The Supply of Charity Services by Non-Profit Hospitals:

Motives and Market Structure

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I. Introduction

In 1988 roughly 70% of all general hospital beds were in non-profit hospitals. Fifty-nine percent of the hospitals were non-profit organizations (American Hospital Association 1989). Non-profit hospitals maintain their tax exempt status, in part, because they are perceived to provide social goods (GAO 1990). Foremost among the social goods provided is free care to the medically indigent. In fact, several recent state supreme court decisions on the tax status of non-profit hospitals have paid special attention to the provision of free care to the medically indigent in arriving at judgments (Friedman et al 1990).

The role of the non-profit hospital in provision of charity care has become increasingly important as the need for such care has expanded. During the 1980s the portion of non-elderly American civilians with no health insurance increased from about 14% to 17% (CRS 1988). Increased need for free care coupled with pressures on hospital operating margins caused by cost containment policies, such as Medicare's prospective payment system, are stressing the resources of many hospitals. This situation is further complicated by the shrinking of the public hospital sector, which historically has served as the provider of last resort. An understanding of the determinants of the supply of charity care by non-profit hospitals is central to formulating public policy for care of the medically indigent.

A number of state governments have begun to experiment with methods for expanding the supply of charity hospital care. They are experimenting with a number of tax and subsidy schemes. Block grant mechanisms are also in use. Which of these policies is likely to be most successful depends in part on the relative magnitudes of the income and substitution effects for the supply of charity care.

In studying the supply of charity care by non-profit hospitals one must also address issues related to: 1) the amount of free care provided by other hospitals in the market (especially public hospitals), and 2) cross subsidization from paying customers. This changes the manner in which economists have traditionally viewed charity. Almost all previous research on the supply of private charity and the effect of government "crowding-out" has focused on individuals as donors (Roberts 1984, Steinberg 1987, Warr 1982, Abrams and Schmitz 1986 and Weisbrod 1988). Rose-Ackerman (1987) has pointed out that private charitable services are typically supplied by non-profit firms. She further argues that these firms should not be treated as simple conduits through which individual donations are channeled in a way that is strictly consistent with the preferences of the donors.

An important reason for introducing the behavior of organizations into the supply of charity is that hospitals raise most of their revenues by selling services to paying customers. The sale of those services may also result in net revenues (profits). Since there are no residual claimants in non-profit hospitals, the management of the firm itself can exercise considerable discretion in choosing how to spend the income of the enterprise. Some of it will be spent on providing care at a zero or reduced price to customers who would otherwise be unable to pay the marginal cost of care. (This will be true in both monopolistic and competitive markets because of the presence of donated capital). Therefore because of the control over funds by management, the behavior and preferences of the firm becomes important for understanding the supply of charity care.

Our focus on the supply of charity care by non-profit hospitals rather than individual donors raises several new analytical issues. First, in the analysis of individual donors, interactions between donors is presumed to be negligible (Roberts 1984). In the analysis of the supply of charity by non-profit hospitals this assumption is harder to justify, especially when the number of hospitals in a market is small. Thus, the effect of a firm's supply of charity care on other firms in the market must be considered. Second, modelling of government crowd-out is complicated because unlike the individual case, the hospital's budget constraint is only indirectly affected by taxes levied to finance indigent care. The tax impact on hospitals is likely to be small since income elasticities of demand for hospital care are low and private donations account for less than 1% of total revenues. The implication of this is that the government crowd-out and income effects are related. We use this relationship to test one model of charity care supply.

The empirical section of the paper focuses on the supply of charity hospital care using data on hospitals from the state of Maryland. We estimate charity care supply functions for individual hospitals which take into account both the economic incentives to the hospital and the supply of charity care by other hospitals in the market.

II. Models of the Provision of Indigent Care

We propose two utility maximizing models of the hospital that assume different motivations and lead to alternative impacts of the supply of charity care by other hospitals on any given hospital's own supply of charity services. The first model is termed the pure altruism model where the hospital's utility depends only on the total level of unmet need for hospital care in the market. Thus if another hospital increases its supply of charity care, a given hospital will reduce it's effort. The second model is referred to as the impure altruism model. This model assumes that the hospital's utility depends on both the level of unmet need and which organization receives "credit" for supplying care.

A. The Basic Model

Our point of departure is a price-taking private nonprofit hospital operating in a market with other private as well as public hospitals. Hospitals may be viewed as price-takers if their rates are regulated (as they are in several states), if prices are set by one or two dominant insurers,[1] or if the local market in which they function is competitive. We also allow for the possibility that the hospital receives an explicit subsidy payment from the government for providing care to the indigent based on the volume of such care provided; we assume the per unit amount of this subsidy is below both marginal cost and the price paid by non-indigent patients so that the provision of this care truly represents a "charitable contribution" on the part of the hospital.

The hospital is assumed to maximize an objective function

(1) $U = U(R, N)$

whose two arguments are net revenue (R) and the amount of need of the indigent

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[1]The degree of market power possessed by apparently dominant private insurers has been questioned in the recent literature on the ground that entry barriers in the health insurance market are quite low (Staten, Umbeck and Dunkelberg, 1987 and 1988); however, this contention has been disputed (Pauly, 1987b). Frech and Ginsburg (1988) discuss the sources of market power of dominant health insurers in the past and the factors underlying its recent erosion. Large public insurers (Medicare and Medicaid) obviously have considerable discretion in setting fee levels.

that is unmet (N), and where $U_R > 0$ and $U_N < 0$. The disutility associated with N indicates that nonprofit hospitals are concerned with a "public bad", unmet need for hospital care. We refer to this formulation of the objective function as purely altruistic in N because the hospital cares only about the amount of unmet need in the community regardless of which hospital gets "credit" for serving the indigents and thereby reducing unmet need.

Hospital net revenue is defined as the sum of endowment income (E) plus revenues from providing services, PQ + rD, where P is the fixed price, Q is the number of paying patients, D is the number of indigent patients, and r is the revenue per indigent patient (where $0 \leq r \leq P$). The hospital's cost function is $C = C(Q+D)$. Thus, net revenue (R) is defined as:

(2) $R = PQ + rD + E - C(Q + D)$.

The inclusion of net revenue as an argument in the nonprofit firm's objective function may seem odd in view of the non-distribution constraint under which these firms operate. A number of recent studies, however, point out that "profits" earned in one activity can be spent by nonprofit firms to pursue other objectives of the management and/or trustees (Frech, 1976 and 1985; Hansmann, 1980; James, 1983; Danzon, 1982; Clark, 1980; Pauly, 1987a). These other objectives might include personal gain from management "perks" (e.g., higher salaries, thicker carpets), assuring the future survival of the firm by accumulating assets, or doing "good works" in the community. Thus, as an argument of U, R may be viewed as a composite "commodity" representing "profits" spent on all "goods" (as perceived by the firm's managers and/or trustees) other than reduction of indigent care need (N). While acquiring these other "goods" may entail expenses on the part of the firm, such expenses are not included in $C(Q+D)$.[2]

The level of unmet need (N) is equal to the total community indigent care need (T) minus the levels of indigent care provided by various types of hospitals. Letting D, H and G respectively denote the number of indigent persons served by the hospital in question, other private hospitals and public hospitals we define:

$$(3)\ N = T - D - H - G.$$

We assume that the hospital can sell as much Q as it chooses at the fixed price P.[3] We further assume excess demand for D, and we employ the Nash-Cournot assumption that the hospital chooses its own supply of indigent care (D) conditional on the amount supplied by other nonprofit hospitals (H). Substituting equations (3) and (2) into (1) allows us to rewrite the objective function as:

$$(1')\quad U = U\,[(PQ + rD + E - C(Q+D)),\ (T\text{-}D\text{-}H\text{-}G)].$$

The first order conditions for a maximum with respect to D and Q are:

$$(4)\ U_D = U_R \cdot [r-C_D] - U_N = 0$$

$$(5)\ U_Q = U_R \cdot [P-C_Q] = 0$$

Equation (4) indicates that at the optimum the hospital will admit indigent

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[2]The reader should note that some models of nonprofit behavior do not include R in the objective function. For example Rose-Ackerman (1987) offers a utility maximization model subject to a breakeven constraint. Feldstein (1971) and Newhouse (1970) proposed utility functions with quantity and quality as arguments with a breakeven constraint. The results presented below are not sensitive to this aspect of the objective function specification. Those results are available in Frank and Salkever (1988).

[3] Alternative models where P is endogenous (the unregulated monopoly model) and where both P and Q are exogenous (the public utility model) are also consistent with our principal theoretical results. These models are discussed in Frank and Salkever (1988).

patients up to the point where the financial loss is just balanced, in utility terms, by the marginal reduction of unmet indigent care need in the community. Equation (5) indicates that price equals marginal cost at the optimum. Note that the second order conditions for maximization of U are: $U_{QQ}<0$, $U_{DD}<0$ and $U_{QQ} U_{DD}-U_{Dq}^2>0$. These conditions are satisfied when:

$$(6)\ U_{NN} - 2[r-C_D]\ U_{NR} + [r-C_D]^2\ U_{RR}<0$$

Inequality (6) follows from the convexity of the indifference curves of U(R,N) and first order condition (4) above. It would also be implied by the more restrictive assumptions the U(R,N) is strongly separable (i.e., $U_{NR} = 0$) and that U_{RR} and $U_{NN}<0$.

Our main interest is in the effects of changes in the exogenous variables on the optimal level of D, the supply of care to the indigent by the hospital. Expressions for the effects of changes in P, r, E and G derived by differentiation of the first order conditions (4) and (5) are shown in Table 1. Equation (7) shows the pure income effect while equations (8) and (9) are directly analogous to Slutsky consumer demand equations. In each case the first term on the right hand side is an income effect, while the second is a substitution effect. The latter is positive in equation (8) and negative in equation (9) since $|J|>0$ and $C_{DD}>0$ are implied by inequality (6), equation (5) and the second order condition that $U_{QQ}<0$.[4] While the magnitude of the two substitution effects are the same, note that the income effect is presumably larger in (9) because Q is likely to be much greater than D. Hence, if the income effect is positive, increases in P are likely to increase the hospital's supply of indigent care unless the negative substitution effect is

[4] When equation (5) holds, $U_{QQ}=-U_R\ C_{QQ}$ but $U_R>0$ and $C_{QQ}=C_{DD}$ so $U_{QQ}<0$ implies $C_{DD}>0$.

very strong.

Equation (10) allows us to examine the conditions under which government care "crowds-out" private indigent care in this pure altruism model. Combining equations (7) and (10) we can also derive the following relationship between the crowding out and income effects[5] :

(11) $dD/dG + (r-C_D)\ dD/dE = -1$

Equation (11) states that "crowding out" will be complete (dollar for dollar or patient for patient) if income effects are zero. It also implies some crowding out ($dD/dG<0$) unless the income effect (dD/dE) is so large and positive that $1 of extra endowment generates $1 or more of charity care supply (i.e. $dD/dE \geq 1/[r-C_D]$.[6] As noted in Section III below, available evidence from previous studies, while somewhat indirect, tends to support the view that <u>both</u> crowding-out and income effects are rather weak. Since this finding is not consonant with equation (11) which is derived from the pure altruism model, we now consider an extension to the model that would resolve this conflict.

B. Impure Altruism as Rivalry

An alternative model involves an "impure altruism" formulation. In our pure altruism model, increases in the supply of charity care by other private hospitals (H), has the same "crowding out" effect on D as does increases in G.

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[5] To derive equation (11), note that $(r-C_D) = (r-C_Q) = (r-P)$ and that $\frac{dD}{dG} + (r-C_D)\frac{dD}{dE} = -\frac{|J|}{|J|}$.

[6] Note that C_D-r is the net marginal cost to the firm of treating an additional charity case. We are indebted to Thomas Bradley for pointing out and interpreting the extensions of our earlier analysis (Frank and Salkever 1988) that yield equation (11).

If, however, the hospital "competes" with other private hospitals for public goodwill by providing charity care, its preferences over feasible combinations of Q and D may depend upon the level of H. This can be represented in our model by a third argument in the utility function (Z) which measures the hospital's performance in supplying charity care relative to its rivals. Formally, we expand the utility function in (1′) to

$$(1") \quad U = \{[PQ+rD-C(Q+D)],(T-D-H-G),Z(D,H)\}$$

where $U_Z>0$, $Z_D>0$ and $Z_H<0$. Differentiating the first-order conditions and solving for dD/dH yields

$$(10') \qquad \frac{dD}{dH} = \frac{U_R C_{DD}[U_{RN}(P-r)+U_{NN}]}{|J|} + \frac{U_R C_{DD}\{U_{RZ}Z_H(r-P)+U_{ZZ}Z_H Z_D-U_{NZ}(Z_H+Z_D)+U_Z Z_{DH}\}}{|J|} .$$

The numerator of the first fraction is the numerator for dD/dG (and dD/dH) in (10) above. The second fraction cannot be signed in the general case; however, assuming $U_{ZZ}<0$ and non-negative cross-partials of U implies that the second term is positive provided that $(Z_H+Z_D)\leq 0$ and $Z_{DH}\geq 0$. This would be so for the simple case where Z=(D-H). This case, at least, provides an example of how adding a rivalry motivation can increase dD/dH and thus diminish the extent of private crowding-out, even when income effects are weak.

III. Evidence to Date on Key Hypotheses

While there is presently little direct evidence testing the model set forth above, several recent studies present results which relate to our theoretical propositions. Thorpe and Phelps (1988) use data from private nonprofit hospitals in the State of New York to estimate the impact of a program to subsidize provision of indigent care by hospitals. Using hospital financial data for 1981 through 1984 as well as county population characteristics and county hospital market structure information, they estimate the subsidy price impact on the volume of uncompensated care supplied (dD/dr above) and the income effect (dD/dE above) . The results show a positive and significant subsidy price supply elasticity of 0.17 while their estimated income effect is not significantly different from zero. Coefficient estimates for additional variables used by Thorpe and Phelps may be related to crowding out phenomena. The share of total hospital discharges in the county that are accounted for by public hospitals yielded a negative coefficient (suggesting crowding out by public hospitals) but its significance level varied somewhat with the estimation technique employed. A market structure variable (the county-level Herfindahl index based on numbers of hospital discharges) yielded a positive coefficient with significance levels again varying by estimation method. While not based on a measure of the actual levels of charity care, this result could be viewed as indirect evidence of private crowding out.[7]

Sloan, Morrisey and Valvona (1988) analyzed the volume of "self-pay" patients served by hospitals in selected years between 1980 and 1985. Explanatory variables in their models included hospital characteristics (e.g. ownership and teaching status) and county characteristics (employment,

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[7]Alternatively, this sort of market structure effect might be viewed as an income effect if profits are greater in more concentrated markets. Since hospital prices are regulated in New York and since the reported direct estimate of the income effect is essentially zero, this alternative interpretation does not seem very plausible.

Medicaid enrollment, and hospital market structure). The models were estimated, using the hospital as the unit of analysis and provide some evidence relating to public and private crowding-out effects (dD/dG and dD/dH). The authors reported a significantly negative coefficient for a binary variable indicating the presence of an "other public hospital" in the county. In contrast, a binary variable indicating that a hospital was the "only hospital in a county" showed no significant effect on the percentage of self-pay discharges, although its estimated coefficient was positive. These results suggest that public hospital crowding-out effects are greater than private hospital effects.

Our own related research (Frank, Salkever, and Mitchell 1990) on nonprofit private hospitals in Florida during the period 1980-1984 was similar to these earlier studies in that most of the estimated charity care supply functions included market structure measures (e.g., the share of beds in other hospitals) rather than direct measures of charity care supply by other hospitals (G and H) as explanatory variables. Estimated coefficients of these market structure measures were generally consistent with the conclusion that charity care supply was reduced when the share of beds in other hospitals was greater; however, since these coefficients were generally far from significant at conventional levels, they do not provide much support for the crowding out hypothesis. One specification did directly test crowding out by replacing the market structure variables with measures of charity care supply of other hospitals. Results were again weakly consistent with the crowding-out hypothesis. In contrast to other studies, however, we did find strong evidence of positive income effects. In view of inequality (11), this may provide at least a partial explanation for the weak evidence of crowding out in the Florida data.

IV. Direct Empirical Tests

We test our structural models of the supply of the charity services by non-profit hospitals using data from 40 non-profit general hospitals in the state of Maryland for the years 1980-1984. Maryland is a state where all hospital payment rates are essentially the same for all payers and are set by a regulatory commission. Thus P in our model is exogenous (but varies among hospitals). During the 1980-1984 period there were no explicit subsidies made to hospitals for provision of indigent care, so $r=0$.

The general specification of the structural model of charity care supply took the form:

(12) $D = D(P, T, r, E, H, G, w)$

where w represents input prices from the cost function and the other variables are defined as above.

A. Measurement of Variables

Regression analyses were carried out with two different dependent variables: the number of equivalent admissions accounted for by uncompensated care in the hospital (UCEQUA) and the number of discharges of inpatients classified at admission as either self-pay or charity cases (SPCDIS). The first of these variables was calculated by dividing the dollar amount of uncompensated care by the hospital's gross inpatient revenue per admission.[8]

[8]Uncompensated care expenses include both bad debts and charity care expenses. Distinctions between bad debts and charity care are difficult to draw. In deciding to serve uninsured individuals, hospitals presumably realize there is a high probability these individuals will not be able to pay their bills. Once the services are rendered, hospitals vary in the extent to which they seek payment from these persons. Thus, hospital billing policies may tend to determine the shares of bad debt and charity care in total

Note that it will include uncompensated care to patients whose bills are paid in part, and to outpatients;[9] it will also be influenced by the ratio of average charges per admission for paying vs. non-paying patients (which will in turn be influenced by the case mix, length of stay, and intensity of care for both groups of patients).[10] The second dependent variable only pertains to inpatients but probably overstates the number of uninsured patients since some of these patients will qualify for coverage (for example, under Medicaid or Workers' Compensation) after they have been admitted.

To obtain estimates corresponding to dD/dG and dD/dH, we included explanatory variables, analogous to our dependent variables, which measured the provision of uncompensated care in the same county by (1) other voluntary hospitals (OVUCEQUA, OVSPCDIS), (2) for-profit hospitals (FPUCEQUA, FPSPCDIS), and (3) public hospitals (PUBUCEQUA, PUBSPCDIS). (For reference, names and definitions for all explanatory variables are shown in Table 2.) We differentiated between voluntary and for-profit hospitals to allow for the possibility that the voluntary hospital's own dD/dH varies with the ownership type of its neighboring hospitals. Because of data limitations in our study sample, however, it is difficult to detect differences between dD/dG, dD/dH for neighboring voluntary hospitals and dD/dH for neighboring for-profit

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uncompensated care, while their policies about rendering care are more important determinants of the total amount of uncompensated care. Since our model focuses on decisions to render care rather than billing policies, the distinction between bad debt and charity care is not used.

[9]Recent data from New York (Thorpe, 1987) and New Jersey (State of New Jersey, 1988) show that outpatient services account for about one-third of all uncompensated care dollars.

[10]In our data this ratio of average charge figures is generally greater than one.

hospitals.[11] Therefore, we also estimated regressions in which the relevant "crowding-out" variable was equivalent uncompensated care admissions at other hospitals in the county aggregated across all three ownership types (ALLUCEQUA). ALLSPCDIS is the corresponding explanatory variable for self-pay and charity discharges at these hospitals.[12]

Four variables served as proxies for the level of need (T): the estimated number of persons with no public or private health insurance coverage (NOINS),[13] the number of births to residents of the county (RBIRTHS), the number of deaths in the county due to external causes (accidents, homicide, etc.) (EXDEAD) and the median household income in a county (HHINC). The rationale for including RBIRTHS and EXDEAD is that obstetrical deliveries and accident cases account nationally for a very large fraction of inpatient admissions of self-pay and charity cases; one recent estimate puts this

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[11]Only three of the 21 study counties had any public hospital beds and only two had any for-profit beds.

[12] We also compared hospitals where the impure altruism motive is not relevant with those where one might expect such a motive to be important. This was accomplished by including a dummy variable indicating that a hospital was the only one in its county. Crowding-out would imply a strong positive coefficients for an only hospital dummy. This result was never observed in models estimated but not reported here (see Frank and Salkever 1988).

[13]To compute NOINS, we first subtracted the number of persons over 65 and the number of under-65 SSI, AFDC, and general assistance recipients in the county from the total population on the assumption that these persons were virtually all covered by Medicare or Medicaid. Data from the 1980, 1982, and 1984 Health Interview Surveys were then used to estimate the number of persons under 65 with private health insurance coverage. Details of the estimation process are available from the authors.

fraction at about one half (Sloan, Valvona, and Mullner, 1986).[14] The corresponding fraction in Maryland for obstetrics cases, however, may be smaller since Maryland law mandates coverage of maternity services under private health insurance plans and since the Maryland Medicaid program includes coverage of first-time pregnant women who fall within the program's income limits. Median household income has been shown by others to be strongly negatively related to insurance coverage (Monheit et al. 1985).

Accurate measurement of endowment income is complicated by a variety of factors, including the existence of multiple endowment funds (some for specialized purposes) and the varying formats used by hospitals to report financial data. Since E could not be measured directly, we use net non-operating income of the hospital (NNINC). The price paid by paying patients (P) was measured by gross patient revenue per equivalent admission (GPREQUA); note that this slightly overstates the average price figure since some patients (such as those covered by Blue Cross insurance) receive modest discounts. The subsidy for indigent patients was assumed to be zero for all hospitals. In the Maryland rate-setting system, full rate reviews were conducted during the latter half of the 1970's and hospitals' actual bad debt and charity costs were included in the resulting rate computations. Once the rates were set, however, they were simply trended forward for inflation and no further recomputation based on hospitals' actual charity and bad debt experience took place in most instances. In the latter part of our study

[14] This specification represents a first order approximation to an arbitrary supply function. The coefficients of births gives the effect on D of additional births. That effect is assumed, by our specification to be larger where the number of uninsured is greater. We also estimated several regressions with RBIRTHS and EXDEAD expressed as rates (relative to total population).

period, a small number of hospitals petitioned for special rate increases as their bad debt and charity costs grew but there was no formal policy of granting these requests. Thus, as a first approximation for our study period, it seems reasonable to view the hospitals as bearing the full costs of any indigent care which they rendered. In general, these costs could not be passed through in the form of higher rates allowed by the rate-setting commission (Maryland Health Services Cost Review Commission, 1984).

Another financial incentive for providing free care may exist for hospitals that have received Hill-Burton funds. Hospitals receiving such funds are obligated to provide specified levels of free care (depending upon the amount of funds they received). Failure to provide such levels of free care could conceivably result in penalties to the hospital though the level of enforcement of this requirement appears to have been minimal. To allow for any possible effect of this requirement on the hospital's supply of free care, we included the dollar value of the hospital's annual obligation (HILLBURT) as an explanatory variable.

To control for variations in cost conditions among hospitals, we include the hospital's average wage plus fringe benefit cost per hour for general duty nurses (RNCOST). We also included the number of beds (BEDS) in the hospital as an explanatory variable. The size of the hospital presumably affects the shape of $C(\cdot)$; at any given level of output, the rate of increase of marginal cost is presumably lower for hospitals with a larger capital stock (as proxied by the number of beds). To allow for differences in preferences of teaching and non-teaching hospitals, we included a teaching dummy (TEACH) to denote the hospitals that operated one or more residency programs approved by the American Medical Association. Finally, to allow for other changes over time not captured by our explanatory variables (e.g., increases in the deductible and coinsurance liabilities of insured persons), we included either a time trend (TIME) or separate intercepts for each of the study years.

All dependent variables and most continuous explanatory variables were included in the regressions in logarithmic form. Since the charity-care-supply variables and NNINC take on zero values in some cases, they were entered in linear form.

B. Estimation Strategy

Our strategy for estimating the supply of charity care model in (12) consisted of several steps. In view of the possibility of hospital-specific temporally-stable omitted factors in the pooled data, we estimated fixed effects and variance components models (Fuller and Battese 1974). We tested the variance components formulation against the fixed effects model using a Hausman (1978) test. We rejected the consistency of the variance components estimates for models where the dependent variable was the number of equivalent admissions of charity care. Thus Table 3 only includes fixed effects estimates. We were unable to reject the consistency of the variance components estimates for models using the number of self-pay and charity discharges as the dependent variable. Table 4 therefore also includes variance components results.

We were also concerned with the possibility that H and G were endogenous due, in part, to the presence of unmeasured factors representing the demand for charity care. We tested the degree to which H and G were exogenous using a Wu (1973) test. The results led us to reject exogeneity of the variables measuring crowding out. Our discussion therefore focuses on results based on two-stage estimates for both fixed effects and variance components models. (A more complete set of results are available from the authors upon request).

Since our model implies that only a hospital's own values for variables such as the number of beds (a cost function factor) and Hill-Burton obligation enter into its charity care supply function, the summed number of beds in other hospitals and the summed Hill-Burton obligations of other hospitals were used as instruments in the first stage regression.[15] These variables will directly affect the values for H and G but not D.

C. Results for Uncompensated Equivalent Admissions (UCEQUA)

The principal findings with uncompensated equivalent admissions (UCEQUA) as the dependent variable are presented in Table 3. Equation (1) is a two stage least squares model with fixed effects. A single crowding out variable (ALLEQUA) is used in this specification. The results indicate a positive and significant coefficient estimate for ALLEQUA. This result is consistent with the impure altruism formulation of hospital preferences. Equations (2) and (3) present estimates where separate crowding out variables are specified for investor owned (FPUCEQUA), non-profit (OVUCEQUA) and public hospitals (PUBUCEQUA). When the crowd-out variables are disaggregated by ownership category positive coefficient estimates are obtained for other non-profit hospitals (one significant at conventional levels). Evidence for crowding out by public hospitals is mixed. The coefficient estimate for PUBUCEQUA in equation (2) is negative with a t statistic of 1.51. In contrast the estimate

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[15] When the "crowding-out" variables were defined for specific ownership categories, the beds and Hill-Burton instruments were also defined for these ownership categories.

for the same variable in equation (3) is positive but very imprecisely estimated.

Results for the price variable (GPREQUA) are weakly consistent with the existence of a strong substitution effect and a relatively weak income effect. The coefficient estimate for GPREQUA in equation (1) is negative but not significantly different from zero at conventional levels. The coefficient obtained in equation (2) is negative an significant, while that in equation (3) is positive and not significant. As noted above, Thorpe and Phelps (1988) reported similar results.

More direct evidence on income effects comes from examination of the NNINC coefficient. The estimate for NNINC is positive in all three specification but is never significantly different from zero. A positive income effect would also imply a negative coefficient for our measure of hospital wages (RNCOST), in fact this coefficient is insignificantly positive in all three specifications on Table 3.

Three variables intended to proxy for the level of need for indigent care, RBIRTHS, EXDEAD and NOINS were expected to have positive coefficients based on our theoretical model. The only significant coefficient estimate was for the RBIRTHS variable and it was negative. The mandated benefits law and Medicaid eligibility rules mentioned above may account for the absence of a positive coefficient.[16] The median household income (HHINC) was estimated to have a positive effect on the supply of charity care. The estimates in equations (1) and (2) of Table 3 are both significant at the 95% confidence

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[16] Reestimation of equation (1) in Table 3 with RBIRTHS and EXDEAD divided by population yielded similar results though the t-statistic for RBIRTHS dropped to 1.62.

level. This result might have occurred because wealthier counties may directly subsidize care in local hospitals.

Coefficients for BEDS suggest elasticities of hospital size (as measured by beds) of between 0.25 and 0.52. Suggesting a less than proportional increase in the supply of charity care as size increases. These estimates are not very precise. The presence of a teaching program tends to reduce the volume of charity admissions. (Note that the three major teaching hospitals in Maryland were excluded from the study sample.)[17]

D. Results for Self-Pay and Charity Discharges

Regression results with the number of self-pay and charity discharges (SPCDIS) as the dependent variable are shown in Table 4. Equation (1) uses a two stage variance components estimator where crowding out is measured by a single variable (ALLSPCDIS) representing self-pay and charity discharges by all other hospitals. Equation (2) uses the same specification as in (1) except that two stage least squares with fixed effects is used for obtaining estimates. Equation (3) disaggregates self-pay and charity discharges supplied by other hospitals according to type of ownership. This model uses a two stage variance components estimator. Equation (4) represents a similar specification to that in (3) using two stage least squares and fixed effects.

The crowding out variables were generally estimated to have positive coefficients that were not significantly different from zero (equation (2) had an insignificant negative coefficient). Thus, the crowding-out hypothesis was

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[17] A number of models were estimated with single-stage methods using ALLUCEQUA as a crowding out measure. The results also supported the rivalry (impure altruism) model. This result also held for non-profit hospitals in cases where ownership-specific crowding out was estimated.

not supported.[18]

Turning to the results for other variables, we observe that the coefficients for GPREQUA are consistently and strongly negative, thus suggesting a strong substitution effect and a weak income effect. Results for RNCOST and, in some regressions, for NNINC imply a negative income effect though this seems implausible. HHINC coefficients are again consistently positive though not significant. The BEDS coefficient is again strongly positive and consistently equal to about 1.0. Among the "need" variables, NOINS and EXDEAD typically have the expected positive signs but they rarely approach significance.[19] Results for the teaching dummy are also positive and only slightly more significant than before.

E. Discussion

Although we did not find strong evidence of crowding out with either dependent variable, there was clearly more support for the rivalry hypothesis (i.e., the reverse of crowding out) in the regressions on UCEQUA. Differences in regression results between our two dependent variables could occur for a variety of reasons. For example, the positive response of UCEQUA to other hospitals' supply of uncompensated care might primarily reflect the hospital's desire to provide a similar quality of care (in terms of length of stay and intensity of service) to charity patients as that provided by its rivals.

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[18] The single stage results for models using ALLSPCDIS as the crowding-out measure indicated a number of negative coefficient estimates. The Wu test results and the subsequent two stage models show that these findings were probably the result of simultaneous equations bias.

[19] Reestimation of equation (2) with RBIRTHS and EXDEAD divided by population yielded essentially the same results.

Alternatively, this positive response might pertain primarily to charity care for outpatients.

To explore these possibilities, we carried out regression analyses with additional dependent variables that measured (1) estimated outpatient charity and bad debt equivalent admissions, (2) total inpatient days for self-pay and charity patients, and (3) the ratio of average charge per admission for self-pay and charity inpatients to the average charge for all inpatients.[20] These additional regressions were estimated by either OLS fixed effects or two-stage least-squares fixed effects (with the analogous crowding-out variables treated as endogenous and the first-stage instruments already described). Regression results produced very few significant coefficient estimates for the crowding-out variables though they did show slightly more support for the rivalry hypothesis with the dependent variables pertaining to outpatient care and the ratio of average charges.[21]

We also examined the implications of our evidence on rivalry for one current policy concern, namely, the consequences of changes in hospital market structure. In particular, we simulated the effects of changes in market structure on the total community supply of charity care. The starting point for our simulation was a county with two 300-bed voluntary hospitals, each providing 1000 equivalent admissions of charity care per year. (This value is roughly in the middle of the range of observed values for our study hospitals.) We simulated the change in total equivalent charity admissions for the county when the 300 bed hospitals were subdivided first into four

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[20]This ratio is used as a proxy for intensity of care.

[21]Results of these regressions are available from the authors.

identical 150-bed hospitals and then into six identical 100-bed hospitals. We simulated Nash-Cournot equilibrium outcomes described by

$$\ln UCEQUA = Z + b_1 \ln (600/n) + (n-1)b_2 \, UCEQUA$$

where b_1 and b_2 are the coefficients of the beds and "crowd-out" variables respectively, n is the number of hospitals in the community and Z is a constant. When b_1 deviates from 1.00, increasing the number of hospitals while holding total beds constant at 600 will alter total community supply for two reasons: crowd-out or rivalry effects (b_2) and scale effects for the individual hospital. For example, when $0<b_1<1$, going from two 300 bed hospitals to 150 bed hospitals will increase total charity care supply in the community even if there are no crowd-out or rivalry effects (i.e. $b_2 = 0$). In order to isolate the market structure implications of rivalry per se, we set $b_1 = 1$ in our simulations and set $b_2 = 9.7102 \times 10^{-5}$ (the coefficient of ALLUCEQUA in Table 3, regression 1).[22] For the change from two to four hospitals, the simulation indicated a 5.8 per cent increase in total community supply while the change from four to six hospitals yielded an additional 2.2 per cent increase.

V. Summary and Concluding Remarks

This paper has developed a theoretical model that demonstrates that in the absence of very large and positive income effects on indigent care supply,

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[22]The following computational method was used in the simulations. Using the ALLUCEQUA coefficient of 9.7102×10^{-5} along with an assumed coefficient for the log of beds of 1.0 and the assumed initial values of 1000, 1000 and 300 for UCEQUA, ALLUCEQUA and BEDS respectively, we solved for the value of Z from the Nash-Cournot equilibrium equation, where n (the number of hospitals in the county) had an initial value of two. Then, using this value of Z and the equilibrium equation, we solved for UCEQUA when n took on values of four and six.

crowding out effects of indigent care supplied by other hospitals. An alternative model which assumes impure altruism (rivalry) provides a possible explanation for the previously reported empirical result that both crowding out and income effects on indigent care supply are often weak or insignificant.

Our own empirical analysis of indigent care supply replicates this finding from the literature; little solid evidence is found to support either the crowding out hypothesis or the hypothesis of strong income effects. We thus interpret our results as supporting the case for exploring alternatives to the pure altruism model. Results with one of our two dependent variables (UCEQUA) also provides some support for the proposed model in which impure altruism takes the form of rivalry. An important policy implication of these results concerns the assessment of varying market structures. In the presence of rivalry, increased numbers of suppliers may lead to a larger total community supply of indigent care services; conversely, mergers of nonprofit hospitals imply reductions in indigent care supply. On the other hand, when our indigent care supply measure pertains only to numbers of inpatient discharges (SPCDIS), the rivalry hypothesis is not supported (though support for the opposite crowding-out hypothesis is at best equivocal). Further investigation is needed to verify and understand this difference in results.[23]

Finally, our finding (in some specifications) of a moderately strong substitution effect on indigent care supply is also of policy interest. It suggests that reductions in the prices paid to hospitals on behalf of paying

[23]The reader should also bear in mind that the rivalry and crowding out results discussed here pertain to other private hospitals. Because of the limited number of public hospitals in Maryland, our estimates of private hospital responses to public indigent care supply are very imprecise. Further research that is better able to distinguish between public and private crowding out and rivalry is clearly needed.

patients would increase the supply of indigent care. Several states (Florida and South Carolina) have implemented indigent care subsidy programs that are financed by taxes on hospital revenues. Our results suggest that this policy will have a large impact on indigent care supply both by increasing the subsidy payment (r) and by reducing the after-tax price received by the hospitals from paying patients. Thus, financing of additional subsidies via taxes (and reductions in after-tax prices) may increase the supply of indigent care without greatly increasing total funds flowing into the hospital sector.

APPENDIX: DATA SOURCES

Data for calculating values of the variables UCEQUA, OVUCEQUA, FPUCEQUA, PUBUCEQUA, ALLUCEQUA, GPREQUA, and NNINC were taken primarily from the annual reports entitled Disclosure of Hospital Financial and Statistical Data published by the Maryland Health Services Cost Review Commission (HSCRC). In several instances where data on numbers of equivalent admissions were missing (for either study hospitals or other hospitals located in the same county as a study hospital), estimates were developed from data published by the American Hospital Association (AHA) and by the Maryland Hospital Association. Data for computing values of SPCDIS, OVSPCDIS, FPSPCDIS, PUBSPCDIS, and ALLSPCDIS were extracted from the hospital discharge abstract tapes submitted to the HSCRC by each hospital. Note that these data pertain to calendar years whereas the financial disclosure data are based on each hospital's fiscal year. Values of HHINC were taken from Sales and Marketing Management. RNCOST is reported in annual wage surveys conducted by the HSCRC. RBIRTHS and EXDEAD were extracted from the Area Resources File distributed by the U.S. Department of Health and Human Services. NOINS values were synthetic estimates based on insurance coverage regressions developed from Health Interview Survey data for 1980, 1982 and 1984. (Estimates for Baltimore City were taken directly from the survey data.) Data on BEDS and TEACH were taken from the Guide to the Health Care Field published annually by the AHA. Data on HILLBURT were supplied by the U.S. Department of Health and Human Services.

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TABLE 1

COMPARATIVE STATISTICS RESULTS FOR SIMPLE ALTRUISM MODEL

Equation*
No.

(7)
$$\frac{dD}{dE} = \frac{U_R C_{DD}[U_{RR}.(r-P)-U_{NR}]}{|J|}$$

where $|J| = U_R C_{DD}[U_{NN}-2U_{NR}.(r-C_D)+(r-C_Q)^2.U_{RR}]$

(8)
$$\frac{dD}{dr} = D\frac{dD}{dE} + \frac{U_R^2 C_{DD}}{|J|}$$

(9)
$$\frac{dD}{dP} = Q\frac{dD}{dE} - \frac{U_R^2 C_{DD}}{|J|}$$

(10)
$$\frac{dD}{dG} = \frac{U_R C_{DD}[U_{RN}.(P-r) + U_{NN}]}{|J|}$$

Table 2

Variable Definitions and Descriptive Statistics

Variable Name	Definition	Mean (Std Dev)
LnUCEQUA	Log of Equivalent Uncompensated Care Admissions	6.032 (0.772)
ALLUCEQUA	Equivalent uncompensated care admisssions in all other county hospitals	5241.4 (6966.4)
LnSPCDIS	Log of self-pay/charity discharges	6.228 (0.853)
ALLSPCDIS	Self-pay charity discharges in all other county hospitals	6109 (7711)
LnHHINC	Log of household income in county	9.936 (0.295)
LnGPREQUA	Log of Gross revenue per equivalent admission	7.764 (0.320)
HILLBURT	Hill-Burton Obligation	62480 (131941)
LnBIRTHS	Log of total births in county	8.110 (1.341)
NNINC	Non-operating income of the hospital	637329 (740190)
LnRNCOST	Log of total hourly compensation for general duty nurses	2.336 (0.173)
LnNOINS	Log of persons with no public or private third party coverage	10.30 (1.44)
LnEXDEAD	Log of death due to external causes	4.951 (1.335)
LnBEDS	Log of beds in hospital	5.405 (0.633)
TEACH	Dummy variable equal to 1 if hospital has residency program(s)	0.350
OVUCEQUA	Equivalent uncompensated admissions in other voluntary hospitals	3850 (5071)

Table 2 (Cont'd.)

Variable Definitions and Descriptive Statistics

Variable Name	Definition	Mean (Std Dev)
FPUCEQUA	Equivalent uncompensated admissions in for-profit hospitals	29.75 (154.05)
PUBUCEQUA	Equivalent uncompensated admissions in public hospitals	1361 (1994)
OVSPCDIS	Self-pay/charity discharges from other voluntary hospitals	4208 (5112)
FPSPCDIS	Self-pay/charity discharges from for-profit hospitals	36.24 (166.30)
PUBSPCDIS	Self-pay/charity discharges from public hospitals	1864 (2775)

Table 3

Regression Coefficients for LN UCEQUA
(t-statistics in parentheses)

Regression #	(1)	(2)	(3)
Method	TSLSICT	TSLSICT	TSLSICT
INTERCEPT	1.248 (0.166)	14.322 (1.418)	-25.363 (0.524)
ALLUCEQUA $\times 10^{-5}$	9.7102[a] (3.652)		
Ln NOINS	0.0701 (0.663)	-0.0553 (1.089)	0.1990 (0.431)
Ln GPREQUA	-0.2883 (1.163)	-0.7769[b] (2.177)	0.5334 (0.256)
Ln RNCOST	0.1226 (0.304)	0.2552 (0.598)	-0.8463 (0.435)
NNINC $\times 10^{-7}$	0.2031 (0.579)	0.0051 (0.137)	0.6304 (0.386)
LnBEDS	0.5160[c] (1.888)	0.2591 (0.782)	0.4669 (0.670)
Ln EXDEAD	0.0463 (0.459)	0.0976 (0.888)	0.0180 (0.717)
Ln HHINC	0.7976[b] (2.019)	0.8272[b] (2.002)	1.6620 (0.821)
HILLBURT $X10^{-5}$	-0.0147 (0.760)	-0.0192 (0.949)	-0.0210 (0.433)
Ln BIRTHS	-0.7643[c] (1.764)	-1.1338[b] (2.341)	
TEACH	-0.1170 (1.608)	-0.1408[c] (1.835)	-0.1023 (0.542)
DUM81	-0.0749 (0.797)	0.2370 (1.262)	
DUM82	-0.6282 (0.346)	0.2992 (1.142)	

Table 3 (Cont'd.)

Regression Coefficients for LN UCEQUA
(t-statistics in parentheses)

Regression #	(1)	(2)	(3)
Method	TSLSICT	TSLSICT	TSLSICT
DUM83	-0.1090 (0.476)	0.2034 (0.725)	
DUM84	-0.0680 (0.257)	0.2997 (0.917)	
OVUCEQUA $\times 10^{-5}$		9.2171[a] (3.331)	13.0265 (1.350)
PUBUCEQUA $\times 10^{-5}$		-38.8098 (1.515)	133.0371 (0.459)
FPUCEQUA $\times 10^{-4}$		-9.5356 (0.547)	16.2980 (0.262)
TIME			-0.1673 (0.434)

Notes: a: p<.01; b: p<.05, c: p<10; d: TSCS denotes Fuller-Battese error components estimates; OLSICT denotes OLS with hospital specific dummies; TSLSICT denotes two-stage least squares with hospital specific dummies.

Table 4

Regression Results for Ln SPCDIS
(t-statistics in parenthesis)

Regression #	(1)	(2)	(3)	(4)
Method[d]	TSLS	TSLSICT	TSCS	TSLS
INTERCEPT	5.6965 (1.829)	-10.7736 (1.340)	-24.8106 (1.484)	-3.0812 (0.449)
ALLSPCOIS $\times 10^{-5}$	-0.2701 (0.087)	7.9028 (1.224)		
Ln NOINS	0.0521 (0.557)	0.1731 (1.402)	0.3532 (1.512)	0.04948 (0.32)
Ln GPREQUA	-1.1596[a] (3.902)	-1.0016[a] (3.333)	-0.7409[a] (1.549)	-1.1239[a] (3.123)
Ln RNCOST	1.563[a] (3.55)	1.4308[a] (2.885)	1.8326[b] (2.463)	1.5682[b] (2.254)
NNINC $\times 10^{-6}$	0.0029 (0.773)	-0.0397 (0.95)	-0.033 (0.618)	-0.0238 (0.508)
Ln BEDS	1.1064[a] (5.051)	1.1014[a] (3.233)	1.094[b] (2.446)	0.9719[a] (2.601)
Ln EXDEAD	0.0881 (0.82)	0.0735 (0.599)	0.0351 (0.217)	0.129 (1.011)
Ln HHINC	0.1459 (0.390)	0.615 (1.224)	0.9647 (1.361)	0.7291 (1.286)
HILLBERT $\times 10^{-5}$	-0.0042 (0.196)	-0.0159 (0.649)	-0.0135 (0.432)	-0.0138 (0.539)
Ln RBIRTHS	-0.3127 (1.443)	0.4824 (0.979)	1.4154 (1.335)	
TEACH	0.1033 (1.309)	0.103 (1.151)	0.0998 (0.880)	0.0992 (1.042)
DUM81	-0.0602 (0.803)	-0.164 (1.622)	-0.3505 (1.613)	
DUM82	-0.0421 (0.307)	-0.2934 (1.413)	-0.6608 (1.506)	

Table 4 (Cont'd.)

Regression Results for Ln SPCDIS
(t-statistics in parenthesis)

Regression #	(1)	(2)	(3)	(4)
Method[d]	TSLS	TSLSICT	TSCS	TSLS
DUM83	0.0896 (0.490)	-0.2294) (0.833)	(0.6787 (1.215)	
DUM84	0.0859 (0.814)	-0.2412 (0.807)	-0.8571 (1.212)	
OVSPCDIS $x10^{-5}$			1.6611 (0.167)	1.9230 (0.283)
PUBSPCDIS $x10^{-5}$			-25.9664 (0.812)	-10.2865 (0.404)
FPSPCDIS $x10^{-4}$			74.7802 (0.936)	29.8961 (0.389)
TIME				-0.0544 (0.395)

Notes: a: p<.10; b: p<.05; c: p<.10 (all p values are two-tailed); d: TSCS, OLSICT and TSLSICT are defined as in Table 3 above; TSLS denotes two-stage variance components estimation with ALLSPCOIS endogenous.