Resource Allocation in the Hospital Industry: The Role of Capital Financing

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This article focuses on the effect of capital financing on the allocation of resources in private nonprofit hospitals. The study—based chiefly on data from the Hospital Economic Survey—points out that limits on the availability of capital funds for an institution exist: Private grants are limited by access to potential donors and the amounts they give; capital raised through Hill-Burton grants is limited by the program funding and the requirement that the funds be used together with those from other sources; and the use of internal funds and commercial borrowing are also limited. The model of hospital behavior indicates that total investment would be determined by reaching the limitation on capital financing. The empirical analysis suggests that total investment is not determined by demand for service but by hospital size and accessibility of hospital funds. Analysis of two investment components shows that such variables as capacity utilization and operating subsidies do influence the components and that operating subsidies influence the mix between bed investment and sophisticated investment but not total investment.

UNDER CERTAIN ideal conditions—such as perfect competition in capital and product markets and equality of private and social costs—the forces of the marketplace will lead to an optimal allocation of resources to the production of various goods and services. Many characteristics of the market for hospital services suggest that a different allocation is likely to occur. Prevalent nonprofit organizations pursue objectives different from profit maximization. Substitution of private and public grant capital for ownership shares affects the flow of capital resources to the industry and the types of facilities that are financed. Imperfect markets for debt capital tend to accentuate these differences. Finally, widespread existence of both public and private hospitalization insurance affects the relationship between private and social costs with a consequent impact on allocation.

The focus of this article is on the effect of hospital capital financing on resource allocation in that industry. Various institutions and services within a given institution are influenced in different directions by the type of capital market faced by hospitals. Underutilization of capacity in parts of the industry can be explained by these forces, which also provide a basis for possible overcrowding in other facilities. Although there is no empirical evidence on the issue as yet, these deviations from the perfectly competitive model may cause the flow of capital to this industry to exceed the flow in a more idealized market.

The major sources of hospital capital funds are described first. A brief model of hospital behavior is presented, and notions about resource allocation in the industry are derived. Regression analysis is used to estimate the determinants of total hospital investment and its components.

HOSPITAL CAPITAL FINANCING

Since a private nonprofit firm is legally barred from making any cash payments to shareholders, special arrangements must be made for capital financing after the formation of the institution. As in a corporation, borrowing and retention of internal funds can be used, but grants of capital must replace sale of ownership shares as a source of additional equity capital. Private individuals, corporations, and the Federal Government are all important sources of hospital grant capital.

The data base for the tables presented and the regression analysis is the Hospital Economic Survey sponsored by the Social Security Administration and described in the preceding article. This paper is restricted, however, to the private nonprofit subset of the sample of community hospitals. State and local government hospitals and

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hospitals operated for profit are excluded because they are thought to follow different behavioral patterns.

Annual capital investment in private nonprofit hospitals rose significantly in the pre-Medicare period, going from $625 million in 1962 to $993 million in 1966—an increase of 58.9 percent. This growth rate is somewhat higher than that of the gross national product, which increased by 33.7 percent during the same period. The growth in capital funds to Catholic hospitals was about three-fourths that for other voluntary hospitals, as the figures below show.

Hospital control	Amount (in thousands)		Percentage increase, 1962–66
	1962	1966	
Additions to plant fund, total	$624,730	$992,822	+58 9
Catholic	154,832	228,801	+47 8
Other voluntary	469,898	764,021	+62 6

Source of Funds

Philanthropy.—Grants from individuals and corporations have traditionally been considered the most important source of capital funds for nonprofit hospitals. The individuals making important contributions to hospitals are almost exclusively the wealthy. Door-to-door fund drives and newspaper appeals are highly visible, but the donations of middle-income individuals add up to only a small percentage of individual contributions. Evidence for this point is derived from data on individual income-tax deductions for contributions (table 1). Individuals whose adjusted gross income was less than $10,000 in 1962 earned 67 percent of reported income, and they gave 49 percent of all contributions but only 11 percent of hospital contributions. In contrast, those whose incomes were between $25,000 and $100,000 in that year reported 7 percent of adjusted gross income, 12 percent of contributions, and 37 percent of contributions to hospitals.

Corporate donations of capital to hospitals are probably much smaller than individual contributions in the aggregate but are not insignificant. Data from the American Association of Fund Raising Counsel [1] show that in 1971 general corporate philanthropy was $1.0 billion, which accounted for 5 percent of charitable contributions to all recipients (churches, schools, hospitals, etc.). The proportion of hospital philanthropy derived from corporations is probably higher as there is little corporate donation to religious institutions, which received 41 percent of charitable contributions in 1971.

Proximity to donors and hospital service mix appear to be the factors that determine access to private grants. Except in the case of nationally known teaching institutions, proximity is important because current or potential hospital use should be an element in both individual and corporate contributions. Since the bulk of individual support comes from those with high incomes, hospitals in middle- and low-income communities may have difficulty raising significant sums through appeals to individuals. Corporations can be expected to contribute primarily to hospitals that treat their employees. Consequently, hospitals in communities with high employment are in the best position to attract corporate donations, particularly if the communities are not large and utilization by the company's employees can thus be identified as an appreciable fraction of the total.

Individual and corporate donors are likely to be attracted to different types of hospital services. Professional fund raising counselors characterize individual giving as being directed toward the exciting and heartwarming. Children's hospitals and those specializing in treatment of cancer are more likely to have particularly good access to individual philanthropy. Research-oriented institutions and those performing complex services are also probably attractive to donors. Corporate philanthropy is directed more toward general medical facilities with a particular emphasis on emergency care—an aim consistent with improving the health of employees. The hospital may be viewed by the corporation as an integral part of an on-the-job health program. Of course, the aspects of hospital services that make the institution attractive to types of donors carry over to the specific projects for which funds are sought. An important part of private capital grants are given in response to appeals to support specific projects rather than on a routine basis.

It should be noted that the U.S. Government plays an important role in private grants to hos-

[1] American Association of Fund Raising Counsel, Inc, *Giving U.S A.*, 1972.

TABLE 1.—Individual income tax deductions for contributions to hospitals, by adjusted gross income, 1962

[In thousands]

Adjusted gross income	All returns		With deductible hospital contributions		With deductible contributions	
	Number	Adjusted gross income amount	Number of returns	Amount	Number of returns	Amount
Total	62,712	$348,701,000	1,011	$113,082	25,144	$7,516,088
$600–4,999	33,699	82,074,000	83	2,547	5,909	921,881
5,000–9,999	20,512	151,332,000	309	10,448	12,185	2,849,154
10,000–14,999	4,940	58,230,000	203	8,395	3,476	1,260,407
15,000–19,999	1,048	17,818,000	102	6,825	848	458,480
20,000–24,999	406	9,018,000	64	6,041	348	250,031
25,000–49,999	538	17,926,000	135	22,953	489	556,367
50,000–99,999	121	7,984,000	48	19,371	116	330,826
100,000 or more	27	5,477,000	14	31,166	26	468,288

Source Internal Revenue Service, *Statistics of Income: Individual Income Tax Returns, 1962*, 1965, p 6

pitals albeit a passive one. Since contributions by both individuals and corporations are tax-deductible, the reduction in taxes allowed by the contribution constitutes an automatic matching grant from the public. In view of the marginal tax rates of the high-income individuals who donate substantial amounts to hospitals and of corporations, these matching grants are rather large.

Data on philanthropy are shown in table 2. In 1966, private grants, including transfers from other funds,[2] accounted for 30.2 percent of capital funds in all voluntary hospitals. Catholic voluntary hospitals derive a much smaller proportion of their capital funds from this source. This fact is particularly worth noting since the regression analysis shown later indicates that Catholic hospitals invest less than other voluntaries, after other variables are taken into account. The Catholic hospitals have compensated for their smaller use of grant funds by slightly larger use of borrowing and substantially greater use of internal funds. Philanthropic funds did not grow as rapidly as hospital capital funds in general during the period 1962–66. Private grants (including transfers from other funds) grew 26.1 percent, while all funds went up 58.9 percent. Grants to Catholic hospitals rose at a rate of 58.3 percent, and those to other voluntary hospitals were 21.9 percent higher.

Government grants.—Private nonprofit hospitals as well as those operated by State and local governments have received substantial discretionary grant support from the U.S. Government. The legislation responsible for virtually all of these funds is the Hospital Survey and Construction Act of 1946, better known as the Hill-Burton Act. As of the end of 1970, 10,584 approved projects have provided 460,316 inpatient beds in hospitals and nursing homes and 3,018 outpatient facilities. (Private nonprofit facilities accounted for 59 percent of the beds built with assistance from this program.) Of the total project cost of $12.3 billion, $3.6 billion was the Federal share.[3]

The program was initiated to assist rural areas in overcoming their widespread problems of obsolescence or absence of health care facilities. Over the life of the program, the emphasis has shifted from new facilities to modernization of existing ones and from rural health care to a balanced priority with urban health care. Administratively, the primary role of the Federal Government is one of allocating funds to the States (according to a formula that incorporates population and reciprocal of State per capita income squared) while State agencies select projects to fund. Grant funds from the program are designed to fill only part of a project's fund needs since it is expected that other funds will be attracted. Recently, changes in the funding mechanism have taken place. The most recent (1970) Hill-Burton authorization legislation included more funds for

[2] The data shown give the sources of additions to the "plant fund," not the source of capital expenditures, but the two concepts should correspond closely when data from many hospitals are aggregated, as in these tables. In classifying the category, "transfers from other funds," there is reason to believe that these funds entered the hospital as private grants (through "endowment" or "special" funds). The large size of the category supports this notion. Such an interpretation is also consistent with a survey by J. L. Stambaugh, "A Study of the Sources of Capital Funds for Hospital Construction in the United States," *Inquiry*, June 1967.

[3] Department of Health, Education, and Welfare, *Health Care Facilities: Existing and Needed*, September 1971, page 5.

TABLE 2.—Additions to plant fund from grants, by source of funds and hospital control, 1962 and 1966

Source of funds and hospital control	1962		1966		Percentage increase, 1962–66
	Amount (in thousands)	Percent of total capital funds	Amount (in thousands)	Percent of total capital funds	
Total grants	$299,087	47 9	$400,538	40 3	+33 9
Catholic	29,040	18 8	45,468	19 9	+56 6
Other voluntary	270,047	57 5	355,070	46 5	+31.5
Government grants	61,257	9 8	100,642	10 1	+64 3
Catholic	1,371	9	1,672	.7	+22 0
Other voluntary	59,886	12 7	98,970	13 0	+65 3
Private grants and transfers from other funds	237,830	38 1	299,896	30 2	+26 1
Catholic	27,669	17 9	43,796	19 1	+58 3
Other voluntary	210,161	44 7	256,100	33 5	+21.9
Private grants	115,583	18 5	165,850	16 7	+43 5
Catholic	16,945	10 9	26,292	11 5	+55 2
Other voluntary	98,638	21 0	139,558	18 3	+41.5
Transfers from other funds	122,247	19 6	134,046	13 5	+9 7
Catholic	10,724	6 9	17,504	7 7	+63 2
Other voluntary	111,523	23 7	116,542	15 3	+4.5

Source Hospital Economic Survey, Social Security Administration

loans, loan guarantees, and interest subsidies than for direct grants.

In 1966, government capital grants to hospitals (most of which were from the Hill-Burton program) comprised 10.1 percent of capital funds. Again, the proportion was much lower for Catholic hospitals—0.7 percent. This difference may be explained in part by the fact that Catholic hospitals tend to be located in urban areas while the program has a historic orientation toward rural areas. In the 1962–66 period, government grants increased 64.3 percent—slightly more rapidly than total capital funds.

Retained funds.—Funded depreciation and surpluses retained from operations constitute another important source of capital funds to hospitals. In the long run, the availability of internal funds for investment is a function of the flow of funds retained from current operations. In the short run, however, the flow of retained funds is small in relation to the requirements of investment projects. The availability of retained funds is then represented best by the stock of financial assets available for investment purposes. In most practical situations involving investment decisions, the relevant horizon is somewhere between the long and short run. Thus, both the stock of internal funds on hand and the rate of flow of new retained funds are relevant, as well as the potential flow of funds if different pricing policies are followed.

The availability of a pool of internal funds depends upon history. Past investments and past retention policies determine the current stock. The institution can do little to affect the present stock except merge with another institution with different resources. A hospital's retained funds flow may be influenced by the capacity of the community to pay for services, costs, the amount of debt carried, case mix, the extent of insurance coverage and methods of reimbursement, and other factors. It is highly likely, however, that there is an effective limit to the flow of retained funds. Hospital administrators mention that too high a rate of net income is avoided through fear of the effect on public relations. The presence of high net income can discourage philanthropy. A recent Social Security Administration research report shows that nonprofit hospital net income averaged 2.9 percent of revenue from 1962 to 1966 and cash flow averaged 7.4 percent of revenue.[4]

Internal funds accounted for 36.3 percent of capital funds in 1966 (table 3), chiefly from transfers from the general fund rather than through funded depreciation. Catholic hospitals used 53.4 percent in internal funds to finance their capital expenditures, and other voluntary institutions used 31.2 percent. During 1962–66, internal funds rose 66.9 percent, with a 69.2-percent increase in the Catholic hospitals and a 65.7-percent increase in the non-Catholic. Transfers from the general fund grew at a more rapid rate than funded depreciation.

[4] Karen Davis and Richard W. Foster, *Community Hospitals: Inflation in the Pre-Medicare Period* (Research Report No. 41), Office of Research and Statistics, Social Security Administration, 1972, table 4.

TABLE 3 —Additions to plant fund from internal funds, by source of funds and hospital control, 1962 and 1966

Source of funds and hospital control	1962		1966		Percentage change, 1962–66
	Amount (in thousands)	Percent of total capital funds	Amount (in thousands)	Percent of total capital funds	
Internal funds, total	$216,107	34 6	$360,639	36 3	+66 9
Catholic	72,197	46 6	122,193	53 4	+69 2
Other voluntary	143,910	30 6	238,446	31 2	+65 7
Funded depreciation	51,252	8 2	71,522	7 2	+39 5
Catholic	21,602	14 0	21,074	9 2	−2 4
Other voluntary	29,650	6 3	50,448	6 6	+70 1
Transfers from general fund	164,855	26 4	289,117	29 1	+75 4
Catholic	50,595	32 7	101,119	44 2	+99 9
Other voluntary	114,260	24 3	187,998	24 6	+64 5

Source Hospital Economic Survey, Social Security Administration

Borrowing.—The most rapidly growing source of hospital capital financing is borrowing from commercial sources (table 4). The principal sources of hospital debt finance are mortgage loans from banks and bonds, secured either by a mortgage or by a lien on hospital revenues. Though the institutions under discussion are nonprofit, their debt is not tax-exempt like that of State and local governments. (Some private hospitals lease their plant and equipment from a local government in order to gain tax-exempt status for their bonds.)

The market for hospital debt finance appears to cope with the problem of risk by limiting the proportion of a project to be financed by debt rather than by charging very high interest rates to compensate for risk. As a result, hospitals face limitations on the amount of capital that can be raised through debt. The proportion of a project that can be financed by debt is a function of expected cash flow from the project and the ability of the institution to continue repayments if cash flow should fall below expectations and requirements.

Leasing is another method of financing hospital investment that has shown rapid growth but does not appear in data on capital financing. In theory, the ability to lease equipment should abolish any constraint on capital funds that the institution has faced. In practice, however, there are important limitations to leasing that stem from the specialized nature of hospital plant and equipment and high risk of obsolescence. Since leased items may be difficult to resell, the lessor may want to keep risk of default low and limit commitments to a fraction of the available cash flow. Furthermore, leasing obligations tend to reduce access to borrowed capital, as lenders consider leasing obligations to be similar to existing debt.

In 1966, borrowing comprised 23.3 percent of capital financing for voluntary hospitals: 17.0 percent of total financing was derived by borrowing from commercial sources and 6.3 percent by borrowing from other sources (such as government agencies, foundations, and individuals). The two ownership categories of voluntary hospitals had roughly similar use of borrowing in 1966 (though not in 1962 when none of the Catholic hospitals in the sample had any new borrowing from commercial sources).

A dramatic phenomenon in borrowing trends can be noted. Borrowing from commercial sources rose 437 percent for the group of voluntary hospitals as a whole, with use by Catholic hospitals going from a zero base to 18.2 percent of capital financing for the group and a 305-percent increase in the non-Catholic voluntary hospitals. Borrowing from noncommercial sources declined by 63.6 percent in the Catholic hospital but increased by 76.0 percent in the other voluntary institutions, with a consequent 111-percent increase in all types of borrowing.

Cost Reimbursement and Capital Financing

Most private insurance plans reimburse hospitals at whatever level the hospital sets its charges. Public plans such as Medicare and Medicaid and some Blue Cross plans reimburse hospitals on the basis of incurred expenses. Whether cost reimbursement increases or decreases hospital access to capital funds has long been a topic of discussion. Clearly, the growth of cost reimburse-

TABLE 4.—Additions to plant fund from borrowing, by source of funds and hospital control, 1962 and 1966

Source of funds and hospital control	1962		1966		Percentage change, 1962–66
	Amount (in thousands)	Percent of total capital funds	Amount (in thousands)	Percent of total capital funds	
Total borrowing	$109,536	17 5	$231,645	23 3	+111 5
Catholic	53,595	34 6	61,140	26 7	+14 1
Other voluntary	55,941	11 9	170,505	22 3	+204 8
Commercial sources	31,509	5 0	169,115	17 0	+436 7
Catholic	0		41,617	18 2	
Other voluntary	31,509	6 7	127,498	16 7	+304 6
Other sources	78,027	12 5	62,530	6 3	−19 9
Catholic	53,595	34 6	19,523	8 5	−63 6
Other voluntary	24,432	5 2	43,007	5 6	+76 0

Source Hospital Economic Survey, Social Security Administration

ment has increased the availability of debt capital. Third-party certification to the hospital that debt repayment from new facilities furnishing patient care will be reimbursable reduces the risk of financing the project. As a result, lenders are willing to finance a larger proportion of each project.

The effect of reimbursement on internal funds available for investment is more complex and may have different net effects across institutions. True, cost reimbursement limits the overall flow of net income since revenues for reimbursable services are limited to costs. The institution may, however, have been sustaining a loss on the covered services before reimbursement with the result that net income could be increased. The effect of reimbursement on the availability of capital funds and on capital spending has not yet been determined through research because of lack of data but remains an important question.

HOSPITAL BEHAVIOR AND THE ALLOCATIVE MECHANISM

The predominant form of hospital ownership in the United States is private nonprofit. This organizational form is one of private ownership without shareholders. The initial equity capital is donated and any profits earned cannot be distributed but must remain within the institution.

Since profits cannot be distributed, objectives other than profit maximization may be pursued by the organization. Many motivations for hospitals have been suggested by researchers. These include quantity of service, quality of service, prestige for the institution, services to the community, and income for the medical staff.[5] Certainly, all hospitals are not alike in their objectives. One cause of difference is that boards of trustees delegate varying degrees of control and the administrator and medical staff tend to compete to acquire the delegated power.

In this model of hospital behavior, the range of objectives is incorporated by assuming that the nonprofit hospital tries to maximize output of the various health services it produces. Different weights are given to various services, however. Open heart surgery, for example, might have a high weight because of the prestige associated with it. Likewise, if provision of emergency-room services is important to the community, it might have a high weight. More routine inpatient care probably gets a lower weight.[6]

Two constraints must be dealt with as this objective function is maximized. First, the deficit on current operations cannot exceed contributions that may be used for operating expenses and income derived from the endowment. If the hospital desires to fund depreciation or earn a surplus to finance future capital investments, this budgetary constraint might require such a surplus to remain. The second constraint is on capital funds. To put it simply, investment must remain within the limits of capital funds available from grants, retained funds, and borrowing.

In this context, each hospital will decide how

[5] For a discussion of various objectives, see Karen Davis, "Economic Theories of Behavior in Nonprofit, Private Hospitals," *Economic and Business Bulletin*, Winter 1972, pages 1–13.

[6] For a more technical treatment of this model, see Paul B. Ginsburg, *Capital Investment by Nonprofit Firms: The Voluntary Hospital*, 1972 (unpublished).

much of each service to produce and, at the same time, choose an array of investment projects that will enable the institution to produce these services. Each unit of each type of service will have a requirement for capital funds, a contribution to or subtraction from net revenue, and a contribution to the objective function. The managers of the hospital will choose an output level of each service based upon these considerations. The services with heavy requirements of these two constrained resources will be produced only if there is a correspondingly high preference weight in the objective function. Conversely, some units of service may also be produced that are not highly prized but profitable and use little capital equipment.[7] Each hospital can be expected to decide on an array of services that maximizes its objective function.

Hospitals differ in their endowments of various resources and thus have differences in output and investment decisions. One hospital may be located in a wealthier area than another, for example, and have better access to philanthropy. Similarly, institutions may have different stocks of liquid assets and different availabilities of borrowed capital (as a result, possibly, of their existing debt situation). The influence of variations in resource endowment on the array of services chosen can be predicted, as well as the accompanying capital investment with the optimization rule of this model.

Hospitals with greater access to capital funds will tend to produce more services, invest more, and orient their output mix and corresponding investment composition toward services that are relatively more capital-intensive than the average for other hospitals. This shift is caused by the fact that capital funds are relatively more abundant in the hospital in question. When output expands in the institution with more capital funds, current budgetary resources become scarcer. There is thus a shift toward services that use more capital and a secondary shift toward those not so unprofitable. (If the greater access to capital funds is directed by the donor to be used for certain types of services, output mix will emphasize those types in relation to other hospitals. In most cases a spillover will occur and some of the effects of a generally greater access to capital funds will therefore be seen.)

Next, consider a hospital with a higher demand for its services. If constraints on capital funds are binding, it will not be able to undertake any more investment than comparable institutions. Consequently, it will take additional steps to economize on the use of capital funds by, for example, substituting services with low requirements of capital for those with high requirements. At the same time, units of service that are not profitable can be supported through the additional operating surpluses resulting from the higher demand.

To summarize this brief sketch of a hospital behavioral model—those institutions with better access to capital funds will invest more, produce more services, and orient toward more capital-intensive outputs of types favored by donors of capital funds. Those hospitals facing a higher demand for their services and constraints on capital funds will attempt to meet this demand through economizing on the use of capital in the projects that they do undertake.

With this concept of hospital behavior, the system of resource allocation that exists within the hospital industry today can be modeled. Those institutions with greatest access to capital funds are not necessarily those with the greatest demands for their services. Institutions that are used by the wealthy and are attractive to them may tend to have a great deal of capital, but they do not necessarily have high capacity utilization. Conversely, a hospital in a lower income area may be harder pressed to meet the effective demand for its services because of limitations in access to capital funds. This situation is mitigated to some extent by government grants and retention of funds. Because of the fractional limitations on project lending, however, the institution with better access to grant capital will be able to obtain more debt. With capital funds allocated among hospitals on the basis of proximity to wealthy donors, it is not surprising to find some hospitals with underutilized beds and sophisticated equipment and others with much higher utilization.

A similar allocative mechanism occurs within

[7] For economists, the optimization rule is that, for any two output types, the ratio of their marginal contributions to the objective function should be equal to the ratio of marginal resource use With two resources, marginal resource use is the marginal net operating deficit times the shadow price of the budgetary resource plus the marginal use of capital funds times the shadow price of capital funds.

the hospital. Private donors are often most interested in the more exciting medical services. By earmarking their donations for certain services or by advertising what is attractive to them, donors may induce hospitals to favor sophisticated and complex services at the expense of general hospital care. As a result, excess capacity and overcrowding may exist in the same institution. These effects are mitigated by other sources of capital. Government grants are more oriented toward general care. Retained funds, however, will be used according to the wishes of the managers, whose objective function might be closer to that of the philanthropist than to the patient demanding general care.

The substitution of philanthropic equity capital for ownership profit-seeking capital is to a large extent responsible for lower correlation between consumer demand and total hospital investment than would occur in an idealized market. (The correlation between consumer demand and certain components of hospital investment may be higher, since only the total capital expenditure rather than that for a given component is limited by the availability of funds.) In a hypothetical profit-seeking situation, high demand for routine care would induce the firm to raise both equity and debt capital to provide these services. The expected profitability of the projects would attract the capital to support it. It is not a coincidence that the proprietary hospitals in this country specialize in providing the general care that is sometimes neglected by the philanthropically supported institutions. Barriers to entry of proprietary hospitals prevent clearing of this market, however. Profit-seeking hospitals do not receive the exemptions from property, sales, and income taxes that nonprofit institutions are generally accorded. In New York, only physicians who are residents of the State are permitted to own hospitals. Low prestige of these firms in the eyes of the medical profession makes it difficult to attract a medical staff without extra inducements.

The capital market faced by hospitals also influences the allocation of resources to the industry as a whole. Free capital in the form of grants will tend to increase such allocation, but lack of ability to raise equity ownership capital in conjunction with imperfect markets for borrowed capital tends to decrease it. Extensive hospitalization insurance is a strong factor in adding to resources allocated to the hospital industry through increasing the demand for services and reimbursement of interest and depreciation cost. The net result may be greater allocation of resources to hospitals than that under idealized conditions.[8]

DETERMINANTS OF HOSPITAL INVESTMENT

Some highlights from earlier extensive analyses of the determinants of hospital investment and flows of capital financing are presented here as they are relevant to the preceding discussion.[9]

The basic thrust of the empirical analysis is to relate hospital investment behavior to data on the effective demand for its services, the availability of various sources of capital, and other pertinent variables suggested by models of hospital behavior. Multiple regression analysis is used to estimate the functional relationship between investment and these variables. After an equation is estimated to explain investment, analysis of variance tests on both the equation as a whole (F-test) and on the coefficients of the independent variables individually (t-tests) are performed to determine if the relationship is significantly different from a random one. Those variables whose coefficients are not significantly different from zero are then dropped from the estimated equation.

Many of the independent variables believed to influence hospital investment directly were not available in hospital financial data and had to be represented by proxies. The availability of government grants, for example, could not be captured from data on the flow of these grants without assuming that all available funds are used—the notion that is being tested. The same problem held for private grants and commercial borrowing. The internal funds variable was not affected by this problem as the stock of internal funds on

[8] Because of the complexity of the issue, welfare judgments on variations in allocation from an idealized model have been excluded here. Philanthropic subsidies of certain services need not, for example, be labeled "misallocation" if the cost of the subsidies are borne by the donors. Though private insurance affects allocation by reducing private cost below social cost, public insurance tries to reduce private cost to the level of social cost.

[9] See Paul B. Ginsburg, *Capital in Non-Profit Hospitals*, unpublished doctoral dissertation, Harvard University, 1970, and Paul B. Ginsburg, *op. cit.*, 1972.

hand does reflect the availability of this source of capital. The proxies substituted for the availabilities of the other sources of capital were the factors believed to affect these variables, discussed above. Income of the community in which the hospital is located, the proportion of families with high incomes, employment, and other variables were used as proxies for the availability of private grants. Similar substitutions were made for government grants and commercial borrowing. The flow aspect of internal funds was represented by net income and cash flow rather than transfers from the general fund to the plant funds, for the same reason.

The demand for hospital care, the other key variable in the analysis, was not affected by this problem. The occupancy rates for beds adjusted for hospital size, for size and urban/rural location, and unadjusted are close indicators of demand.[10] An additional indicator was the trend in the occupancy rate, both alone and in conjunction with the occupancy rate variables.

The data base for this analysis was made up of 180 short-term general private nonprofit hospitals that could provide data for all of the needed variables in their response to the survey questionnaire. In addition to the financial data from the Hospital Economic Survey on these hospitals, data on bed utilization from Guide Issues of *Hospitals* were used; data on the cities in which the hospitals were located were obtained from the Bureau of the Census.[11]

Table 5 presents the most important equations for total hospital investment. The numbers in the table are the coefficients derived from multiple regression analysis and (in parentheses) the *t*-statistics associated with the coefficients. Since all the variables (except dummies) are entered in logarithms, their coefficients can be interpreted as elasticities. In equation 1, for example, a 1-percent change in the ratio of internal funds to capital stock is estimated to cause a 0.37-percent change in total investment in the same direction when other variables are held constant. R^2 represents the proportion of variation in the dependent variable that has been explained.

Equation 1 is the best equation for total capital investment and is so labeled because it includes all variables statistically significant at the 5-percent level in explaining investment but no others. The other equations in the table involve reestimates of the first with additional explanatory variables of possible importance included. Analysis of variance did not, however, justify inclusion of any of these additional variables in equation 1.

A major portion of the variation in total investment is the result of the capital stock variable (reflecting hospital size and the need for replacement investment), all the other variables that are statistically significant appear to reflect the availability of capital funds. Catholic hospitals are shown to invest less than non-Catholic institutions—a reflection of possible reduced access to philanthropy and government grants. Hospitals with larger stocks of internal funds in relation to capital stock tend to invest more than others. Finally, hospitals that are more established tend to invest more. (Little correlation is apparent between this variable and the age of the plant and equipment, since the original building is often a tiny part of the hospital plant if it exists at all.) The reason may be that older institutions have better relations with philanthropists in a community and can raise more as a result.

Other variables that were proxies for access to capital funds were not significant in the equation, though some of this is explained by econometric problems. It is an interesting fact that none of the capacity utilization variables were significant in equation 2 of table 5. Equations for components of investment, where these variables appear (see below), give evidence that this lack of significance reflects a lack of influence of demand, not a failure to reflect the concept of demand accurately. Also noteworthy is the fact that contributions for operating expenses and investment income were not statistically significant in explaining total investment (equation 3). Neither cash flow nor net income were significant in the equation for total investment (equation 4). The last-mentioned result is particularly interesting since hospitals planning large investments might take steps to increase cash flow—a potential upward simultaneous equation bias.

Investment was then divided into two components—one for investment in general facilities and services, the other for investment in more sophisticated facilities and services. The division

[10] The adjustment factor was derived from linear regressions of hospital occupancy rates on these factors.

[11] Bureau of the Census, *County and City Data Book, 1962* and *1967 (A Statistical Abstract Supplement)*, 1962, 1967.

TABLE 5.—Regression equations for total hospital investment,[1] 1962–66

Explanatory variables	Regression coefficients					
	Equation 1	Equation 2	Equation 3	Equation 4	Equation 5	Equation 6
Catholic ownership	−.72	−.72	−.67	−.71	−.70	−.67
	(2.8)	(2.8)	(2.5)	(2.8)	(2.7)	(2.5)
Internal funds stock/capital stock	.37	.36	.37	.35	.37	.37
	(5.0)	(4.7)	(4.9)	(4.6)	(5.0)	(4.9)
Age of institution	.39	.39	.39	.42	.39	.40
	(2.8)	(2.8)	(2.8)	(3.0)	(2.8)	(2.9)
Capital stock	.66	.65	.66	.68	.64	.66
	(9.5)	(9.4)	(9.5)	(9.3)	(8.6)	(9.5)
Occupancy rate adjusted for size		.19				
		(0.3)				
Contributions and investment income/capital stock			.04			
			(0.8)			
Cash flow/capital stock				.10[2]		
				(1.1)		
Medical school affiliation					.14	
					(0.5)	
Debt/total revenue						.13
						(0.6)
Constant	2.1	2.2	2.1	2.0	2.3	2.1
	(2.4)	(2.4)	(2.4)	(2.3)	(2.4)	(2.4)
$\bar{R}^2$	.47	.47	.47	.47	.47	.47

[1] All variables except dummies are in logarithms 1962 values are used except for total investment, which is an average of the 5 years, 1962–66 With a one-tailed test, a *t*-statistic of 1.64 or higher is required for significance at the 5-percent level With a two-tailed test, 1.96 is required The *F*-statistic for equation number 1 is 41—statistically significant

[2] When net income is used in place of cash flow, the coefficient is .02 with a *t*-statistic of 0.5

was made by determining the average cost of a new hospital bed and routine accompanying facilities. This number was multiplied by the increase in beds for each hospital during the period 1962–66 to obtain investment in general facilities or investment in beds. The residual was considered to be investment in more sophisticated facilities. Equations for these two components of investment are given in tables 6 and 7.

Although the coefficient of determination (R^2) for the investment-in-beds equation (number 1, table 6) was disappointing and some of its regression coefficients unstable, the two sets of equations taken together provide highly interesting insights into capital investment decisions. Note that the occupancy rate variable was significant in both sets of equations but had a different sign in each. A high occupancy rate encourages investment in general facilities but discourages investment in sophisticated facilities. A 1-percent rise in the occupancy rate will increase investment in beds by 2.5 percent and decrease sophisticated investment by 2.9 percent. This result reinforces the notion that capital funds are a binding constraint on total investment since utilization does not influence the total but does influence composition.

The reaction of the hospital to high demand of expanding its general facilities at the expense of complex ones when total investment is constrained is an interesting result. Similar results were obtained for the closely related "contributions and investment income" and "income other than from patient revenue" variables. These variables do not influence total investment but influence the two components of investment in different directions, giving further support to the notion that total investment is determined by a constraint on capital funds.

It is interesting that existing debt tended to discourage sophisticated investment but not to have a statistically significant effect on investment in beds—a reflection perhaps of the cash flow criterion discussed above. Presumably, investments in general facilities produce a higher cash flow, so that existing debt should not be as important a consideration.

Other results derived from these equations in tables 6 and 7 include the fact that hospital size is not a significant variable in the equation for investment in beds (2, table 6), with the implication that large hospitals do not build any more beds than small hospitals. Absence of a size variable in the "investment in beds" equation explains the fact that the medical school affiliation variable, which is correlated with size, is present in this equation but not in that for sophisticated investment. A further noteworthy result is that variables with the same sign in both sets of equations tended to have a higher coefficient in the "sophisticated investment" equation, a possible indication that this component of investment is the marginal one and thus more sensitive to

TABLE 6.—Regression equations for investment in beds,[1] 1962–66

Explanatory variables	Regression coefficients			
	Equation 1	Equation 2	Equation 3	Equation 4
Catholic ownership	−63	−61	−.69	−61
	(1 7)	(1 7)	(1 9)	(1 6)
Internal funds stock/beds	18	20	20	19
	(1 7)	(1 7)	(1 8)	(1 7)
Age of institution	34	38	33	34
	(1 8)	(1 8)	(1 8)	(1 8)
Occupancy rate adjusted for size	2 5	2 5	2 4	2 5
	(3 1)	(3 1)	(3 1)	(3 1)
Contributions and investment income/beds	−09	−09	−10	−10
	(2 8)	(2 8)	(2 9)	(2 8)
Medical school affiliation	78	85	79	.76
	(1 9)	(2 0)	(2 0)	(1 9)
Beds		−08		
		(0 4)		
Debt/total revenue			03	
			(0 9)	
Cash flow/beds				−02
				(0 4)
Constant	82	98	96	90
	(0 7)	(0 8)	(0 9)	(0 8)
$\bar{R}^2$	14	13	14	13

[1] See footnote 1, table 5 *F*-statistic was 5 5 for equation 1—statistically significant Some of the dependent variables are significant at the 5-percent level only when one-tailed tests are appropriate When this is not the case, the 10-percent criterion is required for significance

the factors determining investment. The fact that the variable for Catholic ownership was only significant in the equation for bed investment may reflect the lack of access to rurally oriented government capital grants, which presumably favor this component of investment.

SUMMARY

The availability of capital funds for an institution is limited. Private grants are limited by access to potential donors and the amounts they are induced to give. Although hospitals can increase their ability to attract donations by tailoring operations and project plans to suit potential donors, it is unlikely that these actions can attract an unlimited flow of grants. Capital raised through Hill-Burton grants is limited by program funding and the requirement that these funds be used in conjunction with other sources to finance a project. Use of internal funds is limited by the stock on hand and by the fact that current flows of depreciation and net income are small in relation to the financing needs of a large project. Finally, commercial borrowing is generally limited to a fraction of the cash flow expected from the project in order to limit risk to the lender.

The model of hospital behavior indicated a likelihood that total investment would be determined by reaching this limitation on capital financing. Unused availability of capital funds is possible, but extensive insurance for hospital care and long-term flexibility in altering output mix lead one to expect investment to be determined by these limitations on capital funds. The mix of investments in capacity is determined by demand, organizational objectives, and operating subsidies, as well as access to capital funds.

The empirical analysis indicates that total investment is not determined by the demand for service but by hospital size and access for hospital funds. Analysis of two components of investment indicates that variables such as capacity utilization and operating subsidies do influence the components and operating subsidies do influence the mix between investment in beds and sophisticated investment, but not total investment. This reinforces the notion that limitations on capital fund availability determine hospital capital investment.

TABLE 7.—Regression equations for sophisticated investment,[1] 1962–66

Explanatory variables	Regression coefficients			
	Equation 1	Equation 2	Equation 3	Equation 4
Internal funds/capital stock	45	45	43	46
	(2 0)	(2 0)	(1 9)	(2 0)
Age of institution	92	92	92	95
	(2 2)	(2 2)	(2 2)	(2 3)
Capital stock	1 3	1 3	1 3	1 4
	(6 2)	(6 2)	(6 2)	(6 3)
Occupancy rate adjusted for size	−2 9	−2 9	−2 8	−2 9
	(1 7)	(1 7)	(1 7)	(1 8)
Income other than from patient care revenue/capital stock [2]	36	36	39	.44
	(1 5)	(1 4)	(1 5)	(1 7)
Debt/total revenue	−19	−19	−19	−20
	(2 6)	(2 5)	(2 6)	(2 7)
Catholic ownership		−02		
		(0 0)		
Cash flow/capital stock			05	
			(0 4)	
Medical school affiliation				−1 2
				(1 4)
Constant	−9 1	−9 1	−9 0	−1 1
	(3 3)	(3 3)	(3 3)	(3 6)
$\bar{R}^2$	29	.29	29	29

[1] See footnote 1, table 5 *F*-statistic was 13 for equation 1—statistically significant

[2] Income other than from patient care revenue is very close to contributions and investment income It was used here for better fit