TABLE 5 Nonworking Mothers' Demand for Health Care Activities (n = 812)

Independent Variables	PARTIME (4a)	PARTIME (4b)	DOCPRV (5a)	DOCPRV (5b)	DOCCUR (6a)	DOCCUR (6b)
INC	−.0057	−.0028	.019[b]	.0098	.018	.019
	(.0058)	(.0055)	(.010)	(.011)	(.014)	(.014)
DOCFEE	.0013	.0022	−.0025	−.0011	−.0073	−.0064
	(.0024)	(.0026)	(.0043)	(.0046)	(.0061)	(.0066)
TIMCOST	−.0011[b]	−.0011[b]	−.0022[b]	−.0024[b]	−.0028[b]	−.0032[b]
	(.00053)	(.00053)	(.00091)	(.0009)	(.0013)	(.0014)
MEANPART		−.14				
	—	(.11)		—		
VARPART		−.062[b]				
	—	(.026)		—		
MEANDOCP				.56[b]		
	—	—		(.22)		
VARDOCP				−1.75[b]		
	—	—		(.81)		
MEANDOCC						−.001
	—	—		—		(.05)
VARDOCC						−.0085
	—	—		—		(.05)
COLLEGE	.16[b]		.48[b]		.17	
	(.072)	—	(.12)	—	(.18)	
HSPRV	.051		.24[b]		.14	
	(.059)	—	(.10)	—	(.15)	
HSPUB	.085[a]		.29[b]		.095	
	(.052)	—	(.09)	—	(.13)	
EARPAIN					.068	.071
	—	—	—	—	(.14)	(.15)
COLDHIST	.041	.042	−.00035	−.00042	.54[b]	.54[b]
	(.036)	(.037)	(.062)	(.007)	(.09)	(.09)
AGE	.0056	.0048	−.076[b]	−.076[b]	−.053[b]	−.054[b]
	(.0053)	(.0047)	(.0092)	(.0091)	(.013)	(.014)
MALE	−.016	−.021	.013	.015	.097	.11
	(.033)	(.019)	(.057)	(.06)	(.083)	(.08)
N	−.026[b]	−.026[b]	−.0068	−.0054	−.024	−.032
	(.013)	(.013)	(.023)	(.031)	(.033)	(.033)
DOCFAITH	−.015	−.0038	−.0021	−.024	−.0058	−.019
	(.037)	(.038)	(.065)	(.069)	(.094)	(.098)
PARHEAL	.036	.025	−.059	−.035	−.057	−.017
	(.037)	(.038)	(.064)	(.068)	(.093)	(.097)

TABLE 5 (Concluded)

Independent Variables	Dependent Variables					
	PARTIME		DOCPRV		DOCCUR	
	(4a)	(4b)	(5a)	(5b)	(6a)	(6b)
FUTURE	−.12[b]	−.095[b]	.075	.035	.26[b]	.21[b]
	(.036)	(.036)	(.061)	(.065)	(.08)	(.092)
BLACK	−.11[a]	−.13[a]	.052	.052	−.52[b]	−.52[b]
	(.068)	(.068)	(.11)	(.12)	(.17)	(.17)
RELIGION	−.011	−.0011	.087	.011	−.048	.10
	(.038)	(.037)	(.065)	(.068)	(.095)	(.095)
MARD	.012	.013	.19[b]	.23[b]	.062	.073
	(.043)	(.044)	(.075)	(.08)	(.11)	(.11)
$\bar{R}^2$	.04	.03	.15	.09	.11	.11

NOTE: Standard error within parentheses.
[a] Coefficient significantly different from zero at the 0.9 level.
[b] Coefficient significantly different from zero at the 0.95 level.

work are less attractive relative to off-work parent's time as a mechanism for protecting children's health. Therefore as WIFWAGE rises, time with children is substituted for doctor visits. Indeed, WIFWAGE *as a cross-price effect* (i.e., with FULFEE included) is negatively related to DOCPRV (almost significant at the 0.9 level) and DOCCUR in equations (2a) and (3a).

This "rationed" working-mother model was tested directly in (1b), (2b), and (3b). On the criterion of minimizing the sum of squared residuals, the "equilibrium" model performed slightly better than the "rationed" model—1a(207.2) vs. 1b(207.8), 2a(513.2) vs. 2b(517.1), 3a(1434) vs. 3b(1438)—but the explanatory power of the two models for the whole sample is nearly identical. Equations (1c), (2c), and (3c) split FULFEE into its two components, DOCFEE and the product TIMCOST*WIFWAGE = TIMWAGE. If the "equilibrium" model is the correct specification, then the coefficients on DOCFEE and TIMWAGE should be nearly equal and equal to the coefficient on FULFEE. Only in the DOCPRV equation does this appear to hold. In the PARTIME and DOCCUR equations the coefficient on TIMWAGE is two to five times larger than the coefficient on DOCFEE.

On balance, then, the rationed working-hours model is probably closer to the truth, particularly for working mothers with higher wages. Unfortunately, our wage data are based on broad occupational grouping and do not give us enough variation to split the sample and test for this structural break directly. However, a "compromise" model was tested that included INC, DOCFEE, TIMCOST, and WIFWAGE, each as explanatory variables. The coefficient estimates for INC, DOCFEE, and TIMCOST were identical to those presented in (1b), (2b), and (3b), and the WIFWAGE coefficients were similar to the estimates in (1a), (2a), and (3a). The price and income results appear quite robust across all working-mother specifications.

Equations (1ab), (2ab), and (3ab) give a first test of the hypothesis that health care technologies influence health care consumption. Here education-provider dummy variables for each of our four subsamples were used in the demand equations. The eighth grade-public dummy was excluded to avoid singularity. The children in the college-private subsample (COLLEGE) receive significantly more of each health care input than do children in the high school-private (HSPRV), high school-public (HSPUB), or eighth grade-public subsamples. As the other likely effects of mother's education on health care consumption are accounted for in our model through WIFWAGE, N, and labor force participation, the education-provider dummy variables may be detecting consumption differences attributable to perceived differences in the family's health care technology. If so, and if the pattern of the ENT technology with respect to mother's education is as described in Table 3, then mothers are risk averse with respect to their children's health, preferring the low mean-low variance inputs to the high mean-high variance activities.

Equations (1c), (2c), and (3c) provide one direct test of the mean-variance hypotheses. From Table 3, the expected effects and the variance of the effects of the health care activities from each subsample for the NOSICK equation were assigned to each child according to his subsample membership. The only exception was that negative mean effects were assigned a value of zero under the assumption that mothers do not really believe doctors' or parents' time is detrimental to their children's health.

The coefficient estimates imply that changes in the uncertain health care technology do appear to affect consumption decisions in intuitively reasonable ways. An increase in the average health effectiveness of parents' time (MEANPART) increases the time working mothers spend with their children, whereas an increase in the uncertainty of those effects (VARPART) reduces time spent with children.[28] Both effects are significant. An increase in the effectiveness of preventive visits increases DOCPRV, whereas an increase in variance tends to reduce DOCPRV, but this last result is not statistically significant. DOCCUR appears unaffected by health care technology, suggesting that curative visits may be largely motivated by a desire for parental reassurance and comfort ("Have I done all that's possible?") rather than direct child health effects. From our previous results in (3ab), it appears that college-educated mothers are more sensitive to this reassurance motive.

The remainder of the results in Table 4 are straightforward and need no extensive interpretation. The health history of the child (EARPAIN, COLDHIST) influences the decision to seek care in the expected way. Older children (AGE) get less attention and less doctor care, as do children from larger families (N). There is no sign of sexual discrimination (MALE) by the working mother in her care for children. Religious mothers spend more time with their children; working black mothers spend slightly less time with their children. Healthy parents (PARHEAL) and future-oriented (FUTURE) parents tend to use preventive care more, whereas mothers with faith in the curative power of doctors (DOCFAITH) use preventive care less.

The pattern of the results for the nonworking-mother sample (Table 5) are generally similar to those for working mothers. We do, however, lose the inferior-good quality of parents' time with children. The coefficient on INC in the PARTIME equation is negative, but not significantly different from zero. DOCPRV and DOCCUR are normal goods. Changes in doctor fees (DOCFEE) have no appreciable effect on health care consumption, but changes in time costs per doctor visit are quite important. Higher doctor visit time costs reduce *all* health care activities, doctor visits as well as parents' time with children.

The effects of health care technology on health care consumption are basically similar to those observed for working mothers, except that the mean effect of parents' time on health is no longer a significant positive stimulus to PARTIME. DOCCUR is again immune to changes in the technology, suggesting that parental reassurance may be the key motivation for curative visits for nonemployed mothers as well as for working mothers.

In Table 6 are the elasticities (at the means) of the health care activities with respect to prices, income, technology, and the number of children in the family. Price elasticities (FULFEE, DOCFEE, TIMWAGE, WIFWAGE) rarely exceed 0.15 in absolute value, supporting previous results on the price insensitivity of health care demands.[29] Variation in the TIMCOST of doctor visits is one of the strongest determinants of utilization, particularly for

TABLE 6 Health Care Consumption Elasticities

Independent Variables	Dependent Variables					
	Working-Mother Sample			Nonworking-Mother Sample		
	PARTIME	DOCPRV	DOCCUR	PARTIME	DOCPRV	DOCCUR
INC	−.046	.243	.205	~0	.168	.152, .161
FULINC	−.12, −.10	.559, .419	.461, .516	—	—	—
FULFEE	−.022	−.116	−.137	—	—	—
DOCFEE	−.016, −.015	−.086, −.085	−.092, −.076	~0	~0	−.037, ~0
TIMWAGE	−.017	~0[a]	−.147	—	—	—
WIFWAGE	.099, .106	−.295, ~0	~0	—	—	—
TIMCOST	−.016	~0	−.119	−.032	−.170, −.186	−.208, −.237
MEANPART	.012	—	—	−.007	—	—
VARPART	−.032	—	—	−.041	—	—
MEANDOCP	—	.454	—	—	.069	—
VARDOCP	—	~0	—	—	−.265	—
MEANDOCC	—	—	~0	—	—	~0
VARDOCC	—	—	−.12	—	—	~0
N	−.025	~0	−.270	−.043	~0	~0

[a] If the t statistic for the variable is <1, the elasticity is defined ~0

nonworking mothers. Here the elasticities range from −0.17 for DOCPRV to −0.23 for DOCCUR.

The estimates of income elasticities show that the inferior-good influence of income on parents' time with children is only a mild one. For the working-mother sample, a 10 per cent rise in income leads to at most a 1 per cent fall in parents' time. There is no adverse effect of income on PARTIME for the nonworking-mother sample.

Estimates of the elasticity of doctor visits with respect to income center at 0.16 for the housewife sample and range from 0.2 to 0.56 in the working-mother sample, depending on the model specification—FULINC yielding the higher estimates. The results for FULINC appear to be biased upward, however, because of the assumption regarding working hours needed to define the variable. The true income elasticity is probably closer to 0.25.[30]

The sensitivity of DOCCUR and PARTIME to changes in the health care technology is slight, but the utilization of preventive visits (DOCPRV) does seem rather responsive to alterations in the perceived technology.

Finally, children in larger families have less time with parents, but the actual amount lost is very small. For the working-mother sample, however, there is a significant reduction in curative doctor visits as N increases.

5. TOWARD A PUBLIC POLICY FOR CHILDREN'S HEALTH

ENT infections are one of the most prevalent of childhood diseases. In addition to the discomfort for the child, parental anxiety, and lost days from school and work that such diseases generate, there are possible long-run implications to ENT illness as well. Left untreated, ear infections can lead to permanent hearing loss and/or damage to the child's central nervous system. Chronic ENT disease may mean poor school performance, poor adult health, and losses in future earnings.[31] If one of our health care objectives is to reduce the prevalence of this class of diseases, what policy instruments will work? Our empirical analysis of the family's provision of children's health provides some initial insight into this question. Table 7 lists the expected elasticities of a child's ENT health with respect to three prominently mentioned sets of policy instruments: (1) exogenous income and/or wage subsidies, (2) health insurance, and (3) the availability of care.

TABLE 7 The Elasticities of ENT Health with Respect to Economic Policy Instruments

		Target Population					
		Eighth Grade		High School		College	
Policy	Instrument	Working Mother	Nonworking Mother	Working	Nonworking	Working	Nonworking
Income	INC	.03	.02	.017	.013	.02	.014
	WIFWAGE	.016	—	*	—	*	—
Health insurance	DOCFEE	−.027	−.006	−.007	−.003	−.007	−.002
Access to care	TIMCOST	−.023	−.048	−.01	−.017	−.005	−.013

* See text.

The results are based on the elasticities in Table 6 and on calculated elasticities from Table 2 for the NOSICK and NOEARINF equations. For an upper estimate of the effectiveness of policy on children's ENT health, the higher of the two input elasticities from NOSICK and NOEARINF was used. A zero rather than a negative elasticity was assigned to DOCPRV in the eighth grade-public health equation and to PARTIME/N for the college-private health equation. The only elasticities that are substantially different from zero are 0.16 with respect to PARTIME/N and 0.17 with respect to DOCCUR for the eighth grade-public subsample, 0.082 with respect to DOCCUR for the high school-public subsample, and 0.045 with respect to DOCPRV and 0.041 with respect to DOCCUR for the college-private subsample. The elasticities in Table 7 are based on the sum of policy-induced changes in the use of health care inputs (PARTIME, DOCCUR, DOCPRV) times these average effects of inputs on health.[32] The results are disaggregated by the mother's educational level and work status.

Exogenous income transfers (INC) have a consistently positive effect on children's health, primarily through the inducement to buy more medical inputs. The effects of changes in the mother's wage is unclear. Children whose employed mothers have low levels of education are stimulated by the increase in WIFWAGE to substitute parents' time for less effective doctor visits. The net effect is an increase in the child's chances for ENT health. A similar conclusion probably holds for the employed mother, high school, and college subsamples as well, but a likely downward bias in our estimate of the effects of parent's time obscures this result.

A fall in the out-of-pocket costs of physician visits or in the time cost of such visits also has a positive net effect on a child's health prognosis. Such changes prompt an increase in use of physician services without inducing a sufficiently strong offsetting reduction in home care.

Although the effects of these policy changes on ENT health move in the expected direction, what is perhaps surprising is how small the average policy impact appears to be. Any sizable improvements in ENT health prospects resulting from these economic policy instruments will prove exceedingly costly. To increase the probability of NOSICK from 0.9 to 0.91—a 1 per cent improvement—may require an increase in income equal to about 50 per cent of husband's earnings (the main element in "exogenous" income) or a 25–50 per cent reduction in TIMCOST. A reduction in doctor fees appears no more effective. A 100 per cent reduction in out-of-pocket costs (from $6 to $0), as with universal coverage national health insurance, will increase the probability of no ENT infections for a child from about 0.9 to 0.91–0.93. And each of these calculations assumes no offsetting rise in TIMCOST or fall in quality of care, both of which may arise when increased aggregate demand hits the ambulatory care supply constraint. Whether these health gains can justify such costly policy measures remains to be seen.

The more effective policy strategies may be to improve medical technology and parental health knowledge or to alter the patterns of adult-child interactions. Improvements in medical technology or the health effectiveness of parents' time with children not only yield direct health payoffs through the attribute production function but also appear to induce an increased utilization of the more effective inputs. The net effect may be quite sizable. From our production and demand models, for example, a 10 per cent increase in the average health effectiveness of parents' time or doctor visits will lead to a 4 per cent increase in the probability of NOSICK for children whose mothers have an eighth grade education or less. For children in the higher mother-education subsamples a 1–2 per cent increase in probability of NOSICK may result. In addition, for children in the eighth grade sample, family planning or quality day care may be a useful policy for improving a present child's health prospect. Reducing the number of children under twelve (N) by half can lead to a 2 per cent increase in the probability of NOSICK.[33] The reduction in N increases parents' time with each child as well as the likelihood that a child, once sick, will be given curative care. These two effects have a significant pro-health impact for children in the lower-education subsample.

The point of presenting these numbers is not that they constitute a true basis for a children's health policy, but rather to argue that we should think seriously about analyzing policy alternatives that move beyond the usual income and price instruments of the economic model. At least for one important class of childhood diseases, improvements in health will not come easily. Efforts to influence the family's health performance through the economic parameters of price and income will yield only marginal improvements in children's ENT health. Changes in medical technology, parent health knowledge, and the patterns of adult-child interaction *may* be the more promising policy directions.

National health insurance may still be our protector against the financial risks of major illness, but it is not likely to be the cure for our children's runny noses.

DATA APPENDIX: VARIABLE DEFINITIONS

The variables are defined below and their means (variances) are given for each of the relevant subsamples.

Subsample Key

Eighth grade-public:	8GPUB	High school-public:	HSPUB
High school-private:	HSPRV	College-private:	COLPRV
Working mothers:	WM	Nonworking mothers:	NWM

Variable List

AGE: Age of the child in years.

8GPUB	HSPUB	HSPRV	COLPRV	WM	NWM
7.28	6.84	6.96	7.07	7.38	6.56
(11.07)	(10.27)	(9.14)	(10.65)	(9.80)	(10.24)

BLACK: 1 if child is black, 0 otherwise.

WM	NWM
.96	.93
(.03)	(.07)

COLDHIST: 1 if the child has three or more colds a year as reported by parents, 0 otherwise.

8GPUB	HSPUB	HSPRV	COLPRV	WM	NWM
.25	.34	.36	.35	.34	.32
(.20)	(.21)	(.23)	(.23)	(.22)	(.21)

DOCCUR: Number of visits to the doctor within the last six months for ENT diseases as reported by the parents.

8GPUB	HSPUB	HSPRV	COLPRV	WM	NWM
.65	.63	.73	.96	.72	.72
(1.01)	(1.36)	(1.81)	(2.58)	(1.85)	(1.54)

DOCFAITH: 1 if parents agree with "Doctors can cure most serious diseases"; 0 otherwise.

WM	NWM
.72	.73
(.19)	(.19)

DOCFEE: Average out-of-pocket costs for doctor visits as reported by parents.

WM	NWM
5.99	3.63
(64.80)	(53.29)

DOCPRV: Number of doctor check-ups for the child per year as reported by the parents.

8GPUB	HSPUB	HSPRV	COLPRV	WM	NWM
.42	.66	.69	.99	.70	.69
(.56)	(.79)	(.72)	(.74)	(.72)	(.77)

EARPAIN: 1 if child has complained to parents in last two weeks of loss of hearing, dizziness, earaches, plugged ears; 0 otherwise.

WM	NWM
.083	.098
(.07)	(.09)

EARSCAR: 1 if either left or right ear shows scarring of tympanic membrane, 0 otherwise.

8GPUB	HSPUB	HSPRV	COLPRV
.04	.026	.025	.018
(.04)	(.034)	(.024)	(.029)

FUTURE: 1 if parents disagree with "Nowadays, a person has to live pretty much for today and let tomorrow take care of itself"; 0 otherwise.

WM	NWM
.51	.41
(.25)	(.24)

INC: Annual family income in 000's.

WM	NWM
8.69	6.11
(19.27)	(17.22)

INCPC: Annual family income per member of family in 000's.

8GPUB	HSPUB	HSPRV	COLPRV
.87	1.11	1.84	2.55
(.71)	(.62)	(1.04)	(1.39)

MALE: 1 if child is a male, 0 otherwise.

WM	NWM
.51	.51
(.25)	(.25)

MARD: 1 if mother currently married, 0 otherwise.

WM	NWM
.63	.58
(.23)	(.25)

N: Number of children in the family between the ages of 6 months and 12 years.

WM	NWM
2.40	3.03
(1.38)	(1.77)

NOSICK: 1 if child has no diagnosed ENT disease at time of medical survey, 0 otherwise.

8GPUB	HSPUB	HSPRV	COLPRV
.93	.90	.93	.89
(.062)	(.09)	(.06)	(.09)

NOEARINF: 1 if child has no diagnosed symptoms of ear infection (tympanic membrane *not* red or amber/yellow), 0 otherwise.

8GPUB	HSPUB	HSPRV	COLPRV
.96	.93	.97	.94
(.042)	(.059)	(.025)	(.058)

PARHEAL: 1 if mother considers her health good or excellent, 0 otherwise.

WM	NWM
.84	.68
(.14)	(.21)

PARTIME: Amount of time parents spend with all children per day in play or conversation. Based on response to the question "Do you usually play or converse with your children: (1) every day, (2) every other day, (3) once or twice a week, (4) twice a month, (5) once a month or less." Answers were scaled assuming each daily contact with all children was about two hours.

WM	NWM
1.79	1.82
(.25)	(.23)

PARTIME/N: Total estimated time divided by number of children between 6 months and 12 years.

8GPUB	HSPUB	HSPRV	COLPRV
.72	.75	.92	1.09
(.26)	(.25)	(.31)	(.34)

RELIGION: 1 if parents attend religious services once or more a week, 0 otherwise.

WM	NWM
.26	.30
(.18)	(.21)

TIMCOST: The average travel plus average waiting time per child visit to the doctor in minutes.

WM	NWM
47.93	53.37
(880.90)	(1024)

WIFWAGE: Estimated hourly wage of working mothers based on mother's occupation and Washington, D.C., *Area Wage Survey* data.

WM
2.81
(1.32)

NOTES

1. Based on an estimated 20,000 practicing pediatricians earning an average income of $40,000 yearly. The public budget figures include spending at the federal, state, and local level on maternal and child health services and school health. *Statistical Abstract of the United States*, 1973, pp. 68, 71.
2. We concentrate on physical healthiness both in the theoretical and empirical portions of this study simply because the "economic model" is not well-suited for handling the discrete "taste changes" that are likely to accompany changes in mental health.
3. See also Michael Grossman, *The Demand for Health: A Theoretical and Empirical Investigation* (New York: National Bureau of Economic Research, Occasional Paper No. 119, 1972), and Charles Phelps, *Demand for Health*

Insurance: A Theoretical and Empirical Investigation, R-1054-OEO, The Rand Corporation, July 1973.

4. This approach differs from the work of Grossman, *The Demand for Health*, wherein subjective indices are used to specify the individual's healthiness—for example, individual judgments of own health as poor, fair, good, excellent. Grossman is sensitive to the limitations these subjective indices place on his conclusions. Although conclusions about the statistical significance and relative importance of variables can often be made in models involving ordinal dependent variables (see Sanford Labovitz, "The Assignment of Numbers to Rank Order Categories," *American Sociological Review* (June 1970), conclusions about measured marginal impacts are not valid. To correctly specify and estimate a "health production function" requires cardinal, not ordinal, measures of output.
5. This is the approach to health care uncertainty used in all previous work. See, for example, Phelps, *Demand for Health Insurance.*
6. One attractive specification of the attribute technology is to specify (1) as Cobb-Doublas where (1a) incorporates the random effect of $\tilde{u}$ as a shift parameter, $e^{\tilde{u}}$, and $\tilde{v}$ as an additive random term attached to the coefficients on x_i. When $\tilde{u}$ and $\tilde{v}$ are normally distributed, health care attributes, A_t, will be lognormally distributed. For a full development of this case, see Robert Inman, "Health-Care Demand When Outcomes Are Uncertain," mimeo., University of Pennsylvania, 1974.
7. The demand specification above assumes that the consumer's health insurance coverage is exogenously set, either through employment or publicly provided coverage. The recent work of Charles Phelps, *Demand for Health Insurance*; and Isaac Ehrlich and Gary Becker, "Market Insurance, Self-Insurance and Self-Protection," *Journal of Political Economy* (July–August 1972), has led to the development of models in which health care demand and insurance coverage are jointly determined. Our model fits easily into their framework and extends their analysis by allowing for the uncertain effects of health care (self-protection) activities. In the more general model, the consumer's allocation problem can be split into two sequential decisions. At the start of each period, the consumer decides on the level of health insurance coverage, knowing the market prices of x and y, his income I, μ, σ_u^2, β, σ_v^2, A_0, and the market-determined price of health insurance. The demand specifications in (3) above are conditional on the extent of health insurance coverage, especially the coinsurance rate that reduces the gross market prices for health services to the net price, p_x, which is used in (3). Substituting $\phi_i(\cdot)$ into the consumer's utility function $U[x, y, A(x)]$ and optimizing over the insurance parameters allows us to specify preferred insurance coverage (see Phelps, *The Demand for Health Insurance*). Once coverage is set, the consumer buys care according to (3). This extension of our model argues that the price of insurance should be included in the demand equations for health-related goods and services.
8. Of course, if we sufficiently restrict the specification of (1a), and (2), predictions about the demand effects of changes in μ, σ_u^2, β, and σ_v^2 do emerge. See, for example, S. Turnovsky, "A Model of Consumer Behavior under Conditions of Uncertainty in Supply," *International Economic Review* (February 1971), and Walter Oi, "The Economics of Product Safety," *The Bell Journal of Economics and Management Science* (Spring 1973). Turnovsky assumes a quadratic specification for $U(\cdot)$ in (2), whereas Oi assumes a perfect insurance market for commodity failures (in our case, sickness) or a "far-sighted" consumer making many purchases of the good with the uncertain

effect. Neither specification seems particularly attractive for our problem. In another paper, "Health Care Demand When Outcomes Are Uncertain" (mimeo.), University of Pennsylvania, 1974, I develop the demand specifications for a constant relative risk-aversion utility function with lognormally distributed health attributes. There I show that in the three-good cares (preventive care, curative care, and y) with a single health attribute, consumers who are sufficiently risk averse with respect to health (the Pratt-Arrow measure of relative risk aversion exceeding 1) will increase their use of preventive or curative care as the expected marginal health impact for the good increases ($d\beta_{it} > 0$) or as the uncertainty of the marginal health impact declines ($d\sigma^2_{v_{it}} < 0$). Section 4 presents some tentative evidence to support this prediction in the case of children's health.

9. The emphasis here on the consumption benefits of child health care does not preclude the notion that health care can be a means to a further end—say, good school performance. However, the model does ignore the human capital formation motive for child health care allocations. See, for example, Michael Grossman, "The Correlation between Health and Schooling," National Bureau of Economic Research, Working Paper No. 22, December 1973; and Marc Nerlove, "Household and Economy, Toward a New Theory of Population and Economic Growth," *Journal of Political Economy*, Part II (March–April 1974). I provide some tentative evidence on the choice between the two models in Section 4. See the discussion of the variable FUTURE below, and the results in tables 4 and 5 for this variable.
10. The survey was conducted as part of the National Academy of Sciences, Institute of Medicine, study entitled "Contrasts in Health Status: An Analysis of Contrasting Forms of Medical Care Delivery." The survey involved a detailed questionnaire of family health attitudes, economic status, and utilization of health care facilities within six months prior to the date of the interview. Interviews were conducted from December 1970 to April 1971. There were 1,435 families in the study's final sample. Children between the ages of 6 months and 12 years in the sample families were then given a detailed ENT clinical examination and those over 3 years were given sight and hearing examinations as well. Approximately 2,600 children were examined by the survey's panel of physicians. My working sample based on complete data for all variables used in this study came to 1,692 children.
11. An earlier version of this paper also examined nose infections, but Lee Benham correctly pointed out that because of the very low prevalence rate and often small sample sizes, these results were virtually useless.
12. For a biological model generating a logit specification for (1,0) health attributes, see J. Truett, J. Cornfield, and W. Kannel, "A Multivariate Analysis of Risk of Coronary Care," *Journal of Chronic Disease* (April 1967).
13. See David Kessner and D. McEldowney, "The Epidemiology of Otitis Media," in K. S. Gerwin and A. Glorig (editors), *Otitis Media: Proceedings of the National Conference* (Springfield, Illinois: Charles C. Thomas, 1972).
14. Parents' time per day per child in play or conversation is based on the parents' response to the question, "Do you usually play or converse with your children: (1) every day, (2) every other day, (3) once or twice a week, (4) twice a month, (5) once a month or less?" Answers were then scaled into an estimate of total parents' time (PARTIME) with all children by assuming that each daily contact with all children consumed about two hours. Recent work by Arleen Leibowitz, "Education and Home Production," *American Economic Review* (May 1974), finds that parents do spend, on average, about two hours per day on the

physical and educational care of their children. Leibowitz also finds that the amount of time per contact is *not* significantly related to parents' educational levels. This fact is relevant, since our production model will be estimated for subsamples based on mothers' educational levels.

15. See L. Pratt *et al.*, "Physicians' Views on the Level of Medical Information among Patients," in W. Scott and E. Volkhaut (editors), *Medical Care: Readings in the Sociology of Medical Institutions* (New York: John Wiley, 1966); and R. Duff and A. Hollingshead, *Sickness and Society* (New York: Harper and Row, 1968). Also, J. Samora *et al.*, "Knowledge about Specific Diseases in Four Selected Samples," *Journal of Health and Human Behavior* (Fall 1952); S. S. Kegeles *et al.*, "Survey of Beliefs about Cancer Detection and Taking Papanicoloan Tests," *Public Health Reports*, No. 80, September 1965; and D. Rosenblatt and E. Suchman, "The Under-utilization of Medical Care Service by Blue Collarites," in *Blue Collar World* (Englewood Cliffs, New Jersey: Prentice-Hall, 1954), have found that lower socioeconomic families have less accurate information about the causes and characteristics of many diseases than higher socioeconomic families.
16. TIMCOST equals the average travel and waiting time for the child for doctor visits over the six months prior to the family interview. If the child did not go to the doctor during this period, TIMCOST was calculated as the average travel plus waiting time of his or her siblings' visits.
17. WIFWAGE is approximated by the average hourly earnings for the occupational class in which the mother is employed. Exact wage data were not available. Occupational wage information was obtained from the *Area Wage Survey*, 1970, Bureau of Labor Statistics, Washington, D.C.
18. DOCFEE equals the average out-of-pocket costs of the child's physician visits during the six months prior to the family interview. If the child did not go to the doctor during this period, DOCFEE was set equal to the average out-of-pocket costs for the child's siblings' visits. Defining DOCFEE as an average of out-of-pocket costs sidesteps the errors-in-variables problems that arise because of the common physician practice of "two-part" pricing—charging a high initial price for each "work-up" visit and then low to zero prices for all follow-up visits.
19. Theil's work on "models with random coefficients" offers a richer econometric specification of our model, closer to the spirit of the work in Section 2. See Henri Theil, *Principles of Econometrics* (New York: John Wiley, 1971), pp. 622–627. In the framework above, uncertainty about health effects arises only because of inadequate inference on the part of the consumer of a true, "certain" health effect, β. Actually, of course, β is rarely known exactly even by health professionals with large samples. Theil's specification allows the variance of β to remain, even as sample size increases. For testing of our demand model, the extension into Theil's "models with random coefficients" is probably not worth the added effort. But in an analysis of health attribute production functions, it is an extension that should be seriously considered.
20. Comparing the results in Table 2 with my initial estimates of the DOCCUR coefficient shows a significant downward bias in the DOCCUR coefficient when this "instrumental variables" procedure was not employed. The estimates of the other coefficients in the model are nearly identical between the two estimating procedures. However, the asymptotic properties of this instrumental variables procedure for the logit model are not known, and the reader should treat these parameter estimates with suitable caution.
21. The coefficient ξ is in effect the slope of the "production possibility frontier"

for child attributes. Given a level of family inputs, more of one attribute may mean less of another.

22. An argument similar to the one just presented for the bias in the PARTIME/N coefficients can be developed for the income per capita variable as well. If parental income is positively related to child IQ and self-worth, as one might expect ($\delta > 0$), then from the model above, the estimated coefficients on INCPC will be biased toward zero. As with the bias to parents' time effects, I know of no evidence that will permit us to judge the seriousness of this underestimation.

 The arguments here are not likely to apply to the doctor visit inputs or to past health states since the direct relationship of these variables to IQ or self-worth are likely to be negligible ($\delta \sim 0$).

23. If the parameter estimates, $\tilde{\beta}_{it}$, are normally distributed as $N(\beta_{it}, \sigma^2_{v_{it}})$, then statistical tests for the equality of means and variances across subsamples for each health care input can be made. For a test of equality of variances, the test statistic is the ratio of variance estimates that is distributed as F with parameters $(n - 1, n - 1)$, where $n = 200$. The null hypothesis of equal $\sigma^2_{v_{it}}$'s is rejected for all comparisons made by pairs at the 0.9 level and for all but three at the 0.99 level. For a test of equality of means ($= \beta$'s) of two normal populations with known but different variances, the test statistic is $Z^2 = (\beta_0 - \beta_1)^2 / (\sigma_0^2/n + \sigma_1^2/n)$, which is distributed as χ^2 with one degree of freedom. The null hypothesis of equal mean effect was rejected for all pairwise comparisons at the 0.9 level except for the comparison of β_{it} for DOCPRV for the high school-public and the high school-private subsamples.

 Yet even if one accepts the normality assumption for β_{it}, the formal tests for equality of the PARTIME/N coefficients and their variances are biased in an unknown direction because of the bias in our estimates of PARTIME/N. Although we can say with some confidence that β_{it} for PARTIME/N is biased downward, no conclusions about the direction of bias in its standard error can be made. Thus $\sigma^2_{v_{it}}$ is biased away from the true variance in an unknown direction and the formal tests above for PARTIME/N are therefore biased in an unknown direction. Caution should be the keyword here.

24. The pattern is identical for the coefficients and variance estimates from the NOEARINF equation.

25. See, for example, Arleen Leibowitz, "Home Investments in Children," *Journal of Political Economy* (March–April 1972), Part II; and Jerome Kagan and H. A. Moss, "Parental Correlates of Child's IQ and Height," *Child Development* (September 1959).

26. See Arnold Zellner, "An Efficient Method of Estimating Seemingly Unrelated Regressions and Tests for Aggregation Bias," *American Statistical Association Journal* (June 1962).

27. The fact that our analysis is restricted to the provision of ENT health for children makes the first three assumptions less troublesome than they might be for an adult health study or a study of "major" (e.g., crippling) child diseases. Family health coverage is largely exogenous (publicly provided or part of the employee contract) for our sample. For those families buying supplemental insurance, it is unlikely that this coverage will be motivated by a child's ENT diseases.

 The choice of the provider—and subsequently the provider's location, which helps define TIMCOST—is also likely to be independent of a child's ENT health. The possible exceptions are children with chronic ENT problems, but they appear to be few in our sample. Acton's simultaneous equation estimate of the role of outpatient visits as a determinant of travel distance is negative, as expected, but not significant. However, in Acton's work distance is a significant (negative) determinant of outpatient visits, a result similar to the one obtained here. See Jan Acton, "Demand for Health Care When Time Prices Vary More Than Money Prices," R-1189-OEO/NYC, The Rand Corporation, May 1973.

The mother's work status is also independent of the family's provision for ENT health. The correlations of mother's work status (1 if works, 0 otherwise) with DOCCUR, PARTIME, DOCPRV, EARPAIN, and COLDHIST never exceed 0.03.

The fourth assumption that assumes the exogeneity of family size is counter to recent household models that argue that number (N) and "quality" of children (of which ENT health is a part) are jointly determined. An alternative view of the parents' decision to have and care for children is to treat the decisions as a sequential process of decision, learning, and decision subject to the constraint that we cannot freely destroy the fruits of prior labor. In such a model, parents decide to have a child and once it is born care for that child as they see fit. The child is a blessing or a burden relative to prior expectations. If a blessing ("quality" greater than expected), they decide to have another. Once born, the parents care for both children as best they choose. Again they compare expected "joy" to received "joy" and decide to have another child or stop the process. It is clear that the fertility-child "quality" model being suggested here is recursive and allows us to identify the true effects on the provision of children's health. Unfortunately, our data base is not sufficiently rich to allow enough degrees of over-identification so that N might be made endogenous and permit us to test these alternative models of the fertility/child-raising process.

28. The fact that our estimates of the mean effect and the variance of this effect are biased for PARTIME/N will not alter our conclusions if the degree of bias is nearly constant across the four subsamples. I have argued earlier, however, that the degree of bias may be systematically related to mother's education. If so, the mother's education should be included in (1c) along with MEANPART and VARPART. But multicollinearity between these variables prevents us from drawing any inferences about the effects of technology in this case. The results in (1c) must therefore be treated as tentative, limited by the proviso that the bias in MEANPART and VARPART is not systematically related to parental education.
29. See, for example, J. P. Newhouse and Charles E. Phelps, "New Estimates of Price and Income Elasticities of Medical Care Services," in this volume.
30. To check for this bias, I reestimated equations (1a), (2a), and (3a), specifying preferred hours worked (t_w) to be a linear function of WIFWAGE. Substituting $t_w = \alpha + \delta$ WIFWAGE into the definition of FULINC [=INC + $(T - t_w)$*WIFWAGE] and this new specification of FULINC into our demand model yielded reduced-form equations in prices, technology, tastes and INC, WIFWAGE, and WIFWAGE^2. Estimating these equations gave "corrected" utilization elasticities with respect to income of about 0.25, suggesting that the true elasticities lie nearer the lower end of the original range.
31. For an interesting study relating childhood health to schooling and adult earnings, see Michael Grossman, "The Correlation between Health and Schooling," National Bureau of Economic Research, Working Paper No. 22, December 1973.
32. The use of the elasticities based on mean health effect, β_{it}, without regard to the

standard errors of these estimates implicitly assumes that society should be risk neutral when allocating resources to children's health. For arguments to justify this assumption, see Kenneth Arrow and Robert Lind, "Uncertainty and the Evaluation of Public Investment Decisions," *American Economic Review* (June 1970).

33. For a summary of other studies that find that smaller families mean healthier children, see Joel D. Wray, "Population Pressure on Families: Family Size and Child Spacing," in National Academy of Sciences, *Rapid Population Growth* (Baltimore: Johns Hopkins Press, 1971).

6 COMMENTS

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Inman raises two important questions in this paper: (1) How do physician visits and parents' time spent with children affect children's health? and (2) How responsive are parents to the health benefits their children receive from these two inputs? To provide answers to these questions, he develops and estimates a production function for children's health and a demand function for health inputs. I will comment on each of these in turn.

In the production function for children's health, health status is measured by three dummy variables indicating whether the child had an ear, nose, or throat infection; an inner ear infection; or a cold. Approximately 10 per cent of the children in the sample had one or more of these illnesses; less than 3 per cent had a cold. The combination of the relatively small sample sizes and the small proportion of ill children raises serious questions about the reliability of the production function estimates. As an extreme case, Table 2 indicates an eighth grade sample size of 136. According to the overall sample characteristics, approximately 4 children in that group had colds. The dependent (dummy) variable therefore has a value of 1 in approximately 132 cases and zero in the other 4. It is difficult to have confidence in production function estimates based on such small numbers.

Even if the sample size is accepted as adequate for estimating the systematic association between children's health status and the inputs examined, the results in Table 2 provide only very weak support for the view that children's health status is positively associated with inputs of physician visits and parents' time. Of the 36 estimates of input coefficients reported, 22 are positive and 14 negative. Furthermore, these estimates are rarely significantly different from zero. I am not persuaded that productivity benefits from these inputs have been shown.

The demand function includes the usual price and income components plus variables obtained from the production function concerning the mean and the variance of the effect of parents' time and physician visits on children's health. Inman's approach is clever. It provides a method of investigating the response of parents to the benefits and uncertainties of inputs to improve their children's health. As these inputs become more effective, the demand should increase, *ceteris paribus*. As the variance of the effects increases, however, the demand should decline if consumers are risk averse. The problem here, however, is that the measures of health benefits used in the demand equation are taken from the production function estimates. If there are no benefits from physician visits or parents' time, or if the production function estimates are not reliable because of sample size, the coefficient estimates for the health productivity variables in the demand equation will not be meaningful. Thus I do not believe that the estimated coefficients of the variables representing the mean and variance of productivity of parents' time and physician visits shown in Table 4 are reliable indicators of parents' demands for these services.

There is a further problem in the demand equation. Several variables that contain both wage (price) and income components are included simultaneously. Consider the composition of the variables included in equations (1a), (2a), and (3a) in Table 4. WIFWAGE is the estimated hourly wage of the mother based on the earnings of women with the same occupation in the Washington, D.C., area. The average occupational wage rate surely includes a large permanent income component, and the coefficient of this variable will in part measure the impact of income on the demand for parents' time and physician visits. FULINC is a measure of full family income that includes the wife's occupational wage times a fixed number of hours per year plus other family income. FULFEE includes wife's wage multiplied by the time cost of visiting a physician plus the physician's fee. In addition, three dummy variables are entered for parents' years of schooling. These variables are also proxies for permanent income. Since several measures of income and wage rates are included simultaneously as independent variables, the interpretation of the individual coefficients is not obvious. This is perhaps why some of the results appear curious when given a straightforward interpretation. For example, Inman writes, "WIFWAGE, the 'price' of parents' time with children, is *positively* related to PARTIME (parents' time with children) and negatively related to doctor visits. These results suggest that for working mothers time with children is an inferior good with respect to income changes and a Giffen good with respect to changes in WIFWAGE!" Economists have been seeking a Giffen good for a long time. Before we conclude that the quest has ended, additional analysis will be necessary to obtain more precise measures of the income and substitution effects.

The problems discussed above are primarily attributable to data deficiencies and should not detract from Inman's contribution in raising some important issues. He has been clever in developing a model that examines both the productivity of inputs on health status and the effects of productivity and uncertainty on the demand for inputs. It is time that we knew more about these questions, and Inman has given us a good start.

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There are a number of aspects of Inman's analysis that deserve comment. Let me first offer a more general commendation. Although the health of children has attracted little attention from economists, it is clearly a major area of current public policy concern. Although the government health care initiatives of the 1960s diminished social-class differences in the receipt of medical care among adults, their impact on children's medical care was modest at best. The ramifications of poor health status and underconsumption of care among children in lower social classes are probably very significant; Grossman's recent work (1973) suggests that the formation of "health capital" in childhood has very significant effects on the accumulation of several forms of human capital in later life. We are indebted to Inman, as well as Grossman, for bringing the issue to our attention in a forceful and interesting way.

As for the empirical analysis, let me first point out that Inman's production function estimates are not exactly encouraging. Leaving aside the few coefficients with significant and correct signs, his results generally suggest that both parental and professional inputs to the medical care production process have little or no impact on the ENT health of children and that the same is true of the "material environment" (INCPC). But if this is the case, what weapons have we in the war against ENT disease? Are we really as helpless as these results imply? Perhaps because I have been brainwashed by the medical profession and the social epidemiologists, I am reluctant to accept this conclusion and therefore am inclined to search for other explanations of these results.

One possible explanation concerns the way Inman has divided his sample. By estimating separate equations for samples defined by educational level, he seems to have substantially limited the range of variation of a number of variables within each equation. For example, data in his appendix suggest systematic variations across samples in per capita income and parental time inputs that are large relative to within-sample standard errors. This homogeneity within samples may be an important explanation for the consistently insignificant findings.

Another explanation, and the one that I regard as most important, relates to Inman's choice of dependent variables. These are 0-1 dummies indicating the presence or absence of colds or ear infections. By and large, these illnesses probably tend to be mild and short-lived even if untreated. The importance of their prevalence as a measure of health status is not readily apparent. But what is most significant is the resistance of these infections (particularly viral infections) to prevention or amelioration by medical care of either the professional or parental variety. Therefore, zero marginal products for medical care inputs are generally what we would expect.

It could, however, be argued that an alternative interpretation of Inman's dependent variables is more appropriate. Given the natural history of most ENT infections, variations in their prevalence rates at any point in time are largely determined by variations in incidence rates; and variations in incidence rates are probably associated with more fundamental differences in physical health that determine susceptibility to infection. Inman's dependent variables could therefore be viewed as proxies for these more fundamental differences. Should we not then be surprised at the result that the "material environment" and parental and professional care have no appreciable effects on these differences?

Again the answer is no, but for a different reason. The differences in physical health that determine susceptibility must certainly be highly correlated with recent health history. But if his dependent variable is a proxy for these differences, Inman's inclusion of independent variables describing recent health history leads me to expect the insignificance of other independent variables. This same point could be made by an unfair analogy. If we obtained data from a cross-section of firms and ran a regression in which today's capital stock was the dependent variable and the two independent variables were yesterday's capital stock and something else, we would hardly be shocked to find that only the coefficient for yesterday's capital stock was significant.

One other possible explanation of the production function results should at least be mentioned. In their more extensive study of the data used by Inman, Kessner, *et al.* (1974) concluded that the medical services provided to children suffering from ear infections were of poor or at best mediocre quality. If there is a relationship between this quality rating and the efficacy of care provided, then Inman's findings are attributable, at least in part, to the failures of individual physicians rather than the limitations of medical science.

In summary, I am not sanguine about curing our children's runny noses, but I would not conclude from Inman's results that health policy can do little to affect the ENT health of children. There is, after all, considerable evidence—from the National Health Examination Survey and elsewhere—that variations exist among income and educational groups in the more serious consequences of ear infection, such as scarring of the eardrum and resultant hearing loss. (Differences in Inman's sample means for EARSCAR bear this out.) I strongly suspect that these variations are attributable to differences in medical care, parental care, and the "material environment" and that policies relating to these variables would indeed pay off in terms of better ENT health. The problem for now is to build on the work considered here to obtain more reliable quantitative estimates of policy effects.

Turning to Inman's estimated demand functions, I shall only offer several brief comments. First, it is interesting that in the doctor-visit equations for the working-mothers sample, the cross-price effects (i.e., the wage coefficients) are negative. A possible explanation is that the time cost of medical services includes time at home in following the doctor's orders as well as travel and waiting time.

Second, the use of out-of-pocket cost as a price measure poses problems because it does not take account of differing insurance coverage. That is, insured persons may purchase more services per doctor visit than uninsured persons or they may frequent higher-quality providers, and their out-of-pocket costs may be the same or higher. Clearly, they face a lower price than uninsured persons, although the out-of-pocket cost measure of price will understate this difference.

Third, I am uneasy with the parental time demand equations for several reasons. The reported means and standard deviations of the parental time variable indicate very little variability. I suspect that this is not true in reality but that Inman's measure is simply too crude to pick up much of the variability that in fact exists. Also, since this variable measures total time input, only a small part of which will be health-related, it is surprising to find significant cross-effects for the time and money prices of medical care. This is rather like finding that the demand for television sets is significantly related to the price of tickets to a baseball game. Finally, I am not wholly convinced by Inman's argument that parental time inputs and the number of children are not simultaneously determined. Even if parents do not formulate multiperiod maximization problems, they may have rather stable preferences for the manner (including time inputs) in which they raise their children, and they will take these into account in deciding how many children to have.

I have thus far avoided discussing Inman's theoretical framework. But with national health insurance so much in the air, I suppose it is imperative that one's comments achieve universal coverage. For the sake of completeness, then, I offer the following two observations.

First, Inman has skillfully expanded on previous work by explicitly introducing uncertainty into his demand model. However, this may be a mixed blessing. Although it adds realism, it also complicates empirical implementation. Given our current difficulties in simply getting reasonable estimates for production function coefficients, one cannot help but feel a little nervous about demand functions that include the *variances* of these coefficients as independent variables.

Second, Inman's logit production functions differ from previous work in that past health status enters multiplicatively. In the past, this variable has been added to a health-increment production function to obtain current health status. The difficulty with Inman's multiplicative specification is that it results in marginal products for medical care that decrease as past health status decreases. The sicker you are, the less the doctor can do for you. Although there may be some instances in which this is true, as a generalization it is not very appealing. It also seems to suggest that illness reduces the demand for medical care, a result that is certainly counter-intuitive.

I would like to conclude with a more general observation, a comment on my comments. A number of the criticisms I have raised about the empirical work in this paper relate directly to deficiencies in data. Although Inman's analysis is interesting and well executed, it is obviously constrained by these deficiencies. And it is just as obvious that further progress in this important area of economic research will depend on the relaxation of data constraints. I believe the best way to ensure this progress is to become actively involved in designing and generating more useful bodies of data.

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