore, is expected to be negative.

The noninsured expenses variable does capture the effect of changes in private insurance and in Medicare and Medicaid, but it is possible that the Medicare program has an effect on costs beyond that of reductions in out-of-pocket payments generally. To check for this, two approaches are employed. The first includes separate time variables for the pre-Medicare and the Medicaid periods. Any acceleration in a time effect in the Medicare period may be a consequence of the Medicare program. The second approach is to include the proportion of Medicare admissions as a separate variable. If Medicare affects hospital costs by a more substantial amount than changes in insurance generally, this variable should pick up the additional effect of Medicare.

Other demand variables are expected to have a similar impact on costs. Higher incomes could be expected to lead to higher costs per admission: to the extent that higher income persons have longer hospital stays (as several econometric studies have found[13]) and to the extent that persons with higher income demand a more expensive style of hospital care.

A greater availability of physicians may lead to an increase in hospital admissions, but if the additional admissions are less serious the average length of stay may actually decline. The types of physicians in the area may also affect hospital costs. A greater preponderance of specialists, for example, may lead to longer hospital stays, but, if costs are simply spread over a longer period, costs per day may decline. In the regression model, composition of physicians is measured by the ratio of general practitioners to all physicians. Although it is impossible to predict precisely in which direction costs will be affected, a greater proportion of general practitioners may be expected to reduce length of stays and increase costs per day (that is, a greater proportion of specialists reduces costs per day), with the overall costs per admission being determined by the relative strength of these two effects.

In sparsely populated areas, physicians may be more inclined to hospitalize persons for relatively minor conditions to avoid the travel and time costs involved in repeated ambulatory visits. If so, the rate of admissions would be higher in sparsely populated areas and the average length of stay shorter. Since population density is measured as persons per square mile in the area, an increase in population density is expected to increase length of stay and, perhaps, costs per admission.

A young population is expected to have shorter hospital stays and hence lower costs per hospital admission. It might be expected that a greater proportion of blacks in the population would lead to longer hospital stays since blacks tend to be less healthy than whites. Data from a number of sources indicate, however, that whites typically receive more medical services than blacks for every income class, every education class, every type of residence, and every age group.[14] The ratio of white persons to total population, therefore, may have a positive impact on hospital stay and costs per admission.

Education may also have a mixed effect on costs. More highly educated persons may demand higher quality hospital care, thus increasing hospital costs. Yet, because they may also seek hospital care before their health condition deteriorates markedly, their average hospital stays may be shorter. The net impact of costs, therefore, may be positive or negative.

Direct data on case-mix composition of patients treated in the various sample hospitals are not available. Consequently, a number of proxies are used to adjust for differences among hospitals in case-mix. A number of the demand variables above—such as age, population density, and education—may also reflect differences in the composition of case-mix.

Characteristics of the hospital that may reflect differences in the types and complexity of cases

[13] Karen Davis and Louise B. Russell, *op. cit.*, and Martin S. Feldstein, *op. cit.*

[14] See, for example, Karen Davis, "Financing Medical Care: Implications for Access to Primary Care," paper presented at the Sun Valley Forum on National Health, June 28, 1973, and Department of Health, Education, and Welfare, National Center for Health Statistics, *Differentials in Health Characteristics by Color, July 1965–1967* (Series 10, No. 56), 1969.

treated include: hospital bed size, plant assets per bed, and affiliation with a medical school. Larger, more complex hospitals as measured by bed size and intensity of plant assets per bed could be expected to have higher costs. Affiliation with a medical school is also expected to increase costs, since such hospitals are more likely to treat the most difficult cases. If specialized personnel are required to treat more difficult patients, the composition of hospital personnel may also capture some aspects of case-mix—with a greater proportion of very specialized personnel such as interns and residents leading to higher costs. Finally, the number of physicians on the hospital staff per hospital bed may also indicate the severity of cases admitted. If the hospital has many physicians on its staff per available bed, it may put pressures on physicians to admit only extremely serious cases. On the other hand, if the hospital has only a few physicians relative to bed capacity, less serious types of cases may be treated in the hospital.

Since one of the major views of hospital inflation is the notion that rising costs are simply a reflection of technological progress, it is important to include in the regression equation some measure of this effect. Unfortunately, no direct measure of technology is available with which to capture the separate effects of scientific change. A time variable is included in the model (ranging from a value of one in 1962 to seven in 1968) to capture the effect of increases in average costs over time not explained by other factors (such as increasing insurance coverage and rising incomes). Such a variable should capture changes in technology over time but would also pick up shifts in costs traceable to changes in patient, physician, or hospital behavior. It is also possible that other variables in the model, such as plant assets per bed, capture some of the effect of changes in technology.

Finally, average annual earnings of hospital employees (deflated by the consumer price index) is included to capture the effect of rising real wage levels on hospital costs. This component of hospital costs is also examined in a regression estimation to determine if other factors such as demand, case-mix, Medicare, or technological change have affected hospital wage rates as well as other components of hospital expenses.

Average Cost Regression Results

Table 11 presents the major empirical results of the econometric estimation of hospital costs. Results for real expenses per patient day and mean stay are presented as well as for real expenses per hospital admission. All regressions reported are based on a double logarithmic functional form. Exceptions are time, medical school affiliation, proportion of specialized personnel, and proportion of Medicare patients, which enter linearly. Estimates of linear regressions yielded substantially similar results.

The double logarithmic functional form is useful in two respects. First, since "patient days" is the product of admissions and mean stay, the coefficient of each variable in the expenses per admission regression (equation 3) is the sum of the coefficients for that variable in the expenses per patient day regression (equation 1) and the mean stay regression (equation 2).

$$PD = Adm \cdot MS$$

$$\frac{TE}{PD} = AX_1^{a_1}X_2^{a_2} \quad \ldots e_1 \text{ expense per patient day regression}$$

$$MS = BX_1^{b_1}X_2^{b_2} \quad \ldots e_2 \text{ mean stay regression}$$

$$\frac{TE}{Adm} = \frac{TE}{PD}MS = (AB)X_1^{(a_1 + b_1)}X_2^{(a_2 + b_2)} \quad \ldots (e_1 + e_2) \text{ expense per admission regression}$$

The estimates for the expenses per admission regression, therefore, summarize the effects of each variable on the two components.

Second, in a double logarithmic form, the coefficients indicate what percentage effect on average costs a given percentage change in the explanatory variable will cause. For example, a coefficient of 0.2 on income indicates that a 10-percent increase in income will cause a 2-percent increase in average costs.

The factors included in the cost equations explain a substantial portion of the variation in hospital costs ($\bar{R}^2 = 0.66$ in expenses per patient day and $\bar{R}^2 = 0.74$ in expenses per admission).

Including separate time variables and proportion of Medicare patients in the expenses per admission regression adds little to the explanation of costs—an indication that the major forces affecting costs in the Medicare period are similar to those occurring in the pre-Medicare period.

Noninsured expenses and income both are sig-

nificant in explaining hospital expenses, with higher incomes leading to higher average costs and a greater proportion of out-of-pocket payments having a depressing effect on average expenses. Noninsured expense is particularly significant, with a 10-percent decline in the ratio of out-of-pocket expenses giving rise to a 2-percent increase in average hospital costs. From fiscal year 1966 to fiscal year 1967, the proportion of direct consumer payments for hospital care

TABLE 11.—Regression estimates of the effect of demand, mix, wages, and technology on average expenses [1]

Explanatory variables	Real expenses per patient day	Mean stay	Real expenses per hospital admission		
			Constant time effect	Accelerated time effect	Medicare admissions effect
	Equation 1	*Equation 2*	*Equation 3*	*Equation 4*	*Equation 5*
Constant	−2.11	4.17	2.05	2.02	2.03
	(2.01)	(3.35)	(1.48)	(1.46)	(1.46)
Demand:					
Noninsured expenses	−.03	−.16	−.19	−.22	−.16
	(1.10)	(5.94)	(6.17)	(5.48)	(4.21)
Real income	.05	.21	.26	.25	.26
	(1.02)	(3.89)	(4.27)	(4.17)	(4.31)
Physicians per capita	.16	−.07	.10	.09	.10
	(7.87)	(2.70)	(3.55)	(3.51)	(3.59)
Ratio of general practitioners	.06	−.04	.02	.01	.02
	(3.31)	(2.07)	(.65)	(.57)	(.69)
Hospital beds per capita	−.08	.14	.06	.06	.06
	(5.39)	(8.15)	(3.23)	(3.21)	(3.22)
Population density	.02	.04	.06	.06	.06
	(4.07)	(6.26)	(8.71)	(8.51)	(8.77)
Percent of population under age 65	.34	−.74	−.40	−.38	−.40
	(1.57)	(2.91)	(1.41)	(1.34)	(1.42)
Ratio of white population to total	.06	.004	.07	.06	.08
	(1.47)	(.07)	(1.18)	(.97)	(1.31)
Education	.36	−.15	.21	.22	.21
	(4.82)	(1.67)	(2.16)	(2.20)	(2.15)
Mix:					
Hospital bed size	−.003	.05	.05	.05	.05
	(.40)	(5.39)	(4.54)	(4.54)	(4.54)
Plant assets per bed	.06	−.04	.02	.02	.02
	(9.30)	(5.52)	(2.12)	(2.12)	(2.12)
Affiliation with medical school	.08	.03	.11	.11	.11
	(5.02)	(1.73)	(5.37)	(5.42)	(5.34)
Ratio of interns and residents	−.29	5.81	5.52	5.40	5.59
	(.33)	(5.60)	(4.78)	(4.66)	(4.83)
Ratio of registered nurses	−.22	−.32	−.53	−.52	−.53
	(3.49)	(4.28)	(6.49)	(6.40)	(6.52)
Ratio of licensed practical nurses	−.28	−.14	−.41	−.41	−.41
	(3.17)	(1.32)	(3.60)	(3.57)	(3.62)
Physicians per hospital bed	.08	−.07	.006	.008	.005
	(8.35)	(6.49)	(.51)	(.66)	(.37)
Wage:					
Real wages	.24	−.07	.18	.18	.18
	(10.18)	(2.29)	(5.68)	(5.54)	(5.76)
Time:					
1962–68	.034	−.009	.026		.023
	(9.56)	(2.05)	(5.43)		(4.00)
1962–66				.030	
				(5.11)	
1967–68				.024	
				(4.87)	
Medicare:					
Ratio of Medicare admissions					.01
					(1.02)
$\bar{R}^2$	.66	.49	.74	.74	.74
S.E.	.172	.203	.226	.226	.226

[1] Figures in parentheses are *t*-statistics.

fell 33 percent. The regression estimate therefore implies that changes in insurance (primarily Medicare) accounted for a 7-percent increase in average hospital costs. During the 2-year period from fiscal year 1966 to fiscal year 1968, the proportion of out-of-pocket payments fell 42 percent, which is translated into a 9-percent increase in average hospital costs for the 2 years. Both noninsured expenses and income have stronger effects on the length of stay than on expenses per patient day.

Other demand variables that are important in the cost regressions are an abundance of physicians in the area, available hospital beds, and population density, with all of these variables having a significantly positive impact on costs per admission. A greater number of patient-care physicians per capita and a greater proportion of general practitioners tend to reduce length of stay, but the positive effect on expenses per day is sufficiently great that the net effect on costs per admission is to increase costs. Areas with more hospital beds tend to have lower costs per day, but patients stay longer in such areas so that the net effect of bed availability is to increase costs per admission. Areas that are more densely populated tend to have both longer stays and higher costs per day.

A greater preponderance of young persons in the population reduces hospital costs per admission, but not significantly. Similarly, areas with a greater proportion of white persons have insignificantly higher costs.

Education has a strong effect on hospital costs per patient day, with a 10-percent increase in educational levels in the area leading to a 4-percent increase in costs per patient day. Areas with more highly educated persons, however, tend to have somewhat shorter hospital stays so that a 10-percent increase in educational levels leads to only a 2-percent increase in costs per admission.

Variables included in the cost regressions to capture the effect of composition of patients admitted to the hospital contribute significantly to the explanation of average costs. Larger hospitals do not tend to have higher costs per patient day (holding constant for all other factors), but they do have substantially longer stays. A hospital that is twice as large has 5 percent longer hospital stays. The net effect of bed size is to increase costs per admission. Higher levels of capital for hospitals of a given size also lead to slightly higher costs, with a 10-percent increase in plant assets per bed yielding a 0.2-percent increase in expenses per admission. This may indicate that hospitals with more specialized equipment per bed treat more difficult cases or provide higher quality care. Increases in plant assets per bed may also reflect changes in technology requiring greater capitalization, so that part of the increase in cost attributable to higher levels of capital may reflect improved technology.

Affiliation with a medical school has a strong impact on hospital costs. Such hospitals tend to have costs per admission about 11 percent higher than hospitals without such an affiliation. Holding constant for medical school affiliation, greater proportions of interns and residents on the hospital staff have an added effect on cost. If, for example, two hospitals are affiliated with a medical school and 10 percent of one hospital's personnel are interns and residents while 5 percent of the other hospital's employees are interns and residents, the hospital with a greater proportion of interns and residents would have 3 percent higher costs. The regressions indicate that higher ratios of nurses to all personnel result in somewhat lower costs. Presence of more physicians on the hospital medical staff per available bed has little effect on hospital costs.

Increases in earnings of hospital employees also contribute to overall cost increases. A 10-percent rise in annual earnings increases expenses per admission by 1.8 percent. Although increases in wages cannot be held responsible for all of the increase in hospital costs, wage rates exert fairly considerable, independent influence on hospital costs besides that which is traceable to increases in demand, changes in technology, or case-mix.

Holding constant for all other factors that plausibly effect hospital costs, costs continue to rise over time. Expenses per admission rise about 2.6 percent annually. Splitting the time variable into two variables—one for the pre-Medicare period and one for the Medicare period—indicates a slight deceleration in increases over time, holding constant for other systematic increases in costs. Including two separate time variables does not, however, improve the explanatory power of the regression—an indication that the slight deceleration is not an important factor. The fact

that the proportion of Medicare patients is not significant indicates that there is no special effect of Medicare beyond that of increases in insurance generally.

The relative importance of demand, mix, wages, and technology (or all other shifts over time) in overall cost inflation may be summarized by calculating the contribution of each set of factors. Multiplying the percentage change for the nation as a whole in each of the variables by their respective elasticities gives the predicted change in average costs attributable to each variable. Of the predicted increase in expenses per admission, demand variables accounted for 45 percent of the increase. Case-mix variables were responsible for another 7 percent, and increases in average earnings of hospital employees represented another 10 percent of the overall increase. Shifts upward over time were responsible for the remaining 38 percent.

Components of Hospital Costs

Estimation of personnel per hospital admission and real nonlabor inputs per admission yield much the same results obtained in the overall cost regressions (table 12). Demand factors continue to be highly significant for both types of inputs, with higher incomes leading to greater use of labor and nonlabor inputs and greater out-of-pocket payments leading to a reduction in the use of inputs.

Larger hospitals tend to hire more personnel per admission and use more nonlabor inputs—as do hospitals affiliated with a medical school. Hospitals with more plant assets per bed also have more nonlabor inputs (but not more personnel).

As might be expected, increases in wage rates lead to substantial reductions in personnel employed. A 10-percent increase in real wages results in a 6-percent decline in personnel per hospital admission. This relationship could occur because the hospital substitutes other types of inputs for labor as labor becomes more expensive. Another explanation, however, is that the hospital has some given level of costs that it tries to achieve (or tries to stay within). Any increase in cost of one input must result in cutbacks in other areas—either in a reduction in the use of that input or in the use of other inputs. As indicated by the results for nonlabor inputs, the latter explanation seems to be the correct one. Nonlabor inputs are also reduced by increases in wage rates, though not so strongly (a 10-percent increase in real wage rates causes a 2-percent decline in real nonlabor inputs per admission).

The time variable, picking up the effects of changing technology as well as other types of shifts over time, is significant in the nonlabor input regressions but not in the personnel regressions. Real nonlabor inputs increase at a rate of 5 percent a year, after holding constant for other systematic changes over time caused by demand and case-mix factors. Use of personnel, however, does not increase over time, except for that induced by changes in demand or case-mix. The proportion of Medicare patients has no significant effect on either use of personnel or use of nonlabor inputs.

The original analysis of overall hospital costs assumed that hospital wage rates were determined by market conditions and that hospitals had little control over the determination of hospital wages —with wages simply being set at the level dictated by the market as necessary to obtain an adequate labor force. Martin Feldstein [15] has suggested, however, that hospitals may engage in philanthropic wage behavior, paying hospital employees more than the minimal necessary to attract an adequate labor force. If the hospital's willingness to pay wages in excess of the market wage depends upon the demand for its services, demand factors could be expected to increase wage rates. Case-mix variables, particularly those proxies that capture the need for specialized personnel to treat difficult cases, could also be expected to influence average wages.

As table 11 indicates, both demand and case-mix factors are important in determining wage rates. Hospitals in higher income areas pay higher wages, although the effect is only significant at the 10-percent level. More interestingly, wages are significantly higher when patients pay a lower fraction of the hospital bill out of pocket. A somewhat more solid support of the philanthropic wage-behavior contention is provided in this situation. Wage rates are also higher in areas with greater population density and with high proportions of whites, presumably a reflec-

[15] Martin S. Feldstein, *The Rising Cost of Hospital Care*, Information Resources Press, 1971, chapter 5.

tion of labor-market conditions. Areas with higher educational levels also have higher wage rates.

Case-mix proxies that prove to be significant in the wage regression include size of hospital and composition of personnel. As bed size increases, say from 300 to 400 beds, average annual earnings increase by $60. A higher proportion of registered nurses and of licensed practical nurses also raises average annual earnings, with

TABLE 12.—Regression estimates of the effect of demand, mix, wages, and technology on components of average expenses [1]

Explanatory variables	Personnel per hospital admission		Nonlabor inputs per hospital admission		Real average annual earnings	
	Accelerated time effect *Equation 6*	Medicare admissions effect *Equation 7*	Accelerated time effect *Equation 8*	Medicare admissions effect *Equation 9*	Accelerated time effect *Equation 10*	Medicare admissions effect *Equation 11*
Constant	.43 (.29)	.42 (.28)	3.21 (1.63)	3.18 (1.61)	4.22 (3.45)	4.37 (3.59)
Demand:						
Noninsured expenses	−.22 (5.11)	−.16 (3.88)	−.25 (4.48)	−.20 (3.74)	−.18 (5.18)	−.19 (5.84)
Real income	.26 (4.10)	.27 (4.23)	.19 (2.17)	.19 (2.24)	.08 (1.53)	.09 (1.61)
Physicians per capita	.11 (3.81)	.11 (3.89)	.05 (1.32)	.05 (1.38)	−.02 (.96)	−.02 (1.02)
Ratio of general practitioners	.02 (.87)	.03 (.98)	−.01 (.40)	−.01 (.34)	−.009 (.44)	−.008 (.38)
Hospital beds per capita	.05 (2.34)	.05 (2.34)	.10 (3.50)	.10 (3.50)	.02 (1.11)	.02 (1.17)
Population density	.06 (7.96)	.06 (8.22)	.06 (5.91)	.06 (6.07)	.02 (2.73)	.02 (2.61)
Percent of population under age 65	−.54 (1.79)	−.57 (1.86)	−.11 (.27)	−.12 (.30)	.31 (1.24)	.27 (1.08)
Ratio of white population to total	.07 (1.09)	.09 (1.41)	−.03 (.32)	−.01 (.12)	.10 (1.95)	.10 (1.90)
Education	.23 (2.16)	.22 (2.12)	.30 (2.18)	.30 (2.15)	.26 (3.00)	.26 (2.98)
Mix:						
Hospital bed size	.07 (5.83)	.07 (5.84)	.04 (2.34)	.04 (2.34)	.05 (5.27)	.05 (5.24)
Plant assets per bed	−.00 (.38)	−.003 (.39)	.04 (3.05)	.04 (3.05)	.06 (.88)	.006 (.90)
Affiliation with medical school	.10 (4.60)	.10 (4.53)	.12 (4.17)	.12 (4.12)	−.02 (1.05)	−.02 (1.02)
Ratio of interns and residents	5.10 (4.11)	5.28 (4.27)	4.78 (2.90)	4.93 (3.00)	1.67 (1.62)	1.67 (1.63)
Ratio of registered nurses	−.64 (7.31)	−.65 (7.42)	−.29 (2.46)	−.29 (2.52)	.67 (9.52)	.65 (9.39)
Ratio of licensed practical nurses	−.54 (4.45)	−.55 (4.50)	−.07 (.44)	−.08 (.47)	.19 (1.90)	.19 (1.92)
Physicians per hospital bed	.02 (1.50)	.02 (1.21)	−.02 (.85)	−.02 (1.03)	.05 (4.22)	.05 (4.39)
Wage:						
Real wages	−.59 (17.46)	−.58 (17.17)	−.20 (4.44)	−.19 (4.27)		
Time:						
1962–68		.002 (.41)		.05 (6.35)		.022 (4.44)
1962–66	.001 (1.59)		.057 (6.89)		.020 (3.93)	
1967–68	.005 (.97)		.055 (7.87)		.006 (1.40)	
Medicare:						
Ratio of Medicare admissions		.01 (1.24)		.02 (1.11)		−.04 (4.38)
$\bar{R}^2$	.65	.65	.52	.52	.36	.36
S.E.	.242	.242	.322	.322	.201	.200

[1] Figures in parentheses are *t*-statistics.

the rate of increase being higher for registered nurses than for licensed practical nurses.

Somewhat unexpectedly, the regression analysis indicates that hospitals with a higher proportion of Medicare patients pay somewhat lower wages. This finding might result if elderly patients require primarily custodial care, rather than skilled medical care, and the personnel composition needed to treat elderly patients is thus somewhat less skilled than that required for nonelderly patients.

Implications of Trends in Early Medicare Period

Many of the characteristics of hospital inflation evident in the pre-Medicare period continued with greater intensity in the first 2 years of the Medicare program. Increased use of factor inputs, both labor and nonlabor, continued to account for a major portion of hospital inflation. Capital expenses continued to grow at a faster rate than labor expenses, so that by 1968 depreciation and interest expenses represented 6.4 percent of all hospital operating expenses. Most of the increase in expenses has occurred in the provision of ancillary hospital services—such as laboratory expenses—rather than in the provision of basic room-and-board services. Revenues have increased slightly faster than hospital expenses, yielding higher ratios of revenues to direct costs on most specialized ancillary services. Room-and-board revenues grew more rapidly than ancillary revenues, however, in the first 2 years of Medicare, which meant that a slightly larger share of revenue came from room-and-board services in 1968.

These findings are most consistent with the demand-pull view of hospital inflation and the views that emphasize changes in technology and expansion in the role of the community hospital. The labor-cost-push model of inflation does not provide a complete explanation of hospital inflation, since hospital costs per patient day would have increased at an annual rate of 6 percent even if wages had remained constant.

The sizable contribution to hospital inflation made by increases in quantities of factor inputs per day of care and the rapid growth in ancillary service expenses is predicted by the demand-pull model of inflation. In this theory of inflation, expansion of insurance coverage and rising incomes permit hospitals to raise the "quality" of hospital care as perceived by hospital decision-makers—that is, to increase the quantities of inputs used to provide a day of hospital care. The growth in the outpatient component of hospital expenses, on the other hand, clearly indicates an expansion in the community hospital's role.

Econometric estimation of hospital costs over the pre-Medicare and Medicare periods confirms these findings. Demand factors account for a major portion of the growth in hospital costs, with rising incomes and reduced out-of-pocket payment for hospital care both contributing to the rise in costs. The Medicare program had little additional impact on hospital costs beyond that attributable to reduction in out-of-pocket payments generally. That is, Medicare acted in much the same way as growth in private insurance to contribute to hospital inflation. This fact explains why the nature of hospital cost inflation was largely unchanged by the introduction of Medicare, although the extent of inflation increased dramatically.

Changes in technology, which were captured in the econometric analysis by time variables, also contributed to hospital inflation—particularly in the nonlabor input component of costs. Shifts over time, other than those traceable to demand and case-mix factors, continued to rise at much the same rate in the Medicare period as in the pre-Medicare period.

METHODOLOGY

In order to analyze the impact of the Medicare program on hospital financial operations, the Social Security Administration contracted with the American Hospital Association to obtain audited data on hospital revenues, expenses, and capital assets for a representative sample of hospitals in the United States for the 5 years before the introduction of Medicare. Audited data on the same sample of hospitals were submitted directly to the Social Security Administration under the Medicare program.[16]

Table I indicates participation of hospitals by control and bed size for the first 2 years of the Medicare program. As in the earlier years, re-

[16] See Karen Davis, op. cit., *Social Security Bulletin*, October 1972, for details of the sample design and estimation procedures.

TABLE I.—Participation by control and stratum, 1967 and 1968

Type of control and stratum	Sample size	Participants		Participation as percent of sample	
		1967	1968	1967	1968
All strata	462	350	258	75.8	55.8
State and local government, total	125	69	56	55.2	44.8
6–99	53	44	38	83.0	71.7
100–199	15	8	10	53.3	66.7
200–299	7	4	3	57.1	42.9
300–499	9	5	2	55.6	30.9
500 or more	41	8	3	19.5	7.3
Catholic, total	66	53	40	80.3	60.6
6–99	15	15	12	100.0	80.0
100–199	17	13	10	76.5	58.8
200–299	11	7	8	63.6	72.7
300–499	15	12	6	80.0	40.0
500 or more	8	6	4	75.0	50.0
Other nonprofit, total	223	190	137	85.2	61.4
6–99	77	63	53	81.8	68.8
100–199	43	42	26	97.7	60.5
200–299	21	19	13	90.5	61.9
300–499	37	31	22	83.8	59.5
500 or more	45	35	23	77.8	51.1
For-profit, total	48	38	25	79.2	52.1
6–49	17	16	8	94.1	47.1
50–99	13	11	9	84.6	69.2
100–199	12	7	6	58.3	50.0
200 or more	6	4	2	66.7	33.3

sponse rates of State and local government hospitals in the largest bed-size category continued to be fairly low. Response rates of for-profit hospitals, which were relatively low in the pre-Medicare period, improved somewhat in the Medicare period.

Since the estimates presented here are based on samples, they may differ somewhat from the figures that would have been obtained from all hospitals in the universe. As in all survey work, the results are subject to errors of response and nonreporting as well as sampling variability. Table II indicates the approximate standard errors of hospital expenses in 1967 and 1968 for all U.S. community hospitals, as well as control and bed size. For formulas used to calculate the standard errors, see the description of the methodology in the October 1972 BULLETIN article.

TABLE II.—Approximate standard errors of total operating expenses, by type of control and number of beds, 1967 and 1968

Type of control and number of beds	Total operating expenses (in millions)			
	Estimated value		Estimated standard error	
	1967	1968	1967	1968
State and local government:				
0–99	528	564	35	30
100–199	323	402	38	15
200–299	307	268	72	17
300–499	344	345	48	54
500 or more	1,385	1,762	126	247
Catholic:				
0–99	153	174	16	16
100–199	446	469	53	45
200–299	471	558	59	60
300–499	630	689	59	47
500 or more	238	358	29	16
Other nonprofit:				
0–99	748	866	44	76
100–199	1,032	1,212	57	57
200–299	1,034	1,149	78	68
300–499	1,964	2,069	136	84
500 or more	1,277	1,469	45	59
For-profit:				
0–49	156	118	34	26
50–99	160	193	20	21
100–199	158	147	26	17
200 or more	74	82	13	13