NBER Working Paper Series

HEALTH, FAMILY STRUCTURE, AND LABOR SUPPLY

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Working Paper No. 132

CENTER FOR ECONOMIC ANALYSIS OF HUMAN BEHAVIOR
AND SOCIAL INSTITUTIONS

National Bureau of Economic Research, Inc.
204 Junipero Serra Boulevard, Stanford, CA 94305

April 1976

This research was partially supported by grants from the NICHD, National Institutes of Health, DHEW; the Manpower Administration, Dept. of Labor; and NBER. The comments of Michael Grossman and members of the labor workshops at Stanford University and Ohio State University are gratefully acknowledged. David Rahrig provided excellent research assistance.

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I. INTRODUCTION

The growing likelihood of major health difficulties is a principal feature of the aging process and coping with poor health may be the single problem which most distinguishes the economic circumstances of older workers from that of the young. Beyond the direct utility loss of diminished health, the person in poor health suffers other adverse economic and social consequences, including a reduction in income as he or she is forced to reallocate time from market work to health maintenance activities.[1] A number of economists, Grossman and Benham (1974), Johnson and Berkowitz (1974), Scheffler and Iden (1974), Schwartz (1974), and Luft (1974, 1975), have recently attempted to quantify the effect of health status on male labor supply and have found, not surprisingly, that the effects are large indeed.[2]

The magnitude of the economic loss for a given severity of illness or accident depends, of course, on the institutional structure within which the individual lives and works. Since the family has traditionally been an important, if informal health production organization and source of income insurance, the role of the family in conditioning the relationship between health, labor supply, and earnings will be explored in this paper.[3] Obviously the interaction of family structure, health status, and labor supply is quite complex and I focus below only on a few aspects of this issue, largely relating to the ability of older families to buffer the economic losses imposed by the adult male's poor health.

The main labor supply questions to be considered are the effect of family structure on the size of the male's labor force withdrawal for a given health loss and, for married men, the corresponding sensitivity of the spouse's

market activity to the male's health condition. The relative size of the afflicted individual's (and family's) income loss will obviously depend critically on the size of these labor supply responses. The family structure of the male will be characterized simply by the presence or absence of a spouse and the education level of the spouse, if present. Spouse's education is suggested by several health studies which found it to be an important determinant of male health.[4] In the current paper I explore only the labor supply consequences of poor health and not wage rate effects, a process complex enough to require separate study.[5]

Below I consider the health, family structure, and labor supply inter-relationships at both a theoretical and empirical level. The paper is organized in the following way. In Section II, a theoretical model of family time allocation among market, home, and health activities is developed. The concept of a family health maintenance function is formalized to generate qualitative predictions of the effect of wages, health status, health care efficiency, and property income on the labor supply of husband and wife.

In Section III, data from the older male portion of the National Longitudinal Surveys are used to estimate labor supply functions for married and single men with special attention to differences in poor health responses. A simultaneous model of male labor supply and other family income (chiefly transfer income and the earnings of the wife) is then estimated to determine whether variations in the work hours of males, largely due to health differences, induce any substantial changes in income producing activities by other family members. Finally, in Section IV the detailed time budget data on both males and females from the Productive Americans Survey are used to estimate more precisely the effect of health on total family time allocations. These data provide estimates of the impact of poor health on home production time as well as market time for both husband and wife.

II. A THEORETICAL MODEL

In this section I develop a formal model of the family's health maintenance and market time activities to provide a clearer understanding of the behavior of the family when the male member is in poor health. Before proceeding, it will be useful to introduce some health concepts. In the analysis below it is important to distinguish carefully between health status (a stock concept) and health maintenance activities (a flow concept).[6] The individual and family can only determine, for given current health status, how much time and other resources to invest in improving health conditions, although obviously current investments in health improvement will affect later health stocks. Beyond health investments, two related processes affect health capital stock, a more or less continuous decline in capacity due to aging and random, discrete shocks such as disease and accident. The latter are also age dependent as the probability of such shocks rises with age (after a point) while the potential for recovery diminishes.

Given these factors, the family can augment the older male's current health status by allocating his own time to rest, by allocating the time of the wife to nursing and other personal care activities, and by purchasing medical goods and services in the market. Two separate but interdependent choices must be made when the male's health declines; i) the scale of the health investment to undertake and ii) the production process to use. The scale of health investment will depend on the desire for a higher expected stock of health in the future and on the cost of a given increment to future expected health stock.[7]

I assume below that the effect of family structure on time allocation to work and health maintenance, however, is more likely to be shaped by substitution between husband and wife than by differences in choice of scale and so I concentrate on that aspect. It should be born in mind, nevertheless, that health maintenance scale effects may influence the results. Evidence on health status (the stock) suggests that scale effects, if they exist, will be in the direction of larger health maintenance investments for men with highly educated spouse. In the Appendix to this paper for example it is reported that, controlling for other factors, the likelihood of older males to be in fair or poor health is reduced by one percentage point (or about 4 percent since about 25 percent of the sample are in these low health categories) for every additional year of wife's schooling.[8]

The nature of the decision maker in the case of poor health also deserves a short comment. The frequently useful fiction of a family utility function seems inappropriate in this case since the fundamental individuality of the family members is quite obvious in matters of health. Direct sharing of the burden is not possible. The income and home production losses, however, can and generally are redistributed over the other family members.[9] The problem is simplified in the current analysis since I consider primarily the production and not the scale decision. I need only assume that the family will produce the required level of health maintenance in such a way as to yield the maximum production of other goods.

This section then explores the variation in family time allocations induced by poor health and how the allocations are influenced by substitution

possibilities within the family. To focus on the interaction of health and productive hours, the model assumes, first of all, that the leisure time of husband and wife are fixed. The husband therefore allocates his remaining fixed quantity of time (T) between market work (T_1) and health maintenance activities (T_2). The wife must allocate her total time (t) among market work (t_1), health maintenance activities for her husband such as nursing services (t_2), and home production (t_3), so

$$T = T_1 + T_2 \tag{1}$$

and

$$t = t_1 + t_2 + t_3 \ . \tag{2}$$

The level of health maintenance the husband requires in a particular time period is assumed to be given by the husband's current health status. The husband's maintenance requirements, therefore, are treated as a constraint on family time allocation. The maintenance may be produced, however, by different combinations of inputs according to a health maintenance production function. The nature of the health maintenance function is, therefore, crucial to the working of the model. Presumably health maintenance is a function of rest or the male's own time inputs (T_2), nursing services or the time inputs of the wife (t_2), and purchased goods and services such as medicines, doctors, hospitals, etc. The health maintenance function developed here will ignore the purchased goods inputs and consider only the time inputs of husband and wife.[10] Of course, caring and nursing services can themselves be purchased in the market

but the sporadic timing of activity in the nursing function makes transactions costs high if the "nurse" can't be occupied with leisure and other tasks in the household. Health maintenance services (M_0) can in the present case be described by the following function:

$$(3) \qquad M_0 = M(T_2, t_2)$$

where presumably $M_{T_2}, M_{t_2} > 0$ and $M_{T_2T_2}, M_{t_2t_2} < 0$. In the analysis below it will also be assumed that $M_{T_2t_2} \geq 0$, that is, that the marginal product of the time of husband or wife in health maintenance production does not diminish with more of the respective spouse's time in this activity. It will also be useful to introduce an efficiency parameter (α) for wife's maintenance time so that effective maintenance time ($t_2^* = \alpha t_2$) enters the maintenance production function, equation (3).

Since the level of health maintenance is assumed to be given by the current health stock, it is natural to assume that the family wants to maximize its production of home commodities (C) subject to the constraint on the male's health maintenance. The home commodities are produced by combining market goods (I) with home production time, indexed by the wife's time in that activity (t_3), so

$$(4) \qquad C = C(I, t_3)^{11,12}$$

where $C_I, C_{t_3} > 0$ and $C_{II}, C_{t_3t_3} < 0$. Income is equal to the earnings of husband and wife plus property income, or

$$(5) \qquad I = I_0 + WT_1 + wt_1$$

where $I_0 \equiv$ property income and W and w represent the wage rate of husband and wife respectively.

For simplicity we shall eliminate T_2, t_3, and I by substitution using equations (3), (4), and (5) respectively, which leaves the maximization process subject to the health maintenance constraint only. The Lagrangean to be maximized then is

$$(6) \qquad L = C(I_0 + WT_1 + wt_1,\ t-t_1-t_2) - \mu(M_0 - M(T-T_1,\ \alpha t_2))$$

and the corresponding necessary conditions for a maximum,

$$(7) \qquad \frac{\partial L}{\partial T_1} = C_I W - \mu M_{T_2} = 0,$$

$$(8) \qquad \frac{\partial L}{\partial t_1} = C_I w - C_{t_3} = 0,$$

$$(9) \qquad \frac{\partial L}{\partial t_2} = \mu\alpha M_{t_2^*} - C_{t_3} = 0, \text{ and}$$

$$(10) \qquad \frac{\partial L}{\partial \mu} = -(M_0 - M(T-T_1,\ \alpha t_2)) = 0.$$

The necessary conditions have straightforward interpretations. Equation (7) suggests that the husband's time should be split between work and maintenance so as to equate utilities per unit of time input in both activities. Equations (8) and (9) suggest comparable equalization of marginal utilities among the

three time uses available for women (work, husband health maintenance, and home production). The linkage between optimal male and female time allocations can be made clearer by combining equations (7) and (9) which yields the expression:

$$(11) \qquad \frac{M_{T_2}}{M_{t_2}} = \frac{W}{w/\alpha} \, .$$

Apparently the ratio of the marginal products of the two time elements of health maintenance should be equal to the ratio of efficiency corrected wage rates.

The comparative statics of the time allocation decision can be more completely described by forming the differential system of the set of equations (7) through (10) and then solving for various derivatives of time allocations with respect to exogenous variables. The differential system and derivations of qualitative effects reported below can be obtained from the author. The results of the calculations of various qualitative restrictions on the corresponding derivatives are summarized in Table 1. A number of the major qualitative predictions are discussed below.

Necessary Health Maintenance Services (M_0)

If the husband's health condition should deteriorate so greater levels of health maintenance services are required, both husband and wife will shift additional time into health maintenance services. For the husband this directly implies a reduction in work in this model. For the wife the important implication for market time is ambiguous. The source of the ambiguity is clear. Her husband's poor health leads her to devote more time to nursing and care services but, since her husband is simultaneously withdrawing from the market, the family finds her time in market more valuable than before.

Table 1: The Qualitative Effects of Changes in Exogenous Variables on Family Time Allocations with Additive Utility Function.[a]

Exogenous Variables	Time Allocations				
	T_1	T_2	t_1	t_2	t_3
W	+	-	-	+	+
w	-	+	?	-	?
M	-	+	?	+	-
α	+	-	?	?	+
I_0	0	0	-	0	+

[a]The calculations underlying these results can be obtained from the author. The notation is as follows:

$T_1(t_1)$ ≡ work hours of male (female)
$T_2(t_2)$ ≡ maintenance hours of male (female)
t_3 ≡ home production hours of female
$T(t)$ ≡ total hours to allocate male (female)
$W(w)$ ≡ hourly wage male (female)
I ≡ family income
I_0 ≡ family asset income
M ≡ required level of health maintenance
α ≡ efficiency parameter for female time in husband's health maintenance

The extent to which market hours increase (decrease) gives some idea of the self-insurance value of the wife's earning power to the family. If the amount of nursing time she can fruitfully undertake is limited, she could be expected to increase her work time. In any case, the sum of work time plus nursing time should increase and home production unambiguously decrease.

The implications for the labor supply response of males without spouses in this model is clear without the elaborate analysis. Since he has no spouse who may substitute her time in his health maintenance production, single males are likely to withdraw from the market more than married males. Only if single men chose to run down their health capital at a faster rate (or improve it more slowly) than married men would they be likely to withdraw less from the market.

Wage Rate of the Husband (W)

An increase in the wage rate of the husband leads to a shift from health maintenance into market work by the husband as the value of his time rises in the latter activity. The wife adjusts by increasing her health maintenance time and reducing her market time. Home production of the wife also rises since home production is restricted to be a normal good in this case and real income has risen. This time too will be taken from market time.

Wage Rate of the Wife (w)

The effect of a higher wage for the wife on the husband's time allocation is to shift the husband out of the market and into health maintenance. The wife's health maintenance time will, therefore, be reduced. The ambiguity of off-setting income and substitution effects of a wage change on the labor/home production choice is comparable to the more usual labor/leisure ambiguity.

The Health Maintenance 'Efficiency' of the Wife (α)

If the wife is more efficient at providing health maintenance services, the husband will substitute more time in the market for health maintenance. The wife, however, may not increase her time in providing health maintenance, indeed, she may reduce it since each unit of time previously used in that function yields more services. This effect makes predictions about changes in market work time ambiguous as well, as apparently any increase or decrease in maintenance time comes from market time. Home production time unambiguously increases (reflecting again the normal good aspect of this time).

Limitations in the data increase the ambiguity of the predictions yet further. Wife's wage rate and health maintenance efficiency, for example, are not directly measurable (at least for all women) and observable characteristics such as wife's schooling quite likely confound both wage and efficiency effects. Even if it is assumed that higher wages are likely to shift women more into the market and that greater health maintenance efficiency is likely to lead them into a greater nursing and health care role, the sign of the effect of schooling on market time will depend on which of these opposing forces is stronger.

III. THE LABOR SUPPLY OF OLDER MALES: EMPIRICAL RESULTS

The theoretical model of the preceding section emphasizes the importance of empirical work since even the direction of effect of a number of important characteristics are ambiguous. In this section, data from the older male cohort (ages 45-59) of the National Longitudinal Survey (NLS) will be explored. The NLS is a national longitudinal survey of the labor market characteristics of four age cohorts of about 5000 persons each.[13] The survey is representative of the U.S. population except for a substantial oversampling of blacks (30 percent of total). The labor supply behavior of the men and, in particular, their differential response to poor health will be estimated. The sensitivity of other income, specifically earned income of other family members, to the work hours of the males is then estimated in a simultaneous framework.

As a benchmark, a standard labor supply model without health variables with annual work hours as the dependent variable was estimated using the NLS data.[14] The results are reported in Table 2, column 1. Skill variables, schooling and occupation, have their expected positive effect on hours. A high school graduate works on average about 220 hours more than a worker who quit school after sixth grade, although a college graduate works less. A blue collar occupation (craftsman, operative, etc.) has an independent negative effect of 300 hours. Poor labor market conditions reduce work hours as one would expect, as does aging and being black.

The family effects on labor supply are substantial. Married men with spouse present work almost 140 hours more than other men independent of the spouse's education level and about 14 additional hours for each year of schooling of the

Table 2: Annual Market Hours of Men, 45-59, in 1966, Total and by Marital Status[a]

Variable	(1)	(2)	(3)	(4)
Skill				
S[b]	64.80 (5.68)	23.04 (2.15)	27.88 (2.40)	-11.35 (0.38)
S^2	-2.66 (4.58)	-1.42 (2.60)	-1.67 (2.88)	0.48 (0.28)
BLUE[c]	-303.61 (12.09)	-330.68 (14.13)	-338.20 (13.76)	-277.26 (3.73)
Family				
M[d]	136.50 (2.29)	166.29 (3.00)	* *	* *
M x SW[e]	13.58 (2.78)	8.02 (1.76)	8.62 (1.87)	* *
DEPEND[f]	20.78 (2.97)	21.73 (3.32)	18.51 (2.79)	53.85 (1.82)
Demographic				
BLACK[g]	-157.41 (5.46)	-169.33 (6.30)	-174.83 (6.10)	-136.70 (1.72)
AGE[h]	-13.55 (4.69)	-9.02 (3.35)	-10.19 (3.60)	-2.21 (0.26)
Market				
UNEMP[i]	-14.17 (2.66)	-11.83 (2.39)	-10.13 (1.87)	-21.50 (1.67)
Health				
HE[j]	* *	* *	* *	* *
HG[k]	* *	-48.52 (1.93)	-34.43 (1.32)	-157.75 (1.82)
HF[l]	* *	-203.30 (6.26)	-172.09 (5.03)	-391.21 (3.87)
HP[m]	* *	-1301.9 (28.01)	-1222.2 (24.45)	-1677.0 (12.83)
Constant	2458.00 (14.19)	2658.8 (16.41)	2846.4 (16.38)	2528.3 (5.07)
R^2	0.11	0.25	0.23	0.30
Sample	Total	Total	Married, Spouse Present	Other than Married, Spouse Present
Sample Size	4565	4444	3865	569

[a]Data Source: National Longitudinal Survey. Absolute value of t-ratios are in parentheses.

[b]S ≡ years of schooling of man

[c]BLUE ≡ dummy equal to one if current or last occupation blue collar

[d]M ≡ dummy equal to one if married, spouse present

[e]SW ≡ years of schooling of wife, if present

[f]DEPEND ≡ number of dependents excluding wife if married

[g]BLACK ≡ dummy equal to one if race non-white

[h]AGE ≡ age of husband

[i]UMEMP ≡ PSU unemployment rate

[j]HE ≡ dummy equal to one if self reported health status excellent

[k]HG ≡ dummy equal to one if health good

[l]HF ≡ dummy equal to one if health fair

[m]HP ≡ dummy equal to one if health poor

spouse. A married man whose spouse has attained twelve years of schooling will, on average, work about 300 more hours than a single man. With each additional dependent, work hours increase an average of 20 hours per year, a statistically significant if not absolutely large effect.

The question remains whether these results are biased by the absence of health stock. In Table 2, column 2 the annual hour regressions are re-estimated with a set of dummies HG, HF, and HP which equal one if self reported health status is judged to be good, fair, or poor respectively, zero otherwise.[15] The reference health status is excellent health (HE). The health variables, particularly the presence of poor health, strongly influence labor supply. Poor health status, for example, implies a reduction of 1300 hours or 65 percent of a standard work year of 2000 hours. The explanatory power of the regression is dramatically increased from an R^2 of 0.11 to an R^2 of 0.25.

Perhaps the most interesting aspect of the estimates of the non-health variables in column 2 is the apparent lack of bias induced by exclusion of the health variables. Only the schooling and age coefficients change a statistically significant magnitude with the introduction of the health measures. Both the positive schooling effect and the negative aging effect are substantially reduced with the introduction of health, perhaps a predictable result since both are similarly and strongly related to good health (see Appendix). Of particular importance here, the effects of the family variables on labor supply remain generally unchanged, although labor supply is estimated to be somewhat less closely related to schooling level of the spouse with the health variables included.

To answer the question of whether married men have a different labor supply

reaction to poor health than do single men, the total sample was separated into married and single sub-samples and the regression model with health variables reestimated. The coefficient estimates are reported in Table 2, columns 3 and 4.

The differences in behavior by health status are dramatic with hours reductions (relative to a base of excellent health) of 34, 172, and 1222 hours for good, fair, and poor health respectively for married men and 158,391, and 1677 hours for men without spouse present. The differential work hour reduction of single men then is 124, 219, and 455 hours annual for the three lesser health categories. In terms of a fraction of a normal work year (2000 hours), married men in poor health are forced to contract their annual hours in the market by 61 percent while single men contract their work hours by 84 percent. Single men can, then, expect to suffer a reduction beyond that of married men of an additional 23 percent of their original earnings when poor health strikes. In the context of the theoretical model above, this suggests that the wife's nursing and care services are a substantial substitute for the husband's time in the provision of health maintenance services. As a result the married man can remain more in the market for given health levels.

The interesting question arises whether the "quality" of the wife measured by her level of education will also affect the degree of labor force withdrawal of unhealthy married men.[16] Theoretically the answer is ambiguous since schooling is likely to increase the female's efficiency in health maintenance, implying a reduction in male withdrawal from the market, and also likely to increase her market wage,with the opposite effect on male labor supply. Regressions identical to that reported in Table 2, column 3, were run separately for married men whose spouses had 12 or more years of education and those whose spouses has less than 12 years of education. The results, not fully reported

here, suggest very little difference in male labor supply reduction as men with highly educated wives withdrew 0, 152, and 1169 hours when health was good, fair, and poor while men with low educated wives withdrew 69, 191, and 1240 hours per year. The maximum difference is never greater than 71 hours per year or less than two normal weeks.

A Simultaneous Model of Male Work Hours and Other Income

In the analysis above other family income was not included even though several researchers have found a strong effect of other family income on male labor supply. Even though male labor supply may be conditioned by other income sources, other income, particularly transfer income and earned income of other family members (largely that of the spouse), may depend on the labor supply of the male. In this subsection I attempt to provide estimates of the effects of other income on male labor supply and male labor supply on other income using simultaneous methods. This should allow us to determine whether the other income of the family conditions labor supply behavior of the male and, more importantly, whether male labor supply reductions induce increased earnings by the spouse.

The empirical estimates above indicate that the labor supply (and therefore earnings) of older males drops sharply with poor health. An important social question remains, however, of how adequately transfer income and earned income of other family members compensate for this loss. These estimates should provide insights into this question as well as providing a useful introduction to a more complete study of the time allocation responses of the spouse to poor health in the husband, to be carried out in the next section.

The basic argument for a simultaneous model is that other family income is likely to affect the labor supply decision of the man, yet transfers (particularly welfare and unemployment compensation) and earned family income may vary with the work hours chosen. The simultaneous model, therefore, can be represented simply as follows:

$$(12) \quad H = f(OI, X_1)$$

and

$$(13) \quad OI = g(H, X_2)$$

where $H \equiv$ annual work hours, $OI \equiv$ other family income, and X_1, $X_2 \equiv$ vectors of exogenous variables. Several researchers have found a strong effect of other family income on male labor supply. The analysis which follows should provide some tentative answers as to whether that empirical phenomenon is the result of simultaneity bias. As the theoretical model suggests, not even the direction of the change in spouse's earnings in response to health induced work hour reductions in the husband is known a priori. The spouse may drop out of market work to increase her nursing and caring time or alternatively may increase her market time to compensate for the family's income loss.

In the simultaneous model below, total other family income was divided into two components, the sum of wealth income and non-work related transfer payments and the sum of work related transfer income and earned income

of other family members. The former was assumed to be exogenous to the system and was initially treated as an explanatory variable in labor supply, although it was later dropped because it implied positive wealth effects on labor supply.[17] The second sum is assumed to be endogenous in this system and will be called below simply "other income".

The content of the vectors of exogenous variables X_1 and X_2 in equations (12) and (13) remains to be specified before the system can be estimated. The exogenous variables in the work hours equation have been discussed at length above; the relationship will be assumed similar to that reported in Table 2. The exogenous variables in the other income equation presumably include factors which influence the earning power of the wife (schooling, her health, etc.) as well as factors likely to affect the size of transfer flows (number of dependents and urban residence).

Turning to the estimation results, one will find the reduced form estimates of hours and other income reported in Table 3, columns 1 and 2. The estimates of coefficients in the work hours regression are not much different than the earlier results reported in Table 2, although the coefficient on one additional variable, wife's health for married men, is interesting. If the wife has an activity-limiting health problem, the husband works an average of about 100 hours less than he otherwise would, presumably because he must increase his home production time. We will consider this issue at greater length in the next section.

The other income reduced form estimates in column 2 have not been discussed above and bear closer examination. Other income is substantially higher for men with healthy, well educated spouses. The significant quadratic form for wife's schooling in this equation suggests that other income increases at an

Table 3: Annual Work Hours and Other Income of Males, 45-59, in 1966, Reduced Form and Structural Equations[a]

Variables	Reduced Form		Structural[b]	
Dependent Variables	(1) Hours[c]	(2) Other Income[d]	(3) Hours	(4) Other Income
Hours*[c]	* *	* *	* *	-0.74
				(6.38)
Other Income*[d]	* *	* *	0.03	* *
			(1.33)	
Skill				
S	38.28	144.3	44.17	3.75
	(3.15)	(3.72)	(3.68)	(0.29)
S^2	-1.74	-7.70	-2.08	* *
	(2.70)	(3.76)	(3.37)	
BLUE	-300.1	344.9	-335.3	* *
	(11.35)	(4.09)	(12.23)	
Family				
M	130.4	1766	232.2	1532
	(1.24)	(5.27)	(4.74)	(4.63)
M x SW	27.39	-238.9	* *	-126.4
	(1.37)	(3.74)		(2.04)
M x SW^2	-0.96	21.21	* *	15.40
	(0.96)	(6.64)		(5.02)
M x HW[e]	-123.5	-551.0	* *	-126.4
	(3.94)	(5.50)		(2.04)
DEPEND	13.64	-85.08	18.10	-87.97
	(1.91)	(3.74)	(2.43)	(3.97)
Demographic				
AGE	-8.75	10.81	-10.41	* *
	(2.91)	(1.13)	(3.41)	
URBAN[f]	155.0	281.7	* *	159.3
	(5.93)	(3.38)		(1.88)
Market				
UNEMP	-18.21	27.29	-17.86	-44.98
	(3.24)	(1.52)	(3.10)	(2.45)
Health				
HE	* *	* *	* *	* *
HG	-62.40	183.3	-57.94	* *
	(2.22)	(2.04)	(2.02)	
HF	-221.4	342.4	-220.3	* *
	(6.08)	(2.94)	(5.95)	
HP	-1303	999.0	-1315.0	* *
	(24.63)	(5.92)	(23.30)	
Constant	2596	-1213	2558	1776
	(14.56)	(2.13)	(14.06)	(6.74)
R^2	0.26	0.12	* *	* *

[a] Data Source: National Longitudinal Survey. Absolute values of t-ratios are in parentheses. Notation not defined here can be found in Table 2. The sample size is 3428.

[b] The structural equations were estimated using two stage least squares procedures.

[c] Hours ≡ annual work hours. Asterisk denotes instrument derived from column 1.

[d] Other Income ≡ total other family income less asset and non-work related transfer income. Asterisk denotes instrument derived from column 1.

[e] HW ≡ dummy equal to one if wife has an activity limiting health condition.

[f] URBAN ≡ dummy equal to one if urban residence.

increasing rate with wife's education. If the wife has an activity-limiting health problem, other family income is reduced by an average of more than $500. Other income, however, rises with various indices of poor health in the husband, presumably due to some combination of welfare and adjustments in other family earnings. The reasonably small sizes of the health effects on transfers and other family earnings, under $1000 in the case of poor health in the husband, suggest that the effect of male labor supply on other income is substantial but well short of fully compensating the workers in poor health. Urban residence corresponds to about $300 more in other income for the family.

Two stage least square estimates of the structural equations are reported in Table 3, columns 3 and 4. The coefficient of male hours on other family income is significant and indicates that other income increases by about $0.75 for every one hour reduction in male hours worked. The coefficient of other income in the hours equation, however, is insignificant and indeed positive. Taken at face value these results suggest that male hours affect the earnings behavior of other family members and the flow of transfer payments, but themselves are not affected by the size of these other income flows. The latter result, however, must be held with some caution since the instrument used for other income has an R^2 of only 0.12, suggesting that almost 90% of the variation in other income has been discarded in the estimation process. The instrument may not be very useful in this case. Most of the other coefficients are not substantially changed from the reduced form estimates.

To throw some light on the question of whether it is other earned income or transfer payments that primarily account for the increase in other family income when male work hours are reduced, the simultaneous estimation was repeated for married men only and other income limited to other <u>earned</u> family income.

The reduced form and structural estimates of this modified model are reported in Table 4. The reduced form equation for other earned income (column 2) indicates that this income is fairly insensitive to the health status of the male. Income increases by $130, $235, and $182 as health drops from excellent to good, fair, and poor respectively.

This implication is confirmed in the structural estimates presented in columns 3 and 4. Family income has the same anomalous positive impact on male work hours and male work hours have a negative impact on family income. The estimated coefficient of hours on other family income, however, is sharply reduced in magnitude from the preceding model. A loss of one hour worked by the male is offset by only about $0.23 increase in the earned income of other family members. Apparently most of the income compensation for health induced variation in husband work hours results from transfer payments and not from work hour adjustments of other family members.

Dividing the sample by wife's education ($SW \geq 12$, $SW < 12$) and reestimating the equations does not materially alter these conclusions (the full results are not reported here). The insurance value of more highly educated wives is substantially, if not statistically significantly, above that of less educated wives. For every reduction of one hour in male work hours, other family earned income rises by $0.49 for highly educated wives and only $0.14 for less educated wives with respective t-values of 1.72 and 1.06. While interesting, in neither case is the effect substantial.

Apparently other family members do not go into the market in a strong and systematic way when the husband falls ill. This may partially result from the fixed costs of either entering the market if one does not currently have a job or of increasing one's hours if one is already in the market. The model of the

Table 4: Annual Work Hours and Other Family Income of Males, 45-59, Married Spouse Present, in 1966, Reduced Form and Structural Equations[a]

Variables	Reduced Form		Structural	
Dependent Variables	(1) Hours	(2) Other Earned Income[b]	(3) Hours	(4) Other Earned Income
Hours*	* *	* *	* *	-0.23 (1.77)
Other Earned Income*	* *	* *	0.05 (2.33)	* *
Skill				
S	41.83 (3.14)	175.4 (4.11)	44.49 (3.34)	-7.43 (0.53)
S^2	-2.02 (2.93)	-9.12 (4.14)	-2.22 (3.33)	* *
BLUE	-324.1 (11.64)	313.7 (3.52)	-361.1 (12.50)	* *
Family				
SW	28.03 (1.41)	-200.8 (3.17)	* *	-102.8 (1.68)
SW^2	-0.92 (0.93)	18.41 (5.83)	* *	13.17 (4.37)
HW	-128.8 (4.20)	-621.0 (6.33)	* *	-662.3 (6.55)
DEPEND	9.41 (1.30)	-95.46 (4.12)	16.70 (2.18)	-108.3 (4.88)
Demographic				
AGE	-10.08 (3.18)	9.58 (0.94)	-11.88 (3.68)	* *
URBAN	-124.0 (4.56)	254.9 (2.93)	* *	224.5 (2.54)
Market				
UNEMP	-16.64 (2.72)	-29.51 (1.51)	-15.55 (2.47)	-33.56 (1.68)
Health				
HE	* *	* *	* *	* *
HG	-36.35 (1.24)	130.0 (1.39)	-36.49 (1.22)	* *
HF	-177.7 (4.62)	234.9 (1.91)	-183.8 (4.70)	* *
HP	-1197 (2.09)	182.9 (1.00)	-1196 (20.58)	* *
Constant	2749 (13.39)	366.9 (0.56)	2825 (14.71)	2118 (5.25)
R^2	0.23	0.09	* *	* *

[a]Data Source: National Longitudinal Survey. Absolute value of t-ratios are reported in parentheses. Notation is defined in Tables 2 and 3. The sample size is 2970.

[b]Other earned income ≡ earned annual income of all family members other than the older male.

preceding section, however, suggests this result might be due to the increased home time demands of the wife while the husband is ill. The question of intrafamily time allocation is pursued in more detail in the next section with a data set which allows exploration of the behavior of home production hours as well as market hours.

IV. INTRAFAMILY ALLOCATION OF HOURS: HEALTH EFFECTS

The NLS sample of the preceding section unfortunately lacks any information on the non-market uses of time by household members. In this section I examine data from the Productive Americans Survey to develop a more complete picture of the time adjustments families make when husband or wife falls ill or otherwise becomes physically incapacitated. The Productive Americans Survey is a single survey carried out in early 1965 with observations on 2214 families of all ages.[18] Although the subsample of families in the older age group under study here is substantially less in number than the National Longitudinal Survey, the Productive Americans Survey has the advantage of containing measures of home productive work hours (cooking, cleaning, household maintenance, etc.) as well as market work hours for the husband and wife. This obviously allows more complete consideration of the allocation of hours within families. Although a complete analysis would require simultaneous estimation of these hours decisions, the statistical work below is somewhat more modest. The estimated equations can be interpreted as reduced form estimates of the system.

One problem with the Productive American Survey is that the health measures are less complete. The estimates of general health stock are absent and only information on the existence of a work limiting health condition is available, a variable that must be viewed with some caution in a labor supply study. Since the NLS data contain both types of information, the two are compared in Table 5. The cross tabulations suggest that while virtually none of the older men in excellent health have work limiting health and virtually all in poor health do, the relationship is less clear cut for the other health groups. Indeed of the

Table 5: Health Measure Comparison for Older men, 1966[a]

Self Reported Health Status	Does Health Limit or Prevent Work? NO	YES	
EXCELLENT	91.9 / 42.8	8.1 / 10.1	100.0
GOOD	79.8 / 45.7	20.2 / 30.9	100.0
FAIR	46.6 / 11.1	53.4 / 34.0	100.0
POOR	4.1 / 0.4	95.9 / 25.0	100.0
	100.0	100.0	

[a]Data Source: National Longitudinal Surveys

individuals who report that health limits their work in some fashion, only 25 percent are in poor health. With that bit of caution in mind let us turn to the results.

In Table 6, regression results for the market time, home time, and total productive time of older males are reported. Health measures are limited in this data to dummies reflecting the presence (or absence) of an activity-limiting health problem for the husband and wife. In column 1, estimates of market work effects are reported. Consistent with the results reported in the preceding section, the husband's own poor health forces a reduction in work hours of about 700 hours annually. His wife's health problems induce a modest

Table 6. Annual Productive Hours of Married Men, 45-64, Regression Results[a]

Variable	(1) Market Work	(2) Home Work	(3) Total Work
HLA-H[b]	-695.24	2.72	-692.51
	(8.91)	(0.07)	(8.58)
HLA-W[b]	31.96	193.68	225.64
	(0.28)	(3.55)	(1.93)
AGE-H	-22.39	-1.70	-24.09
	(4.34)	(0.68)	(4.51)
S-H	-5.94	2.40	-3.55
	(0.56)	(0.47)	(0.32)
S-W	6.74	5.91	12.64
	(0.53)	(0.97)	(0.97)
BLUE COLLAR-H	-331.88	25.88	-306.00
	(5.18)	(0.84)	(4.62)
BLACK	-270.86	137.97	-132.89
	(2.56)	(2.70)	(1.22)
CONSTANT	3562.00	233.00	3796.00
	(11.06)	(1.50)	(11.40)
R^2	0.21	0.04	0.19

[a]Data Source: Productive Americans Survey. Absolute values of t-ratios are in parentheses. Notation is defined in Table 2, except that hyphen H denotes a husband variable, hyphen W a wife variable. Sample size was 605.

[b]HLA ≡ dummy equal to one if health limits or prevents work, zero otherwise.

and statistically insignificant increase in his work hours of about 30 hours annually. This is inconsistent with the significant and negative coefficient of wife's health on market hours in the NLS sample (See Table 3, column 1) of about 115 hours.

The impact of health on the male's home work corresponds with expectations. The husband's own health status has no effect on his home work hours although poor health in his wife leads to a statistically significant increase in his home work hours. On average the husband seems to increase his home work by about 200 hours when his wife develops a health problem.

The other coefficients are broadly consistent with the earlier results. Both blacks and blue collar workers work in the market substantially less than other males, although in the case of blacks this is partially offset by significantly higher home production hours. In these estimates, neither schooling of the husband nor that of the wife have substantial effects on market or home work hours.

Separating the sample by the schooling of the female (less than twelve years or greater than or equal to twelve years) did not reveal any major differences by type of household. Poor health in the male resulted in an annual work hours withdrawal of 695 hours in low schooling households, 681 in high, with no significant change in male home work hours. Wife's health difficulties did induce a somewhat different time allocation by the male in these two groups. Males with less educated wives tended to increase home work hours by 279 hours while reducing market hours by 91 hours. Males with more educated wives increased home hours by only 73 and <u>increased</u> market hours by 207. Only the result for home time of the husbands of less educated women was statistically significant however.

In Table 7 comparable regression results are reported for married women, 40-64. For married women, poor health involves a reduction in market hours of about 361 hours annually and no significant change in home work hours. Total work hours, both market and home, then drop by about 380 hours. The poor health of the husband leads to an increase of about 140 hours in market work and a small and insignificant decrease in home hours. The latter is made possible, one might conjecture, by the ability to substitute tasks within home hours -- e.g., nursing for cleaning.

The combined effect of poor health of the husband on total family work hours is a loss of 560 market hours and unchanged home hours. The effect on family hours of poor health of the wife is a loss of about 330 market hours and a gain of 173 home hours. The husband works about 600 hours less in total when he is ill, the wife about 400 hours less when she is ill. When the spouse is ill, men increase their work hours and decrease their leisure by about 200 hours, largely in home production, while women increase their work hours by about 100 hours, largely in market work.

The influence of non-health variables on female time allocations is worth considering for its own sake. Aging here leads to a reduction in market work but not home work. The schooling of the husband leads to a reduction in both market and home work for the wife, with the latter effect roughly twice as large in magnitude, so total work hours drop substantially (about 40 hours per year of schooling of the husband). The wife's schooling on the other hand leads to a simple shift in hours from the home into the market of about 40 hours per school year with no change in total hours worked.

The race coefficients are insignificant but seem to suggest black women

Table 7. Annual Productive Hours of Married Women, 40-64, Regression Results[a]

Variable	(1) Market Work	(2) Home Work	(3) Total Work
HLA-H	136.56	-28.31	108.25
	(1.63)	(0.30)	(1.10)
HLA-W	-361.14	-20.85	-381.99
	(2.89)	(0.15)	(2.59)
AGE-W	-27.00	0.14	-26.86
	(4.84)	(0.02)	(4.08)
S-H	-14.68	-27.47	-42.15
	(1.36)	(2.22)	(3.31)
S-W	45.83	-38.46	7.37
	(3.41)	(2.50)	(0.46)
BLACK	134.79	40.15	174.94
	(1.02)	(0.26)	(1.12)
CH < 18[b]	-159.03	241.90	82.87
	(5.02)	(6.65)	(2.21)
DCH < 6[c]	-91.79	194.60	102.78
	(0.32)	(0.60)	(0.31)
CONSTANT	1810.00	2463.20	4273.20
	(5.31)	(6.29)	(10.60)
R^2	0.08	0.11	0.08

[a]Data Source: Productive Americans Survey. Absolute value of t-ratios are in parentheses. Undefined notation can be found in Table 1. The sample size was 737. The sample was limited to women who reported less than 6000 total work hours.

[b]The number of children in the household 18 years of age or under.

[c]A dummy which equals one if children under six are present in the household, zero otherwise.

work more in the market and more in total than white women. The presence of children under 18 in the household leads to a large shift out of the market (160 hours per child), an even larger shift into home production (240 hours), and a corresponding moderate reduction in leisure (80 hours). The presence of children under six leads to a moderate shift out of work and leisure into home production, although the coefficients are insignificant, largely I suspect because of the small number of women in this older sample with children under six.

The separation of the sample by wife's education and reestimation of the wife time regressions reveal an interesting difference in the behavior of the two groups. The positive market work hour effect of husband's poor health, noted in the sample as a whole, is solely due to the response of highly educated wives who increase their work in the market by 270 hours. The less well educated wives did not increase their market hours at all when the husband encounters a health difficulty. Whether this differential response is the result of differential access to the labor market or simply to the comparative advantage of lower educated wives in health maintenance (of the husband) is impossible to tell from this data.

V. CONCLUSION

The main objective of this study has been the exploration of the interrelation of health and the allocation of time within the family. Particular attention is paid to health effects on the joint labor supply of husbands and wives and to the differential labor supply responses to poor health of married and single men. The impact of health on home production hours of the family is also considered. The results are of more than academic interest as they give an indication of how well older individuals and families can economically cope with poor health.

At the theoretical level the concept of a health maintenance function is introduced into a family time allocation model to generate predictions on the time allocation effect of variation in market and health parameters. It is argued that wives can substitute their time for their husband's time in his rehabilitation process, which suggests that married men should devote more time to market activity than single men of equally poor health as long as both demand about the same amount of health investment in total. A number of critical ambiguities arise in the attempt to predict the market behavior of females when their husbands are in poor health. The wife may withdraw from the market to care for her ill husband or alternatively enter the market to compensate for his lost income depending on the relative efficiency of her time in each activity. Actually she may even increase time in both activities at the expense of other home activities. Similar ambiguities arise in attempting to predict the effect of wife's schooling on the time allocation decision since it increases health maintenance efficiency as well as market value.

The empirical analysis of the labor supply of older men (ages 45-59) from the National Longitudinal Survey demonstrates the importance of health condition in the choice of annual work hours and the importance of family structure in conditioning that response. An individual in poor health for example works, on average, 1300 hours less per year than similarly educated (and aged) men in excellent health. The work hours reduction in this case for married men is however 450 hours less annually than for single men (or more precisely men with no spouse present). Considered from a standard 2000 hour year the decline in annual hours for single men in poor health is 84 percent of a full employment year while only 61 percent for married men. Since there is no corresponding fall in the scale of health investment by married men (indeed there appears to be a rise), the evidence is consistent with the notion that married men can marshal resources other than their own time, particularly their wives' time, to augment the health of the male. This effect is largely independent of the wife's education level.

A simultaneous model of male labor supply and other family income is also estimated on the NLS data to determine the effect of other family income on male labor supply and male labor supply on other family income. The models suggest that other income does not have a substantial effect on labor supply but that male labor supply has a significant effect on other family income. Total other income is estimated to increase about $0.75 for each one hour reduction in work hours of the older male. About two-thirds of this subsidy comes from social welfare sources, one-third from increased earnings of other family members. Other family income increases substantially only in households where the wife has high levels of education.

Finally, in Section IV time budget data from the Productive American Survey are used to trace out more fully health effects of family time decisions.

For both husbands and wives, one's own health problems appear to lead to substantial market time withdrawals (about 700 hours and 350 hours respectively) while home work hours remain unchanged. As one might expect, illness in one's spouse leads to quite different time allocation responses as men increase their home production time, women their market work time. These work time increases appear to come largely from leisure time in both cases.

Although the results of this paper are themselves interesting, I believe they represent only the beginning of the investigation of the family as an informal health service organization. Theoretically the choice of level of health maintenance must be more completely integrated with choice of technique. Beyond this theoretical development other aspects in the interrelation of health, the market, and family structure remain to be explored. A particularly crucial element that requires further study is the role of wage rate variations and other productivity effects of poor health in this choice structure.[19] A number of other researchers have found significant racial differences in labor supply response to poor health so this again may be a useful area for further exploration.[20]

Appendix Table: Health Status of Males, 45-59, in 1966, Regression and Probit Results[a]

Variable	Health Status[b] (1)	Fair or Poor Health[c] (2)	(3)
S	0.07	-0.033	-0.065
	(5.86)	(5.51)	(3.17)
S^2	-0.001	0.0007	-0.000
	(1.95)	(2.30)	(0.25)
M	-0.11	0.055	0.193
	(1.78)	(1.80)	(1.90)
M x SW	0.02	-0.009	-0.031
	(3.68)	(3.45)	(3.53)
AGE	-0.012	0.005	0.017
	(4.15)	(3.35)	(3.37)
BLACK	0.039	0.004	0.016
	(1.24)	(0.25)	(0.32)
LABORER[d]	-0.138	0.071	0.208
	(3.05)	(3.24)	(2.97)
FARMER[e]	-0.242	0.129	0.389
	(4.67)	(5.11)	(4.81)
FARM LABORER[f]	-0.318	0.139	0.373
	(4.25)	(3.81)	(3.31)
CONSTANT	3.08	0.233	-0.949
	(17.31)	(2.69)	(3.24)
R^2	0.10	0.09	0.12
ESTIMATION METHOD	OLS	OLS	PROBIT

[a]Data Source: National Longitudinal Survey. The absolute value of t-ratios are in parentheses. The sample size in each case was 4468. For undefined notation see Table 2.

[b]An index with excellent, good, fair, and poor health given weights 4,3,2 and 1 respectively. This is a measure used extensively by Grossman (1972).

[c]A dummy equal to one if respondent in fair or poor health, zero otherwise.

[d]LABORER ≡ dummy equal to one if current or last occupation is laborer.

[e]FARMER ≡ dummy equal to one if current or last occupation is farmer.

[f]FARM LABORER ≡ dummy equal to one if current or last occupation is farm laborer.

FOOTNOTES

[1]Some portion of this loss is no doubt insurable although the problems of moral havard are likely to be quite large in this situation for all but the most obvious phyisical difficulties.

[2]The study by Morgan et al (1962) also remains interesting and useful. Other economists have examined the determinants of work days due to sickness. See Newhouse (1970), Silver (1970), and Grossman (1972). Since this measure is limited to employed persons it is not a very useful measure for severe health difficulties.

[3]For one interesting effort to consider this problem from a largely sociological viewpoint see Nagi and Hadley (1972).

[4]Grossman (1973), for example, has found in one sample that the health of an older male is more closely correlated with the education of the wife than his own education.

[5]The wage effects of poor health are considered in an interesting piece by Grossman and Benham (1973).

[6]Grossman (1972) stresses this distinction. The further distinction made by Grossman between health maintenance time and sick time is ignored here.

[7]This aspect has been ably discussed by Grossman (1972).

[8]An alternative explanation of this relationship is possible, namely that healthier males can attract and marry higher quality (educated) females. Since these results are for older males, ages 45-59, the simultaneity problem is somewhat diminished. The bulk of these individuals are likely to have developed health problems in the twenty to thirty years since the usual marriage age. See Benham (1974) and Welch (1974) for a discussion of this issue.

[9]Relatively stable shares among family members when one suffers some economic adversity implies the "rents" to the relationship going to the unaffected party or parties will fall. Presumably increased marital instability might result.

[10]A number of researchers including Auster, Leveson, and Sarachek (1969), Grossman (1972), and Fuchs (1974) have stressed the importance of social phenomenon -- consumption habits, personal relationships, etc. -- as determinants of health status, in contrast to narrowly defined medical care.

[11]Note that this home commodity is somewhat different from that used by Becker since home work time but not leisure are used to produce it. See Becker (1965).

[12]In the derivation of qualitative predictions from the differential system generated below, this function is assumed to be additive.

[13] See Parnes et al, (1970).

[14] Annual hours were chosen because of interest in measuring roughly an earnings effect of health. Other researchers have estimated health effects on labor force participation, weeks worked per year, and hours worked per week. Both Davis (1972) and Scheffler and Iden (1974) report that weeks worked are more sensitive to poor health than are hours per week. Burgess and Kingston (1974) report modestly greater duration of unemployment for workers in poor health.

[15] A classic piece by Nagi (1969) compares self reported health condition with a doctor's opinion and finds a substantial correspondence of the two. Deviations where systematic are not necessarily in the intuitively predictable direction.

[16] As mentioned earlier Grossman (1973) found wife's schooling to be strongly related to the health status of one sample of middle-aged man.

[17] A complete model would, no doubt, treat assets and asset income as an endogenous variable.

[18] See Morgan et al (1966) for a more complete description of the data.

[19] Again see Grossman and Benham (1974).

[20] See Berkowitz and Johnson (1974), Scheffler and Iden (1974), and Luft (1975).

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