

**THE CBO  
HOSPITAL COST CONTAINMENT MODEL:  
A TECHNICAL ANALYSIS**

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**CONGRESSIONAL BUDGET OFFICE  
U.S. CONGRESS  
WASHINGTON, D.C.**

**THE CBO HOSPITAL COST CONTAINMENT MODEL:  
A TECHNICAL ANALYSIS**

**The Congress of the United States  
Congressional Budget Office**

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PREFACE

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In September 1979, CBO published Controlling Rising Hospital Costs, a report analyzing the Carter Administration's hospital cost containment proposal and other options to contain hospital costs. The report had been prepared at the request of the Subcommittee on Health and the Environment, House Committee on Interstate and Foreign Commerce. An important tool used to analyze the Administration's proposal was a microsimulation model of the hospital industry. This paper describes the model for a technical audience.

Paul B. Ginsburg, T. Scott Thompson, and Lawrence A. Wilson, of CBO's Human Resources and Community Development Division, prepared this report under the supervision of Nancy M. Gordon and David S. Mundel. The authors wish to thank Malcolm Curtis, Joshua Greene, Daniel Koretz, and Frank Sloan for their useful comments. Francis Pierce edited the manuscript. Special thanks go to Toni Wright who patiently and expertly prepared the paper for publication.

An earlier version of this paper was presented at the Annual Meeting of the American Economic Association, Atlanta, Georgia, December 29, 1979.

In keeping with the Congressional Budget Office's mandate to provide objective and impartial analyses, this study offers no recommendations.

Alice M. Rivlin  
Director

February 1981



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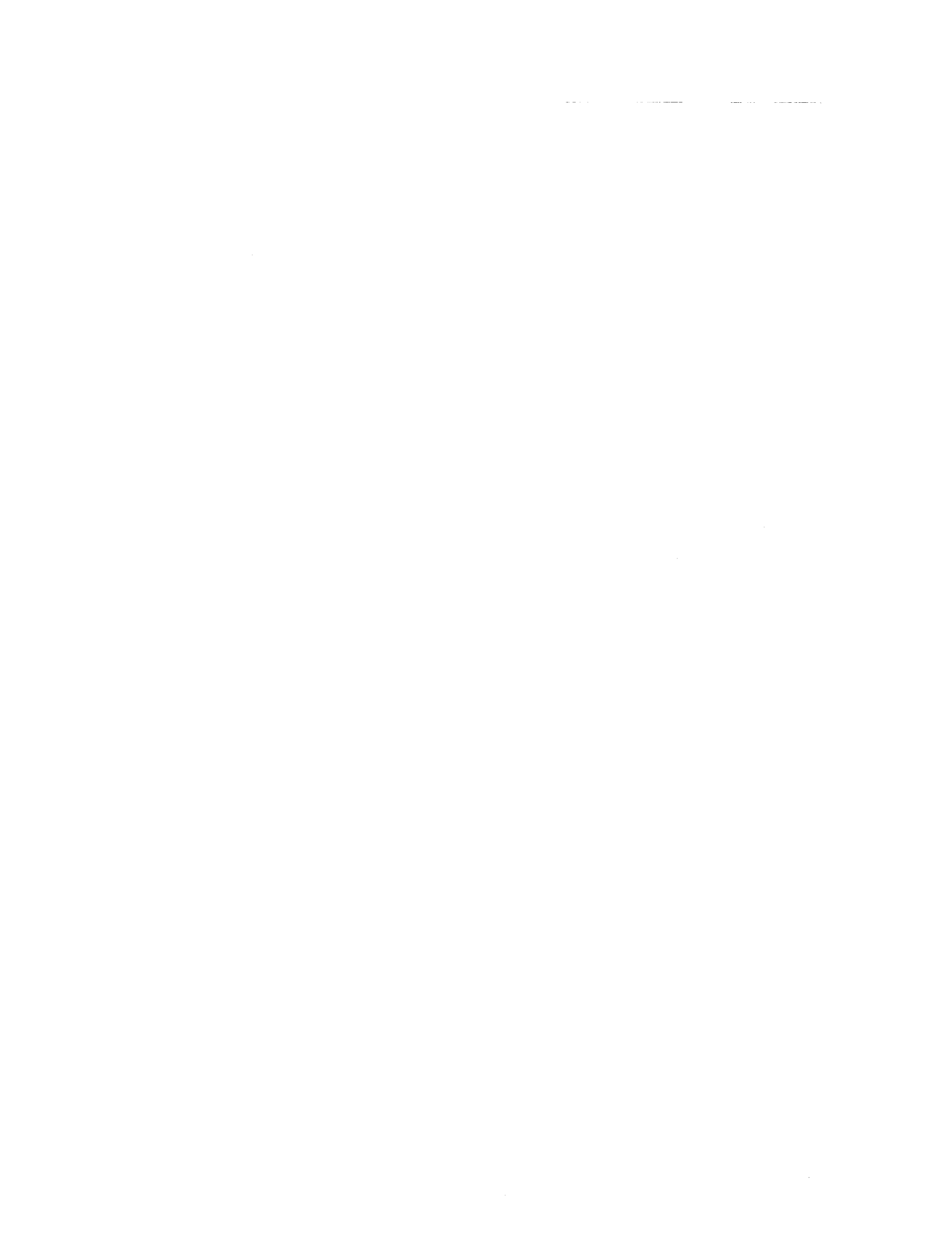
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FIGURE

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## SUMMARY

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The Congressional Budget Office developed a microsimulation model of the hospital industry to analyze the Hospital Cost Containment Act of 1979 and other proposals aimed at reducing the growth in hospital expenditures. The analysis appeared in the paper Controlling Rising Hospital Costs, which was published in September 1979. This second paper describes the model, which was used to assess:

- o The likely savings to the federal government and other purchasers of hospital care; and
- o The distribution of these savings by type of hospital and by type of purchaser.

## THE LEGISLATION

The Hospital Cost Containment Act of 1979 (H.R. 2626 and S. 570), proposed in March 1979 by the Carter Administration, would have set guidelines for increases in hospital expenditures and placed revenue controls on hospitals that failed to keep within them. The guidelines--based on the inflation rate for hospital purchases, population growth, and an intensity-of-resources factor--would have allowed hospital expenditures to increase by an estimated 14.5 percent in 1980. The controls would have limited increases in inpatient revenues per admission. Several kinds of hospitals--including small, nonmetropolitan hospitals and those in states with effective mandatory hospital cost containment programs--would have been exempt from the proposed program.

## WHY MICROSIMULATION?

Microanalytic simulation involves forecasting the behavior of economic units--in this case individual hospitals--on the basis of a macroeconomic forecast and observed historical patterns of microeconomic behavior. With this process, data on past frequency distributions of levels and rates of change of hospital variables

are used to project future distributions. As a result, values for individual hospitals sum to projected aggregate values, while the historical distributional patterns are preserved.

Microsimulation was chosen to analyze the proposal because of the complex nature of the legislation, interest in the distributional effects of the legislation, and the need for speed and flexibility in performing analyses. Computation of the guidelines and revenue limits specified in the legislation required an analysis over several years of joint distributions of several variables such as hospital type and hospital location, and rates of change of expenditures, wage rates, and admissions, a task best handled with a microsimulation model. Microsimulation also permitted speedy estimates of the effects of amendments to the legislation. The model also allowed estimation of which types of hospitals would have been most affected by the legislation.

#### THE MICROSIMULATION MODEL

The task of estimating the size and distribution of the potential savings of the hospital cost containment proposal involved several steps. Specifically, we forecast aggregate hospital expenditures and other variables, developed forecasts for these variables for each individual hospital, determined which hospitals would meet or exceed their guidelines, and, for those hospitals exceeding their guidelines, determined the savings--that is, the amount by which revenues would be limited by controls.

#### Aggregate Current Policy Forecast

Hospital industry expenditures, revenues, admissions, wage rates, and the labor/nonlabor factor mix were forecast with econometric time series models using quarterly data. The forecasts assumed no changes in current policies for 1980 to 1985.

#### Simulation Base

A file of individual hospital data covering 1972-1977 was transformed ("aged") on the basis of the aggregate current policy forecast so that it represented the population of hospitals six years later. The annual level for each variable of interest for each hospital was inflated by the ratio of the projected aggregate level for that variable to the actual aggregate level from the

historical data. For example, since the increase in aggregate hospital expenditures between 1976 and 1982 was projected to be 140 percent, each hospital's 1976 expenditures were inflated by 140 percent to generate their values in 1982. As a result of this process, the ratio of a hospital's expenditures to the aggregate expenditure level for, say, the simulated 1982 survey was equal to the actual ratio in the 1976 survey.

### Determining the Guidelines and Their Effects

Guidelines were determined for each hospital on the basis of formulas stipulated in the legislation. Once the guidelines were calculated, they were compared to the projected rate of increase in expenditures for each hospital. Hospitals with expenditure increases exceeding their guidelines were placed in a pool that would fall under controls the next year, while those that passed the guidelines were placed in the pool that would be reexamined the next year.

### Measuring the Savings to Purchasers of Hospital Care

Limits on revenues per admission were calculated for those hospitals exceeding their guidelines the previous year. Savings were calculated by taking the difference between each hospital's projected revenues under current policies and those allowed by the legislation. For example, if a hospital's revenues were \$1.00 million in 1979, and if they would increase by 15 percent to \$1.15 million under current policies, a 12 percent revenue limit would result in \$0.03 million savings (\$1.15 million minus \$1.12 million) to purchasers of hospital care. Total savings were determined by summing the individual hospital savings.

### Sensitivity Analyses

Three tests were made to determine the sensitivity of the savings estimates to the aggregate hospital forecasts, to the time period used to simulate future years, and to changes in assumptions about hospital behavior in response to the legislation. First, the tests found that the savings estimates were moderately sensitive to errors in the aggregate forecasts of hospital resource intensity. For example, a one percentage-point increase in intensity growth (the difference between expenditure growth per admission and input price growth) would increase five-year savings

by about 25 percent. Second, the estimates were not very sensitive to the specific years of survey data that were used. Third, the estimates were sensitive to assumptions about hospital behavior. While the main case assumed no change in hospital behavior in response to the guidelines, an alternative assumption that hospitals close to their guidelines would moderately alter their behavior would decrease five-year savings by about 20 percent.

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## CHAPTER I. INTRODUCTION

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The Congressional Budget Office was asked by the Subcommittee on Health and the Environment, House Committee on Interstate and Foreign Commerce, to analyze the Hospital Cost Containment Act of 1979 and other options to contain hospital costs.<sup>1</sup> An important part of the analysis contained in Controlling Rising Hospital Costs, published in September 1979, was based on a microsimulation model of the hospital industry that was developed to analyze the impacts of this proposed legislation. The model was designed to assess:

- o The likely savings to the federal government and other purchasers of hospital care; and
- o The distribution of these savings by type of hospital and by type of purchaser.

This paper presents a technical description of the model. The remainder of this chapter describes the legislation and summarizes the microsimulation model. Chapter II discusses why the microsimulation technique was chosen. Chapter III describes in detail the microsimulation model and its use. Some of the results obtained from the model are presented in Chapter IV, which also discusses their sensitivity to assumptions and data.

### THE HOSPITAL COST CONTAINMENT ACT OF 1979

The Hospital Cost Containment Act of 1979 (H.R. 2626 and S. 570), introduced in March 1979 by the Carter Administration, was designed to reduce the rate of increase in hospital expenditures. It would have been implemented in two stages. First, it would

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1. A report on these analyses was released in September 1979. See Congressional Budget Office, Controlling Rising Hospital Costs (September 1979).



have screened hospitals on the basis of their characteristics or performance, exempting a substantial number. Second, revenue controls would have been placed on the remaining hospitals.<sup>2</sup>

### Exemptions

The bill would have exempted a large number of hospitals from controls on the basis of their characteristics or their performance. With respect to characteristics, it would have exempted from revenue controls hospitals that:

- o Were located in nonmetropolitan areas and had admitted less than 4,000 patients per year over the previous three years;
- o Were operated by the federal government;
- o Provided mostly long-term or special care;
- o Derived at least 75 percent of their revenues from health maintenance organizations during the previous year;
- o Had been in operation less than three years; or
- o Were located in a state with a mandatory cost containment program approved by the Secretary of the Department of Health and Human Services (HHS).

The proposal also would have exempted other hospitals from controls on revenue as long as they stayed within the expenditure

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2. The Hospital Cost Containment Act of 1979 was favorably reported by the House Committee on Ways and Means, the House Committee on Interstate and Foreign Commerce, and the Senate Committee on Labor and Human Resources in 1979. Although the committees altered the original proposal in many ways, they retained the basic thrust of the Administration's bill. The House of Representatives eliminated the controls from the bill in October 1979. The Senate took no action on the bill.

Unless noted otherwise, this paper describes the version of the proposal ordered reported by the Senate Committee on Labor and Human Resources.

guidelines set by HHS. Should a hospital exceed its guidelines in any year, it would be subject to revenue controls for the duration of the program.

National Guidelines. The first performance test under the guidelines would have been a national one. If total national hospital expenditures increased by less than the national guideline, all hospitals would have been exempted from mandatory controls for the following year. Three elements would have comprised the national guideline: the percentage increase of a price index for hospital purchases, called a "market basket"; an allowance for population growth (currently 0.8 percentage point); and an allowance of one percentage point for increases in resource intensity.<sup>3</sup> HHS would have calculated the price index using national weights and national price increases for each expenditure category in the hospital market basket. CBO estimated that this market-basket index would increase 12.7 percent in 1980 over 1979, resulting in a national guideline of 14.5 percent (the 12.7 percent for the market basket plus 0.8 percent for population growth plus 1.0 percent for resource intensity).<sup>4</sup> This represented a rate lower than the 15.6 percent increase projected by CBO under existing policies.<sup>5</sup>

State Guidelines. If total national hospital expenditures exceeded the national guideline, then a performance test would have been applied to hospitals on a state-by-state basis. If total hospital expenditures within a state increased less than the state's guideline, the bill would have exempted all hospitals in

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3. Resource intensity refers to the level of resources provided on a per patient basis, after taking inflation into account.
  4. The higher of the actual increase or the increase estimated by HHS would be used to calculate the national guideline.
  5. Estimates presented here are the last ones provided to the Congress. They were based on January 1980 CBO economic assumptions, and assumed that hospitals would face guidelines first in 1980 and could first come under revenue controls in 1981.

that state.<sup>6</sup> The guidelines would have varied among the states for two reasons. First, each state would have its own population growth factor. Second, hospitals would have their wage increases for nonsupervisory employees who were not physicians "passed through," so that each state's guideline would fully reflect differences in expenditure growth due to differences in wage increases for such workers.

Individual Guidelines. If the total expenditure increase in a state exceeded that state's guideline, the bill would then apply the performance test within the state on an individual hospital basis. The guideline for each hospital would differ from that for other hospitals in the state to the extent that its wage increases for nonsupervisory employees differed from those of other hospitals.

#### The Revenue Controls

The Hospital Cost Containment Act of 1979 would have placed controls on revenues of hospitals not exempt on the basis of either their characteristics or their performance. While the guidelines would apply to increases in total hospital expenditures, including those for outpatient services, the revenue controls would apply only to inpatient revenues. For hospitals under the revenue controls, the bill would have applied a cap on increases in inpatient revenue per admission from the year that the guideline was breached. If a hospital's revenue rose less than the cap in any year, the unused portion could be carried over into future years.

The starting point in the calculation of each hospital's cap would have been the percentage increase in the prices of the hospital's market basket for goods and services. Hospitals would have used the higher of the percentage increase forecast by HHS or the percentage increase actually experienced. The wage pass-through under revenue controls would have been the same as that

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6. In practice, guidelines would be calculated for each hospital. If the sum of the differences between each hospital's actual expenditures and those allowed according to its guideline was zero or negative, then the entire state (or nation) would be exempt from revenue controls the next year.

used for the guidelines. No automatic resource intensity component would have been added in calculating the revenue cap, however.<sup>7</sup>

The proposals included three important adjustments to the basic revenue cap. The first of these was an "efficiency adjustment." HHS would increase the cap for hospitals with relatively low per diem routine costs, while that for hospitals with relatively high costs would be reduced. The second adjustment, which would have compensated for changes in a hospital's admission rate, was intended to reduce incentives to increase the number of admissions.<sup>8</sup> The third adjustment, called the base-period adjustment, was intended to remove incentives for hospitals to increase their costs during the year before they expected to be subject to revenue controls. The cap would have been reduced by the amount by which a hospital exceeded its guideline in the previous year.

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7. For more details and other adjustments to the revenue cap, see CBO, Controlling Rising Hospital Costs.
  8. The admissions adjustment would have been left to the discretion of the Secretary of HHS. Under the formula assumed by the HHS staff, and used for this estimate, allowed hospital revenues would have equaled "deemed" admissions times allowed revenues per admission. "Deemed" admissions would have equaled actual admissions if the increase in admissions over the previous year had been less than 2 percent. If admissions had increased by more than 2 percent, "deemed" admissions would have equaled 102 percent of the previous year's admissions plus 75 percent of the admissions above 102 percent. If admissions had declined from the year before, deemed admissions would have equaled prior-year admissions minus 75 percent of the decline.

For example:

Base Period Admissions	Actual Admissions	"Deemed" Admissions
100	102	102
100	110	108 [102 + .75 (110-102)]
100	92	94 [100 - .75 (100-92)]

The Secretary of HHS would have been authorized to grant exceptions to hospitals under certain conditions. Although the legislation mentioned some general conditions for exceptions to be granted (for example, renovation costs or significant new services), no specific criteria were included.

#### THE MICROSIMULATION MODEL

Microanalytic simulation was chosen as the method for analyzing the hospital cost containment legislation. The technique involves forecasting the behavior of individual hospitals on the basis of an aggregate hospital forecast and past patterns of individual behavior relative to aggregate trends.

The task of estimating the size and distribution of the potential savings of the hospital cost containment legislation involved the following four basic phases, which are discussed in detail in Chapter III:

- (1) Forecasting aggregate hospital expenditures and other variables for 1980 through 1985 assuming no change in current federal policies (the "current policy" forecast);
- (2) Developing a current policy forecast for expenditures and other variables for each individual hospital (the simulation base). For example, if total hospital expenditures were projected to increase 14 percent in 1981, the numbers of hospitals that would increase their costs by 12, 13, 14, or 15 percent were projected;
- (3) Determining which states, and then which hospitals, would meet or exceed their guidelines; and
- (4) For those hospitals exceeding their guidelines, determining the difference between each hospital's current policy revenues and the revenues that would be allowed under the controls. Estimates of savings to the federal government and other purchasers of hospital care were derived by aggregating these differences.

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## CHAPTER II. WHY MICROSIMULATION?

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Microsimulation involves forecasting the behavior of microeconomic units--in this case individual hospitals--on the basis of a macroeconomic forecast and observed historical patterns of microeconomic behavior. The starting point is an historical microdata file such as a survey. A set of behavioral equations are applied to each microeconomic unit to transform the historical file into a file simulating the original survey under different, in this case future, conditions. The simulated microeconomic behavior is constrained in the aggregate by macroeconomic parameters forecast outside of the model.<sup>1</sup> Using this process, distributional characteristics of the simulated population are determined by the behavioral equations and by the initial survey data, while the aggregate levels of the variables are determined by the macroeconomic forecast.

As mentioned in Chapter I, microsimulation was chosen to analyze the hospital cost containment proposal because of the complex nature of the legislation, the interest in distributional analyses, and the need for speed and flexibility in examining alternative proposals. The legislation specified a complex screening process, with guidelines for percentage expenditure increases applied first to state aggregates and then to individual hospitals in those states exceeding their guidelines. Revenue controls, in turn, would have been based, in part, on each hospital's past expenditure growth.

The microsimulation model was able to incorporate the necessary frequency distributions of rates of change of expenditures and other variables, which were particularly complex. To begin

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1. In some simulation models, but not this one, feedback mechanisms are built into the model so that distributional information forecast by the microsimulation modifies the parameters of the external macroeconomic model. This was unnecessary for the hospital cost containment model because no behavioral algorithms were simulated that would change the parameters of the macroeconomic model.

with, because the legislation specified guidelines and revenue caps based on a variety of variables, analysis of the legislation required the computation of joint distributions of such variables as hospital type and location, level of per diem routine costs (for the efficiency adjustment), and the rates of change in expenditures, inpatient revenues per admission, admissions, and wage rates. Assumptions of either independence or linear relationships among these distributions were unwarranted. Second, the shapes of the distributions, especially the percentage change in total expenditures, were skewed and non-normal (see Table 1).<sup>2</sup>

In addition, the savings estimates required the behavior of individual hospitals to be traced over time. It was necessary to determine which hospitals meeting their guidelines in the first year would meet them the next year as well. Those hospitals exceeding their guidelines in one year would be subject to revenue limits in the following year, with the limit determined partly by current activity and partly by the amount by which the guidelines were exceeded in the previous year. It was therefore necessary to preserve patterns of year-to-year variation in the rates of change of expenditures and revenues for individual hospitals in order to estimate savings for each hospital.

The microsimulation model allowed the determination of which type of hospitals would be most affected by the legislation. In other words, the model allowed CBO to answer questions such as, would large hospitals be penalized more than small ones, public hospitals more than proprietary ones, teaching hospitals more than nonteaching ones?

The development of a microsimulation model also allowed speed and flexibility in analyzing alternative proposals. It was anticipated that a large number of estimates would have to be made under strict time pressures when the bills reached the Committee mark-up stages. The ability to reestimate savings quickly in response to alternative assumptions about macroeconomic conditions or hospital behavior was crucial, as was the ability to incorporate proposed legislative amendments quickly into the estimation process.

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2. For total expenditures, the null hypothesis of normality was rejected on the basis of the Kolmogorov-Smirnov D-test at the 0.01 percent level.

TABLE 1. DESCRIPTIVE STATISTICS ON SELECTED HOSPITAL VARIABLES:  
1976-1977<sup>a</sup>

	Percentage Change in Total Expenditures	Percentage Change in Adjusted Admissions <sup>b</sup>	Percentage Change in Expenditures per Adjusted Admission	Percentage Change in Wage Rates <sup>c</sup>
Median	13.7	0.2	13.9	8.3
Mean	14.8	0.7	14.6	8.6
Standard Deviation	11.5	9.9	11.9	12.4
Skewness	1.7	1.1	1.0	0.6
Kurtosis	10.3	8.2	5.6	2.9

SOURCE: American Hospital Association Annual Hospital Surveys, 1976, 1977.

- a. These statistics exclude hospitals with missing data, unusual data, and those exempted by legislation on the basis of characteristics or state cost containment programs. See Chapter III for details.
- b. Adjusted admissions is a measure combining the number of inpatient admissions and the volume of outpatient services in terms of equivalent inpatient admissions based on revenue levels. It is derived by multiplying the number of outpatient visits by the ratio of outpatient revenue per visit to inpatient revenue per admission and adding this to the number of inpatient admissions. For further details, see American Hospital Association, Hospital Statistics (1979).
- c. Payroll per full-time equivalent employee, used as a proxy for wage rate for nonsupervisory, nonphysician employees.



Two alternatives to microsimulation were considered. First, the aggregate forecast of hospital expenditures could have been compared to a forecast of the average limit on hospital revenues. But such a technique would have ignored the important screening process in the proposal and would have incorrectly summed individual hospital revenue increases that were lower than allowed increases with those greater than the limit.

Second, the distributions of relevant variables could have been summarized by fitting them with appropriate functional forms and then manipulating them manually. Such a method would have been less accurate and less flexible than microsimulation, however. Accuracy would have been lost in the process of approximating distributions. The loss of information would have been particularly severe when attempting to approximate the joint distribution between different years. Flexibility would have been lost as additional time would have been necessary to change the model's parameters in response to amendments to the bill or to new forecasts of hospital performance or economic conditions.

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## CHAPTER III. THE SIMULATION MODEL

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As described in Chapter I, the modeling process involved four basic phases: (1) the aggregate current policy forecast; (2) the application of the aggregate current policy forecast to historical data for individual hospitals to create the current policy simulation; (3) the determination of which hospitals passed and failed their guidelines; and (4) the determination of the probable savings to purchasers of hospital care resulting from the cost containment legislation. This chapter describes in more detail the techniques employed.

### AGGREGATE CURRENT POLICY FORECAST

Hospital industry expenditures, admissions, wage rates, and the labor/nonlabor factor mix were forecast separately. Time series regression models estimated with quarterly data from the National Hospital Panel Survey were used to forecast the aggregate variables. Revenue growth under current policies was assumed to equal expenditure growth; hence, growth in inpatient revenues per admission was proxied by growth in expenditures per adjusted admission. Wage increases were approximated by changes in each hospital's payroll per full-time equivalent employee, as specified in the legislation.

Prior to the simulation, the current policy forecast was adjusted to reflect the exemption of hospitals in states with their own cost containment programs (see below). On the basis of a separate analysis, we estimated that annual expenditure growth in the eight states with programs would be 3 percentage points below that in states without programs.<sup>1</sup> This raised the current policy forecast for annual expenditure growth for the remaining hospitals by 0.7 percentage point.

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1. See CBO, Controlling Rising Hospital Costs, Chapter 4.

## CREATING THE SIMULATION BASE

A file of data on individual hospitals covering six years of experience was transformed or "aged" on the basis of the aggregate current policy forecast to represent the same population six years later. This aging process resulted in a simulated data base of future hospital behavior.

### Selection of the Data

The historical data were obtained from the American Hospital Association's (AHA) Annual Hospital Survey. Computer tapes for the years 1972 through 1977 were merged by hospital so that the behavior of individual hospitals could be analyzed over time.<sup>2</sup> While over 8,300 hospitals, including virtually every American hospital, are represented on this tape, only some were selected for use in the simulation (see Table 2).

Hospitals were deleted from the data base for four reasons. First, the legislation exempted hospitals in states with their own mandatory hospital cost containment programs, provided that the state's rate of expenditure increase was within 1 percentage point of its guideline. On the basis of our analysis of state program effectiveness and the discretion afforded the Secretary of HHS in the legislation, we assumed that eight states--Connecticut, Maryland, Massachusetts, New Jersey, New York, Rhode Island, Washington, and Wisconsin--would be exempt. Hospitals in these states (about 18 percent of all hospitals) were dropped from the analysis.<sup>3</sup>

- 
2. The data for earlier years were considered too incomplete and unreliable to use.
  3. HHS also assumed these states would be exempted. When the bill was introduced, Colorado had a cost control program. It was subsequently repealed in February 1980. The Rhode Island program is run by Blue Cross under guidelines from the state. Rhode Island hospitals were nevertheless dropped from the analysis because HHS officials expected the state's program to qualify for the exemption.

TABLE 2. HOSPITALS ELIMINATED BY COST CONTAINMENT MODEL SCREENS,  
IN ORDER OF REJECTION

Reason for Elimination	Percent of Total Eliminated by the Legislation	Percent of Total Eliminated by CBO Screens	Percent of Total Failing Any Screen
State has mandatory cost containment program	18	--	18
Not a community hospital	13	--	13
Incomplete reporting or not in operation for full period (1973-1977) <sup>a</sup>	--	25	25
Failed one or more screens for outlier data	--	2	2
Small rural hospital	17	--	17
-----			
Total	48	27	75

a. Includes hospitals in existence for less than three years.

Second, the legislation specified the elimination of hospitals that were not "community hospitals." These included federal hospitals, long-term hospitals, and special service hospitals (such as psychiatric hospitals). About 13 percent of all hospitals were eliminated at this stage.

Third, hospitals were dropped if they had incomplete data for the period from 1973 to 1977, or if they failed to report to the AHA in any of these years.<sup>4</sup> About 25 percent of all hospitals were eliminated on these grounds at this step.<sup>5</sup>

The assumption underlying these deletions is that the phenomenon of incomplete reporting is not related to the behavior of the variables used in the analysis. Separate analyses showed little correlation of hospital characteristics such as ownership, size, and levels of cost with variables such as expenditure growth (see below).

The AHA approach of assigning the average values of similar hospitals to hospitals with missing data was not used because it would artificially shrink the distributions. This would have invalidated hospital cost containment savings estimates, which are sensitive to the shapes of key distributions.

Fourth, hospitals exhibiting highly unusual behavior were dropped. For example, hospitals whose expenditures per adjusted admission increased by more than 100 percent or decreased by more than 50 percent in any year were excluded. Roughly 2 percent of all hospitals were dropped at this point because of such suspicious data.

The assumption underlying this screen was that hospitals reporting changes so extreme were likely to have made errors in reporting. To the extent these changes actually occurred, the hospitals would be likely candidates for exceptions. Undoubtedly, some hospitals were dropped whose unusual behavior was due to changes such as mergers or the opening or closing of substantial numbers of beds. To the extent that not all of these shifts reflect errors and that these hospitals would not receive exceptions, the process of eliminating outlier hospitals may have distorted the shape of the distribution of hospital expenditure increases. This, in turn, may have reduced estimates of savings. On the other hand, some hospitals that were not eliminated, such as hospitals with 95 percent increases in expenditures per adjusted admission, may have been erroneously reporting unusual

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4. The simulation also used data for 1972, but looser standards were applied because the 1978 experience that it was used to simulate was only of minor importance for estimating the effects of the legislation.
  5. This screen also indirectly eliminated new hospitals as specified in the legislation.

behavior. This would have introduced an opposite bias to the savings estimates. The net effect on the savings estimates is not known.

The hospitals remaining at this point (about 42 percent of all hospitals) were used in the aging process (see next section). Thirty-one percent of all hospitals were eliminated by the legislation, and 27 percent by CBO screens.

Finally, small rural hospitals (which were excluded by the legislation) were dropped. These 17 percent of the hospitals were eliminated after the aging process because they were included in the current policy forecasts.

After all the screens had been applied, about 25 percent of the hospitals were used in the simulation, and 75 percent were not. The legislation eliminated 48 percent of all the hospitals, and 27 percent were eliminated by CBO screens. Of the hospitals not eliminated by the legislation, 52 percent were used in the simulation.

#### Aging the Files

The Method Used. Data from individual hospitals from 1972 through 1977 were aged so that they simulated the same hospital population for the period 1978 through 1983. The aging algorithm "shifted" each data point ahead six years using the aggregate current policy forecasts. Thus for example, 1974 historical data were aged to simulate 1980. The variables that were aged included total expenditures, adjusted admissions, wage rates, and the wage/nonwage input mix. The aging algorithm was modified to include a data smoothing process which allowed distributional analysis of the savings estimates.

For each hospital, levels of variables in each projected year were determined by applying the ratio of the aggregate value of that variable in the projected year to the aggregate value in the relevant historical year to the individual hospital level in the historical year, as in (1).

$$(1) \quad e'_{it} = e_{i,t-a} \times \frac{E_t}{\sum_i e_{i,t-a}}$$

where

$e_{it}$  = total hospital expenditures for hospital  $i$  in year  $t$ .

$e'_{it}$  = simulated total hospital expenditures for hospital  $i$  in year  $t$ .

$E_t$  = projected aggregate hospital expenditures in year  $t$ .

$a$  = number of years to age the data (in this case  $a = 6$ ).

For example, since the increase in aggregate hospital expenditures between 1976 and 1982 was projected to be 140 percent, each hospital's 1982 expenditures were projected to be 140 percent of its 1976 level.<sup>6</sup> This process results in the ratio of a hospital's expenditures to the aggregate expenditure level for a simulated year being set equal to the actual ratio six years earlier. For example, if a hospital's expenditures equalled .00137 of total hospital expenditures in 1976, its projected expenditures for 1982 would equal .00137 of total hospital expenditures projected for 1982. Also, the ratio of the increase in a hospital's expenditures to the increase in aggregate expenditures between any two simulated years was left equal to the actual ratio six years earlier as in (2).

$$(2) \quad \frac{\left[ \frac{e'_{it}}{e'_{i,t-1}} \right]}{\left[ \frac{E_t}{E_{t-1}} \right]} = \frac{\left[ \frac{e_{i,t-a}}{e_{i,t-a-1}} \right]}{\left[ \frac{\sum_i e_{i,t-a}}{\sum_i e_{i,t-a-1}} \right]}$$

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6. Recall that this projection was for hospitals in states without their own cost control programs.

For example, if a hospital's ratio of 1976 expenditures to 1975 expenditures was 110 percent of the national average for those years, its ratio of 1982 expenditures to 1981 expenditures would be 110 percent of the projected national average ratio for those projected years. The same process was applied to each variable (for example, wages, admissions) for each year.<sup>7</sup>

The result of the aging process was a simulated file of hospital behavior for 1978 through 1983. For each hospital, there were simulated values for expenditures, adjusted admissions, wage/nonwage factor mix, and wages for 1978 through 1983. Similarly, there were simulated rates of change for these variables for that time period.

The goal of the aging process is a reasonably accurate joint distribution of levels and rates of change of variables for individual hospitals. No connection is intended, however, between any specific hospital's historical data and its projected data. For example, if hospital A had a low level of expenditures per patient day in 1974 but a high rate of increase in total expenditures from 1974 to 1975, the aging process would simulate a hospital with low per diem expenditures in 1980 but a high rate of increase in total expenditures from 1980 to 1981. Nevertheless, the model does not imply that the simulated hospital with that performance is in fact hospital A. While the model attempts to simulate distributions of levels and rates of change of the variables of interest, no linkage between specific individual hospitals in the simulated data and those in the historical data is attempted.

A refinement to the aging process was necessary in order to analyze more accurately the relative effects of the legislation on different types of hospitals (for example, large public, or small

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7. The macroeconomic aging process was applied to the means of hospitals remaining in the population after screening the data, so that dropping hospitals with incomplete or outlier data had no effect on the effect of the macro controls on individual hospital values. Small rural hospitals were dropped after the aging was completed, however, because there was insufficient data to forecast hospital aggregates excluding them.



investor-owned). Although the behavior of any one group of hospitals may be quite similar to the behavior of the hospital population as a whole in the long run, it still may differ significantly from the average in any one year. A process was designed to smooth the data to eliminate these random fluctuations, so that the choice of 1972 instead of 1973, for instance, to simulate 1978, would not be prejudicial to any single type of hospitals.<sup>8</sup>

As in the basic part of the aging process, this smoothing adjustment involved inflating each hospital's value of a variable by a constant group multiplier for that year. The group multipliers for each year were computed as the ratio of the simple means of each variable averaged over time for each group to the variable's mean for the group in the given year, as in (3).

$$(3) \quad S_{gt} = \frac{\frac{1}{k} \sum_t \left( \frac{1}{n_g} \sum_i e_{git} \right)}{\frac{1}{n_g} \sum_i e_{git}}$$

where

$S_{gt}$  = smoothing multiplier for group  $g$  in year  $t$ .

$e_{git}$  = total expenditures in year  $t$  for hospital  $i$  in group  $g$ .

$n_g$  = number of hospitals in group  $g$ .

$k$  = number of years of survey data summed (in this case  $k = 6$ ).

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8. When hospitals were grouped into cells according to ownership and size, regressing individual annual hospital expenditure growth over the 1976-1977 period on dummy variables for each cell showed hospital group to be a poor predictor of hospitals' time-series behavior. There were, however, substantial differences between the behavior of different hospital groups in any one-year time period.

This multiplier was used to modify the basic aging equation (1) to produce the final aging equation (4).

$$(4) \quad e'_{git} = e_{g,i,t-a} \times \frac{E_t}{\sum_g \sum_i (S_{g,t-a} \times e_{g,i,t-a})} \times S_{g,t-a}$$

The smoothing process eliminated year-to-year variations in relative changes of the simulated variables in each group while preserving the long-term relationships between hospital groups. In general these adjustments had only small effects on the final relative values of different hospital groups.

### SIMULATING THE PROPOSAL

After the data base was aged, the next step involved simulating the proposal. For each hospital, simulated guidelines were compared to simulated expenditure increases. For each hospital that exceeded its guideline, revenue limits were simulated and savings calculated.

#### Simulating the Guidelines and Their Effects

Guidelines were determined for each hospital according to the formulas specified in the legislation. Once calculated, they were compared to the simulated rate of increase in expenditures for each hospital.

The guidelines were combinations of the percentage increase in a national input price index, hospitals' percentage increases in the wage rates of nonsupervisory personnel, and the percentage increases in state populations. The wage rate increases simulated by the aging process were used to calculate the guidelines, as were the simulated payroll/nonpayroll factor mixes.<sup>9</sup>

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9. A rather complex reporting period adjustment process specified in the legislation was also incorporated, but it is not discussed here. See CBO, Controlling Rising Hospital Costs.

The guidelines were used to determine, for each year, which hospitals would be subject to mandatory revenue controls in succeeding years and which hospitals should be reexamined the following year. Once each hospital's guideline was calculated for a year, it was subtracted from the hospital's simulated expenditure change. The difference was multiplied by the hospital's expenditure level in the preceeding year. These amounts were summed over all hospitals in a state. If the sum was negative, then the state was judged to have met its guideline, and all hospitals in the state were placed in a pool to be reexamined the next year. If the state guideline was exceeded, then those individual hospitals exceeding their guidelines were placed in a pool that would be subject to controls in the following year. Those hospitals meeting their guidelines were placed in the pool to be reexamined in the following year.

This guideline evaluation process identified those hospitals subject to controls in the following years. The simulation process provided insight into the toughness of the guideline. Information on the average guidelines faced by hospitals not exempted from the controls was generated as were data on the proportion of hospitals exceeding their guidelines (see Chapter IV).

#### Calculating the Revenue Limits

Limits on revenues per admission were calculated for those hospitals exceeding their guidelines the previous year. The per admission revenue limits were computed from each hospital's simulated wage rate increase, the projected increase in national input prices, a penalty based on the hospital's simulated performance under the guidelines, and the hospital's simulated revenue per admission during the year in which the hospital exceeded its voluntary guideline. Adjustments for relatively efficient and inefficient hospitals called for in the bill were made on the basis of an efficiency formula provided by HHS.<sup>10</sup>

A total dollar limit on each hospital's revenue was computed by multiplying its revenue per admission limit by its deemed admissions level. This value was computed from the hospital's

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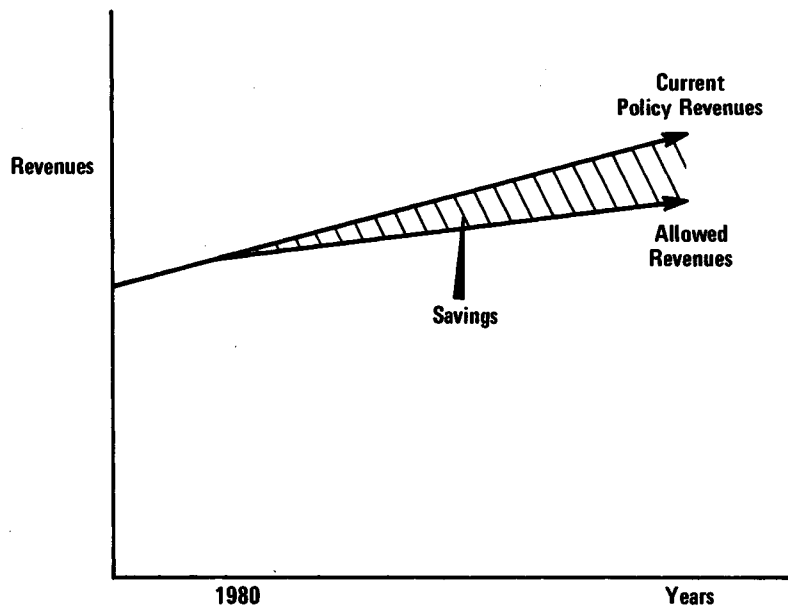
10. Medicare data on routine costs were used in determining the efficiency adjustment.

actual admissions level in the previous year and the hospital's percent change in admissions according to a formula assumed by HHS staff (see Chapter I).

### Applying the Revenue Limits

The savings were calculated by summing the differences between each hospital's simulated current policy revenues and those simulated to be allowed under the legislation (see Figure 1). For example, if a hospital's revenues were \$1.00 million in 1980, and if they would increase by 15 percent to \$1.15 million under current policy, a 12 percent revenue limit would result in \$0.03 million savings (\$1.15 minus \$1.12 million). Total savings were determined by summing the individual hospital savings. The estimates were based on the assumption that no hospital would change its behavior from current policy unless it was forced to do so by imposition of a mandatory limit. In this case, a hospital was assumed to spend the maximum allowed by the limit. These assumptions are discussed in detail below in Chapter IV.

Figure 1.  
Effect of Cost Containment Legislation on a Hypothetical Hospital



### Calculating the Savings to Purchasers of Hospital Care

Four steps were necessary to determine savings to the federal government from reduced outlays for Medicare and Medicaid for each fiscal year. First, savings for each hospital's own reporting period were estimated.<sup>11</sup> Second, the savings were evenly divided between quarters in each hospital's reporting year. Third, the savings per quarter were aggregated to federal fiscal year totals (October-September). Fourth, the federal fiscal year savings were adjusted to allow for time lags between when savings would accrue and when they would appear as reductions in federal outlays. Savings were computed separately for Medicare and other payers to take into account the relatively higher growth rate, and the resulting more stringent limits, of Medicare revenues per admission.<sup>12</sup>

CBO usually provides savings estimates for the five-year period following enactment of bills.<sup>13</sup> This presented a problem because the six years of micro-data could only be aged to simulate the 1978 to 1983 period.<sup>14</sup> Therefore, a different procedure was

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11. Whenever information about Medicare reporting periods was available, these dates were used in the analysis instead of the AHA reporting dates. Data were adjusted accordingly to reflect the difference between Medicare and AHA reporting periods.
  12. The legislation specified applying revenue limits separately to each class of payers.
  13. Although the legislation specifies guidelines starting in 1979, the CBO simulation summarized here, a reestimate of an earlier simulation, starts the guidelines in 1980 due to the stalled progress of the bill through the Congress. Savings estimates were therefore required for fiscal years 1981 through 1985.
  14. Simulating the proposal required 1978 data because the legislation specified adjustments to the guidelines for hospitals with 1980 reporting periods starting before January 1. These adjustments were based on the 1978-79 rate of change of total expenditures for each hospital.

developed to simulate hospital behavior in 1984 and 1985. Fortunately, the need for microdata for those years was slight. By 1984, virtually all hospitals were projected to be subject to mandatory controls, so the inability to measure guideline compliance was of minor consequence.<sup>15</sup> For each hospital projected to be subject to mandatory controls in 1984, current policy inpatient revenues per admission and other variables for 1984 and 1985 were projected to increase at a rate which deviated from the national increase by the same margin as in 1983. This preserved the 1983 distributions of these variables.

The estimate of savings should have been reduced to reflect the exceptions process included in the legislation. The bill, however, did not specify conditions for exceptions, making it impossible to estimate the magnitude of their effect.<sup>16</sup> A decision was made to label the savings estimate as probably too high rather than speculate about the size of the reduction from the exceptions process.

Another question not addressed by the model is how much of the savings would come from expenditure reductions rather than from reduced surpluses or increased deficits. Ultimately, all savings should reflect expenditure reductions, but hospitals may defer such reductions for years by slowing capital accumulation. An estimate of the proportion of savings achieved by expenditure reduction would be useful for assessing the impact of the legislation on inflation as well as its possible effect on the quality of care.

The absence of much research on the issue of how rapidly hospitals can cut costs in response to controls on revenues discouraged examination of this issue. While there is some evidence that the Economic Stabilization Program (ESP) and New York State's control program affected revenues more than costs,

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15. The simulation projected that only 2 percent of the hospitals would have met their guideline each year at this point.
  16. The bills reported by the committees specified some of the conditions necessary for exception, but offered no clear-cut rules. Financial hardship was emphasized, but the data base lacked adequate information from hospital balance sheets to determine which hospitals were in financial difficulty.

inference from these experiences is inappropriate.<sup>17</sup> Expectations that controls would be temporary makes ESP a poor prototype for this question, while New York State's program has important differences from the Hospital Cost Containment Act of 1979.

The model assumes that hospitals would not alter their behavior in response to the controls except to comply with the revenue ceilings. This, of course, would not be the case. Alternative assumptions about hospital behavior are discussed in Chapter IV in the section on sensitivity analyses.

#### ALTERNATIVE SIMULATION METHODS

The aging process differs considerably from other forms of microsimulation, which usually involve the application of a set of behavioral equations to each unit of a microdata file. The equations may be of several sorts: regression models estimated from historical data, simple inflation equations, probability models using random number generators, or merely the mathematical expression of theoretical or pragmatic assumptions. Usually these equations, once specified, are applied repetitively to a single cross-sectional microdata file to project future changes.

Estimation of behavioral equations with regression models was rejected because of the inability to predict individual hospital variations over time with any accuracy. The rates of change of various expenditure and admissions variables for individual hospitals (standardized for the aggregate annual rate of change) were regressed on various combinations of independent variables such as hospital ownership, hospital size (number of beds), medical school affiliation, and urban location and the lagged dependent variable.

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17. See Paul B. Ginsburg, "Impact of the Economic Stabilization Program on Hospitals: An Analysis with Aggregate Data," in Michael Zubkoff, Ira E. Raskin, and Ruth S. Hanft, eds., Hospital Cost Containment: Selected Notes for Future Policy (Milbank Memorial Fund, 1978), pp. 293-323, and Abt Associates, Inc., Analysis of Prospective Payment Systems, Prepared for the Office of Research and Statistics, Department of Health, Education, and Welfare, HEW-OS-74-261 (April 6, 1976).

Even when lags of up to four time periods were employed, none of the regressions explained more than 2 percent of the variation in the dependent variables. Given the need to predict the distribution of individual rather than mean hospital behavior, a regression explaining less than 2 percent of individual hospital variation would have been inadequate.

This apparently random behavior in individual hospital annual rates of change is demonstrated more graphically by simple correlation coefficients (see Table 3). For example, the correlation between the rate of change of individual hospital expenditures from 1975 to 1976 with that from 1976 to 1977 is only 0.06. Correlations for other variables are small and negative.

TABLE 3. CORRELATION BETWEEN PERCENTAGE CHANGE 1976-1977 AND PERCENTAGE CHANGE 1975-1976 IN EXPENDITURES, ADJUSTED ADMISSIONS, WAGE RATE, AND EXPENDITURES PER ADJUSTED ADMISSION<sup>a</sup>

Variable	Correlation Coefficient (r)
Total Hospital Expenditures	0.06
Adjusted Admissions	-0.01
Wage Rate	-0.28
Total Expenditures per Adjusted Admission	-0.13

SOURCE: CBO calculations using American Hospital Association Annual Hospital Surveys, 1975, 1976, 1977.

a. Excludes hospitals exempted by legislation on the basis of characteristics or state cost containment programs, and those with missing or unusual data.



Other standard microsimulation techniques were also inappropriate to the task at hand. Any type of probit analysis would have experienced the same problems as other types of regressions. Such techniques also would have resulted in the loss of important information. Simply estimating the probabilities of hospitals being over or under their guidelines would not have been sufficient, because the amount a hospital was over or under was also needed. Simple inflation equations were inappropriate because of the sensitivity of the final estimates to the distribution of rates of change. Simple inflation would have preserved the distribution of absolute levels at any point in time, but at the expense of eliminating any distribution of rates of change.

Instead, the aging process was based on an assumption that the behavior of individual members of the selected subset of community hospitals in 1972 through 1977 relative to the mean for the subset is an accurate predictor of the behavior of the same hospital population in 1978 through 1983. More explicitly, the shapes of the distributions of the aged variables relative to their means are assumed to be constant over time. Furthermore, the pattern of linkages between these distributions is assumed comparable in the historical and the simulated periods. While the simulated surveys probably do not forecast the behavior of any individual hospital accurately, they should reasonably represent the population of hospitals taken as a whole.

The assumption that the distribution of behavior of hospitals in the model during the 1972-1977 period would be representative of the behavior of the same group of hospitals for the 1978-1983 period is a potential problem. The existence of the Economic Stabilization Plan from mid-1971 to early-1974, and the hospital industry's "Voluntary Effort" to control hospital costs that began in December 1977, may have altered the shape of the distribution of hospital expenditure increases, raising doubts about this assumption. A sensitivity analysis (see Chapter IV) showed that moving the starting point by one year does not significantly affect the savings estimates, however.

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## CHAPTER IV. SAMPLE RESULTS AND SENSITIVITY ANALYSES

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This chapter illustrates how the model was used to estimate aggregate savings for purchasers of hospital care, the distribution of savings among hospitals, and the sensitivity of these results to certain assumptions.<sup>1</sup>

### SAVINGS TO PURCHASERS OF HOSPITAL CARE

#### The Guidelines

The average hospital not exempted by characteristics would have faced a guideline of approximately 16.5 percent in 1980 (see Table 4). About 73 percent of those hospitals would have met the guideline for hospitals in their states. About 28 percent of the hospitals would have met the guidelines in both 1980 and 1981, approximately 11 percent of the hospitals would have met the guidelines in 1980, 1981, and 1982, and some 2 percent of the hospitals would have met the guidelines in 1980, 1981, 1982, and 1983.

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1. Estimates presented here are for the Hospital Cost Containment Act of 1979 as ordered reported by the Senate Labor and Human Resources Committee. Since 1979 was over when the estimates were prepared, 1980 was treated as the first year hospitals would face guidelines and 1981 is the first year they could have come under revenue controls. The estimates are the last official CBO estimates provided to the Congress and are based on January 1980 CBO economic assumptions. To summarize the forecast from 1980 to 1985 used in these estimates (which is no longer the current CBO forecast), total hospital expenditures were projected to increase at an average annual rate of 16.0 percent, adjusted admissions at 1.5 percent, and the hospital market basket index at 10.3 percent.

TABLE 4. ESTIMATES OF AVERAGE PERCENTAGE GUIDELINES IN THE VOLUNTARY PROGRAM AND PERCENTAGE OF COMMUNITY HOSPITALS MEETING THEM, 1980-1983<sup>a</sup>

Year of Reporting Period	Unadjusted Guideline	Guideline Adjusted for Reporting Period	Hospitals Meeting Guideline <sup>b</sup> (percent)
1980	15.3	16.5	73
1981	14.2	14.2	28
1982	13.2	13.2	11
1983	12.4	12.4	2

- a. Average guidelines are expenditure-weighted averages for all community hospitals not in states with mandatory hospital cost control programs and not exempted on the basis of characteristics.
- b. This is the percentage of those hospitals not already exempted by characteristics or by the existence of a mandatory state program. For 1981, 1982, and 1983 this is the percentage meeting the guideline for two, three, and four years respectively.

#### The Revenue Limits

Hospitals that would have failed to meet their 1980 guideline would have faced an average limit on their 1981 inpatient revenue per admission increase of 11.4 percent (see Table 5). This includes an average 4.5 percentage point penalty for excessive expenditure increases during the base year (1980) and a net 0.3 percentage point penalty for excessive increases in admissions levels. The combined penalties would have declined substantially by 1985 to 0.6 percentage points. The reporting period adjustment, which allows hospitals to average part of their base-year

expenditure increases into their revenue limits, would have raised the limits by 2.9 percentage points in 1981 (from 8.5 percent to 11.4 percent) but would have been eliminated by 1985 because no hospitals were simulated to enter the mandatory phase of the program after 1984.

TABLE 5. ESTIMATES OF AVERAGE PERCENTAGE INPATIENT REVENUE LIMITS APPLIED TO HOSPITALS IN MANDATORY PROGRAM, 1981-1985<sup>a</sup>

Year of Reporting Period	Market Basket	Base-Period Adjustment	Admissions Adjustment	Unadjusted Limit <sup>b</sup>	Reporting Period-Adjusted Limit
1981	13.1	-4.5	-0.3	8.5	11.4
1982	11.6	-3.6	-0.1	7.9	10.7
1983	10.6	-2.4	0.1	8.3	9.0
1984	10.2	-1.2	0.0	9.1	9.3
1985	10.4	-0.6	0.0	9.8	9.8

- a. Averages are for all hospitals subject to mandatory controls in that year and are weighted by allowed revenues in the previous reporting period.
- b. Components may not sum to total because of rounding. The efficiency adjustment raises the unadjusted limit by 0.2 percentage points in 1981 but has no net effect thereafter.

Effects of the Limits on Revenue Growth. The controls on the hospitals failing to meet the guidelines would have had a substantial impact on the rate of growth of hospital revenues. For all community hospitals, the average annual rate of increase for 1980 to 1985 would have fallen from 16.0 percent to 13.4 percent (see Table 6).

TABLE 6. JANUARY 1980 ESTIMATES OF THE EFFECT OF COST CONTAINMENT ON TOTAL COMMUNITY HOSPITAL REVENUES IN FISCAL YEARS 1981-1985 (In billions of dollars)<sup>a</sup>

Fiscal Year	Revenues Under Current Policy		Revenues With Cost Containment		Effect of Cost Containment
	Revenues	Annual Increase (percent)	Revenues	Annual Increase (percent)	Savings
1979	66.8		66.8		
1980	76.6	14.7	76.6	14.7	0
1981	89.4	16.7	88.4	15.4	1.0
1982	104.0	16.3	100.6	13.8	3.4
1983	120.4	15.8	113.3	12.6	7.1
1984	139.2	15.6	127.5	12.5	11.7
1985	160.8	15.5	143.8	12.8	17.0
1981-1985	613.8	16.0	573.6	13.4	40.2

NOTE: Components may not add to totals because of rounding.

a. Revenues are on a cash accounting basis. Both inpatient and outpatient net revenues are included.

Federal outlays would have been reduced by a total of approximately \$17 billion over the 1981-1985 period (see Table 7). The outlay reductions would have been much larger in later years than in 1981, when they would have been only about \$0.4 billion. This pattern results from the phasing-in of revenue controls, the reporting-period adjustment for a hospital's first year under

revenue controls, and the fact that each year's cap would be applied to the revenues allowed by the bill the previous year rather than to the hospital's actual revenues the previous year.

TABLE 7. JANUARY 1980 ESTIMATES OF SAVINGS FROM THE HOSPITAL COST CONTAINMENT ACT OF 1979, 1981-1985 (In billions of dollars)

Fiscal Year	Federal Savings			Nonfederal Savings	Total
	Medicare	Medicaid	Total		
1981 <sup>a</sup>	0.3	0.1	0.4	0.6	1.0
1982	1.2	0.2	1.4	2.1	3.4
1983	2.6	0.4	3.0	4.1	7.1
1984	4.4	0.6	5.0	6.7	11.7
1985	6.3	0.9	7.2	9.8	17.0
1981-1985 <sup>a</sup>	14.8	2.2	17.0	23.2	40.2

NOTE: Components may not add to totals because of rounding.

a. Includes savings from 1980.

Savings to nonfederal payers (for example, private insurers and individuals) would have totaled \$23.2 billion over the 1981-1985 period. The year-to-year pattern would have paralleled that for federal savings.

#### Distribution of Savings

The model indicated that the burden of the controls would probably not have been concentrated on any one type of hospital (see Table 8). Hospitals subject to controls would have been quite similar to those exempted, in terms of ownership, size, and

teaching status. Estimates indicate that the distribution of savings among types of hospitals would have been in rough proportion to the share of each type in total hospital expenditures.

TABLE 8. PERCENTAGES OF HOSPITALS AND REVENUE REDUCTIONS FROM COST CONTAINMENT, BY TYPE AND SIZE, 1981-1985

Category	Percentage of Hospitals		Revenue Reduction of Controlled Hospitals as Percentage of Total Expenditure in Their Categories <sup>a</sup>
	Controlled	Exempt	
Public (city-state)	99	1	9.1
Private, Nonprofit	98	2	9.2
Private, For-Profit	96	4	8.4
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Number of Beds			
1-99	96	4	10.3
100-299	98	2	8.9
300-499	99	1	8.7
500 or more	100	0	9.7
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Teaching	99	1	9.6
Nonteaching	98	2	8.7

NOTE: Estimates exclude hospitals in states with mandatory hospital cost containment programs and those exempted on the basis of characteristics.

a. Total expenditures based on current policy projection.

## SENSITIVITY ANALYSES

This section analyzes the sensitivity of the savings estimates to three factors:

- o The aggregate hospital forecast;
- o The time period for the baseline hospital survey data; and
- o The assumption of no changes in hospital behavior in response to the program during the guideline phase.

### Aggregate Hospital Forecast

Forecasting aggregate hospital expenditure increases is not a precise science. Errors of one or even two percentage points must be expected. Forecasting hospital expenditures is particularly difficult now. Increases in the intensity of hospital resources (i.e., the increase in real resources per admission) have slowed over the past two years, perhaps due to the hospital industry's Voluntary Effort to control hospital costs or to the threat of mandatory controls. The degree to which this decline in intensity growth will continue is difficult to predict.

Sensitivity analysis showed estimates of savings to be moderately affected by aggregate projections of hospital resource intensity (Table 9). For example, a one-percentage-point increase in the forecast for overall intensity growth would have increased fiscal year 1981 savings by roughly 50 percent and total savings over the 1981-1985 period by about 25 percent.<sup>2</sup> On the other hand, if actual hospital expenditures had increased less than forecast, savings could have fallen by a larger degree because that would have increased the probability of the national and state triggers not being pulled. On the other hand, when errors in the projected increases in both expenditures and the hospital market basket price index are of similar magnitude and direction, estimates of savings are affected only slightly.

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2. For ease in computation, a one-percentage-point forecasting difference for intensity was approximated by reducing each of the voluntary and mandatory caps by one percentage point before applying other adjustments.



TABLE 9. JANUARY 1980 ESTIMATES OF SAVINGS FROM THE HOSPITAL COST CONTAINMENT ACT OF 1979 UNDER ALTERNATIVE AGGREGATE HOSPITAL EXPENDITURE FORECASTS, 1981-1985 (In billions of dollars)

Fiscal Year	CBO Forecast		CBO Forecast with One-Percentage-Point Increase in Intensity	
	Federal Savings	Total Savings	Federal Savings	Total Savings
1981 <sup>a</sup>	0.4	1.0	0.6	1.5
1982	1.4	3.4	1.8	4.6
1983	3.0	7.1	3.7	9.0
1984	5.0	11.7	6.1	14.5
1985	7.2	17.0	8.7	20.7
1981-1985	17.0	40.2	21.0	50.2

a. Includes savings from 1980.

Baseline Years

Results were not very sensitive to the specific years of survey data that were aged to represent the 1978-1983 period. Shifting the data base forward by one year, so that 1973 instead of 1972 was simulated to represent 1978, increased fiscal year 1981-1985 savings by only 1 percent. Fiscal year 1981 savings increased by 8 percent, but from a base that was so small that the difference was totally absorbed by rounding.

### Hospital Behavior<sup>3</sup>

Results were sensitive to assumptions about hospital behavior during the guideline phase but not to assumptions about behavior during the mandatory control phase. The model assumed that hospitals would not alter their behavior in response to the controls except to comply with the revenue ceilings. This, of course, would not have been the case. Some hospitals that would have exceeded their guideline or mandatory revenue ceiling probably would have taken action to lower their costs, thereby increasing first-year savings, but decreasing future savings since fewer hospitals would have been controlled. Those expecting to be below the guideline might, despite the penalties contained in the bill, have taken actions to increase costs for that year in order to place themselves in a better position to meet the guideline the next year, thereby decreasing first-year savings. These actions might have included speeding up capital expenditures and hiring or stockpiling supplies.

For hospitals subject to revenue controls, the timing of revenue or expenditure increases would not affect the savings estimates because the revenue limits were applied to a constant base which was not updated. Furthermore, estimates of savings are not dependent on whether hospitals would cut costs or run deficits in order to comply with the revenue limits. Shifting services to outpatient departments or other gaming on the part of hospitals could lower savings, however.

HHS analysts, in their official estimates of the impact of the legislation, assumed that each hospital would reduce its rate of expenditure growth by one percentage point during the first year under the guidelines, and that those hospitals meeting their guidelines in that year would keep their expenditure growth within the guidelines thereafter. These assumptions roughly doubled first-year estimated savings and increased five-year estimated savings by about 30 percent. They were responsible for an important part of the difference between HHS and CBO estimates.

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3. Estimates of the sensitivity of savings estimates to alternative behavioral assumptions were made in 1979 using different economic assumptions and an older version of the simulation model than those discussed elsewhere in this paper.

CBO did not adopt these assumptions because, among other things, it was reasoned that if hospitals were to alter their behavior, most would do so in ways that would reduce, rather than increase, savings over the five-year period. It was considered likely that hospitals would change their behavior in response to the legislation in a manner that minimized their net revenue reduction, if they changed their behavior at all.

In order to further test the sensitivity of the estimates to changes in behavior, CBO developed the following set of what were felt to be reasonable alternative behavioral assumptions:

- o Hospitals below their guidelines during the first year would increase expenditures by a maximum of two percentage points (but not so much as to exceed the guidelines).
- o Hospitals above their guidelines whose long-term increases in admissions were less than their states' population growth plus one percentage point:
  - would reduce expenditures to meet the guidelines if they were within two percentage points of their guidelines.
  - would not change their behavior if they were more than two percentage points above their guidelines.
- o Hospitals above their guidelines whose long-term increases in admissions were greater than their states' population growth plus one percentage point:
  - would reduce expenditures so as to meet the guidelines if they were within one percentage point of their guidelines.
  - would not change their behavior if they were more than one percentage point above their guidelines.

These assumptions about changes in behavior resulted in lower estimated savings than when no changes in behavior were assumed. They lowered five-year savings by about 20 percent. Using these assumptions, a small net increase in hospital expenditures (negative savings) during the first year under the guidelines was simulated, compared to no changes in expenditure levels during this period using the main assumptions. Savings for the first year under mandatory controls were simulated to decline about 55 percent.



