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The Determinants of Hospital Costs

An Analysis of Ethiopia

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For hospitals to become more independent in financing their costs, they must know how those costs are influenced by output and other variables. This analysis of costs in Ethiopian hospitals addresses for the first time the issues of economies of scale and scope in delivery of hospital-based health care services in a poor country.

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The problem of financing health care in poor countries has become acute. Hospitals are viewed skeptically as facilities that are not cost-effective in providing primary health care services. Increasingly it is thought that hospitals should become more financially independent from government subsidies and find other ways to finance both their recurrent and capital costs.

First, it is necessary to know how hospital costs are influenced by output and other variables. In this paper, Bitran-Dicowsky and Dunlop analyze the determinants of hospital expenditures (a proxy for hospital costs) in a poor country, using data from Ethiopia.

The authors specified and estimated a translog-like cost function, using ordinary least squares (OLS). This specification allows an explicit determination of the marginal expenditure for care, given the structure of output and other factors, such as input prices, that might affect the structure of expenditures. Thus it provides a theoretically more appropriate framework for analysis than the overworked "unit cost" approach.

The sample consisted of 38 observations of 15 hospitals, with 1 to 3 annual observations per hospital. About half the hospitals had fewer than 76 beds; the other half had more than 150 (some more than 300). Hospitals reported expenditures rather than costs (thus undoubtedly understating total costs). Data on input prices were unavailable; proxy variables were used.

Analysis showed that the number of inpatient days, deliveries, and laboratory exams had a positive and statistically significant effect on total cost. The volume of outpatient activity, as measured by the number of first outpatient visits to the hospital's clinic, also had a positive impact on total costs.

The estimated cost function was used to compute marginal and average incremental costs. Calculated marginal costs slightly exceeded average incremental costs — suggesting that hospitals in our sample had reached the pont of constant economies of scale for inpatient days, laboratory exams,and delivery outputs.

A negative and statistically significant coefficient associated with the output interaction term indicated the existence of economies of scope between the number of inpatient days and the number of first outpatient visits.

The number of total beds in a hospital appeared to have a positive and significant independent effect on total hospital cost. Neither of the input price proxy variables had a statistically significant impact on total cost.

This paper is a product of the Health and Nutrition Division, Population and Human Resources Department. Copies are available free from the World Bank, 1818 H Street NW, Washington DC 20433. Please contact Visantha Israel, room M4-053, extension 48121 (26 pages with tables).

THE DETERMINANTS OF HOSPITAL COSTS: AN ANALYSIS OF ETHIOPIA

Table of Contents

List of Tables

I. INTRODUCTION

The problem of financing health care in poor countries has become increasingly acute in the decade since Alma Ata. In the context of health financing, hospitals are viewed with skepticism as facilities which are not cost-effective in the provision of primary health care services. Given this view, it is increasingly thought that such institutions should become financially independent from government subsidies and find other ways to finance both their recurrent and capital costs.

In order to develop a financing strategy package which will help to cover all or some of the costs involved in operating such institutions, it is necessary to know how hospital costs are influenced by output levels and other variables. The purpose of this paper was to analyze the determinants of hospital cost in a poor country by conducting a case study using data from Ethiopia. To the best of our knowledge, this analysis explicitly addresses for the first time the issue of economies of scale and scope in the delivery of hospital based health care services in a poor country. A translog-like cost function specification similar to the one employed by Grannemann et al. (1986) was used in the analysis. This specification enables an explicit determination of the marginal expenditure of care, given the structure of output, and other factors, such as input prices, that might affect the structure of expenditures. Thus, the specification provides a more theoretically appropriate framework of analysis than that of the overworked "unit cost" approach (see Chapter II).

The analytical approach followed in this paper allows for the fact that hospitals in poor countries typically can be characterized as multi-product firms which produce a number of different types of both in- and out-patient curative services such as surgery, laboratory exams and x-rays, and preventive care such as family planning, maternal and child health, and immunizations. The empirical specification allows for output heterogeneity and thereby enables an analysis of whether there are efficiency advantages from producing these services individually or jointly, i.e., whether economies of scale and scope exist.

This paper constitutes a preliminary methodological effort to utilize a relatively new conceptual approach in the health economics literature to analyze hospital cost determinants in a poor country context and to ascertain whether improved policy insight can be obtained in the process, particularly with respect to the development of a financing strategy.

The cost function model used in this analysis is specified in Section II. Section III then defines all dependent and independent variables used in the empirical analysis and Section IV describes the data. In Section V the methodological approaches taken to address the econometric problems encountered in the empirical estimation are described. Also in Section V, the empirical results of the analysis of the determinants of total hospital cost in the Ethiopian case are presented. The results from several analyses are shown: a) the determinants of total costs; b) the marginal and average incremental costs of providing health services; and c) an analysis of economies of scale and scope. The implications of the empirical results for financing and other policy issues in Ethiopian hospitals are preliminarily explored in the concluding section.

II. MODELS OF HOSPITAL COSTS

This paper draws its theoretical framework from a recent set of papers by Cowing and Holtmann (1983), Conrad and Strauss (1983), and Grannemann et al. (1986), in which a translog-like cost specification is employed. The approach represents a departure from the previous analyses of hospital costs built upon the work of Martin Feldstein (1967), the Lave's (1970 and 1972), Rafferty (1972), and Bays (1979), which specified the dependent variable in terms of the average cost or "unit cost" of a hospital in-patient day and/or stay and employed a set of independent variables thought to determine or be correlated with average cost. There are several disadvantages of the Feldstein and Lave's approach to hospital cost analysis. These include: a) the use of a single output measure for a multi-product firm; b) the problem of including output as the dependent variable (in the denominator) and as an independent variable; and c) the lack of underlying economic rationale for the inclusion of certain independent variables in the cost function.

The econometric analysis employed in this paper specifies that total hospital costs are assumed to be an exponential function of: a) input prices (P variables); b) output types and volume (Y and Z variables); and c) other factors assumed to be determinants of fixed costs (X variables). The marginal cost of each of the output vector (Y) variable can be computed, given the level of the other set of X, P, and Z variables included in the analysis. This functional form of the cost function is homothetic, in the sense that the cost-minimizing input mix remains constant as the output level changes. This characteristic also means that as input prices change, cost estimates are affected only by a scale factor, but the relationship between marginal and average incremental cost or measures of economies of scale are not affected. Third, the approach explicitly allows for the use of separate measures of as many important hospital outputs as may exist in any given situation, including a disaggregation of output according to case type defined by disease and/or other characteristics. For example, in the context of Ethiopia, the hospital is an important producer of ambulatory as well as in-patient care. Thus, in this instance, both in- and out-patient measures of service are included as well as measures of lab and x-ray tests and surgical procedures.

A. Issues in Modeling Hospital Costs

i. Assumptions of Hospital Behavior

Econometric studies of hospital costs such as those cited above have assumed that hospitals in their samples are cost minimizers. Cost-minimizing behavior on the part of the firm implies that the cost function is homogeneous of degree one in input prices. Cost minimization can be tested econometrically (Friedlander, 1977) if adequate information on both output levels and input prices are available. Unfortunately, the Ethiopian data, like the data set employed by Grannemann et al. (1986), does not contain adequate input price information. Thus, in this study, it was not possible to estimate a general, more flexible translog cost function, let alone test for cost-minimizing behavior or other theoretical features of cost functions. Another constraint of this study which thwarted a cost-minimization analysis resulted from the way in which hospital resource allocation decisions are made in Ethiopia. In effect, since the Ministry of Finance in Ethiopia allocates all financial resources to each health facility, with the agreement of the central MOH, most hospitals have very little discretion over the quantity of inputs available to them for the provision of health services. Thus, the focus of decision making regarding the use of hospital resources is withheld from facility administrators and are retained by the MOF and MOH in their control over specific line item budget allocations for each facility.

ii. Costs and Expenditures Analysis

Although the language of "cost function" is used throughout this paper, our dependent variable is hospital expenditure rather than cost. The distinction between these two terms is, generally, semantic. However, in this case, there is more to the distinction than a semantic one. First, total expenditure data under-estimate the actual resources used since there is a large number of unrecorded in-kind gifts provided to many health facilities throughout the country by international organizations such as UNICEF and other private groups. The amounts of these gifts vary from year to year and from facility to facility and there is no information system in place which is monitoring these flows. For example, based on limited available data, Donaldson and Dunlop (1987) have estimated that in some Ethiopian hospitals, donated resources amounted to at least 15 percent of total government allocated expenditures. More importantly, often such donations comprised a large share (in some cases, over 50 percent) of certain drugs and supplies. Thus, the actual total recurrent expenditure requirements of providing health services to the population in Ethiopia is higher than the recorded level of official MOH monitored expenditures, particularly with respect to the drugs and other repair and maintenance supplies. In addition, this analysis, does not include an estimate of the depreciation of the capital stock which constitutes an important cost element. Finally, typical budgetary expenditure flows are seldom valued on the basis of the opportunity cost of the resources made available via government allocations. Thus, although the terms cost function and cost analysis are used throughout the paper, the empirical study presented here is an analysis of government hospital expenditures and not of total hospital cost, the former being an underestimate of the latter. However, if in-kind gifts and depreciation costs represent a share of total costs similar among hospitals then the use of GOE expenditure, as opposed to total cost, does not affect the interpretation of our study results.

iii. Capital Stock Adjustments

One of the important costs of hospitals, the initial capital, represents a major component of the total expenditure of the facility. It is difficult to adjust capital inputs quickly as desired levels of output change. Thus, the amount of capital will undoubtedly not be set at the cost minimizing level for the output produced in any given year. This is true even though there are a number of instances of hospitals in East Africa operating at occupancy levels that exceed 100% where floors are commonly used for the overflow. This is particularly the case in maternity wards of large urban hospitals (see Dunlop, 1984). Over time a hospital might have an adjustment made in its capital stock, but in the Ethiopian case, that adjustment period may be a long time given resource scarcities and the general lack of alternative domestic private philanthropic resources which a facility in other contexts may tap. It is unlikely that the period of time is under the control of the facility or even the MOH. Even Ethiopia's National Committee for Central Planning is not able to easily predict if it might be able to adjust hospital capital stocks during any given time period due to the macro-economic problems facing the country. This problem was highlighted in Ethiopia over the last several years when it had to adjust downward its planned health sector capital budget by over 50 percent in three years due to adverse economic performance (see Donaldson and Dunlop, 1987).

The implication of the foregoing discussion is that unlike many situations in more affluent countries where capital stocks cannot be considered exogenous, it is possible in the case of Ethiopia during the present period, that decisions regarding the size of the capital stock in the hospital sector of the health care system must be considered outside the purview of present decision makers. Thus, in this instance, it is possible to estimate a total cost function that includes measures of the capital stock in the equation without risking simultaneous equation bias. Measures of the "quality" of the capital stock, in the sense of its level of maintenance and repair, have been included in several specifications to assess the extent to which the condition of buildings and equipment affect the level of total recurrent expenditure. These, and other findings, are reported below.

B. Specification of the Empirical Total Cost Model

As stated earlier, there are four types of independent variables in the cost function: a) "X" variables, which are a vector of factors that affect the level but not the shape of the expenditure function with respect to the outputs; b) "Y" variables which are a vector of primary outputs such as the number of out-patient visits, in-patient admissions, and in-patient days; c) "P" or input price variables; and d) "Z" variables which include a vector of other outputs produced in the hospital such as surgical procedures, x-ray tests, laboratory tests, and normal deliveries.

The total cost function employed in the analysis is an exponential and multiplicative function of its arguments. Such a functional form is characteristic of a translog (transcendental logarithmic) specification. Thus, the cost function is as follows:

$$(1) \qquad C = e^{(m_0 + m_1 \cdot \text{BEDS})} \cdot \pi_i P_i^{a_i} \cdot e^{f(Y)}$$

where C is total hospital cost, e is the base of the natural exponential function, π_i denotes the product of i terms of the form P_i^{ai}, m_0, m_1, and a_i are coefficients to be estimated, BEDS is the total number of beds in the hospital and has been included as a proxy measure for capital stock (i.e., an X variable), P_i is the price of the i^{th} input, and f(Y) is a function linear in output levels. Using the properties of multiplicative and exponential functions, the expenditure function can be linearized by taking the natural logarithm on both sides of expression (1):

$$(2) \qquad \ln C = m_0 + m_1 \cdot \text{BEDS} + \sum_i (a_i \ln P_i) + f(Y)$$

where

$$(3) \qquad \sum_i (a_i \cdot \ln P_i) = a_1 \cdot \ln PHY/PER + a_2 \cdot \ln MILES, \text{ and}$$

$$(4) \qquad f(Y) = b_{11} \cdot IP + b_{12} \cdot OP + b_{13} \cdot DELIV + b_{14} \cdot XRAY + b_{15} \cdot SURG + b_{16} \cdot LAB + c_{11} \cdot IP^2 + c_{12} \cdot OP^2 + d_{11} \cdot IP*OP.$$

In expression (3) PHY/PER which we have used as a proxy for input price, represents the proportion of physicians out of the total personnel in a hospital, and is intended to capture the relative average cost of labor in different hospitals. The second input price proxy, MILES, is the distance in miles from the hospital to the capital city of Addis Ababa. It has been included to capture the fact that important inputs such as drugs and gasoline become more expensive when the hospital is farther away from the capital due to additional transport and storage costs.

In expression (4), IP and OP represent the volumes of in- and out-patient activity, respectively (i.e., Y vector variables). As is explained later, several alternative indicators were used to measure the above. The "Z" variables DELIV, XRAY, SURG, and LAB represent the number of deliveries, x-rays, surgical procedures, and laboratory exams performed at the hospital. The terms IP^2 and OP^2 represent the square of the variables IP and OP. The variable, IP*OP, is an interaction term which corresponds to the product of the variables IP and OP.

The above specification corresponds neither to a general multiple output trans-log function nor to a structural function; rather, it combines features of both types. The lack of adequate measures of input prices thwarted the inclusion of interaction terms between input prices and output levels. In addition, given the limited number of observations, it was thought that a gain in flexibility from including those terms would not offset the loss in terms of degrees of freedom. Finally, the above specification is linear in both the variables and the coefficients and therefore can be estimated using OLS.

Expressions for the marginal cost of in- and out-patient services can be derived from the above cost function by taking the partial derivatives with respect to the variables IP and OP:

(5) $$MCIP = \frac{\partial C}{\partial IP} = \left(\frac{\partial C}{\partial \ln C} \right) \cdot \left(\frac{\partial \ln C}{\partial IP} \right) = C \cdot \left(\frac{\partial f(Y)}{\partial IP} \right), \text{ and,}$$

(6) $$MCOP = \frac{\partial C}{\partial OP} = \left(\frac{\partial C}{\partial \ln C} \right) \cdot \left(\frac{\partial \ln C}{\partial OP} \right) = C \cdot \left(\frac{\partial f(Y)}{\partial OP} \right).$$

Given the specification of the f(Y) function, the marginal expenditure functions become:

(7) $$MCIP = C.(b_{11} + 2 \cdot c_{11} \cdot IP + d_{11} \cdot OP), \text{ and}$$

(8) $$MCOP = C.(b_{12} + 2 \cdot c_{12} \cdot OP + d_{11} \cdot IP).$$

The cost specification also enables one to compute the average incremental cost (AIC). AIC tells by how much average total cost will increase if output Y_i is produced versus not produced at all. For example, consider a hospital with two types of output: days of in-patient service and out-patient visits. The AIC of the in-patient care produced at the hospital measures the increase in hospital average cost that would result if the hospital added that service relative to the case where no in-patient care was produced at the facility. AIC is specified for a given level of output for all variables. More formally, AIC is defined in the following way:

(9) $$AIC\ Y_i = \{C(Y_1, Y_2, \ldots, Y_i \ldots Yn) - C(Y_1, Y_2 \ldots, 0, \ldots, Yn)\} / Y_i$$

A final useful measure to compute is an indicator of product-specific economies of scale (EOS). In the multiple output case, the product specific EOS indicator can be computed as the ratio between the AIC and MC for any given output. Where economies of scale exist, the ratio between AIC and MC is greater than one. Where diseconomies of scale exist the ratio is less than one. This concept is equivalent to the ratio of average and marginal cost in the single output case.

III. VARIABLE DEFINITION

A. Dependent Variable

In this analysis the dependent variable is the total annual GOE expenditures by hospitals in the provision of health care services. This variable specification does not include any provision for capital replenishment. However, repair and maintenance of the capital stock are included as part of the expenditure items. As has been discussed, the above-defined variable specification does not include in-kind gifts which many hospitals in Ethiopia have received in recent years from various international organizations.

B. Independent Variables

The dependent and independent variables included in the analysis are presented in Table 1 by variable type.

i. <u>"X" Variables</u>

This set of variables includes indicators of the capital stock of the hospital which are: the number of hospital beds and the physical condition of the hospital buildings as measured by a periodic MOH survey of all health facilities. The expected hypothetical relationships between total hospital cost and "X" vector variables are presented in Table 1. These relationships can be summarized as follows. It is expected that hospital cost rises with the capital stock, as measured by the number of beds. However, newer, or more carefully maintained facilities, require lower maintenance costs.

ii. <u>"Y" Variables</u>

The "Y" vector variables comprise the primary hospital output variables. These variables include measures of in- and out-patient activity, such as: a) the number of hospital admissions; b) the number of in-patient days; c) the total number of out-patient visits; d) the number of first out-patient visits; and e) the number of repeat out-patient visits. A first visit is recorded at the time an individual comes to the facility for a new illness episode, whereas a repeat visit is recorded if the visit is for an existing episode. The sum of first plus repeat visits is equal to the total number of out-patient visits. The hypothesized relationship between these independent variables and total hospital cost is summarized in Table 1 and shows that as the total amount of patient activity increases, so does total cost.

Table 1

List of Variables, Definition, and Data Sources For An Analysis of Total Hospital Costs

	Acronym	Definition	Data Source	Expected Sign
I.	Dependent Variable			
1.	EXPEND	Total Expenditure in Thousands of Birr	(1)	NA
II.	Independent Variables			
	"X" Vector Variables - Those Which Affect Level But Not Shape of Cost Function			
2.	BEDS	Number of Hospital Beds	(2)	POS
3.	BDGA	Maintenance Condition of building is "A", i.e., in good condition relative to "D" condition which needs replacement	(2)	NEG
4.	BDGB	Maintenance Condition of building is "B", i.e., requires some minor repair relative to "D" condition which needs replacement	(2)	NEG
5.	BDGC	Maintenance Condition of building is "C", i.e., requires major repair relative to "D" condition which needs replacement	(2)	NEG
	Y Vector Variables - Those Which Are Measures of "Primary Outputs"			
6.	IPDAYS	Number of Inpatients Days	(2)	POS
7.	NIP	Number of Inpatients	(1), (2)	POS
8.	NFOP	Number of First Outpatient Visits	(1), (2)	POS
9.	NOP	Total Number of Outpatients Visits (First and Repeat)	(2)	POS
10.	NROP	Number of Repeat Out-Patient Visits	(2)	POS

Table 1 (continued)

Acronym	Definition	Data Source	Expected Sign
Z Vector Variables - Those Which are Measures of "Other" Hospital Outputs			
11. DELIV	Number of Normal Deliveries	(2)	POS
12. LAB	Number of Lab Tests Performed	(2)	POS
13. XRAY	Number of X-ray Tests Performed	(2)	POS
14. SURG	Number of Surgical Procedures Performed	(2)	POS
P or Input Price Vector Variables - Those Which Measure Input Price Variations Between Hospitals			
15. MILES	Miles from Addis Ababa to facility (a proxy measure for input cost differentials between Addis Ababa and other locations)	(2)	POS
16. PHY/PER	Physician Share of total employment	(2)	POS

SOURCE: (1) Donaldson and Dunlop, 1986.
(2) MOH Directory 1982 and 1986.

iii. "Z" Variables

"Z" vector variables contain other hospital outputs such as the number of normal deliveries, laboratory tests, x-ray tests, and surgical procedures. These output indicators further define the complexity of the ambulatory and in-patient care provided. They also define the skill level of the staff employed at each facility and, thus, the cost of service. It is hypothesized that all of these outputs positively contribute to the total cost.

iv. "P" Variables

"P" vector variables comprise a set of input price indicators which are included to control for possible differences in costs among facilities due to input price differences. Often one of the important input price differences across facilities is due to wage differences between various labor markets. Although wage information for each hospital was not available from our data set, in the case of Ethiopia there is little wage variation among facilities within personnel categories. This is because wage scales are nationally defined by the civil service system. However average personnel compensation may differ across facilities due to differences in personnel mix as well as differences in experience levels of the personnel employed in each facility. Further, it is expected that there is a tendency for a larger share of skilled health workers, particularly physicians, to be in the facilities which produce the more complex set of services, particularly those embodied in the "Z" set of output indicators. Thus, it is hypothesized that the ratio of physicians to total personnel employed in any facility is positively related to total cost.

Input price data other than labor were not available either. The other input price proxy which was included in the analysis was the distance (in miles) from Addis Ababa to the hospital as an indicator of transportation cost differentials. The assumed relation between miles from Addis Ababa and the periphery and costs is positive to reflect the additional transport cost.

IV. DESCRIPTION OF ETHIOPIAN DATA

As Table 1 indicates, two data sources were principally used in conducting our analysis: the three MOH Health Service Directories compiled in 1976, 1982 and 1984 and the World Bank supported health financing study conducted by Dayl Donaldson and David Dunlop in 1986. The three MOH Directories provide a complete listing for the year specified of all health facilities operating in the country, excluding those operated by and on behalf of the military. They also provide information about the location, the date of initiating service, service utilization, number of personnel by staff cadres, vehicle number and state of repair, hospital building state of repair, and approved hospital budgets. The health financing study draws upon the information provided in the Directories but adds certain specific information about the actual hospital operating expenditures and other health facilities for the 1983-85 period. The actual expenditure data were obtained from the accounting division of the MOH which monitors all hospital data and was verified by information from each hospital's accounting records. In addition, the study uses utilization data for the same period of time. Thus, by using these two sources of information it was possible to develop a pooled cross-section, time-series data set of 38 observations for fifteen of the country's eighty-three hospitals for the variables specified in Table 1. Appendix Table A.1 contains the data set descriptive statistics.

Observations were pooled across hospitals and over time. The limited number of observations per hospital (between one and three) precluded us from statistically checking for the validity of the time series pooling. Time series pooling tests are important to check whether hospital cost behavior changes over time. (Annual expenditure data have been adjusted for inflation and all expenditures are in 1985 birr.)

Given that hospitals in our sample were either large or small, with no medium-sized hospitals, it was thought that the behavior of small and large hospitals might differ. Thus, observations were sorted in ascending order of total annual expenditure. The sample was divided into two sub-samples, each containing one-half (19 observations) of the sorted sample. The first sample contained small hospitals with annual expenditure ranging from 281,000 to 727,000 Birr while the second exhibited a range of 789,000 to 4,908,000 Birr per year. OLS regressions were run on each of the two samples and on the aggregate sample. An F-test, known as the "Chow test" (Chow, 1960), was constructed to test the hypothesis that hospitals in both half samples exhibited the same type of cost behavior. A value of 2.92 for the so computed F-test suggested that the hypothesis should be rejected at the 95% confidence level. In other words, the test implied that the cost function coefficients were significantly different for each sample. Nevertheless, pooling was done to increase the robustness of the estimates. Thus, the coefficient estimates can be interpreted as representing the expenditure behavior of hospitals in neither sample but rather that of a representative hospital of average size, i.e., with 152 beds and total expenditures of 1,373,000 Birr.

V. EMPIRICAL RESULTS

A. Total Cost Function

The regression results of the determinants of total hospital cost are presented in Table 2. The original regression included the variable XRAY and the logarithm of the two input price proxy variables PHY/PER and MILES. All three variables were excluded from the basic regression for the reasons discussed later in this section. The exclusion of the variables resulted in a better statistical fit, as measured by R-bar squared (i.e., R-squared adjusted for the number of degrees of freedom).

Results from three other regression equations presented in Appendix Table A.3 showed that the number of in-patient days, deliveries, first out-patient visits, and laboratory exams performed, had a positive and statistically significant impact on hospital's total costs. The number of surgical procedures as well as the number of first out-patient visits also appeared to have a positive impact on total cost though the coefficients were not statistically significant.

As is shown in Table 2, both the intercept and the number of BEDS variable which can be interpreted as measures of fixed cost were positive and statistically significant. An estimate of the fixed costs of an average-size hospital can be obtained by evaluating the estimated cost function at a zero output level and by using average values for the number of beds. When outputs are set to zero, the total expenditure function defined in (1) becomes:

$$C = e^{(m_0 + m_1 \cdot \text{BEDS})}$$

When this equation is evaluated at the average value of BEDS=152, and using the estimates for m0 and m1 from Table 2 we obtain a fixed cost estimate of 476,240 Birr. This fixed cost represents approximately 34.7 percent of the total annual expenditure for the average hospital of nearly 1,373,000 Birr. The main expenditure item which comprises the fixed component is wages and salaries. Other fixed costs are staff housing, some transport costs for supplies and drugs, utility costs, and certain equipment maintenance.

As was discussed in the variable specification section of the paper, ambulatory care output can be measured by several alternative indicators, including the total number of out-patient visits (NOP), a subset of that number, namely the number of first out-patient visits (NFOP), and the number of repeat visits (NROP). In most instances, the first visit per illness episode is more resource intensive than repeat visits since the diagnosis

Table 2. Empirical Results of the Determinants of Ethiopian Total Hospital Costs, 1983-1985

Regression Statistics

Variable Name		Coefficient	t-statistic
Intercept,	mo	5.45	22.51***
BEDS,	ml	4.71 E-3	8.89***
IPDAYS,	b11	2.18 E-5	3.44***
NFOP,	b12	1.91 E-6	0.08
DELIV,	b13	1.68 E-4	5.39***
SURG,	b15	3.21 E-6	0.11
LAB,	b16	7.63 E-6	7.97***
IPDAYS2,	c11	-1.65 E-12	-0.02
NFOP2,	c12	1.42 E-10	0.26
IPDAYS_NFOP	d11	-7.50 E-10	-2.42**

Total number of observations: 38, Degrees of freedom: 28, Adjusted R2: 0.963, F=107.5

Notes:
- * statistically significant at the 0.10 level.
- ** statistically significant at the 0.05 level.
- *** statistically significant at the 0.01 level.

and initial treatment are performed during that visit. Thus, from a resource use perspective, both NFOP and NROP are more homogeneous measures of ambulatory care relative to NOP and should be entered individually in the cost equation.

Each of these indicators of ambulatory output was empirically investigated singly and in various combinations. The results presented in Table 2 include NFOP as the indicator of ambulatory care with the estimated coefficient being positive but not statistically significant. Alternative specifications which included both NFOP and NROP, as well as ones which just included NOP did not provide better statistical results relative to the specification that used only NFOP. Since NOP includes both resource intensive and relatively non intensive visits, it is understandable that it did not perform as well as a more disaggregative indicator such as NFOP. Also, since repeat visits (NROP) are less resource intensive it was expected that their impact on cost would not be as great. Thus, from an empirical perspective NFOP was the preferred out-patient indicator.

In an investigation of the differences in the determinants of total expenditures between small and large hospitals, it was observed that in small hospitals, NFOP was consistently positive and statistically significant. This finding suggests that when more observations are available the sample should be segmented into larger and smaller hospitals and analyzed separately. The separate analyses would yield additional insight into the determinants of hospital expenditures as the output mix changes with increasing service and patient complexity in larger hospitals relative to the smaller (and more rural) facilities.

From an in-patient care perspective, two measures of output were investigated. These were the number of in-patients (NIP), and the number of in-patient days (IPDAYS). These indicators were highly and negatively correlated with one another with a partial correlation coefficient of -0.83. This finding can only be explained by assuming that the patient populations of the various hospitals in the sample are not similar in disease mix. This possibility is corroborated by the fact that the average length of stay across the sample of hospitals for the various years included in the sample varied from a low of 2.2 days in a hospital known for its high volume of deliveries and other obstetrical care to a high of 24.6 days in a hospital with many accidents and injuries and other long-term care patients.

Since NIP and IPDAYS are highly correlated multicolinearity was suspected. (When NIP was also included in an estimated equation, its sign was negative, though not statistically significant) The variable, IPDAYS appeared to be the most consistently significant and positive as expected. Thus, it was used in most of the empirical analyses conducted. In Table 2, IPDAYS was positive and statistically significant at the 0.01 level.

Again, when a preliminary analysis was conducted of the differences in the determinants of hospital cost between large and small hospitals, it was noted that in-patient indicators of hospitals output were not as often statistically significant as was the out-patient indicator, NFOP. This suggests that the output structure between large and small facilities bears further investigation when a larger sample is available.

Four other output variables were included in the empirical analysis: DELIV, LAB, XRAY, and SURG. It was found that three of the four (DELIV,LAB, and SURG) consistently had the expected positive sign and two (LAB and DELIV) were consistently statistically significant.

It was unclear from the analysis why the variable XRAY performed contrary to expectations with a negative sign, and often statistically significant. This result can be attributed to the fact that the XRAY variable was correlated with both DELIV (0.69) and the interaction term, DAY-NFOP, (0.72). In addition, in reviewing the sample data, certain small hospitals (in terms of beds) reported performing a large number of x-rays while some large hospitals reported few x-rays. This reflects output mix specialization and could explain the seemingly puzzling result.

The empirical performance of the two P variables MILES and PHY/PER was disappointing. They were generally statistically insignificant. The variable MILES, which was intended to capture the positive effect that distance from the capital city to a given facility had on input costs, turned out to have a negative sign. This result may reflect a characteristic of the sample rather than any cost behavior. It suggests that total hospital cost is reduced as the distance between the hospital and Addis Ababa grows which may be the case due to the fact that hospitals are smaller outside of Addis Ababa but not because the travel cost of supplies and other inputs is decreased. It is also likely that rural-based hospitals are not fully billed for the transport cost of all items shipped to them from Addis Ababa.

The variable PHY/PER was statistically insignificant and therefore dropped from the results presented in Table 2. Further, the exclusion of both proxy variables resulted in a better statistical fit as measured by R-bar squared. If we assume that input prices were relatively similar across hospitals within the sample then the omitted variable bias becomes unimportant. The fact that salaries, which are a major cost component, are set at the central level in Ethiopia, points into the above direction (see discussion on salaries above).

The impact on cost of the physical condition of the hospital facility buildings on total hospital costs was also assessed. The tested hypothesis was that the poorer the rated physical condition of the buildings the larger the repairs and maintenance costs would be. Thus, the three rated building conditions (A, B, and C) should be associated with lower cost levels than building condition D.

The results of this test are presented in an Appendix Table, A.3. They showed that two of the three conditions relative to the poorest condition appeared to have an impact on total cost, but not in the hypothesized (positive) direction. Building conditions B and C appear to have a significantly positive impact on total costs, with building condition A having the hypothesized impact but not being statistically significant.

The data may help to explain this unexpected finding. In the sample, most of the large (as measured by the number of beds) hospitals' buildings are rated in condition B or C. Since their expenditure levels tend to be greater than other facilities, the statistical finding may be only reflecting an artifact of the data rather than any behavioral relationship of interest to the policy maker. The finding may also reflect the fact that Ethiopian decisionmakers only expect to allocate scarce resources to maintenance after a minimum period of time has transpired subsequent to the construction of the building.

B. Marginal and Average Incremental Cost

The marginal and average incremental cost for the principal outputs whose estimated parameters were statistically significant (i.e., IPDAYS, DELIV, and LAB) were calculated using equations similar to (7), (8), and (9), as specified earlier. The calculations were done using the mean values for all variables (see Appendix Table A.1) and are presented in Table 3 along with the calculated product specific economies of scale index (EOS). Finally, for purposes of comparison with MC and AIC, the table provides information on prices charged in 1985 for these services and the ratio of 1985 prices in comparison with their respective marginal cost.

The results in Table 3 reveal several important findings. First, for those services enumerated in the table, the data show that the services' marginal cost was always greater than average incremental cost (i.e., the EOS index was less than one for all three services). This finding indicates that the representative hospital was operating slightly within the diseconomies of scale range of output for these three services.

Table 3: Estimates of Marginal and Average Incremental Cost, Product Specific Economies of Scale Index, and Prices Charged at Ethiopian Hospitals in 1985

(Expenditures in 1985 Birr)

OUTPUT

	Inpatient Days (IPDAYS)	Delivery (DELIV)	Laboratory Exams (LAB)
1. Marginal Cost (MC)	2.58	169.1	7.7
2. Average Incremental Cost (AIC)[1]	2.53	155.4	6.5
3. Product Specific Economies of Scale Index (EOS)	0.98	0.92	0.84
4. Range of Prices Charged at Ethiopian Hospitals, 1985[(2),(3),(4),(5)]			
High	30	100	10
Low	1	5	0.25
Median	2	15	1.5
5. Ratio of Median Price to (MC)	0.78	0.09	0.19

Notes:
1. See Appendix Table A.2 for how this figure was calculated.
2. Bed day fee only.
3. Normal delivery fee only.
4. All types of laboratory tests.
5. Each hospital has the jurisdiction to establish its own fee structure. Typically the inter-hospital differences in fees are based on rural-urban distinctions and on the historical management of the hospital, i.e., mission vs. government. For further information about fees see Donaldson and Dunlop, 1987.

Source: Donaldson and Dunlop, 1986

Public goods pricing theory recommends that prices be set according to the marginal cost of production in order to achieve economic efficiency. In certain instances which are discussed in greater detail by David de Ferranti (1985), departures from marginal cost pricing may be justified for equity reasons or where positive externalities may accrue to society.

A comparison of prices actually charged at Ethiopian hospitals with the above computed marginal costs show that prices are generally below the estimated marginal cost. The median fee charge per bed day was about one half birr in 1985, or 25 percent, below the estimated marginal cost figure. The median laboratory fee of around one and one half birr was only one fifth of the estimated marginal cost for a given lab test. Finally, the median delivery fee was well below the estimated marginal cost for a normal delivery.

Society may obtain certain positive externalities from health-facility-based normal deliveries to the extent that the infant mortality rate is reduced below the level at which it would otherwise be, and, as a consequence, over time, the demand for additional children is thereby reduced and is reflected in slower population growth. This argument is discussed in greater detail in the 1984 World Development Report (World Bank, 1984). However, it is unclear whether the positive social externality per normal delivery would justify the differential between the median price charged in Ethiopia in 1985 and estimates of the marginal cost for a delivery. In conclusion, some upward adjustments in this and other fees appears warranted.

VI. CONCLUSIONS

Several conclusions emerge from this analysis. First, it provides greater insight into the various factors which influence the cost of providing hospital based health services in Ethiopia. Second, the theoretical approach employed in conducting this empirical investigation has provided results which appear plausible and robust over several alternative empirical specifications to the theoretical model. Most if not all principal hospital outputs had a positive effect on total cost. Third, the results also indicated that the volume of out-patient activity, as measured by the number of first out-patient visits to the hospital's clinic, had a positive impact on total costs. The marginal costs slightly exceeded average incremental costs suggesting that hospitals in our sample had reached the point of constant economies of scale for the impatient days, laboratory exams, and delivery outputs. A negative and statistically significant coefficient associated with the output-interaction term indicated the existence of economies of scope between the number of in-patient days and first out-patient visits. The number of total beds in a hospital appeared to have a positive and significant independent effect on total hospital cost. Neither of the input price proxy variables indicated a statistically significant impact on total cost. Finally, the estimated marginal expenditure on an in-patient day was around 3 birr, and a lab test, 5 birr.

This document is viewed by the authors as a report of work in progress. Additional empirical investigation is warranted; however, it must await further information from additional facilities. Clearly, when additional information becomes available, it will be important to disaggregate the sample by hospital size to separately estimate the equations of cost determinants. Both the output and input structure may be different enough between small and large facilities to warrant a separate analysis. Improved measures of input prices are also required. With additional data, other statistical tests can be conducted to ascertain whether the typical assumption of cost or expenditure minimization behavior pertains.

In spite of these aforenamed issues, the approach to the problem and the results appear to be promising and can have important policy implications for pricing services in the hospital sector of a poor country's health system and for reviewing that option's relative importance in helping to financially sustain the entire health care system in similarly situated countries.

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Appendix Table A.1: Descriptive Statistics for Ethiopia Total Cost Function Values

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	STD ERROR OF MEAN	SUM	VARIANCE	C.V.
EXPEND	38	1150.07	1177.87	218.00	4908.00	191.07	44083.00	1387287.5	101.5
REXPEND	38	1373.38	1394.42	281.43	5011.66	226.20	52188.72	1944413.6	101.5
BUDGET	38	1434.10	1299.84	264.00	4931.00	237.31	43023.00	1689589.1	90.6
BEDS	38	152.52	138.47	26.00	495.00	22.46	5795.00	19176.0	90.7
BDCA	38	0.23	0.43	0.00	1.00	0.06	9.00	0.2	181.9
BDGB	38	0.34	0.48	0.00	1.00	0.07	13.00	0.2	140.5
BDGC	38	0.31	0.47	0.00	1.00	0.07	12.00	0.2	149.1
NIP	38	3136.89	2199.43	200.00	7423.00	356.79	119202.00	4837516.7	70.1
ALOS	38	9.62	5.28	2.20	24.60	0.85	365.70	27.9	54.9
NFOP	38	25520.39	10413.45	7993.00	45202.00	1689.28	969775.00	108439989.4	40.8
NROP	38	28667.78	16098.10	10601.76	73049.00	2611.45	1089375.98	259149121.4	55.1
NOP	38	54188.18	23936.10	25748.00	116019.00	3882.94	2059150.98	572937095.4	44.1
DELIV	38	1016.13	1339.99	0.00	4190.00	217.37	38613.00	1795583.6	131.8
LAB	38	46691.28	43158.25	2912.00	155673.00	7001.19	1774269.00	1862635366.4	92.4
XRAY	38	4781.63	6776.86	0.00	28438.00	1099.35	181702.00	45925916.6	141.7
SURG	38	1758.02	1595.33	0.00	5540.00	258.79	66805.00	2545082.4	90.7
LMILES	38	3.04	2.51	0.00	5.69	0.40	115.67	6.3	82.7
LPHYPER	38	-3.35	0.48	-4.57	-2.65	0.07	-127.55	0.2	-14.3

Appendix Table A.2: Ethiopian Data Set

OBS	NAME	YR	EXPEND	REXPEND	BUDGET	BEDS	BDGA	BDGB	BDGC	NIP	ALOS	NFOP	NROP	NOP	DELIV	LAB	XRAY	SURG	LMILES	LPHY_PER
1	BLI	1975	3882	5011.86	4593	462	0	0	1	6156	16.2	38881	32279.5	71171	4153	95706	28438	5540	0.00000	-2.89
2	ELI	1977	4808	4908.00	4831	495	0	0	1	7423	9.6	40284	55591.9	85876	4153	95706	28438	5540	0.00000	-2.8
3	GAN	1975	846	1082.19	845	76	0	1	0	6489	2.2	20388	10601.8	30990	4190	10685	0	2367	0.00000	-3.1
4	GAN	1976	888	1057.61	847	76	0	1	0	6408	2.2	21586	12086.2	33674	4190	10695	0	2367	0.00000	-3.16
5	MEN	1975	2482	3204.26	2585	360	0	0	1	373	21.6	34415	35781.6	70207	0	89962	9043	3326	0.00000	-2.71
6	MEN	1976	2364	2815.52	2660	360	0	0	1	2403	22.0	34784	38175.4	70959	0	89962	9043	3326	0.00000	-2.71
7	MEN	1977	2428	2428.00	2789	360	0	0	1	2445	24.6	43289	44999.8	88269	0	89962	9043	3326	0.00000	-2.71
8	RAS	1975	876	1260.02	1090	105	0	1	0	1768	14.7	13286	18334.7	31621	0	101147	6148	1218	0.00000	-3.4
9	RAS	1976	917	1092.15	1069	112	0	1	0	1324	14.1	24592	43773.8	68366	0	101147	6148	1218	0.00000	-3.47
10	RAS	1977	952	952.00	1131	115	0	1	0	1129	15.2	22041	39233.0	61274	0	101147	6148	1218	0.00000	-3.47
11	SPA	1975	3764	4859.32	2832	425	0	1	0	5606	15.4	34267	55855.2	90122	2868	62853	9286	3209	0.00000	-2.86
12	SPA	1976	2565	3078.73	2843	425	0	1	0	6114	13.2	42970	73049.0	118019	2868	62853	9286	3209	0.00000	-2.
13	YEK	1975	2391	3088.78	2596	315	0	1	0	6262	11.0	45202	52886.3	98088	1924	155673	13598	1866	0.00000	-2.
14	ZAU	1975	2127	2745.95	2491	179	0	1	0	5072	9.4	24213	45036.2	69249	2346	129701	7640	2285	0.00000	-3.
15	ZAU	1976	2208	2829.73	2456	180	0	1	0	4506	9.5	30576	51982.6	82551	2346	129701	7640	2285	0.00000	-3.
16	BAH	1975	438	565.46	.	150	1	0	0	4430	7.4	39811	14730.1	54541	560	23509	1407	438	5.69036	-3.
17	BAH	1976	611	727.70	774	150	1	0	0	4191	7.6	36483	24443.5	60927	560	23509	1407	438	5.69036	-3.
18	BAH	1977	663	663.00	787	150	1	0	0	4361	7.1	37528	24017.9	61546	560	23509	1407	438	5.69036	-3.
19	DEM	1975	392	506.07	.	67	0	0	1	515	5.7	17157	22818.8	39975	272	28378	0	219	5.01728	-3.
20	DEM	1976	440	524.04	677	67	0	0	1	643	6.0	21098	16667.4	37765	272	28378	0	219	5.01728	-3.
21	DEM	1977	573	573.00	690	67	0	0	1	451	6.1	21620	17728.4	39348	272	28378	0	219	5.01728	-3.
22	FIS	1975	244	315.00	438	33	1	0	0	821	7.7	16194	23319.4	39513	210	10475	0	22	5.19850	-3.
23	FIS	1976	307	365.64	408	70	1	0	0	831	10.4	15549	19747.2	35296	210	10475	0	22	5.19850	-3.
24	FIS	1977	395	395.00	460	105	1	0	0	1225	12.0	19077	13163.1	32240	210	10475	0	22	5.19850	-3.
25	ATT	1975	440	568.04	.	55	1	0	0	4216	4.8	34746	21195.1	55941	704	43009	616	3828	4.66344	-4.
26	ATT	1976	468	557.39	.	55	1	0	0	3966	4.9	31805	21945.4	53750	704	43009	616	3828	4.66344	-4.
27	ATT	1977	492	492.00	.	55	1	0	0	3588	6.2	26694	21889.1	48583	704	43009	616	3828	4.66344	-4.
28	DEB	1975	292	376.87	383	40	0	0	1	622	5.2	13398	14469.6	27866	372	3056	804	22	4.51086	-3.51
29	DEB	1976	288	343.01	379	40	0	0	1	1199	6.5	13809	12704.3	26513	372	3056	804	22	4.51086	-3.51
30	DEB	1977	361	361.00	413	40	0	0	1	1144	5.7	15698	13971.2	29669	372	3056	804	22	4.51086	-3.51
31	DEZ	1975	242	312.42	305	50	0	0	1	4650	3.4	18670	12508.9	31179	0	5772	2277	0	3.71357	-3.46
32	GEB	1975	218	281.44	264	26	0	0	0	200	9.8	7093	31972.0	39065	35	2812	0	534	4.61612	-4.1
33	DIL	1975	297	383.43	357	48	0	0	0	1546	6.3	12874	12874.0	25748	480	11402	1347	922	5.39816	-3.31
34	DIL	1976	316	378.36	361	48	0	0	0	1065	10.9	19962	24353.6	44316	480	11402	1347	922	5.39816	-3.31
35	DIL	1977	366	366.00	487	48	0	0	0	1698	7.4	29775	57763.5	87538	480	11402	1347	922	5.39816	-3.31
36	YIR	1975	763	985.03	.	120	0	1	0	4464	6.0	16536	20021.0	36559	562	26396	5526	2544	5.30330	-3.63
37	YIR	1976	869	1058.80	.	126	0	1	0	4974	6.6	16926	19803.4	36729	562	26396	5526	2544	5.30330	-3.63
38	YAR	1977	870	870.00	.	126	0	1	0	4884	9.0	13904	19589.8	33184	562	26396	5526	2544	5.30330	-3.63

Appendix Table A.3

Calculation of Marginal and Average Incremental Cost

Average Size Hospital

		(1) Coefficient reg.	(2) Average Value	(3) Product (1)x(2)	Marginal Expenditures Using Projected C Figure	
INTERCEPT	m0	5.45E+00	1	5.45		
IPDAYS	b11	2.18E-05	28410	0.619338	MC IPDAYS	2.58
NFOP	b12	1.91E-06	25520	0.0487432		
DAY NFOP	d11	-7.50E-10	7.3E+08	-0.543767	MC NFOP	-12.23
IPDAYS2	c11	-1.65E-12	8.1E+08	-0.001331		
NFOP2	c12	1.42E-10	6.5E+08	0.0924803	MC LAB	7.68
DELIV	b13	1.68E-04	1016	0.170688		
LAB	b16	7.63E-06	46691	0.3562523	MC DEL	169.05
SURG	b15	3.21E-06	1758	0.0056431		
BEDS	m1	4.71E-03	152	0.71592		

(4)=sum of column (3)	(4)	6.913659 projected logC for avg. hospital
(5)=1000 x exp(4)	(5)	1,006,225 projected C for average hospital
from descr. stat.	(6)	1,373,387 C for average hospital
same as (4) excl IPDAYS	(7)	6.8397271 proj logC avg hosp, IPDAYS excl
(8)=1000 x exp(7)	(8)	934,230 proj C avg hosp, IPDAYS excl.
(9)=(5)-(8)	(9)	71,995 IPDAYS incremental cost
(10)=(9)/IPDAYS	(10)	2.53 IPDAYS average incr. cost
same as (4) excl DELIV	(11)	6.7433 proj logC avg hosp, deliv excl.
(12)=exp (11)	(12)	848,333 proj C avg hosp, deliv excl.
(13)=(5)-(12)	(13)	157,892 deliv incremental cost
(14)=(13)/DELIV	(14)	155.4 deliv average incr. cost
same as (4) excl LAB	(15)	6.5577 proj logC avg hosp, lab excl.
(16)=exp(15)	(16)	704,656 proj C hosp, lab excl.
(17)=(5)-(16)	(17)	301,570 lab incremental cost
(18)=(17)/LAB	(18)	6.5 lab average incr. cost

Appendix Table A.4: Additional Regression Results From Different Functional Forms

DEP VARIABLE: LEXPEND
ANALYSIS OF VARIANCE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	11	29.05580348	2.64143668	82.410	0.0001
ERROR	26	0.83338343	0.03205252		
C TOTAL	37	29.88916691			

ROOT MSE	0.1790322	R-SQUARE	0.9721
DEP MEAN	6.635716	ADJ R-SQ	0.9603
C.V.	2.698006		

PARAMETER ESTIMATES

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > |T|
INTERCEP	1	5.07749346	0.59354634	8.559	0.0001
IPDAYS	1	0.000029285	0.000010338	2.833	0.0088
HIP	1	-0.000042384	0.000046530	-0.911	0.3707
NFOP	1	0.000018388	0.000024483	0.751	0.4594
DAY_NFOP	1	-6.08298E-10	3.28461E-10	-1.852	0.0754
IPDAYS2	1	-1.11966E-10	9.22332E-11	-1.214	0.2357
NFOP2	1	-2.05751E-10	6.01609E-10	-0.342	0.7351
DELIV	1	0.000193188	0.000064672	2.987	0.0061
LAB	1	0.0000064081	.00000110555	5.798	0.0001
SURG	1	0.000014016	0.000044243	0.317	0.7539
LPHY_PER	1	-0.006778521	0.13896325	-0.049	0.9615
BEDS	1	0.004702017	0.000937138	5.017	0.0001

DEP VARIABLE: LREXPEND
ANALYSIS OF VARIANCE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	10	29.67088166	2.96708817	179.818	0.0001
ERROR	27	0.44551350	0.01650050		
C TOTAL	37	30.11639517			

ROOT MSE	0.1284543	R-SQUARE	0.9852
DEP MEAN	6.798458	ADJ R-SQ	0.9797
C.V.	1.889482		

PARAMETER ESTIMATES

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > |T|
INTERCEP	1	5.29110394	0.11002071	48.092	0.0001
IPDAYS	1	0.000012849	.0000049916	2.574	0.0158
NFOP	1	0.000013586	.00000493261	2.746	0.0105
DAY_NFOP	1	-5.10704E-10	1.32894E-10	-3.843	0.0007
DELIV	1	0.000111030	0.000024343	4.561	0.0001
LAB	1	.00000542298	6.09327E-07	8.701	0.0001
SURG	1	0.000032636	0.000022586	1.445	0.1600
BCCA	1	-0.03263741	0.08583381	-0.380	0.7067
BCCB	1	0.36980175	0.09745149	3.795	0.0008
BCCC	1	0.14750031	0.08117646	1.817	0.0803
BEDS	1	0.004399174	0.000433882	10.144	0.0001

DEP VARIABLE: LREXPEND
ANALYSIS OF VARIANCE

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PROB>F
MODEL	12	29.68077097	2.47339758	141.946	0.0001
ERROR	25	0.43562419	0.01742497		
C TOTAL	37	30.11639517			

ROOT MSE	0.1320037	R-SQUARE	0.9855
DEP MEAN	6.798458	ADJ R-SQ	0.9786
C.V.	1.941671		

PARAMETER ESTIMATES

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB > |T|
INTERCEP	1	5.32609310	0.18601648	28.643	0.0001
IPDAYS	1	0.000012751	.00000606476	2.102	0.0457
NFOP	1	.00000918272	0.000018135	0.506	0.6170
DAY_NFOP	1	-6.35183E-10	2.44220E-10	-2.601	0.0154
IPDAYS2	1	4.49432E-11	5.95584E-11	0.752	0.4583
NFOP2	1	1.68046E-10	4.33249E-10	0.388	0.7014
DELIV	1	0.000110174	0.000027605	3.991	0.0005
LAB	1	.00000553169	8.51552E-07	6.496	0.0001
SURG	1	0.000031317	0.000023310	1.344	0.1912
BCCA	1	-0.02691015	0.08863450	-0.304	0.7639
BCCB	1	0.38443229	0.10218321	3.762	0.0009
BCCC	1	0.15144619	0.08525228	1.776	0.0878
BEDS	1	0.004323458	0.000458581	9.428	0.0001

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