ON THE LABOR-SUPPLY EFFECTS OF AGE-RELATED INCOME MAINTENANCE PROGRAMS*

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ABSTRACT

In this paper a model is developed which is designed to capture the channels through which income transfer programs are likely to affect working hours of family members. The model demonstrates that the appropriate framework is neither a pure one-period or life-cycle one, but rather one that contains elements of both models. The final section illustrates a method of estimating the labor-supply reactions to income maintenance programs. The labor-supply effects are functions of the duration of a family's participation and the relevant importance of male market investment.

A large proportion of current policy research deals with the direct and indirect consequences of income transfer programs. One behavioral response that has received considerable attention both for existing government programs (social security) and for newly proposed legislation (family assistance plans [FAP], day care centers) is the labor-supply effect. Because these programs contain negative income tax elements, it was felt that they might seriously disrupt work incentives and lead to a large reduction in the work effort of new welfare recipients. Since economists could offer a well-developed theory dealing with the labor-supply aspects, it was expected that they would play a central role in designing and evaluating alternative proposals.

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The model that economists used for the social security program (Gallaway [5]), and more recently for FAP (Greenberg-Kosters [7] and Green-Tella [6]), was the standard textbook theory of an individual choosing between labor and leisure. These programs were viewed as including two features that would reduce the market hours of individuals participating in the program: an income subsidy reducing market work as long as leisure was a normal good, and an implicit tax on market earnings lowering the cost of not working. This unambiguity in the theory unfortunately has not been matched by similar success in the empirical work already completed by economists. In their book summarizing a number of empirical studies of income maintenance programs, Cain and Watts [4] emphasized the wide range of labor-supply reactions estimated in these studies. Many of the criticisms and suggestions for improving these estimates have centered either on improving the quality of the data or on using more sophisticated econometric techniques (Aigner [1]). There has been little questioning of the appropriateness of the theoretical model (one notable exception is the recent work of Metcalf [8])[1] as a framework to analyze the economic effects of these programs. In this paper, I argue that the standard labor-supply model used is inadequate and gives misleading and at times incorrect predictions on the labor-supply effects.

One difficulty is that the standard model contains only one time period, but income transfer programs generally have important interperiod or life-cycle effects. The one-period model is appropriate only when the proposal being investigated operates so that it does not alter the incentives to substitute economic activity between time periods. But FAP and social security programs typically do provide individuals with incentives to alter the timing of their market participation. In this paper, I develop a model designed to capture the channels through which income transfer programs are likely to affect working hours of family members. The model demonstrates that the appropriate framework is neither a pure one-period or a life-cycle one, but rather one that contains elements of both models. Because these programs alter the rate of exchange between time and market goods and increase a family's wealth, the one-period model incorporates some of the relevant economic factors at work. The life-cycle aspect must also be included, because such programs change the relative cost of consuming at different ages, inducing families to reallocate their con-

1 In spite of some differences in the formal structure of our models, there is a definite similarity in the spirit of Metcalf's work and this paper. We both focus on the discrepancies between single-period and life-cycle models of labor choice. Metcalf's principal emphasis concerns the biases that may exist if one uses the observed labor-supply reactions in limited duration experiments (i.e., the New Jersey–Pennsylvania experiment) to predict the effects of permanent (lifetime) income maintenance programs. I contend here that permanently instituted programs need not imply permanent participation by families (social security is the most obvious case). I attempt further to identify these subgroups in the population where reactions may differ. The empirical techniques that we use to isolate the labor-supply effects are quite different.

sumption and working patterns over time. Finally, the incentives to invest in human capital may be altered.

A second theme of this paper is that the existing treatment of these policy issues has often not recognized fully the importance of the family context in which economic decisions are made. A FAP, for example, simultaneously alters the work incentives of all family members. Current research has typically selected one family member and attempted to estimate the magnitude of the reduction in market work encouraged by changing the incentives that he alone faces. In contrast to this approach, the model developed in this paper explicitly allows the work incentives of all family members to be changed. This permits us to study the relative size of the reduced work effort by married men and women. With this model, a strong a priori case can be made that the largest labor market withdrawals will be those of married women. Indeed, I shall show that a family assistance program is likely to increase the market work of men at some ages. The final section of this paper illustrates a method of estimating the labor-supply reactions to income maintenance programs. These labor-supply effects are functions of the duration of a family's participation and the relative importance of male market investments.

THE LABOR-SUPPLY MODEL

In the Appendix, a model is developed from which derived demand equations are obtained giving the amount of time required in home production at every age for each family member. This model differs from the standard analysis in that it allows the intensity of market participation to vary with age due to temporal variations in wage rates and other variables that elicit timing responses about the long-run desired levels. From equation (14) of the Appendix, the demand for home time in differential equation form is (all symbols are defined in the glossary):

$$(1) \qquad \frac{dM_t}{M_t} = \frac{d(R/P)}{(R/P)} - \sigma_c\left(\frac{d\pi_t}{\pi_t} - \frac{dP}{P}\right) - (S_F\sigma_{MF} + S_X\sigma_{MX})\frac{dw_{mt}}{w_{mt}} + S_F\sigma_{MF}\frac{dw_{ft}}{w_{ft}} + \sigma_c\,(r - \alpha)$$

Equation (1) states that the demand for home time for any family member will be larger (and market hours lower): (1) the larger the family's real wealth (R/P); (2) the lower the cost of consumption at that age relative to the lifetime price (π_t/P); (3) the lower the wage of the family member at that age (w_{mt}); (4) the larger the wage of other family members at that age (w_{ft}); (5) the older one is (assuming that the rate of interest exceeds the rate of time preference).

This model of labor supply can be used to investigate the effect of income transfer programs. The program components associated with any specific FAP or social security program are fairly complex so that income guarantees and marginal tax rates may vary substantially among households. For analytical simplicity, I will reduce these programs to their two essential provisions: (1) families with zero earnings receive an income payment of S dollars per year for each year they are eligible for benefits, and (2) this payment is reduced by μ cents for each dollar of earnings in a year. The welfare payments a family receives in any year t are:

$$S_t = S - \mu \left(E_{M_t} + E_{F_t}\right) \tag{2}$$

A family will not receive benefits when family earnings exceed S/μ.[2] However, many families will qualify for benefits only during some part of their life cycle, because the age variability of family earnings will make participation in the program beneficial only at certain ages. The relatively flat age-earnings profiles observed for the less educated and the poor does not necessarily imply that these life-cycle considerations are unimportant. The income relevant for eligibility is earned and not potential income. Many nonpoor will have low observed income at certain life-cycle stages (college students, older workers near or after retirement). The observed income profiles for the poor are also averages over individuals and could suppress many instances of individuals in that group having more typical concave age-family earnings profiles. Finally, another characteristic of the poor is income instability from one year to the next.

Eligibility criteria other than income that are specific to a life-cycle stage are often part of these programs. Some income maintenance programs explicitly restrict participation to certain stages of the life cycle. The most obvious example is the social security program where age determines eligibility. Using a single-period framework would be particularly inappropriate for the program. But other income maintenance programs implicitly introduce age as a criterion for eligibility by restricting participation based on individual characteristics that are closely related to one's life-cycle stage. Provisions excluding individuals based on marital status; schooling; number, age, or existence of children; and financial worth have been introduced into some recent welfare proposals so that the probability of participation is conditional on one position in the life cycle. In the FAP proposed by the Nixon Administration, a family could not receive benefits if its assets in certain categories exceed \$1500. Although income-age profiles for the poor may be relatively flat, this is not in general true for net worth profiles. Those proposals involving day care subsidies alter incentives principally in the life-cycle stage when young children are present.

Although these programs are unlikely to alter interest rates or time prefer-

2 Actually, families with incomes initially slightly higher than S/μ will participate because it will be beneficial to them to react by lowering working hours and reducing their earnings below S/μ.

ences, they will affect labor supply through the other categories. As long as payments are received at any age, a family's real wealth is increased. If a family is not eligible for a subsidy at every age, the cost of household consumption will be lowered at ages when payments are received relative to other ages. Finally, during the periods of eligibility, the opportunity cost of time of men and women are lowered relative to market purchased goods. Each factor may alter the supply of market hours, but it is convenient to discuss separately the effect of a change in real wealth and all those changes attributed to substitution effects (either substitution in consumption between time periods or substitution between time and goods in any time period). Not surprisingly, economic theory has more to say about the latter category.

WEALTH EFFECT

To evaluate the increase in lifetime wealth, it is necessary to know the ages when benefits are received and the subsidy at each age. Assume for simplicity that a family receives benefits only between periods t_1 to t_2 and is not eligible at any other age. If we let $\bar{S}$ be the constant subsidy over time periods t_1 to t_2 that is equivalent (in wealth terms) to the actual subsidy received over this period, the increase in real wealth for participants is:[3]

$$\Delta R = (\bar{S}/r)e^{-rt_1}(1 - e^{-rn}) \tag{3}$$

where n is the number of periods in which benefits are received. The increase in real wealth will be larger the earlier the benefits are received (the smaller t_1), the larger the number of time periods when benefits are received, and the larger the average per-period subsidy.

Even this simple representation illustrates some conceptual and statistical problems in the existing literature dealing with the wealth effects of these programs. In the spirit of the one-period model, researchers are acting as if benefits are received at every age, so that $\bar{S}/r$ measures the change in real wealth. But this clearly overestimates the additional wealth for families receiving benefits only for some fraction of their life. Empirically, the income used to estimate the wealth effect is current-period nonearnings income or assets. Only if this income is assumed to be received at every age will percentage differences in this income among individuals correspond to percentage differences in wealth. Unfortunately, nonlabor income and assets are characterized by large transitory components. Even if one knew the appropriate time horizon for the statistical measures of income, one must still determine the subgroups in the population who differ in n or t_1.

3 Throughout, I am assuming that the characteristics of these programs are properly anticipated. Thus I ignore all the complex issues associated with the effects of unexpected programs.

This analysis suggests that the usefulness of the controlled experimental data collected to study FAP is limited. These experiments have been conducted for relatively short periods of time.[4] For families whose participation in a FAP exceeds the time span of the experimental program, the results obtained for families in the experimental program are not applicable. The number of periods of eligibility is a critical variable in determining the hours response to a FAP because it determines in part the increase in real wealth and also the strength of the incentive to substitute consumption between time periods.

Because of the apparent similarities in the two programs, some economists have suggested [5] that behavior under the social security program may be used to predict the labor-supply effects of a FAP. However, our model shows that since social security payments generally can be received only by older workers, their labor force adjustments will not be representative of groups of workers distributed more uniformly over the age distribution. The discounting process itself makes the value of transfers received under social security worth less than equivalent money transfers to younger families. Any wealth effects estimated for a social security program would likely fall short of the actual reduction in market hours with a FAP. Moreover, social security is received at ages characterized by little market human capital investments. I will show that a study of social security programs will tend to underestimate the relative reduction in female market hours and overestimate the decrease in market work of male heads of households induced by a FAP.

THE SUBSTITUTION EFFECT

By holding real wealth (R/P) constant in equation (1), we can isolate those labor-supply reactions that are pure substitution effects. Two relative prices are altered by these maintenance programs: (1) the cost of consuming in one time period relative to another, and (2) the cost in some periods of using one input in household production relative to other inputs.

If we ignore for the moment human capital investments, the cost of consuming (π_t) in any period is lowered because the real cost of using male and female time in the household sector falls by the implicit marginal tax rate (μ).

At those ages when the family is not eligible for benefits, the wages of all family members are unaffected, but the cost of consuming at these ages relative to ages when benefits are received is increased.[5] Using equation (1), the per-

4 For example, the New Jersey–Pennsylvania experiment lasted three years.

5 Assuming for simplicity that benefits are received only between time periods t_1 and t_2, the change in the lifetime price index caused by the income maintenance program is

$$dP/P = -\int_{t=t_1}^{t_2} (k_t S_{M_t} + k_t S_{F_t})\mu \, dt$$

As an approximation, we may write

centage decreases in the demand for male and female home and market goods time during these noneligible ages is:

(4) $$\frac{dM_t}{M_t} = \frac{dF_t}{F_t} = \frac{dX_t}{X_t} = -[\sigma_c (\bar{S}_M + \bar{S}_F)\Omega]\mu$$

where $\bar{S}_M$ and $\bar{S}_F$ are the average lifetime shares of male and female time in household production and $\int_{t=t_1}^{t_2} k_t dt = \Omega$ is a measure of the fraction of a family's life during which it receives program benefits.[6]

A different set of demand equations is appropriate for those ages when the family is covered. In addition to the lower cost of consuming, there is a percentage reduction in the opportunity cost of male and female time of μ percent. The home time demand equations for the eligible age is:[7]

(5) $$\frac{dM_t}{M_t} = \left\{\sigma_c[(\bar{S}_M + \bar{S}_F)(1 - \Omega)] + S_{X_t}\sigma_{MX}\right\}\mu$$

(Only the male equations are in the text; the female and market goods equations are contained in footnotes.) These equations show the importance of distin-

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$$dP/P = -(\bar{S}_M + \bar{S}_F) \int_{t=t_1}^{t_2} k_t \mu\, dt = -(\bar{S}_M + \bar{S}_F)\Omega\mu$$

Since $S_{M_t} = \bar{S}_M + \delta_t$ where δ_t is the deviation of the share in that period from the mean lifetime share, the approximation involves

$$\int_{t=t_1}^{t_2} k_t \delta_t\, dt \cong 0$$

that is, a weighted average of the deviations of the time shares from the mean lifetime share is approximately zero. In any case, any error caused by this approximation is likely to be small.

6 This interpretation of Ω holds precisely if the shares are identical in each period. In that case,

$$\int_{t=t_1}^{t_2} k_t\, dt = nk_t = n/N = \Omega$$

where n is the number of time periods the family receives benefits and N is the total number of time periods in the lifetime. Even if the shares are not equal, Ω is a positive monotonic function of the number of periods of eligibility, and that is the interpretation maintained in the text.

7 Since both male and female wages fall by the same percentage (μ), we may write

$$dM_t/M_t = -[\sigma_c(\bar{S}_M + \bar{S}_F)\Omega - S_{M_t}(\sigma_{MM} - \sigma_c) - S_{F_t}(\sigma_{MF} - \sigma_c)]\mu$$

or

$$dM_t/M_t = \sigma_c[(S_{M_t} + S_{F_t}) - (\bar{S}_M + \bar{S}_F)\Omega] + S_{X_t}\sigma_{MX}$$

By a similar proof, the female equation is

$$dF_t/F_t = \sigma_c[(\bar{S}_M + \bar{S}_F)(1 - \Omega) + S_{X_t}\sigma_{FX}]\ \mu$$

and the market goods demand function is

$$dX_t/X_t = [(\bar{S}_M + \bar{S}_F)\sigma_c(1 - \Omega) + S_X\sigma_{XX}]\mu$$

guishing between the eligible and noneligible stages of the life cycle. On the substitution effect, market work of men and women and the demand for market goods will actually increase during the noneligible periods. With the higher cost of household consumption in these periods, the family has an incentive to reallocate some of its household production toward the eligible periods. This releases time of men and women from the household sector, and their market work will tend to increase.

However, during the eligible periods, due to the substitution effect, market hours of men and women should decline.[8] The family will attempt to produce more of its lifetime consumption in the periods of eligibility, increasing the demand for male and female time in the household sector. This effect will be stronger the more elastic (the larger σ_c) the intertemporal demand elasticity, the larger the combined share in household consumption of male and female time ($\bar{S}_M + \bar{S}_F$), and the fewer the number of periods of eligibility $(1 - \Omega)$. Because household production costs are lowered by approximately the same percentage in all eligible periods, there is no incentive to reallocate consumption between these periods. As the number of eligible periods increases, the importance of this intertemporal substitution diminishes. The second term in equation (5), (S_{X_t} σ_{MX}), measures the incentive to substitute the time of men and women for market goods in the household production process. Because the prices of both have fallen by μ percent, there is no incentive to substitute between the two time inputs. The family will attempt, however, to substitute both time inputs for market purchased goods.

For market goods, the two substitution effects are working in conflicting directions. The increased relative cost of market goods induces substitution toward the use of time in household production. However, the cost of consuming at these ages relative to other ages has fallen, and this should increase the use of all inputs including market goods consumption. For the substitution effect alone, on theoretical grounds, we cannot determine whether consumption will fall or increase. But the different incentives in the eligible and noneligible ages does suggest that these income maintenance programs will alter the age pattern of market goods consumption.

This model may be contrasted with the one based on a single-period framework that currently dominates the literature. Using the one-period model derived in the Appendix (equation 19), the effect of an income maintenance program on home hours would be:

$$(6) \qquad dM/M = -S_M \; \sigma_{MM} \mu + n_t(dR/R)$$

where dR/R is the percentage increase in real income resulting from the subsidy.

8 The term in equation (5), $\sigma_c[(\bar{S}_M + \bar{S}_F)(1 - \Omega)]$, summarizes the interperiod substitution component.

There are basically two reasons why equation (6) differs from the model derived in this paper; it ignores the life-cycle dimension and some important aspects of the family context. Although the necessity of the family context has been accepted on econometric grounds (that is, because of specification bias, the male wage coefficient in a labor-supply equation will be biased downwards if the wife's wages are not included), the role of the family context cuts deeper. In some of the more prominent work in this field [7, 6], the effect of a FAP on male hours worked is simulated by letting male wages decline by the marginal tax rate while holding female wages constant. We have seen that the wages of both spouses will be affected and that some of the incentive to substitute in favor of male time is offset by the lower female wage. An additional factor that will be developed below is that income maintenance programs will not generally affect male and female wages to the same degree. A more important defect of the standard model is the neglect of the life cycle. The lower cost of consuming while a family receives welfare benefits strengthens the incentive to withdraw market hours caused by the substitution in household production. Also, the possibility of increased market participation at other stages of the life cycle is by definition ignored if a one-period approach is followed.

A frequently asserted hypothesis is that income maintenance programs will have a larger impact on the work behavior of secondary workers (married women) than on male heads of households, but there exists little systematic justification of this hypothesis based on the underlying theory. Ignoring wealth effects, equations (4) and (5) describe the percentage change in male and female household time. During the noneligible ages, this simple model predicts an equal percentage reduction in home time for both spouses.[9] Because married women specialize more in the nonmarket sector, this implies a larger absolute and percentage increase in female market hours during the noneligible ages. The relative change during the eligible ages is:

(7) $$\frac{dM_t}{M_t} - \frac{dF_t}{F_t} = S_X(\sigma_{MX} - \sigma_{FX})$$

There will be a larger percentage increase in home time demand for that time input that substitutes more easily for market goods. A priori arguments on the relative magnitude of the ease of substitution of male and female time against market goods typically are not convincing, so that empirical tests must be relied upon. The interest of policy-makers usually centers on the relative reduction in market hours. Males spend many fewer hours in the nonmarket sector, so larger percentage increases in nonmarket hours for males could easily translate into

9 It is easy to construct models in which this is not the case. One could include in each time period many commodities varying both in their relative input intensities and the ease with which they substitute between commodities in other periods. The model in the text illustrates how far a much simpler model takes us.

small reductions in male market hours. The difference between the percentage changes in male and female market hours is:[10]

$$\frac{dN_{mt}}{N_{mt}} - \frac{dN_{ft}}{N_{ft}} = [(\frac{F_t}{N_{ft}} - \frac{M_t}{N_{mt}})(S_M + S_F)(1 - \Omega)\sigma_c] + [S_X(\sigma_{FX}\frac{F_t}{N_{ft}} - \sigma_{MX}\frac{M_t}{N_{mt}})] \quad (8)$$

Even though our empirical estimates will show $\sigma_{MX} > \sigma_{MF}$, both terms in equation (8) are almost certainly positive.

HUMAN CAPITAL INVESTMENT

These predictions concerning the intrafamily work patterns are reinforced if we include human capital investments in the model. As a simplication, assume that all human capital investment costs are forgone earnings.[11] If E_t^P are the earnings an individual would receive if he did not invest at age t, and C_t are the dollar costs of investments in that time period, his observed earnings (E_t*) will be:

$$E_t^* = E_t^P - C_t$$

This discrepancy between observed and potential wages is important because the potential wage represents the opportunity cost of time and hence governs the allocation of that time among alternative uses. But only observed wages are subject to the tax. A marginal tax rate of μ percent will lower observed earnings by μ percent, but potential earnings will fall by $\mu(1 - C_t^*)$ percent where C_t^* is the fraction of potential earnings absorbed by human capital investments.[12] Clearly, if individuals differ in C_t^*, their labor-supply reactions to income maintenance provisions will differ as well. We can use the theory of the optimal

10 Because $dN^m/N^m = (-M/N^m)(dM/M)$, both terms in equation (8) should be positive. The first term is necessarily positive as long as females specialize relatively more in nonmarket activities. In the second term, the partial elasticities of substitution are weighted by the degree of specialization in the nonmarket sector. Based on 1967 SEO data, σ_{FX} receives a weight of 13 and σ_{MX} has a weight of 3. Thus even though my empirical estimates presented later indicate that goods substitute more easily against male time than female time, the difference is not likely to be large enough to offset the much greater female home specialization. There is a strong presumption based on the theory that there will be a larger absolute and percentage reduction in female market work.

11 That is, only time enters the production of human capital.

12 It may be rewritten $E_t^* = E_t^P(1 - C_t^*)$ where $C_t^* = C_t/E_t^P$ and $\mu E_t^* = \mu(1 - C_t^*)E_t^P$. This concept of the fraction of potential earnings that are invested was introduced by Jacob Mincer.

life-cycle path of human capital investment to identify the distribution of C_t^* over demographic subgroups in the population.[13] Since one determinant of the probability of these investments is the expected length of future labor force participation, males have a greater incentive than women to invest in market forms of human capital. The observed wage profiles for men and women confirm this prediction, since the female profile is considerably flatter than the male. Therefore, income maintenance programs will not lower the true wages of males and females by the same percentage. Equations (4) and (5), which assumed proportionate reductions in wages, are no longer appropriate. For example, if male wages fall by a constant fraction (λ) of female wages at every age in which benefits are received, the new equations for males would be:[14]

(9) noneligible period $$dM_t/M_t = -[(\lambda \bar{S}_M + \bar{S}_F)\, \sigma_c\, \Omega]\mu$$

(10) eligible period $$dM_t/M_t = [\sigma_c (1 - \Omega)(\lambda \bar{S}_M + \bar{S}_F) + S_{X_t}\, \sigma_{MX} \lambda - (1 - \lambda)\, \sigma_{MF}\, \bar{S}_F]\mu$$

The quàlitative predictions for the noneligible ages (equation 9) remain the same. However, in the eligible periods the family has an incentive to substitute female for male time in home production because male wages no longer fall as much as female wages. This tends to dampen somewhat the previously predicted increased demand for male home time and to further increase the specialization of females in the household. The relative demand for the two inputs may be expressed as:

(11) $$[S_X(\sigma_{MX}\lambda - \sigma_{FX}) - (1 - \lambda)\sigma_{MF}(S_M + S_F)]\mu$$

In contrast to the model with no investments, $\sigma_{MF} > \sigma_{FX}$ will not guarantee a larger percentage increase in male nonmarket hours. Indeed, both terms are likely to be negative so that the percentage increase of female nonmarket hours will exceed that of males. Of course, all the previous statements involving the larger female market hours effect are reinforced.

A well-known implication of human capital theory is that investments will decline with age. Thus even in the eligible periods, the cost of household production will not fall by an equivalent amount at each age. Rather, the largest decreases will occur at older ages when investments are less important. Consider

13 In Mincer's terminology $C_t^* = k_t$. Mincer uses the age or experience distribution of k_t to explain log earnings age profiles of individuals. The optimal life-cycle investment model was developed by Ben-Porath [3].

14 This assumes that the male and female investment profiles are parallel. Obviously, this need not be the case. Also μ now is the percentage reduction in female wages. The female equation is:

$$dF_t/F_t = [\sigma_c(1 - \Omega)(\bar{S}_M + \bar{S}_F) + S_{X_t}\sigma_{FX} + (1 - \lambda)\sigma_{MF} S_M]\mu$$

two families that participate in a FAP–one family during ages 26–30 and the other from ages 56–60. The model predicts a larger reduction in male working hours in the older family. λ serves as a negative index of human capital investments. As λ increases, the reduction in male wages approaches that of females, and the increase in male home time increases.[15] The principal avenue of male market withdrawal might well be in the form of earlier retirement. For females, however, there will be a larger reduction in the working time of the wife in the younger family where the relative reduction in her wage is the largest.[16]

The incentives to invest in human capital are also altered by programs such as FAP. Each additional dollar of potential earnings used to finance self-investment increases the subsidy received by μ cents. Moreover, if, as our theory suggests, male market hours rise during the noneligible period, the returns from any investments will increase. Because the fraction of total investment costs that are forgone earnings is probably higher for job investments than for schooling, these programs especially encourage on-the-job investments.[17] We should also expect some switching to more time-intensive techniques of producing human capital and an increase in the proportion of specific job training financed by employees. If policy-makers ignore these incentives to invest and use market earnings to estimate potential participants in these programs, the number of young families opting to receive benefits will be underestimated. Finally, this encouragement of job investment is more important for males. But hours spent investing on the job are reported as working hours. This makes even more plausible the possibility of observed job hours increasing for young married males, while the family is receiving income transfers.

A TENTATIVE SIMULATION

Predictions about the direction and importance of the labor-supply effects require estimates of the relative magnitude of the parameters of the household production and intertemporal utility functions. In Table 1, I present estimates of the pure life-cycle home time demand functions for white married men and women. In the Appendix (equation 15), the demand equation for the pure life-cycle model was shown to be:

$$dM_t/M_t = -(S_M\sigma_c + S_F\sigma_{MF} + S_X\sigma_{MX})(dw_{mt}/w_{mt}) + S_F(\sigma_{MF} - \sigma_c)(dw_{ft}/w_{ft}) + \sigma_c(r - \alpha) \quad (12)$$

15 From equation, $[d(dM_t/M_t)]/d\lambda = \sigma_c(1 - \Omega)S_M - S_F\sigma_{FF}$. This derivative is positive.

16 From equation, $[d(dF_t/M_t)]/d\lambda = S_M(\sigma_c - \sigma_{MF}) - \Omega\sigma_c$. Since empirically $\sigma_c < \sigma_{MF}$, this derivative is negative.

17 If job training is completely general, all investment costs will appear as forgone earnings.

TABLE 1

LIFE-CYCLE HOME TIME DEMAND EQUATIONS

	Independent Variables (t-Values in Parentheses)					
Dependent Variable	Log Male Hourly Wage	Log Female Hourly Wage	Age	Number of Children Less than Seven	Constant	R^2
Log male home time[a]	−.1065	.0283	.00007	−.0158	9.31	.88
	(11.71)	(1.71)	(.49)	(5.92)	(241.6)	
Log female home time	.0246	−.0852	.0007	.0364	9.31	.88
	(2.78)	(4.20)	(4.02)	(11.20)	(121.3)	

Source: [12], based on 1967 Survey of Economic Opportunity data. Regressions covered white married spouse-present families, ages 22–64.

[a]Home time defined as (8760−average yearly hours work).

These regressions were based on a sample of white married spouse-present families using the 1967 SEO survey.[18] This sample was stratified by the age of the husband, and within every age cell, mean values of all variables were calculated. In the absence of secular growth, the observed variation between age cells will correspond to the expected life-cycle variation for a cohort if the cohort's expectation is unbiased on average. Of course, real wages have grown over time so that younger cohorts have a higher expected wealth. But if we further assume that real wages were expected to grow at a constant rate secularly, the estimated wage coefficient will be unbiased, but the age coefficient will be a biased estimate of the interest rate effect.[19] Using equation (2), aggregating at each husband's age and integrating, we have:

$$\log M_t = a_0 + a_1 \log \bar{w}_{mt} + a_2 \log \bar{w}_{ft} + a_3 \text{ age} \tag{13}$$

which are the equations estimated in Table 1.

18 The female life-cycle equation is:

$$dF_t/F_t = -\ (S_F\sigma_c + S_M\sigma_{MF} + S_X\sigma_{MX})(dw_{ft}/w_{ft}) + S_M(\sigma_{MF} - \sigma_c)(dw_{mt}/w_{mt}) + \\ + \sigma_c(r - \alpha)$$

For a more detailed description of the sample and the empirical procedure followed, see [12].

19 Intuitively, if real wealth grows at a constant rate secularly, wealth becomes perfectly correlated with age and all wealth effects are picked up by the age variable.

TABLE 2
ESTIMATED CHANGE IN MARKET WORK
(SUBSTITUTION EFFECT ONLY)

		Eligible Period				Noneligible Period
		% Change in Nonmarket Time		Absolute Change in Market Work		
Sex Group	Investment Assumption	Maximum	Minimum	Maximum	Minimum	Maximum Increase in Market Work
Males	λ = 1	3.91	1.89	−259	−125	134
Females		3.03	1.01	−248	−83	166
Males	λ = 2/3	2.14	.44	−141	−29	111
Females		3.44	1.76	−282	−139	138
Males	λ = 1/2	1.25	−.29	−83	18	100
Females		3.64	2.13	−298	−175	124
Males	λ = 1/3	.36	−1.02	−24	67	89
Females		3.85	2.50	−316	−197	110

Note: Absolute changes evaluated at mean home hours of 6612 for males and 8196 for females, based on 1967 SEO survey.

These life-cycle estimates may be used to simulate the pure substitution component of an income transfer.[20] One difficulty is that the reactions depend also upon the expected number of years a family will participate and the extent of differential investment profiles among family members. But by assuming extreme values for duration of program participation and differential family investments, limits may be placed on the labor-supply effects.

First, consider the case of no human capital investments (λ = 1). If we add the male and female wage coefficients in the estimated life-cycle equations, we have:

$$dM_t/M_t = -\ [(\bar{S}_M + \bar{S}_F)\,\sigma_c + S_X \sigma_{MX}] = -.0782$$

$$dF_t/F_t = -\ [(\bar{S}_M + \bar{S}_F)\,\sigma_c + S_X \sigma_{FX}] = -.0606$$

20 It is only possible to calculate the substitution effect in the life-cycle model because we have assumed that a single cohort has unbiased expectations of future incomes, so that real wealth remains constant through a cohort's life-cycle experience. Differences in wealth between cohorts are in the age variable, and this wealth effect cannot be disentangled from the interest rate and time preferences effects. Of course, it is the appealing feature of the life-cycle equation that the substitution effect can be isolated.

These are the predicted effects of an income maintenance program (equations 5 and 6) for the eligible periods if the family joins for only one year ($\Omega = 0$). Because the importance of the incentive to substitute between time periods diminishes as the number of periods of participation increases, the substitution effect will be strongest when a family participates for only one year. According to the first two lines of Table 2, for families in which human capital investment is not important, the maximum percentage increase in male and female non-market hours for a 50 percent marginal tax rate is 3.91 percent and 3.03 percent. Based on the 1966 mean levels of nonmarket time of 6612 hours for males and 8196 for females, the reduction in market hours are 259 and 248 for males and females, respectively. The larger percentage increase in male home time suggests that market goods are a better substitute for male home time than for female since:

$$(dM_t/M_t) - (dF_t/F_t) = S_X(\sigma_{FX} - \sigma_{MX}) = -.076$$

In terms of the disruption of market activity, there will be a 12 percent reduction in market hours for males and a 44 percent reduction in market hours for females. This considerably larger effect on females is dramatic since at a typical age 50 percent of married women do not work at all during a year. For working women, this means a reduction from 1128 to 632 hours worked (a change of 486 hours). The minimum estimates in Table 2 are obtained by assuming that a family participates in the program at every age so that there is no interperiod substitution, but only substitution between inputs in production. In this case, only the $S_X\sigma_{MX}$ and $S_X\sigma_{FX}$ components of the total substitution effect are relevant. We can obtain a lower bound on these by rewriting the equation as:

$$dF_t/F_t = \sigma_c + S_X(\sigma_{FX} - \sigma_c) = .0606$$

The positive signs of the cross substitution effects in the life-cycle equation imply that substitution in production between inputs exceeds substitution in consumption between time periods.[21] Therefore, σ_c must be smaller than .0606. It is also unlikely that the share of market goods in household production is less than one third. Based on these assumptions, $S_X\sigma_{MX} \geqslant .0378$ and $S_X\sigma_{FX} \geqslant .0202$. These numbers were used to obtain the minimum effect of a reduction of 125 hours for males and 83 hours for females in their market work. The maximum increase in market work for the noneligible periods was calculated from equation (4) using the upper bound assumption for σ_c and letting $\Omega = 1$.[22] The predictions for the other investments assumptions were obtained using

21 Ghez [2] also found this for the life-cycle market goods consumption equations which directly supports the argument in the text.

22 The largest increase in market work in the noneligible period will occur when a family participates in the income maintenance program for all years but one.

equation (10) and plugging in the appropriate value of λ. For the maximum estimates, it is only necessary to multiply the male coefficient by λ before summing the two wage coefficients.[23]

These results suggest what the theory itself implied—transfer programs will have a larger impact on the work behavior of married women than on male heads of household. This is always true for percentage withdrawal of market hours. For investment parameter of two-thirds, the maximum absolute withdrawal of female market work is twice that of men. When investments are important, the reduction in male market work becomes very small, and we can not exclude the possibility that their market hours will actually increase.

APPENDIX

Assume that a family maximizes lifetime utility

(1) $$U = [\int_0^N Z_t^{([\sigma_c - 1]/\sigma_c)} e^{-\alpha t} dt]^{(\sigma_c/[\sigma_c - 1])}$$

facing the following household production function, and time and money expenditure constraints:

(2) $$Z_t = f(X_t, M_t, F_t)$$

(3a) $$M_t + N_{Mt} = F_t + N_{ft} = T$$

(3b) $$\int_0^N X_t e^{-rt} dt = \int_0^N (w_{mt}N_{mt} + w_{ft}N_{ft})e^{-rt}dt + A_0$$

(4) $$R = \int_0^N \pi_t Z_t e^{-rt} dt = T\int_0^N (w_{mt} + w_{ft})e^{-rt}dt + A_0$$

When the family maximizes utility function (1) subject to budget constraint (4), the following must hold between consumption in period t and $t + j$:

(5) $$-dZ_{t+j}/dZ_t = (Z_{t+j}/Z_t)^{(1/\sigma_c)} e^{\alpha j} = (\pi_t/\pi_{t+j})\, e^{rj}$$

Therefore consumption in any period $t + j$ can be expressed by rearranging terms as:

(6) $$Z_{t+j} = Z_t[e^{(r-\alpha)j}(\pi_t/\pi_{t+j})]^{\sigma_c}$$

and since

(7) $$R = \int_0^N \pi_t Z_t e^{-rt} dt = \int_{-t}^{N-t} \pi_{t+j} Z_{t+j} e^{-r(t+j)} dj$$

we may substitute (6) into equation (7):

(8) $$R = Z_t \pi_t^{\sigma_c} e^{(\alpha-r)t\sigma_c} \int_{-t}^{N-t} (\pi_{t+j} e^{-r(t+j)})^{1-\sigma_c} e^{-\alpha\sigma_c(t+j)} dj$$

or

(9) $$R = Z_t \pi_t^{\sigma_c} e^{(\alpha-r)t\sigma_c} \int_0^N (\pi_t e^{-rt})^{1-\sigma_c} e^{-\alpha\sigma_c t} dt$$

23 For the minimum estimates, one must also know $\sigma_{MF}S_F$ and $\sigma_{MF}S_M$. But from the life-cycle model $\sigma_{MF}S_F = S_F\sigma_c = .0283$ and $\sigma_{MF}S_M = S_M\sigma_c + .0246$, so that $\sigma_{MF}S_F \cong .0485$ and $\sigma_{MF}S_M \cong .0448$.

Define the lifetime price index P as follows:

(10) $$P = [\int_0^N (\pi_t e^{-rt})^{1-\sigma_c} e^{-\alpha\sigma_c t} dt]^{(1/1-\sigma_c)}$$

Then

(11) $$Z_t = (R/P)\,(\pi_t/P)^{-\sigma_c} e^{(r-\alpha)\sigma_c t}$$

In percentage changes, we may rewrite (11) as

(12) $$\frac{dZ_t}{Z_t} = \frac{d(R/P)}{R/P} - \sigma_c\left(\frac{d\pi_t}{\pi_t} - \frac{dP}{P}\right) + \sigma_c(r-\alpha)$$

It is well known from the theory of derived demand that we may write the demand for an input as

(13) $$\frac{dM_t}{M_t} = \frac{dZ_t}{Z_t} - (S_F\sigma_{MF} + S_X\sigma_{MX})\frac{dw_{mt}}{w_{mt}} + S_F\sigma_{MF}\frac{dw_{ft}}{w_{ft}}$$

so that

(14) $$\frac{dM_t}{M_t} = \frac{d(R/P)}{R/P} - \sigma_c\left(\frac{d\pi_t}{\pi_t} - \frac{dP}{P}\right) - (S_F\sigma_{MF} + S_X\sigma_{MX})\frac{dw_{mt}}{w_{mt}} + S_F\sigma_{MF}\frac{dw_{ft}}{w_{ft}} + \sigma_c(r-\alpha)$$

The single-period and life-cycle models may be viewed as special cases of the more general demand function (14). In the life-cycle model, the percentage changes in (14) refer to changes in the demand for home time from one age to the next. Since R and P are independent of age, and $d\pi_t/\pi_t = S_M dw_{mt} + S_F dw_{ft}$, the life-cycle demand equation becomes

(15) $$\frac{dM_t}{M_t} = -(S_M\sigma_c + S_F\sigma_{MF} + S_X\sigma_{MX})\frac{dw_{mt}}{w_{mt}} + S_F(\sigma_{MF} - \sigma_c)\frac{dw_{ft}}{w_{ft}} + \sigma_c(r-\alpha)$$

The pure one-period model results when there are no interperiod price effects. This will result when the wage of individual i exceeds the wage of individual j by λ percent at age t, i's wages exceed j's by λ percent at all ages. Given this age neutrality assumption, the percentage difference in R among families is:

(16) $$dR/R = (T^*/R)\,\bar{w}_m\,(dw_m/w_m) + (T^*/R)\,\bar{w}_f\,(dw_f/w_f) + (dA_0/A_0)(A_0/R)$$

That is a weighted average of the percentage changes in male wages, female wages, and the initial assets of families. The weights are the shares in total full wealth of male human capital wealth, female human capital wealth, and all nonhuman forms of wealth. The percentage change in the lifetime price index may be expressed as

$$dP/P = (dw_m/w_m)\,\Sigma_{t=1}^n\, k_t S_{M_t} + (dw_f/w_f)\,\Sigma_{t=1}^n\, k_t S_{F_t}$$

or

(17) $$dP/P = (dw_m/w_m)\bar{S}_M + (dw_f/w_f)\bar{S}_F$$

Substituting these into equation (14) and taking percentage changes at a given age

$$\frac{dM_t}{M_t} = \frac{dA_0}{A_0} \frac{A_0}{R} + [(\frac{T^* w_{mt}}{R} - \bar{S}_M) + S_{M_t}\sigma_{MM}] \frac{dw_m}{w_m}$$

$$+ [(\frac{T^* w_{ft}}{R} - \bar{S}_F) + S_{F_t}\sigma_{MF}] \frac{dw_f}{w_f}$$

or

$$(18) \quad \frac{d_M}{M} = \frac{dA_0}{A_0} \frac{A_0}{R} + (\frac{\bar{E}_m}{R} + S_{M_t}\sigma_{MM}) \frac{dw_m}{w_m} + (\frac{\bar{E}_F}{R} + S_{F_t}\sigma_{MF} \frac{dw_f}{w_f})$$

If we drop the assumption of unitary income elasticities implied by the CES, this generalized to

$$(19) \quad \frac{dM}{M} = \eta \frac{dA_0}{A_0} \frac{A_0}{R} + (\eta \frac{\bar{E}_m}{R} + S_{M_t}\sigma_{MM}) \frac{dw_m}{w_m} + (\eta \frac{\bar{E}_F}{R} + S_{F_t}\sigma_{MF}) \frac{dw_f}{w_f}$$

which is the standard version of the one-period labor-supply model derived in a number of sources.

GLOSSARY OF SYMBOLS

U	Family utility
Z_t	Level of consumption of commodities in period t
N	Number of periods in family's horizon (equal to lifespan)
α	Index of time preference
X_t	Total quantity of market goods purchased in period t
M_t, F_t	Amount of male (husband's) time and female (wife's) time spent in home production in period t
N_{mt}, N_{ft}	Amount of husband's time and wife's time spent at work in period t
r	Interest rate
A_0	Initial assets
w_{mt}, w_{ft}	Husband's and wife's wage in period t
R	Family's level of full wealth
π_t	Shadow price of commodities in period t
P	Lifetime price index of commodities
σ_{ij}	Allen partial elasticity of substitution in home production between inputs i and j ($i,j = m,f,$ and x for M_t, F_t, and X_t)
k_t	Share of full wealth accounted for by commodities consumed in period t
s_{it}	Share of total cost of commodities in period t accounted for by input i ($i = m,f,$ or x for M_t, F_t, and X_t)
$\bar{s}_i$	Average value of s_{it} over lifetime weighted by k_t
η_t	Full-wealth elasticity of consumption of commodities in period t
$\bar{w}_m, \bar{w}_f$	Average discounted values of w_{mt} and w_{ft} over lifetime

E_{mt}, E_{ft}	Total earnings in period t by husband and wife
E_m, E_f	Present value of discounted lifetime earnings by husband and wife
T	Total time available per person per period
σ_c	Intertemporal elasticity of substitution in consumption
T^*	Total time available per person over lifetime (equal to nT)
η_{ij}	Elasticity of i with respect to j ($i = m,f$ for M_t and F_t; $j = m,f$ for w_m and w_f
S	Maximum welfare subsidy
S_t	Welfare payments received in period t
μ	Marginal tax rate of a family assistance program (FAP)
Ω	Proportion of lifetime in income maintenance program

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