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Appendix E

ADDITIONAL EMPIRICAL RESULTS

1. A PRIORI ESTIMATES

The observed effects of education and the wage rate on the demand for health reported in Chapter V are precisely the ones predicted by the investment model. The coefficients of these two variables have the "wrong signs," however, in the demand curve for medical care. Appendix D showed that biases introduced by (1) measurement error in the wage rate and (2) a positive association between the wage and innate ability operate in opposite directions on a given health regression coefficient but in the same direction on the corresponding medical care coefficient. Since the two sources of bias tend to offset each other in the health demand curve, it is not surprising that the estimates of its parameters are more consistent with a priori notions. Moreover, the correlation between the wage rate and education exceeds the correlation between the former and any of the other independent variables except income. So the negative relation between the wage rate and the medical care function's error term seriously affects not only the estimate of the wage elasticity but also the estimate of the education parameter.[1]

Assuming that the biases exactly offset each other in the health demand function, one can use its education or wage coefficient to solve for the corresponding medical care coefficient. He can then force the education coefficient, for example, to assume its proper value and examine the effect of this procedure on the estimates of the other coefficients of the medical care demand curve. In the stock of health demand curve in Table 1, the education coefficient is $r_H \varepsilon = .025$. Since $\varepsilon = .5$, $r_H = .05$. Therefore, education's medical care parameter should be $r_H(\varepsilon - 1) = -.025$. Consequently, if $\ln M + .025E$ were the dependent variable in the medical care demand function and if E were excluded from the regression, its coefficient would be forced to equal the appropriate value.

[1] The difficult question of the effect of the biases on the income elasticity of medical care was not treated in Appendix D. This appendix comments on the change in the income elasticity induced by improved estimates of the wage and education parameters.

Along similar lines, the stock elasticity of the wage rate is $(1 - K)\varepsilon = .090$, which suggests $K = .82$.[2] The wage elasticity of medical care is given by $(1 - K)\varepsilon + K\sigma_p$, where σ_p is the elasticity of substitution between medical care and own time in the production of gross investment. The Cobb-Douglas specification implies $\sigma_p = 1$, so the wage elasticity of medical care should equal .910. By defining the dependent variable as $\ln M - .910 \ln W$ and excluding $\ln W$ from the regression, such a value would actually be obtained. The structure and reduced form of the model would be practically unaffected if medical care and own time were employed in fixed proportions. Therefore, σ_p might also be set equal to zero to get a lower bound on the wage elasticity. In this case, the elasticity would be .090, and the dependent variable in the medical care demand curve would be $\ln M - .090 \ln W$.

Table E-1 gives demand curves for medical care that take account of the a priori restrictions on the coefficients of E and $\ln W$. In the first regression in Part A of the table, the coefficient of E is set equal to $-.025$. In the second, the wage elasticity equals .910, while in the third, it equals .090. The fourth regression defines the dependent variable as $\ln M + .025E - .910 \ln W$ so that both restrictions are imposed simultaneously. Finally, the fifth regression uses $\ln M + .025E - .090 \ln W$ as the dependent variable.

The regressions in Part B of the table are based on the coefficients of E and $\ln W$ in the health flow demand curve.[3] This function suggests that education's medical care parameter should be $-.046$. It also suggests a wage elasticity of .676 if $\sigma_p = 1$ and an elasticity of .324 if $\sigma_p = 0$.

The table shows that when the education coefficient alone is restricted, the wage elasticity increases in absolute value. In Table 3, this elasticity equals $-.105$, in Part A of Table E-1 it equals $-.009$, and in Part B, it equals .046. Although the wage elasticity is still negative in Part A and is never statistically significant, the magnitude of its increase is substantial.

Restricted wage elasticities that are based on an elasticity of substitution equal to unity make the education coefficient negative but not statistically significant. These wage elasticities generate income elasticities equal to .080 (Part A) and .221 (Part B). Such elasticities are smaller than

[2] In this section, all wage elasticities of health are taken from regressions that use $Y4$ as the income variable. These elasticities give conservative lower estimates of the true parameters.

[3] In particular, averages of the wage and education coefficients in the work-loss days and restricted-activity days regressions are used.

TABLE E-1
A Priori Estimates of Demand for Medical Care by Whites with Positive Sick Time

Assumed σ_p	ln $Y4$	ln W	E	i	Sex	ln FS	$\bar{R}^2$
			A. Based on Stock Coefficients				
Not restricted	.685	−.009	−.025[a]	.013	.548	−.222	.073
	(3.86)	(−.05)		(2.41)	(2.82)	(−1.41)	
1	.080	.910[a]	−.035	.014	1.024	−.020	.072
	(.56)		(−1.51)	(2.35)	(5.78)	(−.13)	
0	.576	.090[a]	.002	.016	.600	−.168	.067
	(4.17)		(.11)	(2.67)	(3.47)	(−1.09)	
1	.064	.910[a]	−.025[a]	.015	1.025	−.009	.069
	(.46)			(2.56)	(5.79)	(−.06)	
0	.618	.090[a]	−.025[a]	.014	.599	−.199	.070
	(4.61)			(2.43)	(3.49)	(−1.31)	
			B. Based on Flow Coefficients				
Not restricted	.680	.046	−.046[a]	.012	.576	−.232	.075
	(3.82)	(.27)		(2.16)	(2.95)	(−1.47)	
1	.221	.676[a]	−.024	.014	.903	−.062	.063
	(1.58)		(−1.06)	(2.45)	(5.15)	(−.50)	
0	.435	.324[a]	−.008	.015	.721	−.126	.061
	(3.13)		(−.36)	(2.58)	(4.16)	(−.82)	
1	.254	.676[a]	−.046[a]	.013	.902	−.086	.063
	(1.87)			(2.28)	(5.15)	(−.56)	
0	.492	.324[a]	−.046[a]	.012	.720	−.168	.064
	(3.65)			(2.22)	(4.15)	(−1.10)	

[a] Coefficient *forced* to assume the value shown.

all existing estimates, and few students of the demand for medical care would accept their validity.[4] More reasonable income elasticities result when σ_p is set equal to zero, particularly when the education coefficient is

[4] Previous studies indicate that the income elasticity of medical care is slightly less than unity. If the wage elasticity is positive, then these estimates are biased upward. In a recent study, Morris Silver computed an income elasticity that did hold the wage rate constant. He obtained an income elasticity of 1.20 and a wage elasticity of 2.07. (See "An Economic Analysis of Variations in Medical Expenses and Work-Loss Rates," in Herbert E. Klarman (ed.), *Empirical Studies in Health Economics*, Baltimore, 1970, and reprinted as Chapter 6 in Victor R. Fuchs (ed.), *Essays in the Economics of Health and Medical Care*, New York, NBER, 1972. In my judgment, Silver's elasticities are unreasonably high.

also constrained to be negative. If the wage coefficient alone is restricted and is assumed to equal .090, the education coefficient falls from .012 (Table 3) to .002 (Table E-1, Part A). While education still has a positive effect on medical care in the a priori demand curve, the size of this effect is much smaller.

The conclusions to be drawn from a priori estimation are, at best, tentative because the technique assumes that the health coefficients are unbiased. But the results do indicate that an a priori computation of the education parameter improves the actual estimate of the wage elasticity. Conversely, an a priori computation of the wage elasticity improves the actual estimate of the education parameter. The reduction in the calculated education effect and the increase in the wage effect suggest that biases introduced by errors of measurement may play an important role in the demand curve for medical care. The results also indicate that the elasticity of substitution between medical care and own time is small. This means that even if the wage elasticity is positive, it cannot be very large.

2. DEMAND CURVES: ALL WHITES IN THE LABOR FORCE, MALES, AND FEMALES

Tables E-2, E-3, and E-4 present a complete set of demand curves for all whites in the labor force. Tables E-5, E-6, and E-7 present a complete set of these functions for males with positive sick time; and Tables E-8, E-9, and E-10 give demand curves for females with positive sick time. The reader is left to inspect these tables for himself.

TABLE E-2
Stock Demand for Health by All Whites in the Labor Force

Income Measure	ln *Y*	ln *W*	*E*	*i*	Sex	ln *FS*	$\bar{R}^2$
*Y*1	.006	.067	.022	−.007	−.036	−.027	.106
	(.26)	(3.15)	(6.83)	(−8.54)	(−1.43)	(−1.20)	
*Y*2	.015	.062	.022	−.007	−.034	−.030	.106
	(.61)	(2.92)	(6.85)	(−8.56)	(−1.52)	(−1.30)	
*Y*4	.019	.060	.022	−.007	−.041	−.032	.106
	(.84)	(2.96)	(6.76)	(−8.56)	(−1.58)	(−1.37)	
*Y*4	.057		.025	−.007	−.080	−.043	.102
	(3.00)		(7.58)	(−8.39)	(−3.60)	(−1.87)	
Y omitted		.070	.022	−.007	−.035	−.026	.106
		(4.14)	(6.96)	(−8.55)	(−1.40)	(−1.17)	

NOTE: The health stock series is 1 = poor, 2 = fair, 3 = good, 6 = excellent.

TABLE E-3
Flow Demand for Health by All Whites in the Labor Force

Income Measure	ln *Y4*	ln *W*	*E*	*i*	Sex	ln *FS*	$\bar{R}^2$
			TL = *WLD*1				
*Y*1	.048	.207	.066	−.009	.114	.180	.008
	(.26)	(1.25)	(2.52)	(−1.23)	(.57)	(1.02)	
*Y*2	−.128	.295	.066	−.009	.163	.220	.008
	(−.66)	(1.80)	(2.66)	(−1.17)	(.80)	(1.23)	
*Y*4	−.092	.277	.066	−.009	.150	.216	.008
	(−.52)	(1.75)	(2.65)	(−1.18)	(.75)	(1.20)	
*Y*4	.079		.079	−.009	−.031	.163	.007
	(.55)		(3.11)	(−1.07)	(−.17)	(.92)	
Y omitted		.229	.066	−.009	.123	.185	.009
		(1.76)	(2.60)	(−1.22)	(.63)	(1.09)	
			TL = *RAD*				
*Y*1	−.132	.066	.054	−.006	−.222	.282	.004
	(−.67)	(.38)	(2.02)	(−.92)	(−1.09)	(1.56)	
*Y*2	−.300	.150	.054	−.006	−.156	.336	.005
	(−1.45)	(.86)	(2.09)	(−.88)	(−.72)	(1.80)	
*Y*4	−.294	.144	.060	−.006	−.156	.348	.005
	(−1.56)	(.85)	(2.15)	(−.87)	(−.75)	(1.87)	
*Y*4	−.204		.060	−.006	−.252	.324	.005
	(−1.31)		(2.40)	(−.82)	(−1.38)	(1.75)	
Y omitted		−.006	.048	−.006	−.252	.264	.004
		(−.02)	(1.93)	(−.97)	(−1.23)	(1.46)	

TABLE E-4
Demand for Medical Care by All Whites in the Labor Force

Income Measure	ln *Y*	ln *W*	*E*	*i*	Sex	ln *FS*	$\bar{R}^2$
*Y*1	.450	.036	.026	.012	.585	−.197	.039
	(3.79)	(.35)	(1.60)	(3.04)	(4.72)	(−1.80)	
*Y*2	.548	−.008	.027	.012	.495	−.257	.042
	(4.44)	(−.07)	(1.74)	(3.04)	(3.86)	(−2.30)	
*Y*4	.521	.014	.025	.012	.507	−.280	.043
	(4.66)	(.14)	(1.53)	(3.03)	(4.01)	(−2.48)	
*Y*4	.530		.025	.012	.499	−.282	.043
	(5.71)		(1.60)	(3.04)	(4.59)	(−2.54)	
Y omitted		.272	.036	.013	.670	−.122	.032
		(3.28)	(2.25)	(3.30)	(5.47)	(−1.13)	

TABLE E-5
Stock Demand for Health by Males with Positive Sick Time

Income Measure	ln *Y*	ln *W*	*E*	*i*	ln *FS*	$\bar{R}^2$
*Y*1	.040	.106	.028	−.010	.018	.193
	(.63)	(1.69)	(4.01)	(−5.89)	(.41)	
*Y*2	.041	.109	.028	−.010	.018	.193
	(.70)	(1.95)	(4.03)	(−5.90)	(.40)	
*Y*4	.041	.111	.028	−.010	.017	.193
	(.76)	(2.13)	(4.01)	(−5.89)	(.38)	
*Y*4	.118		.033	−.009	.010	.186
	(2.90)		(5.13)	(−5.73)	(.22)	
Y omitted		.138	.028	−.010	.019	.194
		(3.53)	(3.98)	(−5.87)	(.43)	

NOTE: The health stock series is 1 = poor, 1.6 = fair, 2.9 = good, 4.9 = excellent.

TABLE E-6
Flow Demand for Health by Males with Positive Sick Time

Income Measure	ln *Y*	ln *W*	*E*	*i*	ln *FS*	$\bar{R}^2$
			TL = *WLD*1			
*Y*1	−.324	.660	.050	−.012	.318	.125
	(−1.88)	(3.87)	(2.65)	(−2.62)	(2.68)	
*Y*2	−.289	.606	.048	−.012	.319	.125
	(−1.80)	(3.99)	(2.57)	(−2.61)	(2.69)	
*Y*4	−.040	.434	.052	−.012	.314	.118
	(−.27)	(3.06)	(2.77)	(−2.69)	(2.63)	
*Y*4	.260		.073	−.011	.287	.099
	(2.34)		(4.14)	(−2.45)	(2.39)	
Y omitted		.409	.052	−.012	.312	.120
		(3.87)	(2.79)	(−2.71)	(2.62)	
			TL = *RAD*			
*Y*1	−.340	.515	.045	−.014	.257	.088
	(−1.91)	(2.92)	(2.31)	(−3.01)	(2.10)	
*Y*2	−.292	.450	.044	−.014	.258	.087
	(−1.76)	(2.87)	(2.24)	(−3.01)	(2.10)	
*Y*4	−.138	.339	.047	−.014	.257	.082
	(−.91)	(2.32)	(2.40)	(−3.06)	(2.09)	
*Y*4	.096		.063	−.013	.236	.072
	(.84)		(3.48)	(−2.89)	(1.91)	
Y omitted		.251	.048	−.014	.251	.082
		(2.30)	(2.46)	(−3.19)	(2.04)	

TABLE E-7
Demand for Medical Care by Males with Positive Sick Time

Income Measure	ln Y	ln W	E	i	ln FS	$\bar{R}^2$
Y1	.857	−.477	.028	.025	−.294	.071
	(3.24)	(−1.83)	(.97)	(3.74)	(−1.62)	
Y2	.934	−.449	.034	.025	−.301	.080
	(3.83)	(−1.94)	(1.18)	(3.70)	(−1.67)	
Y4	.869	−.369	.027	.025	−.314	.082
	(3.92)	(−1.73)	(.94)	(3.76)	(−1.75)	
Y4	.618		.009	.025	−.293	.077
	(3.70)		(.32)	(3.63)	(−1.62)	
Y omitted		.188	.021	.026	−.278	.049
		(1.15)	(.71)	(3.86)	(−1.51)	

TABLE E-8
Stock Demand for Health by Females with Positive Sick Time
($N = 152$)

Income Measure	ln Y	ln W	E	i	ln FS	$\bar{R}^2$
Y1	−.086	.130	.013	−.004	.035	.006
	(−.80)	(1.21)	(.98)	(−1.14)	(.40)	
Y2	.046	.051	.011	−.005	−.024	.003
	(.40)	(.46)	(.85)	(−1.38)	(−.23)	
Y4	.110	.009	.011	−.005	−.071	.010
	(1.10)	(.08)	(.84)	(−1.52)	(−.68)	
Y4	.116		.011	−.005	−.075	.016
	(1.44)		(.89)	(−1.53)	(−.79)	
Y omitted		.080	.011	−.004	[a]	.015
		(.92)	(.88)	(−1.38)		

NOTE: The health stock series is 1 = poor, 1.8 = fair, 1.6 = good, 5.1 = excellent.
[a] The variable was deleted by the regression program since its F ratio was less than .005.

TABLE E-9
Flow Demand for Health by Females with Positive Sick Time

Income Measure	ln Y	ln W	E	i	ln FS	$\bar{R}^2$
			$TL = WLD1$			
$Y1$	−.193	.228	.039	.008	.080	−.011
	(−.77)	(.90)	(1.24)	(1.04)	(.38)	
$Y2$	.097	.053	.035	.007	−.049	−.014
	(.36)	(.20)	(1.12)	(.82)	(−.20)	
$Y4$	.184	−.004	.034	.006	−.115	−.010
	(.78)	(−.02)	(1.11)	(.74)	(−.47)	
$Y4$	.182		.034	.006	−.114	−.004
	(.96)		(1.15)	(.74)	(−.51)	
Y omitted		.113	.035	.007	[a]	−.001
		(.56)	(1.15)	(.91)		
			$TL = RAD$			
$Y1$	−.223	.082	.050	.006	.144	−.015
	(−.85)	(.30)	(1.52)	(.70)	(.66)	
$Y2$	−.091	.005	.046	.005	.117	−.019
	(−.32)	(.02)	(1.42)	(.58)	(.45)	
$Y4$	−.099	.011	.046	.005	.129	−.019
	(−.40)	(.04)	(1.42)	(.60)	(.50)	
$Y4$	−.093		.047	.005	.124	−.012
	(−.46)		(1.48)	(.60)	(.53)	
Y omitted		−.052	.046	.004	.062	−.013
		(−.24)	(1.41)	(.54)	(.32)	

[a] The variable was deleted by the regression program since its F ratio was less than .005.

TABLE E-10
Demand for Medical Care by Females with Positive Sick Time

Income Measure	ln Y	ln W	E	i	ln FS	$\bar{R}^2$
$Y1$	.518	.354	−.019	−.002	.077	.027
	(1.51)	(1.03)	(−.45)	(−.18)	(.27)	
$Y2$	.409	.405	−.012	−.001	.019	.020
	(1.13)	(1.12)	(−.27)	(−.06)	(.06)	
$Y4$	.349	.437	−.011	−.001	.028	.019
	(1.08)	(1.26)	(−.26)	(−.07)	(.08)	
$Y4$	.590		.003	−.001	−.144	.015
	(2.27)		(.08)	(−.06)	(−.47)	
Y omitted		.661	−.009	.001	.265	.018
		(2.36)	(−.22)	(.13)	(1.04)	