COST OF CAPITAL TO THE HOSPITAL SECTOR*

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This paper provides estimates of the cost of equity and debt capital to for-profit and non-profit hospitals in the U.S. for the years 1972-83. The cost of equity is estimated using, alternatively, the Capital Asset Pricing Model and Arbitrage Pricing Theory. We find that the cost of equity capital, using either model, substantially exceeded anticipated inflation. The cost of debt capital was much lower. Accounting for the corporate tax shield on debt and capital paybacks by cost-based insurers lowered the net cost of capital to hospitals.

1. Introduction

One of the 'hottest' topics in hospital economics in the United States relates to the workings of capital markets in the hospital sector. There are at least two reasons for the topic's current popularity. First, the U.S. hospital industry is experiencing a dramatic transformation in ownership structure. In recent years, many freestanding hospitals have been acquired by chains, both for-profit and non-profit [Ermann and Gabel (1984)]. In particular, widespread concern has been expressed about the growth of for-profit chains [see, for example, Relman (1980)]. Most recent empirical research indicates that chain hospitals in general and for-profit chains in particular do not systematically demonstrate superior operating efficiencies [Institute of Medicine (1986)]. A number of experts, both inside and outside the hospital sector, have pointed to 'cheap and accessible' capital markets as the main reason for the growth of hospital chains. [See Ermann and Gabel (1984) for a recent, comprehensive review of this literature.] Unfortunately, such conclusions are largely based on casual observation rather than on finance

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theory and careful empirical comparisons of the cost of capital by ownership.

Second, there are the normative issues of how and how much to pay for hospital capital. Two basic methods are used to pay for hospital capital. Cost payers compensate for 'their' share of actual interest and depreciation expense incurred; some in addition pay a return on equity (ROE) to for-profit hospitals. Others, in lieu of an ROE payment, pay a 'plus' on top of the payer's share of operating cost. This system is used by Medicare, Medicaid, about half of the Blue Cross plans, and state hospital rate-setting programs [Cromwell et al. (1984), Melcer (1983)]. Under cost-based reimbursement arrangements, hospital investment generates added cash flow in the form of explicit payments for interest, depreciation, and equity costs for some providers. By contrast, charge payers base reimbursement on the hospital's charge rather than on various elements of cost. Such payers guarantee neither a return of nor a return on capital. Principal charge payers are commercial insurers, the remaining Blue Cross plans, and self-pay patients.

The cost-based system of capital payment is subject to two major criticisms: it distorts choice of scale, and it distorts the use of debt relative to equity for many hospitals.

If better payment systems are to be developed, these are among the questions that must be answered. First, how should the cost of capital to for-profit and non-profit hospitals be measured? Second, what is the cost of debt and equity to the industry and does it differ across ownership types? Third, is there reason to base capital payment on hospital ownership?

The objectives of this study are: first, to determine the costs of debt and equity in the hospital industry and to identify any advantages of lower capital costs which have accrued to for-profit and non-profit hospital types; and second, to use these results to provide insight into the questions of capital payment policy for debt and equity and for-profit and non-profit hospitals. Section 2 reviews the concept of the weighted average cost of capital. The corporate tax shield is discussed and shown to encourage the use of debt over equity by for-profit firms. The Medicare pass-through of interest payments, modeled analogously, reduces the cost of debt to all hospitals. Finally, by providing revenue as a function of the hospital's equity base, Medicare ROE payment is shown to have reduced the net cost of equity to for-profit hospitals. Section 3 estimates the cost of debt to for-profit and non-profit hospitals over the 1972-83 period. Section 4 provides estimates of the cost of equity capital, based on both the Capital Asset Pricing Model (CAPM) and Arbitrage Pricing Theory (APT). Estimates of the cost of equity for for-profit chains are obtained with each model. We then impute the cost of equity to non-profit hospitals, both chain and non-chain. In section 5, we present estimates of the weighted average cost of capital. Section 6 further discusses the results as well as capital payment policy issues.

2. Background

Funds to acquire equipment, buildings, or other inputs have alternative uses. As a consequence, hospitals and other firms must pay a cost of capital to use those funds. There are two sources of capital: debt and equity. The holders of each must receive their required return to willingly make the funds available; let the required returns on debt and equity be K_d and K_e , respectively.

From the point of view of the hospital, the marginal cost of attracting new capital is given by the weighted average cost of capital (*WACC*),

$$WACC = DK_d + (1 - D)K_e, \quad (1)$$

where D is the ratio of debt to assets. The profit-seeking firm determines its optimal D by weighing the value of the tax shields from additional indebtedness against increased bankruptcy risk [Bradley et al. (1984)]. Non-profit institutions do not have corporate tax shields; nor are dividends paid to the shareholders that are subject to personal income taxation. In the non-profit case, increased bankruptcy risk from additional borrowing is weighed against the extra utility to the hospital derived from the added cash flow [Wedig et al. (1988)]. For purposes of this study, we assume that hospitals have determined their target debt-to-assets ratio, and their capital structure is at its target value. Once at the target D , *WACC* is the firm's appropriate cost of capital at the margin [Copeland and Weston (1983)].

Five factors differentially influence the cost of capital to hospitals by ownership: tax treatment; differential availability of tax-exempt bond financing; the Medicare and other cost-based payers' 'pass-through' of interest expenses; treatment of a 'return on equity' by cost-based payers, including Medicare; and availability of tax free donations.

The corporate tax rate, t_c , effectively reduces the cost of debt by treating interest payments as tax deductible expenses of doing business. This serves to lower the overall cost of capital and encourages firms to acquire more debt. [This is the classic finding of the finance literature, see Modigliani and Miller (1958, 1963) and Miller (1977).] Obviously, the corporate tax incentive for an increased use of debt only applies to for-profit corporations in the hospital industry.

Second, the non-profit hospital has access to tax-exempt bonds through state and local government financing authorities. These bonds lower the return that hospitals must pay in proportion to the marginal income tax rate of bondholders. For-profit hospitals only have access to one type of tax-exempt security, industrial revenue bonds. These hospitals have relied much less extensively on tax-exempt bond financing [Sloan et al. (1987)].

Third, while Medicare now pays hospitals for operating costs based upon

fixed DRG prices, capital payments continue to be paid on an allowable cost basis. That is, Medicare (and other cost-based payers) pay their 'share' of interest expense (M) based upon the proportion of their patients in the hospital. Depending on the hospital department, the share is either measured in terms of Medicare days to total days or Medicare charges to total charges [Beck (1984), Bolandis (1982)]. As with the tax shield, this reimbursement provision serves to lower the net cost of debt to hospitals.¹

Fourth, until very recently, Medicare and Medicaid made a provision for a return on equity payment to for-profit hospitals (K_e^M). This guaranteed payment reduces the cost of equity capital to the investor-owned hospital.

Finally, non-profit hospitals may receive gifts from donors, the amount of which is deductible from the donor's personal income tax. This form of external equity financing is unavailable for the for-profit sector. Yet for-profit chain hospitals may obtain external equity funds from the sale of stock.

Thus, for purposes of evaluating the cost of capital to the hospital sector historically, the $WACC$ for non-profit hospitals is

$$WACC_{NP} = D(1 - M)K_d + (1 - D)K_e, \quad (2)$$

and for the for-profit hospital it is

$$WACC_{FP} = D(1 - M)(1 - t_c)K_d + (1 - D)(K_e - (M(1 - t_c)K_e^M)). \quad (3)$$

Our interest is in estimating K_d and K_e for each sector for the period 1972-83 and then calculating the tax and cost-based payer adjusted costs of capital.

The usual way to treat a payment such as for ROE is as an addition to cash flow rather than as an adjustment to the discount rate.² We have incorporated the ROE payment as in (3) because we wish to compare the for-profit discount rate net of the advantage (ROE payment) and disadvantage (corporate income tax) with the corresponding discount rate for non-profit hospitals. The for-profit hospital's corporate tax obligation applies to profits from operating as well as capital sources. To simplify the analysis, we only consider the effect of corporate taxation applied to profit from capital payments.

¹Under the law in effect in fiscal year 1987, Medicare pays capital cost on a pass-through basis at cost minus 3.5 percent and will pay capital cost minus 7 and minus 10 percent in fiscal years 1988 and 1989, respectively [Trustee (1987, p. 6)].

²For perpetual cash flows, adjusting the discount rate for a repayment like a return of equity payment can be made equivalent to adjusting the cash flows to account for such payments. If the cash flows over time are unequal because, for example, Medicare's ROE payment policy is expected to vary, the two types of adjustment do not yield the same result.

3. Cost of debt capital

3.1. Method for estimating cost of debt capital

Publicly-traded companies must file annual 10-K Reports with the Securities and Exchange Commission. Using 10-K Reports and annual reports from each of the six for-profit hospital chains, we calculated the cost of new long-term debt issues by company and year, 1972–83. The six chains were American Medical International (AMI), Charter Medical, Hospital Corporation of America (HCA), Humana, Lifemark, and National Medical Enterprises (NME). Interest rates for individual debt issues within each year were weighted by the face value of each issue. We also calculated means by company and year and a grand mean over all companies and years. We computed annual means with the total value of debt issued by each company as weights. We were unable to obtain 1972 10-K Reports for two hospital companies. We replaced these missing values with the 1972 annual average based on data from the other companies. Lifemark was acquired by AMI in 1983, and therefore no value was available for that year.

To obtain corresponding estimates for the non-profit sector, we analyzed data on new debt issues from the American Hospital Association's (AHA) 1983 *Capital Finance Survey* (CFS). We computed interest rates on long-term debt by year of issue for independent and chain non-profit hospitals, using face values of debt issued during the year as weights. A chain hospital is one that is owned, sponsored, or leased by a multi-hospital system. We obtained a list of chain hospitals from the AHA 1983 *Multihospital Validation Survey*. As with the for-profit calculations, we excluded capital leases and 'other debt'. The CFS could not be used for generating accurate costs of debt for all hospitals because the large for-profit hospital chains did not respond to this survey. Also, the CFS did not contain information on debt issued in 1983. To compute a 1972–83 mean cost of debt, we substituted 1980 values for 1983 since yields on municipal bonds in 1980 and 1983 were virtually identical [U.S. Department of Commerce (1986, p. 505)].

As noted above, borrowing generates cash flow for two reasons: reimbursement policy and corporate tax provisions. The cost of debt capital to the hospital is, therefore, the interest rate net of these flows. First, cost-based plans pay back interest expense incurred by the hospital. The amount of the payback is based on a combination of data on patient days and charges. Lacking data on days for Blue Cross cost-based plans, we based our computations exclusively on ratios of hospital charges to Medicare patients to total charges. We determined the percent of revenue from cost-based payers from a combination of sources [Sloan and Steinwald (1980), AHA *Annual Survey of Hospitals* for 1980–83 and various editions of the AHA *Survey of Blue Cross Plans*]. Second, for-profit hospitals can deduct interest expense in calculating their corporate income tax obligation. Since interest is

treated as a pass-through by cost-based plans, the tax shield only applies to the share of revenue not covered by such plans. From 10-K Reports and company annual reports, we estimated that the marginal corporate tax rate paid by publicly-traded companies during 1972–83 varied from 0.31 to 0.52 with a mean of about 0.4. This rate includes deferred tax payments; excluding such payments, the mean marginal rate was 0.22. We used the latter rate for our calculation of the net nominal interest rate.

3.2. *Estimated cost of debt capital*

There was some fluctuation in the relative cost of debt by publicly-traded companies among the years, but relatively little inter-firm variation for the 1972–83 period as a whole (table 1). Firm-specific differences reflect annual fluctuations in sources of debt and in the length of the loan, among other factors. The mean nominal interest rate for the six companies was 10.3 percent. Individual company means varied from 9.5 percent (AMI and NME) to 11.6 percent (Charter). The non-profits paid about two percentage points less for debt than their for-profit counterparts, 8.4 percent. This differential is attributable to greater reliance on tax-exempt bond issues by the non-profits.

To compute the net nominal interest rate for the publicly-traded companies, we subtracted 5.0 percent for the interest pass-through paid by cost payers (10.3 percent times the share of hospital revenue from cost-based sources for for-profit hospitals during 1972–83, 0.49) and 1.2 percent for the corporate income tax shield on interest payments $[(10.3 - 5.0) \cdot 0.22]$, the effective t_c ; this yielded a net nominal interest rate of 4.1 percent. For the non-profits, we subtracted 4.6 percent for the cost-based insurers' pass-through (8.4 percent times the cost-based share for non-profit hospitals, 0.55) yielding a net nominal interest rate of 3.8 percent. (Since the yields on tax-exempt bonds reflect their tax-exempt status, we made no explicit adjustment for marginal personal income tax rates.) Thus, with a 0.3 percent difference in net nominal interest rates, the investor-owned hospital companies were at a very slight competitive disadvantage in terms of debt cost during 1972–83.

4. *Cost of equity*

4.1. *Cost of equity capital to hospital companies*

4.1.1. *Methods for estimating cost of equity capital*

There is no generally-accepted method for measuring the cost of equity capital [Howe and Rasmussen (1982), Copeland and Weston (1983), Kolbe et al. (1984)]. The two methods used in our study, based on the Capital Asset Pricing Model (CAPM) and Arbitrage Pricing Theory (APT), represent relatively modern approaches.

Table 1
Mean cost of long-term debt by hospital ownership, 1972-1983.^a

Ownership	Companies	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	Mean
For-profit	HCA	7.5	8.5	7.9	8.3	8.4	8.4	8.4	8.4	10.3	11.3	11.1	10.9	10.2
	Humana	7.3 ^b	8.1	8.7	8.4	8.3	8.3	8.5	10.7	10.5	11.7	12.3	12.2	10.7
	AMI	6.5	6.2	8.2	6.8	8.6	7.5	9.3	8.0	9.2	9.5	10.9	10.4	9.5
	NME	7.3 ^b	8.1	8.8	8.4	8.3	8.1	8.1	8.1	10.1	9.7	10.6	10.1	9.5
	Charter	9.3	10.9	11.6	8.5	8.6	9.4	6.8	11.6	11.1	12.1	13.2	13.0	11.6
	Lifemark	7.1	8.7	11.3	10.3	10.2	10.1	10.1	10.5	9.7	10.6	10.9	10.4	10.4
Non-profit	Mean	7.3	8.0	8.6	8.2	8.5	8.3	8.5	9.7	10.2	11.1	11.4	11.1	10.3
	Independent	6.9	8.4	9.8	7.9	7.5	8.0	7.2	7.5	7.2	9.1	9.3	7.2 ^d	8.3
	Chain	7.6	7.3	7.1	7.9	8.5	7.0	7.1	8.0	7.7	9.6	9.5	7.7 ^d	8.6
	Mean	7.2	8.3	9.3	7.9	7.8	7.7	7.2	7.7	7.4	9.3	9.3	7.4 ^d	8.4

^aRates are weighted by the face value of debt.

^bMissing values replaced by the column mean.

^cLifemark ceased to exist in 1983 (merged with AMI).

^dActual values were not available, replaced by 1980 values as long-term municipal bond rates were similar between these two years [U.S. Department of Commerce (1986, p. 506)].

Capital Asset Pricing Model. The Capital Asset Pricing Model (CAPM) was developed by Sharpe (1963, 1964) and Treynor (1961) and extended by a number of investigators. It builds on traditional portfolio theory in that risk averse investors are only concerned about the risk and return of each asset. Its contribution is to argue that risk is measured as the covariance of an asset's return with that of the market portfolio of assets. Thus, risk in the traditional sense is decomposed into two elements: systematic risk and unsystematic risk. The forces of the market are such that no premium is paid for unsystematic risk because such random variation can be completely eliminated by a judicious choice of assets included in one's portfolio. For example, one company may suffer from an adverse decision by a regulatory agency, but a company in another (trade-dependent) industry may simultaneously benefit from a favorable unanticipated change in foreign exchange rates. Systematic risk, however, affects all assets in the market and thus no amount of diversification can eliminate it. Business cycles, for example, introduce systematic risk in the market for which investors receive a premium.

In the CAPM, the ex ante return on an asset i [$E(R_i)$] depends on one type of systematic or non-diversifiable risk, i.e., the difference between the expected return on an efficient market portfolio [$E(R_I)$] and a risk-free bond rate R_F .

$$E(R_i) = R_F + \beta_i[E(R_I) - R_F], \quad (4)$$

where β_i is $\text{cov}(R_i, R_I)/\text{var}(R_I)$. Thus, the expected rate of return is the sum of a risk-free time value of deferred consumption plus the price of risk multiplied by the riskiness of the asset. Assets which are more risky than the market as a whole (i.e., have $\beta_i > 1$) receive a higher expected equilibrium return. To estimate β_i , the dependent variable is often expressed in the form of excess returns [$E(R_i) - R_F$].

$$E(R_i) - R_F = \beta_i[E(R_I) - R_F]. \quad (4')$$

Returns expected by investors are not observable, and hence it is necessary to use actual returns for estimating beta and the risk premium. Replacing expected returns with their actual counterparts is legitimate if one can assume that the return on any asset is a fair game – that is, the expected rate of return on an asset equals the realized return on average. There is evidence that the market is indeed a fair game [Copeland and Weston (1983)].

To estimate the model, monthly stock returns (including dividends) for the period January 1972 through December 1983 were selected from the University of Chicago's Center for Research in Security Prices (CRSP) monthly file. For companies which were missing only one or two months of

data, we calculated monthly returns from the CRSP daily file and added them to the data base, yielding a total sample of 923 companies. The CRSP monthly file contained returns for 1,519 companies between 1972–83. We dropped those which were not in business continuously during 1972–83 and which had substantial gaps in the data. Included among the 923 were the six aforementioned hospital companies. Returns for Charter, Lifemark, and NME were only available on the daily returns CRSP tape. We aggregated these data to a monthly basis.

The 923 companies were then grouped into 27 portfolios based on Standard Industrial Classification (SIC) codes. Industries were defined using the first two digits of the SIC code in most cases. Three digit SIC codes were used to separate pharmaceutical companies from other chemicals, hospital companies from other health services, and electric and gas companies from all utilities. The number of companies per industry portfolio ranged from six for hospital companies and lodging places to 69 for insurance, real estate, and other investment companies. Using portfolios with different numbers of securities leads to different levels of confidence about the estimates. The convention in CAPM and APT analysis is to randomly select equal numbers of companies per portfolio. Since we focus on the hospital sector, we based portfolios on industries [see Pari and Chen (1984) for an analogous approach].

Monthly returns on a value weighted index (market value of company equity) of all New York Stock Exchange (NYSE) companies were used as estimates of the expected market return (R_t). We follow standard practice in selecting a stock portfolio to calculate R_t . While this portfolio is certainly sufficiently large to permit diversification, in principle, the portfolio should include all assets, not just a stock market index [Roll (1977)].

We used yields on 90-day Treasury Bills to estimate the return on a riskless asset (R_f). Monthly yields on 90-day Treasury Bills from January 1972 through December 1983 were coded from the *Survey of Current Business*. Short-term bills are subject to no credit risk and very limited market risk. Use of such securities as empirical counterparts to R_f is common practice [see Fama and MacBeth (1973), and more generally, Copeland and Weston (1983) and Kolbe et al. (1984)]. Monthly stock returns, market returns, Treasury Bill rates, and SIC codes were merged onto one file. Excess returns were then computed by subtracting the risk-free rate from individual portfolio returns for each month.

We estimated betas for all 27 industries using (4) and, alternatively, (4') with monthly observations. Next, to determine the effect of varying β_i on the expected return of securities in a portfolio, we estimated 144 cross-sectional regressions, one for each month, 1972–83. Each regression was based on eq. (4) [or (4')] and included 25 observations, one for each industry. The estimated industry beta served as the independent variable. We then gauged

the price of systematic risk from the mean of the 144 coefficients on the beta variable and the risk-free rate from the intercept. We excluded hospital and lodging place industries from the pricing regression because we intended to compute the cost of equity capital in each of these industries.

Arbitrage Pricing Theory. The Arbitrage Pricing Theory (APT), developed by Ross (1976), is a generalization of CAPM, but it relaxes some of the CAPM's restrictive assumptions. Most importantly, APT allows equilibrium returns on assets to depend on many factors rather than on one as in CAPM. In contrast to CAPM, tests of APT can be based on a subset of assets rather than the universe of assets. APT does not require a definition of an efficient market portfolio [about which empirical CAPM applications have made arbitrary assumptions, see Roll and Ross (1983)].

Rather than respond to one factor, the excess market return, APT allows asset returns to reflect effects of several dimensions of systematic risk. The unsatisfying element of the APT is that the various elements of risk are undefined. The most recent literature in the finance field has begun to seek economic interpretations for the factors. Chen (1983) found the first APT factor to be highly correlated with the CAPM beta. Chen et al. (1983) examined the relation of the factors they extracted to selected macroeconomic variables. They obtained preliminary evidence that the factors relate to such macrovariables as industrial production, twists in the interest yield curve, and measures of unanticipated inflation.

The expected return on asset i is given by

$$E(R_i) = \lambda_0 + \lambda_1 b_{i1} + \lambda_2 b_{i2} + \cdots + \lambda_K b_{iK}, \quad (5)$$

where λ_0 is interpreted as the rate of return on a risk-free asset, λ_j s are risk premiums (analogous to $[E(R_I) - R_F]$ in CAPM), and the b_{ij} s are sensitivities to each of the K factors. As with CAPM, this model is estimated with actual rather than expected returns of asset i .

Our APT analysis consisted of the following steps: First, the 923 companies were grouped into the same 27 portfolios as for CAPM. Second, we factor analyzed (maximum likelihood with Varimax rotation) a monthly time series-cross section of asset returns. The observational unit was the month and one of 27 portfolios. The observational period was again 1972-83 or 144 months. We retained four factors which accounted for 98 percent of the variance. While previous research has used from three to 10 factors, recent work indicates that four factors adequately account for the variations in returns [Roll and Ross (1984)]. Third, the four (factors) by 144 (months) factor matrix was merged to the portfolio monthly return matrix. Fourth, following Bower et al. (1984) and like our CAPM analysis, sensitivity coefficients were obtained by running 25 separate industry regressions with

the four factor scores as independent variables. These regressions yielded 25 sets of four parameter estimates, the b_{ij} s. Fifth, 144 monthly return regressions were run with the b_{ij} s as independent variables. The dependent variable was the monthly return for the portfolio. We then computed mean risk premiums (mean λ_j s) from the 144 monthly regressions.

4.1.2. Estimates of expected return

Capital Asset Pricing Model. We found the mean $\hat{\beta}$ for the six hospital companies to be 1.41 using eq. (4') (table 2). Among the 27 industries, hospitals had the second highest beta (after lodging places) and the highest realized return over the 1972–83 period.

The price investors require for undertaking systematic risk is given by the following equation:

$$\text{CAPM equation: } -0.011 + 0.132\hat{\beta}, \quad (6)$$

$$(-0.23) \quad (1.63)$$

$$R^2 = 0.21, \quad \bar{R}^2 = 0.17, \quad F(1, 23) = 9.45.$$

The parameter estimates are mean values of the risk premiums from 144 monthly CAPM return/risk regressions, associated t -values (in parentheses) and mean R^2 , corrected $\bar{R}^2$, and F -values from the 144 regressions. The t -values were derived by dividing the standard errors of 144 parameter estimates into the means (-0.011 or 0.132). The F -values are means of F s from the 144 regressions. The parameter estimates are expressed as annual rates. Theoretically, the intercept should provide an estimate of the nominal risk-free rate; thus, the negative sign was not anticipated, but the associated t -value is almost zero. The risk premium on beta is 13 percent; previous studies have generally obtained a lower premium. For example, Black et al. (1972) obtained a premium of 10 percent. The mean $\bar{R}^2$ from the 144 regressions is 0.17.

We also estimated the CAPM equation using the excess return (actual return – risk-free rate) as the dependent variable. We obtained the following equation:

$$\text{CAPM equation: } R_F + 0.036\hat{\beta}, \quad (6')$$

$$(0.56)$$

$$F(1, 24) = 116.73.$$

The mean nominal risk-free rate for the period 1972–83 was 8.1 percent. In this case, the risk premium is lower than anticipated, but the intercept (R_F) is

Table 2
Mean realized rates of return and estimated betas, 1972-1983.

Industry	Realized returns (%)			Beta 1972-83
	1972-83	1972-77	1978-83	
Hospital companies	30.66	12.14	49.18	1.41
Lodging places	23.18	11.64	34.71	1.49
Mining	15.74	12.10	19.38	0.87
Electric machinery	14.84	7.49	22.19	1.12
Transportation equipment	14.49	6.52	22.45	1.09
Communication	13.95	5.19	22.72	0.93
Other services	13.75	4.21	23.30	1.13
Wholesale trade	13.62	6.77	20.47	0.98
Miscellaneous manufacturing	12.92	4.42	21.43	1.09
Construction	12.67	8.08	17.26	1.23
Fabricated metal	12.26	6.21	18.32	1.01
Primary metal	11.98	9.50	14.47	0.92
Retail	11.69	2.53	20.85	1.03
Transportation	11.68	2.93	20.43	1.08
Food and tobacco	11.42	5.84	17.01	0.73
Non-electric machinery	11.09	8.33	13.85	0.98
Petroleum, rubber and plastics	10.86	5.31	16.41	0.77
Chemicals	10.79	6.36	15.23	0.89
Insurance, real estate and other financial	10.70	5.00	16.41	0.89
Lumber and paper products	10.70	5.43	15.98	0.99
Textiles and apparel	10.40	-1.25	22.04	1.03
Pharmaceuticals	9.25	1.15	17.34	0.68
Utilities (gas)	9.20	7.95	10.45	0.63
Stone, clay and glass	8.30	4.20	12.40	0.98
Bankers, brokers, credit agencies	7.70	-0.58	15.98	0.91
Utilities (combined gas and electric)	2.72	0.85	4.58	0.50
Utilities (electric)	0.79	-0.03	1.60	0.49

positive.³ We use these alternative estimates of the cost of equity capital to hospital companies below.⁴

Arbitrage Pricing Theory Model. We obtained the following risk premium equation on APT, as before based on 144 monthly regressions and 25 industry portfolios:

³Eq. (6') was estimated in deviation form. We have moved the R_F term to the right side to make the expression parallel to eq. (6).

⁴Since the estimated betas from the first step have sampling errors associated with them, there is a built-in errors-in-variables problem in the second step. Fortunately, the sampling error from the first step is small. The t -values for individual industry betas varied from 10.7 to 44.0 in the specification with an intercept and from 10.2 to 43.6 in the specification with the intercept suppressed. In the presence of autocorrelation, the standard errors are downward-biased. Judging from the Durbin-Watson statistics, there was a small amount of positive autocorrelation in the equations for a minority of the 27 industries. We corrected for autocorrelation using a procedure developed by Yule-Walker and described by Gallant and Goebel (1976). The resulting betas were virtually identical to those obtained without the autocorrelation correction procedure as were the associated standard errors.

$$\text{APT equation: } 0.046 + 1.244\hat{b}_1 + 1.324\hat{b}_2 - 0.870\hat{b}_3 + 0.950\hat{b}_4, \quad (7)$$

(0.47) (1.19) (1.13) (-0.54) (1.04)

$$R^2 = 0.54, \quad \bar{R}^2 = 0.44, \quad F(4, 20) = 9.05.$$

The mean $\bar{R}^2$ is over twice that of its CAPM counterpart [eq. (6)], indicating that the APT model is better able to explain variance in returns than CAPM.

To interpret the results for individual factors, it is useful to examine factor loadings by industry. The italicized coefficients in table 3 show the highest factor loading for each industry. Each loading reveals the correlation between the industry and the common factor. Twenty-two industries have their highest loading on the first factor which, judging from the very high correlation between CAPM betas and the first factor's sensitivities ($\hat{b}_1$), must be a measure of the excess market return. Although the hospital industry loads higher on the first factor than any other, the loading is lower than for most of the other 26 industries. The second factor is most important for: mining;

Table 3
APT factor structure matrix after varimax rotation.

Industry	Factor 1	Factor 2	Factor 3	Factor 4
Retail	<i>0.85</i>	0.20	0.36	0.21
Electric machinery	<i>0.83</i>	0.41	0.27	0.12
Textiles and apparel	<i>0.82</i>	0.23	0.33	0.08
Transportation equipment	<i>0.81</i>	0.41	0.27	0.09
Miscellaneous manufacturing	<i>0.81</i>	0.43	0.27	0.17
Communication	<i>0.81</i>	0.31	0.38	0.17
Lumber and paper	<i>0.80</i>	0.39	0.30	0.02
Fabricated metals	<i>0.80</i>	0.46	0.32	0.05
Stone, clay, glass	<i>0.79</i>	0.39	0.33	0.01
Transportation	<i>0.79</i>	0.38	0.25	0.08
Other services	<i>0.79</i>	0.34	0.38	0.22
Non-electric machinery	<i>0.78</i>	0.53	0.26	0.04
Wholesale trade	<i>0.78</i>	0.39	0.30	0.23
Chemicals	<i>0.74</i>	0.53	0.28	0.13
Lodging places	<i>0.73</i>	0.18	0.27	0.08
Primary metals	<i>0.70</i>	0.61	0.17	-0.17
Construction	<i>0.69</i>	0.50	0.30	0.14
Food and tobacco	<i>0.69</i>	0.40	0.46	0.24
Insurance, real estate	<i>0.66</i>	0.44	0.53	0.20
Banking, credit agencies	<i>0.66</i>	0.38	0.46	0.19
Hospital companies ^a	<i>0.62</i>	0.29	0.25	0.27
Pharmaceuticals ^a	<i>0.54</i>	0.42	0.20	0.44
Mining	0.30	<i>0.87</i>	0.15	0.11
Petroleum, rubber, plastics	0.51	<i>0.69</i>	0.31	0.16
Utilities (gas)	0.34	<i>0.66</i>	0.55	0.15
Utilities (combined)	0.34	0.21	<i>0.91</i>	0.04
Utilities (electric)	0.30	0.18	<i>0.91</i>	0.06

^aThese industries were excluded from eq. (4).

petroleum, rubber and plastics; and gas utilities – industries involved in or closely related to extraction of natural resources. The third factor is most important for electric utility and combination electric and gas utility industries, both regulated industries. Since public utilities historically have had a low rate of return (see table 2), it is not surprising that the coefficient on $\hat{b}_3$ is negative. Factor four never has the highest loading, but it stands out for pharmaceuticals and hospital companies. Thus, the fourth factor appears to deal with a dimension of systematic risk generally affecting health care industries.

Estimated cost of equity capital. The CAPM equations (6) and (6') yielded an estimated nominal cost of equity capital to the investor-owned hospital companies of 17.5 and 13.2 percent, respectively. We found small differences among the six companies. Using eq. (6), the cost ranged from 15.7 (NME) and 15.8 (HCA) to 20.4 percent (Charter). With (6'), the cost ranged from 12.7 (HCA) to 14.0 percent (Charter). The smaller companies tended to have higher equity cost. This is consistent with other studies of CAPM and is one of the empirical criticisms of the CAPM approach [Reinganum (1981)]. From APT equation (7), we obtained a mean nominal cost of 18.5 percent.

Medicare–Medicaid paid a return on equity (ROE) to proprietary hospitals. To adjust for this ROE payment, using eq. (3) we multiplied the for-profit hospitals' share of charges obtained from Medicare–Medicaid ($M=0.44$) by one minus the marginal corporate income tax rate $[(1-t_c)=0.78]$ by 1.5 (Medicare paid 1.5 times the Trust Fund rate [Kinney and Lefkowitz (1982)], by the mean return on the Hospital Insurance Trust Fund during 1972–83 [7.87 percent from Myers (1982) and Federal Hospital Insurance Trust Fund (1984, 1985)]. The percent yielded an ROE adjustment of 4.1 percent. Subtracting 4.1 percent from our estimates of the nominal cost of equity (K_e), the mean net nominal cost of equity capital was 13.4 and 9.1 percent based on CAPM equations (6) and (6'). The corresponding net equity cost using APT estimates from eq. (7) was 14.4. These estimates are appreciably higher than the estimated mean net nominal cost of debt for hospital companies of 4.1 percent for the same period. The higher required return on equity is not inappropriate but rather reflects the higher risks incurred by shareholders in their roles as residual claimants.

4.2. Cost of equity capital to non-profit hospitals

The source of external equity to non-profits is philanthropy. Several recent studies have argued that the cost of non-profit equity equals the return on equally risky tax-free securities [Conrad (1984, 1986), Silvers and Kauer (1986), Heizlinger and Krasker (1987)]. According to this view, the donor that the hospital must attract at the margin is interested in obtaining the

maximum possible return per donated dollar so that the funds may be used for worthy acts in the community, such as support for indigent care and unsponsored research. The donor's opportunity cost is decreased in proportion to the personal income tax shield on donations. If the hospital spends donated capital on X-inefficiency, it will not be possible to generate this required return for worthy acts.

Not all donors may have the community interest at heart. Initially, it may be possible to find donors who merely wish to have a brass plaque on a hospital wall and who do not care whether the hospital spends money on emoluments for managers. In such cases, the required (pecuniary) return is virtually zero (the price of a plaque). However, as more philanthropy is demanded by the hospital, such donors will disappear, and, in equilibrium, hospitals have to deal with donors who demand a competitive risk-adjusted return less the tax subsidy and perhaps a plaque or two as well.

Since debt obligations are satisfied before 'obligations' to equity holders, the comparable security should be equity, not debt. Systematic risk of non-profit firms should be equal to their for-profit counterparts; they operate in the same factor and product markets and in the same regulatory environment.

To compute the cost of capital to the non-profit sector, we made two adjustments to the CAPM-based estimates for the hospital companies. First, we adjusted for differences in leverage. A parallel calculation cannot be made with APT. To do this, we computed an unlevered beta for hospital companies, using

$$B_U = B_L / [1 + (1 - t_c) D_e], \quad (8)$$

where B_U = unlevered beta, B_L = levered beta (1.41, see above), D_e = debt-to-equity ratio, t_c = corporate tax rate (0.22).

Given the high rate of inflation during the period, book value estimates of D_e would be highly misleading. Lacking estimates of the market debt-to-equity ratio, we assumed that the hospital companies operated at or near their target D_e during 1980–83, and computed the change in book value of long term-debt to change in book equity over this time interval from Compustat data which was 1.12. The 1980–83 time interval is sufficiently short so that book values are reasonably close to their market counterparts, yet sufficiently long to smooth out year-to-year fluctuations in debt and equity issues. The resulting unlevered beta was 0.75. We then calculated a levered beta for the non-profit sector, using a debt-to-equity ratio of 0.94 (computed from 1980 and 1983 AHA *Annual Surveys of Hospitals* in the same way as for the for-profits) and a zero corporate tax rate. The non-profit levered beta was 1.46, yielding a cost of equity capital of 18.2 percent [based on eq. (6) parameter estimates].

Since philanthropic contributions are deductible from the personal income tax, it is appropriate to reduce the non-profits' cost of equity by $(1 - t_p)$ to obtain the cost of donated capital, where t_p is the marginal personal income tax rate applicable to hospital donors [Silvers and Kauer (1986)]. The marginal federal-state tax rate during the observational period for married persons with two dependents with an adjusted gross income of \$95,000 (1985\$) was around 0.5. Assuming that one-third of the gifts to hospitals was in the form of appreciated assets with a marginal rate of 0.2, then an appropriate value of t_p is 0.4. With $t_p = 0.4$, the cost of equity capital to the non-profit sector during 1972–83 was 10.9 percent. The corresponding estimate based on CAPM equation (6') was 8.0 percent. Thus, using eq. (6), the net nominal cost of equity capital to the non-profit sector was 2.5 percentage points lower than for the for-profits; with (6'), the non-profits' cost of equity capital was 1.1 percentage points lower.

5. Weighted average cost of capital

The weighted average cost of capital net of tax shields and ROE payments provides a convenient measure for comparing the competitive advantages of the for-profit and non-profit ownership forms. Using CAPM equation (6), the estimated weighted average cost of capital was 8.5 percent for the hospital companies and 7.5 percent for non-profit hospitals. With CAPM equation (6'), the corresponding estimates were 6.5 and 6.0 percent. Using APT equation (7), the corresponding estimate for the hospital companies was 8.9 percent. If non-profits enjoyed any advantage in terms of the weighted average cost of capital, the differential was small.

All of the above cost of capital estimates are in nominal terms. Anticipated inflation rates were used to adjust for inflation. Such inflation rates were computed by Hamilton (1985) from actual nominal interest and inflation rates using a Kalman filter process. Hamilton published annual expected inflation rates by quarter for 1950 through first quarter 1982. We extended his series by seven quarters using equations in his article, and then took the mean of the annual rates for the period 1972–83. The expected inflation rate for the period was 6.8 percent versus an ex post rate of 8.8 percent.

Real counterparts to the above nominal estimates based on CAPM equation (6) and APT equation (7) were positive, but low. At 6.5 and 6.0 percent, respectively, the nominal estimates from (6') were slightly less than the anticipated inflation rate. The cost of capital was substantially reduced by the cost payers' interest cost pass-through, the return on equity payment, and widespread availability of tax-exempt bond financing which created an unusually large wedge between the cost facing the hospitals and the rate required by suppliers of capital to this sector.

6. Discussion and policy implications

Using either CAPM or APT models, our results indicate that investors required an appreciable rate of return on the equity they supplied to hospital companies. These required returns, which substantially exceeded anticipated inflation, reflected high underlying risks of equity cash flows rather than rents to shareholders.

We argue that non-profit hospitals also must pay a return on equity, albeit in a different form. We estimated the return demanded by suppliers of equity to the non-profit sector to be 10.9 percent or 8.0 percent during 1972–83, depending on the CAPM equation specification used. This was only one to three percentage points below the corresponding values for the hospital companies.

Neither the CAPM nor the APT offers much insight into the question of why the cost of equity capital to the hospital industry was so high. Both techniques are ‘black boxes’ which only establish that the industry is risky in a very precise sense. That is, the industry is disproportionately affected by factors which cannot be mitigated by diversification of the shareholders’ portfolio.

There may be two reasons for sizable non-diversifiable risk in the hospital industry. First, the industry faces the uncertainty of government payment policy. Medicare and Medicaid provide almost half of hospital revenues. Changes in their policies can have major impacts on expected revenue. When viewed *ex post*, government policies over the 1972–83 period were largely favorable to hospitals. However, looked at *ex ante*, there were significant fears of: national health insurance with attendant limitations on payment, national price controls and state-mandated rate setting, and changes in insurers’ capital payment policies. Such risk is probably relatively difficult to eliminate by diversifying. Second, the industry was, in one sense, an infant industry. Although hospitals have existed from the 1700s, the large stockholder-owned hospital company is a recent phenomenon, originating in the late 1960s. As such, investors may not have known the covariances of returns between this industry and others – increasing the *ex ante* risk associated with providing capital to hospital companies.

We also have compared the cost of debt to the hospital companies to that of non-profit hospital organizations, both independent and chains. The nominal cost of debt (before applying the corporate tax shield) was almost two percentage points higher for the hospital companies. Non-profits on average paid an interest rate of 8.4 percent relative to an anticipated inflation rate of 6.8 percent. The cost of debt to independent and chain non-profit hospitals was virtually identical. The fact that suppliers of equity have required a higher return than suppliers of debt capital is understandable in view of their role as residual claimants.

With respect to a capital payment policy for Medicare (and other payers), there are three fundamental issues: making a distinction between debt and equity capital costs, making a distinction by type of hospital ownership, and deciding how much to pay.

Although future Medicare capital payment policy remains to be decided, there is clearly momentum toward developing a single set of prospectively-determined prices incorporating payment for both hospital operating and capital costs. Under this type of system, equity and debt cost are placed on the same footing with other hospital input costs. This is appropriate. Medicare's traditional method of paying for capital cost distorts the relative prices of debt and equity to hospitals, which in turn influences capital structure [Wedig et al. (1988)].

The second major issue is that of providing differences in payment levels for non-profit and for-profit hospitals. The ideal solution, in principle, is the same solution as that offered for differences in types of capital, namely, that Medicare should pay the same amount for capital regardless of hospital ownership. Hospitals would then legally organize themselves as for-profit or non-profit. The rub is that reimbursement policy is not set in a vacuum. Tax-exempt debt financing and donor avoidance of personal income taxes, policies beyond Medicare's control, work to lower the effective cost of capital to non-profit hospitals. This results in a policy conundrum. If the Medicare policy objective is to provide a 'level playing field', it should pay for-profit hospitals more to offset the otherwise favorable treatment of non-profit hospitals by other government agencies. Moves to change tax law or access to tax-exempt debt would then be met with changes in the level of Medicare reimbursement to one group or the other. On the other hand, if the Medicare policy objective is to minimize program costs, then it should make equal payments across ownership classes, causing a shrinkage of the investor-owned sector.

The third issue is how much Medicare should pay for capital costs. If investors or donors do not expect to receive the opportunity costs of their funds, there will be a capital outflow from this sector. Two policy questions are relevant: Has the change to prospective payment caused a change in the required return? And as a 'guaranteed payer', should Medicare pay a rate below other payers?

Even though we do not fully understand *why* the required returns were as high as they were for the period 1972-83, if anything, the non-diversifiable risk should have increased since 1983. Historical estimates provide conservative estimates of the current cost of equity capital. In particular, Medicare payment policy is now subject to much more frequent and unpredictable changes than heretofore. Also, since Medicare has become a major target for budget balancing, hospitals may from now on be especially vulnerable to budget reductions when the federal government's tax revenue shortfall is

predicted to be the greatest, such as during recessions. This would surely increase the non-diversifiable risk to suppliers of hospital equity. The only argument in support of reduced risk is that since the industry has matured, the covariances of returns are now better understood (the 'infant industry' argument).

Because Medicare historically has paid 'reasonable cost', one might conclude that Medicare reimbursement should have included compensation for equity at the risk-free rate, presumably to non-profit as well as for-profit hospitals. Whether the non-diversifiable risk associated with investments in securities of hospital organizations that derive high shares of revenue from Medicare is lower is an empirical issue. With six publicly-traded companies, it is not possible to determine with an acceptable degree of precision whether a high share of revenue from Medicare and other cost-based sources led to a lower beta.

Lacking the necessary information, we cannot answer the question of whether the required return is less when Medicare is the payment source. But we can narrow the range of uncertainty. The following argument shows that the cost of equity capital to a hypothetical hospital firm that derived all of its revenue from Medicare-Medicaid would have been above the risk-free rate during 1972-83. If the cost of equity capital to such a firm were equal to the risk-free rate, its beta would be zero. Extending this argument, one could view the observed beta of 1.41 for the hospital companies as a weighted average of two betas, one for a firm completely reliant on revenue from Medicare-Medicaid, and the other with no revenue from this source. Then with the Medicare-Medicaid share equal to 0.44, the beta for a company with no Medicare or Medicaid patients can be inferred to be 2.52. During 1972-83, investors in the latter company would have demanded a nominal return of 32.2 percent [based on (6)] or 16.1 percent [based on (6')]. Although not a logical impossibility, such rates are implausibly high.

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