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11. Education, the Price of Time, and Life-Cycle Consumption

by Gilbert R. Ghez

INTRODUCTION There is now considerable evidence that education has systematic effects on many facets of life. In this chapter I examine generally the effects of education on life-cycle behavior. More specifically, I analyze how education affects the consumption pattern of households over their lifetime. My emphasis is on the timing of efficient consumption and the effect of education on this dimension of household behavior.

As an individual ages, many of his personal conditions change. His economic status; his knowledge about places, people, and techniques; his social environment and marital status; his physical strength; his capacity to recall and absorb new knowledge; his fecundity—all these conditions tend to change with age, thereby resulting in changes in observed behavior. Education is a major determinant of personal conditions. There is ample evidence, some of which is reported in other chapters in this volume, that schooling and even postschool training are received largely at a relatively young age.[1] One would therefore expect education to have distinct effects on observed behavior over the life cycle.

The particular channel analyzed here is the effect of education on consumption behavior through its effect on the wage rate.

Schooling is undertaken largely to raise one's future earnings. While schooling may yield other benefits such as direct consumption value, improvement in the efficiency with which resources are used in the nonmarket sector, and improvement in portfolio management, its most firmly documented contribution lies in raising future market productivity, that is, in raising the future wage rates of the investor.

NOTE: I am grateful to Theodore Schultz for his gracious comments.

[1]See in particular the chapters by J. Mincer and S. Rosen in this volume.

Why does the wage rate—i.e., the price of time—influence consumption decisions? I take the approach that time is important in consumption, just as labor is important to firms. This view has been put to test in a variety of studies. The application of these ideas to consumption versus savings decisions constitutes the core of this chapter.[2] Put differently, the permanent-income hypothesis of consumption behavior is reformulated here to include the cost of time. I explore the direction and magnitude of response of consumption to the wage rate—a factor that is greatly influenced by schooling.

THE NEW VIEW OF CONSUMPTION

The new theory of consumption has three basic ingredients. First, households are regarded as producers in the nonmarket sector. They strive to achieve their goals using their own resources. These goals may include prestige, security of one's environment, healthy children, and a good game of squash. The goals, in turn, enter the household's preference function or utility function; for instance, an individual may be willing to give up some security if he is compensated by a sufficient amount of additional fame.[3]

The second ingredient of the theory is that at least some, and probably most, goals require the use of time, combined with market goods and services. Housecleaning, for instance, requires time and effort as well as some equipment. Health is produced with a doctor's advice and drugs as well as patient time, not the least part of which is spent waiting for the doctor's services. Summer vacations are produced with transportation services, hotel accommodations, and one's own time.

The third ingredient of the theory is the fact that people are concerned with their future and therefore have an incentive to obtain accurate estimates of their future income and lifetime prospects. An extreme form of this assumption would be that individuals have perfect foresight. With a lifetime horizon, individuals are faced with a lifetime budget constraint, and their basic decision is how to allocate scarce resources over their lifetimes.

In this model the demand for goods is a derived demand, derived in part from the demand for the outputs or goals to which these goods contribute. Similarly, the demand for home time (and there-

[2] For a more extensive discussion, see Ghez and Becker (forthcoming).

[3] This framework was first developed by Becker (1965) and Lancaster (1966).

fore the supply of labor) is a derived demand for a factor of production.

How does the demand for goods vary over the lifetime? One important determinant is the price of time, i.e., the wage rate the individual commands in the market. The theory of investment in human capital predicts, and observed lifetime profiles reveal, that an individual's efficiency at work increases initially and then tapers off later in life. When the wage rate is rising, four effects are set in motion:

1 The cost of using time rather than market goods in the production of each activity is raised, thereby inducing substitution toward goods. For instance, a greater cost of one's time may result in more TV dinners and less elaborate meals. I shall call this effect the *factor-substitution effect.*

2 A rise in the wage rate also raises the cost of time-intensive activities relative to those activities which are less time-intensive. To give an example, a rise in the price of time would raise the relative cost of raising children, an activity for the mother that is relatively time-intensive. As a result, one expects households to substitute toward relatively goods-intensive activities, thereby raising the overall demand for market goods. I shall call this effect the *point-in-time goal-substitution effect.*

3 Moreover, if the wage rate is rising, the cost of all future activities or goals will be greater than the current cost of these goals. Consequently, the household has an incentive to substitute away from future time-intensive activities toward present ones. For instance, the cost of going to a movie is greater for the 45-year-old executive than for the 20-year-old college student. One expects movie-attendance rates to be lower for prime-age executives than for college students. I shall call this the *intertemporal-substitution effect.* The outcome of this sort of substitution is to discourage the consumption of goods when the price of time, and therefore the implicit price of achieving goals, is relatively high.

4 Finally, an unanticipated rise in wage rates will increase the discounted value of the future income stream, hence increasing an individual's wealth: the value of his resources is higher than expected. This increment in real income is consumed, at least in part,

during the period of time that the windfall or human capital gain is received. Thus an unexpectedly high wage rate, via its effect on wealth, causes the individual to raise his consumption. Similarly, an unexpectedly low wage rate will cause him to reduce consumption. The wealth effect is smaller, the more accurately individuals have predicted their future circumstances, and it is nonexistent if the future is perfectly foreseen.

The first two effects of a rising wage rate work toward raising the demand for goods over time. Both the factor-substitution effect and the point-in-time goal-substitution effect make for higher levels of consumption of goods when the wage rate is high than when it is low. The third effect—namely, intertemporal substitution—works in the opposite direction: It tends to reduce the demand for goods when the wage rate is high. The wealth effect, in principle, could work either way: To the extent that people were excessively pessimistic and were always surprised with better wage realizations than they anticipated, the effect would be to make for a rising consumption of goods as long as the wage rate was rising. The converse would hold true if people tended to be optimists and were always disappointed. Since it is unlikely that individuals are systematically pessimists or optimists, given their incentive to make accurate forecasts, I shall assume as a first approximation that their forecasts are correct and that there is no wealth effect.

On balance, therefore, if we neglect the wealth effect, the consumption of goods would be positively related to the wage rate over the life cycle if substitution in production, including both factor substitution and substitution toward goods-intensive activities, dominated the effect of intertemporal substitution.

Over and above the wage rate, an additional variable to be reckoned with is the rate of interest, i.e., the rate at which income can be transferred over time. The higher the rate of interest, the greater the incentive to save and to postpone consumption; i.e., the higher future consumption would be relative to present consumption. What this means is that if the price of time did not vary with age, consumption would be steady if the rate of interest was zero, and it would rise as long as the rate of interest was positive.[4]

More formally, one shows that the timing of consumption is described by

[4] I am assuming no time preference. Preference for the present would reduce the incentive to postpone consumption.

$$\frac{d \log X(t)}{dt} = b_1 \frac{d \log w(t)}{dt} + b_2 \qquad (11\text{-}1)$$

where $X(t)$ is the rate of consumption of goods at age t; $w(t)$ is the real wage rate at age t; b_1 is the effect on consumption of a 1 percent rise in the wage rate (b_1 is positive or negative according to whether the substitution-in-production effect, including both the substitution between factors in each activity and the substitution toward relatively goods-intensive activities, exceeds or is dominated by the intertemporal-substitution effect); and b_2 is the effect on consumption of the rate of interest; b_2 would be positive if the rate of interest (net of time preference for the present) was positive. To see this, suppose that the wage rate were stationary; Eq. (11-1) tells us that the demand for goods would be rising if b_2 was positive.

Assuming that the parameters b_1 and b_2 are constant, Eq. (11-1) can be integrated to yield the logarithmic consumption function

$$\log X(t) = b_0 + b_1 \log w(t) + b_2 t \qquad (11\text{-}2)$$

The constant of integration b_0 in the consumption function (11-2) is an index of the real wealth of the individual. The higher real income is, the larger is b_0. To the extent that price and income expectations are fulfilled, real wealth is fixed over the life cycle, and so b_0 is independent of age.

EDUCATION AND THE PRICE OF TIME

Until now, I have described variations in consumption with age as if all prices were beyond the individual's control. In this section I show how the price-of-time sequence may be generated by introducing investment in human capital into the model. Considerable evidence has been accumulated on the effects of schooling and on-the-job training on earnings. In the formulation of earlier models, investment in human capital, on the one hand, and consumption behavior, on the other, have been analyzed separately. In other words, consumption decisions and accumulation of human capital decisions have been considered essentially separate. By implication, the supply of time to market activites has been left unexplained. I shall give a brief description of optimum investment, with special emphasis on the price of time.

Assume that, in any period, time may be spent in three different sectors. It may be allocated to consumption activities, to working activites (i.e., to the production of current income), or to the production of human capital (i.e., to increasing future earnings capacity). The latter two allocations combined may be called *market activities.* The current wage rate depends on the individual's accumulated stock of human capital, which can be augmented through net investment. Time spent in training is combined with goods (such as books, instructor's time, and the use of educational facilities) to produce a gross output of human capital. Over the life cycle, one's stock of human capital depreciates, in part through the decay caused by imperfect memory, especially at older ages; in addition, as new techniques are introduced, one's human capital becomes obsolete. Gross output is used to increase future earnings potential and to replace depreciated or obsolete human capital.

There is a strong incentive to invest in human capital at an early age. At young ages, the returns to investment are relatively large, since returns are collected over a long period of time—namely, over the whole remaining period of labor force participation. Moreover, the cost of early investments is relatively low, since the cost of time is still relatively low. These two mechanisms provide an incentive to concentrate investments in human capital in one's early years.

In the very early stages, the incentive to invest may be so great that the individual spends all his market time in education. During this stage the current wage rate is smaller than the true shadow price of time, measured by the discounted value of marginal returns from an extra hour spent in training.

Since no returns can accrue to the individual if he is not at work, it follows that during this first phase of life, the shadow wage rate cannot be falling. It will be rising if the rate of interest and the rate of depreciation of human capital are positive; indeed, both a positive rate of interest and a positive rate of depreciation reduce the advantage of investment at young ages.

During the first phase, the potential wage rate is also rising. Eventually, it will equal the shadow price of time, at which point the individual enters the labor market.

During the second stage, the individual is at work. Hence the price of time is measured by his current wage rate, whether or not he is investing in human capital. The time pattern of the wage rate depends on the individual's investment decisions. It will rise as long as net investment is positive and will even rise beyond that point if growth in real wages is occurring in the economy. Since investments tend to fall with age, the individual's potential wage rate rises at a declining rate. Eventually the wage rate will tend to fall, when depreciation on human capital—due mainly to faltering health—becomes large.

In the third stage of life, the individual stops working altogether because the value of his time in consumption exceeds the value of his time in the market. After the individual has retired, variations in his market efficiency have no effect on his consumption decisions.

The investment in the human capital decision and the consumption decision are very much interrelated. First, the size of the returns to investment in education depends on the amount of time spent in market activities. Thus if we compare two individuals who differ in their level of real income—because let us say, the first one received an inheritance from his great-aunt—the first individual will take this increased wealth in part in the form of reduced hours of work, thereby reducing the incentive to invest in schooling and postschool training.[5] Second, if we compare two individuals who differ in their amount of schooling, the one who has engaged in more schooling and training will have a steeper wage profile, and therefore his consumption profile will likewise be steeper. The peak wage of the larger investor will occur later in life; therefore, the peak consumption age of the larger investor will also tend to occur later in life. This effect is mitigated insofar as differences in the amount of training result from differences in the cost of funds. To the extent that larger investors are ones for whom the rate of interest is low, the later peak in the wage rate raises the peak consumption age, while the lower rate of interest lowers the peak consumption age.

Formally, these effects may be seen through Eq. (11-1). If we differentiate Eq. (11-1) with respect to schooling S, we get

$$\frac{\partial}{\partial S}\left(\frac{d \log X(t)}{dt}\right) = b_1 \frac{\partial}{\partial S}\left(\frac{d \log w(t)}{dt}\right) + \frac{\partial b_2}{\partial S} \qquad (11\text{-}3)$$

The first derivative on the right-hand side of Eq. (11-3) is presumably positive. It measures the steeper wage profile of those having more schooling. The second derivative on the right-hand side of Eq. (11-3) measures the correlation between schooling and the rate of interest; it may well be negative. The responsiveness of consump-

[5] This effect would be mitigated if human capital were also a consumption good, in which case part of the increased wealth would be spent on schooling.

tion to wage-rate changes may also depend on the level of schooling—i.e., b_1 may depend on S—but there seems to be no compelling reason why this should be so. The coefficient b_1 depends basically on substitution parameters of the household, and there appears to be no important reason why these parameters should differ by level of education. This is an empirical question that will be explored further on.

Individuals with more schooling would have greater real wealth if they had more facility at learning or if they had easier access to funds to finance their investments. If this were so, the overall consumption profile would be positively related to the level of schooling. Moreover, the higher wage rate associated with more schooling induces substitution toward goods, both because it becomes more efficient to use less time relative to goods in the realization of household goals and because time-intensive activities become relatively more costly. These combined income and substitution effects may be looked at through the consumption function (11-2). Taking the derivative of Eq. (11-2) with respect to schooling S, we get

$$\frac{\partial}{\partial S} \log X(t) = \frac{\partial b_0}{\partial S} + b_1 \frac{\partial}{\partial S} \log w(t) + t \frac{\partial b_2}{\partial S} \qquad (11\text{-}4)$$

where $\frac{\partial b_0}{\partial S}$ measures the correlation, presumably positive, between schooling and real wealth. While b_1 can, in principle, be negative, the sum of the effects of schooling on consumption through the price of time is almost certainly positive; i.e.,

$$\frac{\partial b_0}{\partial S} + b_1 \frac{\partial}{\partial S} \log w(t) > 0$$

To sum up, consumption and human capital investments are interrelated. One important connection is through the cost of time. The empirical research report which follows provides some measures of this association.

EMPIRICAL IMPLEMENTATION

The purpose of the empirical work is to estimate the effect of changes in the price of time on consumption behavior over the life cycle.

Before proceeding, it is necessary to put the model in a family context. Up until now I have maintained the assumption that the household is of unit size. Changes in family size and composition may exert some direct influence on the consumption of households. At a given level of income, an increase in family size raises the demand for goods. The number of children in the family is not exogenous, and as several recent studies have shown, it responds to economic variables.[6] Although the determinants of completed family size have been extensively investigated, much less is known about the timing and spacing of children. One factor seems clear, however: Since the raising of children requires time, especially that of the mother, the spacing of children depends on changes in the cost of her time. All other things being equal, the more rapid the rise in her price of time, the greater her incentive to bunch her production of children at the outset of marriage. On the other hand, the timing of children is related largely to the timing of marriage, which itself may depend on expected variations in the cost of time as well as on the success of one's search for a mate. While recognizing that family size is endogenous and should therefore be part of a simultaneous system of equations and decisions, I maintain that *changes* in family size are largely independent of *current* changes in the price of time. Consequently, treating changes in family size as exogenous may not lead to very serious biases.

Moreover, once we put the model in a full-family context, variations in the price of time of each earner will affect consumption as long as he or she engages in market activities. Thus if husband and wife are in the labor force during a certain interval of time, the time rate of change in the consumption of goods during that interval will depend on variations in both their wage rates.

Let us reconsider the expectation model. We have seen above that if individuals possessed perfect knowledge of all relevant future variables, their real wealth would not change over their lifetime. Given conditions of foresight, real wealth is independent of age. Variations in consumption with age would be due exclusively to substitution effects. Perfect foresight is presumably a less-than-perfect assumption, although as I pointed out earlier, there is a strong incentive for individuals to reduce their uncertainty about the future. It seems reasonable to suppose that although some individuals overestimate their future incomes and prices, other individuals underestimate their prospects, so that cohort income and price expectations are unbiased. This unbiased-expectations

[6] For instance, see Schultz (1973, 1974).

hypothesis is not in itself innocuous, but it seems sensible enough. It suggests that if we consider a homogeneous group of households—homogeneous with respect to such permanent characteristics as schooling—the observed average wage of this group at any age is a good indicator of what the average household in the group had anticipated.

Reinterview data are not available for testing the model. Instead, I have used cross-sectional data of the United States population, namely, the Bureau of Labor Statistics (BLS) Survey of Consumer Expenditures for 1960–61. Households were cross-classified by:

1 Age of head: single years of age from 22 through 65
2 Education of head: educational level 1: 0 to 8 years of schooling; educational level 2: 9 to 12 years of schooling; educational level 3: more than 12 years of schooling.

Much care was exercised in the choice of the range of ages to be included in the sample. Indeed, as I have already pointed out: (1) at an early age, when all market time is spent in school, the wage rate understates the true price of time, and (2) at a late age, when individuals are retired, variations in the wage rate have no bearing on consumption behavior.

Households were classified by education in order to verify whether life-cycle consumption patterns differ across households differing in their level of schooling. In principle, the level of schooling of the wife is to be reckoned with, as well as that of the head of the household, presumably the husband. The BLS survey, however, does not report on the schooling level of wives.

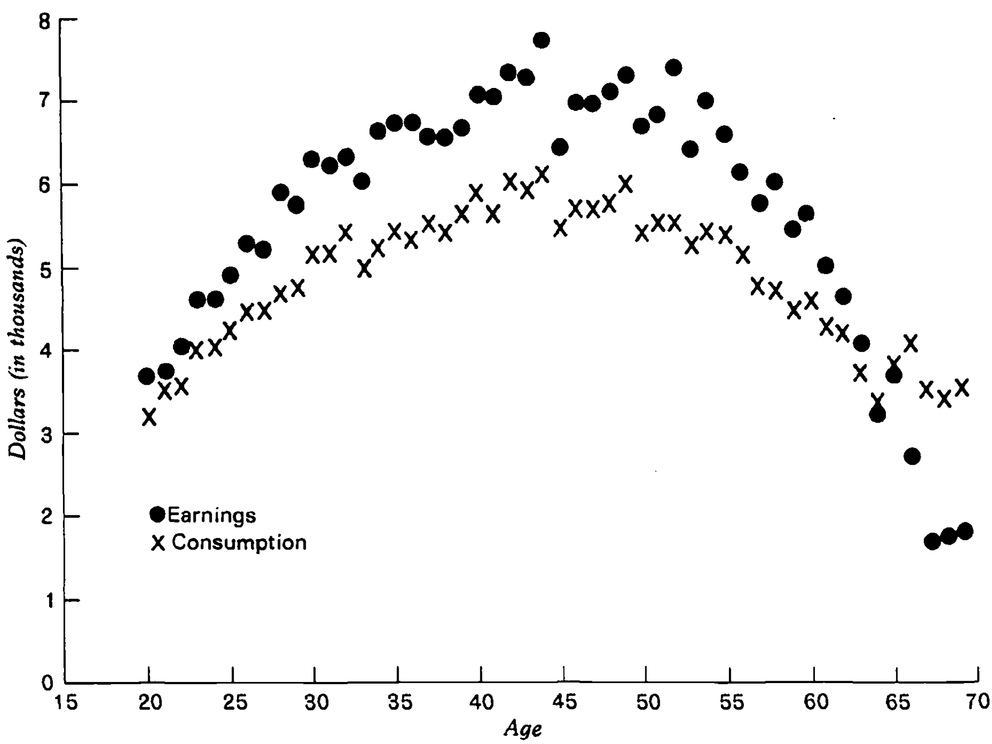
Within each age-education cell, I constructed the arithmetic mean of family consumption, earnings, and family size. Consumption was defined as purchases of nondurable goods, plus the imputed value of housing services, plus gifts. In principle, it would be desirable to have estimates of the imputed value of all durable goods. Although such an estimate can be constructed for housing, given information on the rent paid by renters, no imputation for other durable goods seems practical in working with this consumption survey.

Earnings E are family earnings before tax. A proper specification would require wage rates of each family earner; these variables are not available in the BLS survey. However, a definite implication of our model is that family earnings and wage rates will be positively correlated over the life cycle because hours of work and wage rates are positively related.

The life-cycle patterns of mean earnings and mean consumption are displayed in Figures 11-1 to 11-3. As predicted by the theory, earnings tend to rise initially, reaching a peak in the mid-forties or late forties and then declining. The rise and subsequent decline in earnings are presumably due not only to the rise and fall in wage rates but also to variations in hours worked. Consumption also shows a distinct rise initially and a decline later in life. Peak consumption occurs at approximately the same age as peak earnings. The consumption profile lies essentially below the earnings profile. The reason for this is that I have plotted earnings and consumption, rather than earnings and expenditures.

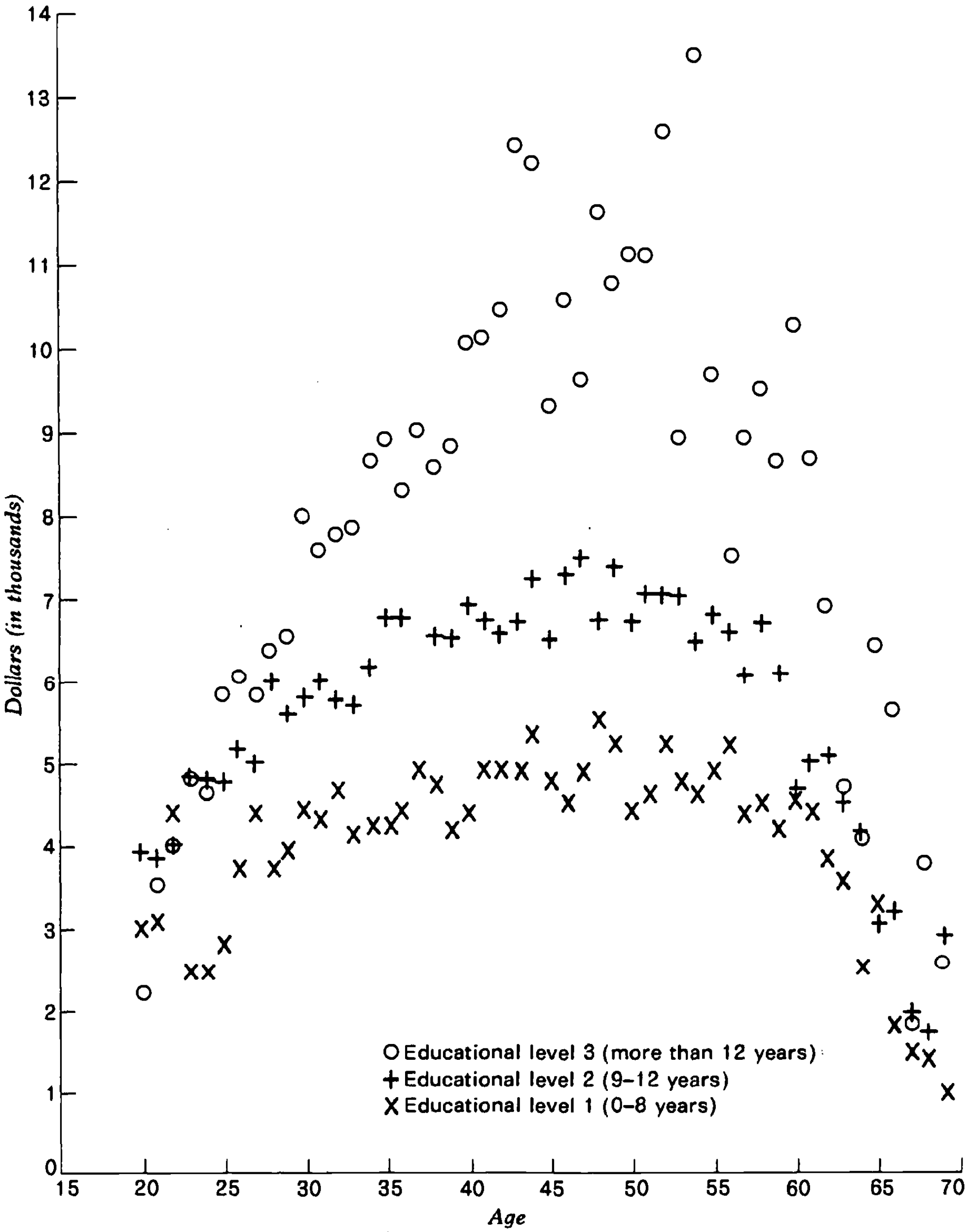
Households with a higher level of education have higher earn-

FIGURE 11-1 ***Family consumption and earnings by age of head: all education levels combined***



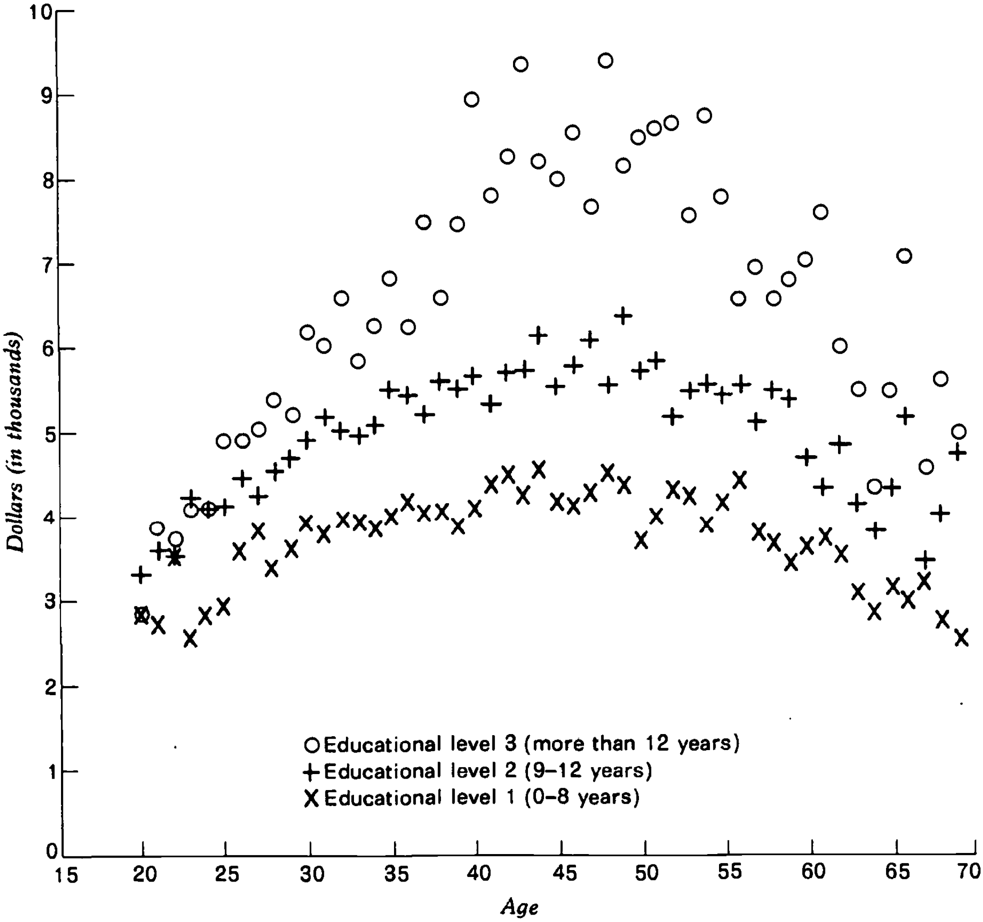
SOURCE: U.S. Bureau of Labor Statistics, *General Purpose Tapes of the Survey of Consumer Expenditures, 1960–61.*

FIGURE 11-2 ***Family earnings by age and education of head***



SOURCE: Same as Figure 11-1.

FIGURE 11-3 ***Family consumption by age and education of head***



SOURCE: Same as Figure 11-1.

ings profiles, as depicted in Figure 11-2. Their earnings tend to rise more rapidly and for a longer period of time. This is precisely what one would expect if on-the-job training is positively related to schooling. The corresponding consumption profiles are given in Figure 11-3. These show that the higher the level of education, the higher the consumption stream.

To be sure, these are not longitudinal cohort earnings and consumption profiles, since they plot variations at a point in time. They differ from cohort profiles as long as trends in earning power or in nonmarket productivity are present.

Rather than adjusting the data for the existence of trends, presumably in a somewhat arbitrary way, I have used the cross-sectional data directly for empirical estimation. A positive trend in the earnings of households means that older households in the cross section have lower real wealth than younger households. This implies that the observed rise in consumption with age would be smaller than over the life cycle, while the peaking of consumption occurs sooner than for a given cohort. Essentially, a trend in real wages introduces a trend in consumption.[7]

The model of the earlier sections is now adapted to apply to cross sections. In particular, Eq. (11-2) can be applied to averages of consumption and earnings by age of the head of the household. With observations ordered by age, I ran within each education class linear regressions of the logarithm of mean consumption on the logarithm of mean earnings, the logarithm of mean family size and age of head. Let X_t denote mean consumption at age t, E_t denote mean earnings at age t, and Z_t denote mean family size at age t. The estimating equation now reads:

$$\log X_t = b_0 + b_e \log E_t + b_z \log Z_t + b_t t \qquad (11\text{-}5)$$

Results are presented in Table 11-1. Changes in the price of time exert a positive effect on changes in consumption with age. The

[7] This rise in the production of human capital means that improvements in technology in the production of goods are biased toward human capital, or that physical capital is more complementary to skilled labor than it is to unskilled labor.

TABLE 11-1 ***Estimates of the life-cycle consumption function: level equations***

Dependent variable: log X							
Data (ages 22–65)	*Intercept*	*Independent variables* *log E*	*log Z*	*Age*	*Multiple correlation coefficient*	*Adjusted R^2*	*Durbin-Watson d*
Education All levels	3.4835	.5253 (16.3477)*	.2593 (7.7945)	.0035 (7.2497)	.9904	.9794	1.7386
0–8 years	3.6870	.4859 (13.2405)	.2586 (5.9641)	.0038 (3.7202)	.9717	.9401	2.3476
9–12 years	4.2127	.4219 (7.7016)	.2932 (5.5886)	.0071 (7.1918)	.9577	.9109	2.0118
> *12 years*	2.9662	.6001 (9.8524)	.1746 (2.9582)	.0051 (3.8379)	.9659	.9279	2.2035

* Figures in parentheses are t-values.

NOTE: X = consumption; E = earnings; Z = family size.

SOURCE: U.S. Bureau of Labor Statistics, *General Purpose Tapes of the Survey of Consumer Expenditures, 1960–61.*

estimate of b_e for the group "all educational levels combined" is .53. The estimate is significant at the 1 percent level. A 10 percent rise in earnings raises consumption by approximately 5 percent, when family size is held constant. I interpret this result to mean that substitution in production, including both the change in time intensity in each activity and the propensity to engage in more goods-intensive activities as the wage rate rises, exceeds the intertemporal-substitution effect.

The same positive effect of variations in the price of time on consumption behavior appears within each schooling group. The responsiveness appears to be somewhat larger at the highest level of education and least at the high school level, but all estimates fall within the range of .42 to .60.

These estimates provide a strong test arguing against the Modigliani-Brumberg life-cycle hypothesis of consumption.[8] Indeed, that well-known model asserts that consumption depends on real income and that variations in the price of time will have no effect on variations in consumption with age. In other words, it predicts that $b_e = 0$. This alternative hypothesis seems to be contradicted by the data at all levels of education.[9]

The coefficient of age is supposed to pick up the interest rate effect net of time preference and the effects of trends. For the group "all education," the coefficient is .0035. What this means is that in the absence of changes in earnings with age, consumption would grow at a rate of one-third of 1 percent per annum. One can show

[8] See, in particular, Modigliani and Brumberg (1954).

[9] While the Modigliani-Brumberg model is inconsistent with the BLS data ordered by age, a simple current-income hypothesis fits the data quite well. Indeed, under that hypothesis, variations in consumption depend on variations in total current income, regardless of its source. In a regression of consumption by age on total income, nonwage income, and family size by age (all variables in log form), the coefficient of nonwage income was near zero and statistically insignificant, as the current-income hypothesis would predict. On the other hand, under our derived-demand hypothesis with a lifetime horizon, one would expect the coefficients of total income and nonwage income to be of opposite sign and the ratio of the consumption elasticities with respect to total income and nonwage income to be equal to the ratio of earnings to nonwage income at the mean.

The weakness of the current-income hypothesis has been documented in the vast literature on the consumption function. In particular, it fails to reconcile the long-run stability of the savings ratio with the declining propensity to consume as a function of income observed in cross sections.

What remains puzzling is why the derived-demand hypothesis developed in this chapter does not meet the sorting-by-source-of-income test referred to here.

that correcting for trends in real wages, the pure interest rate net of time-preference effect is no greater than 1 percent.

The positive effect of age appears at all levels of education. The highest effect appears for the high school group. The estimates fall in the range of .004 to .007. Since trends in real wages are not systematically different by level of schooling, the difference in the effect of age in the cross section across schooling groups basically reflects differences in interest rate (net of time preference) effects across these groups. These differences are not very large, nor are the differences systematic by level of schooling.

The level of consumption of those households with more schooling is higher. As shown in Figure 11-3, the whole consumption profile is shifted up at higher levels of education. This effect would be borne out by differences in the intercept of the regression equation if this estimate were unbiased. The intercept estimate, however, is a biased estimator of its true value, and no meaningful statements can be made about it.

The level equations of Table 11-1 display little or no evidence of first-order serial correlation of the residuals, as measured by the Durbin-Watson *d* statistic. As a further check on the model, however, I have run the same regressions in first-difference form;

TABLE 11-2 ***Estimates of the life-cycle consumption function: first-difference equations***

Dependent variable: Δ log X		Independent variables				
Data (ages 22–65)	Intercept	Δ log E	Δ log Z	Multiple correlation coefficient	Adjusted R^2	Durbin-Watson d
Education						
All levels	.0045	.5377 (9.4550)*	.2675 (3.1582)	.8882	.7783	3.0556
0–8 years	.0026	.4642 (8.6485)	.1815 (2.3061)	.8406	.6919	2.8512
9–12 years	.0098	.4041 (4.2662)	.3464 (2.7413)	.6771	.4314	2.5312
> 12 years	.0074	.5495 (6.7195)	−.1262 (−1.1860)	.7308	.5108	2.9477

* Figures in parentheses are t-values.

NOTE: Δ = first-difference operator for one-year differences in age; X = consumption; E = earnings; Z = family size.

SOURCE: Same as Table 11-1.

TABLE 11-3 ***Estimates of the elasticity of substitution in production***

Dependent variable: log (X/L_m)						
Data (ages 22–65)	*Intercept*	*Independent variables*		*Multiple correlation coefficient*	*Adjusted R^2*	*Durbin-Watson d*
		log w_m	*log Z*			
Education						
All levels	−1.0148	.7657 (7.4226)*	.5911 (8.6526)	.8663	.7382	.8195
0–8 years	−.9026	.7518 (3.7126)	.4176 (5.4791)	.6766	.4314	1.2669
9–12 years	−.8148	.8693 (8.5616)	.3994 (5.4808)	.8154	.6485	.8765
> 12 years	−.8777	.8223 (12.7152)	.5058 (5.5780)	.9118	.8231	1.1579

* Figures in parentheses are t-values.

NOTE: X = consumption; L_m = adjusted nonworking time of males; w_m = male wage rate; Z = family size.

SOURCE: L_m, w_m, and Z were constructed from the 1/1,000 sample of the United States population, 1960. The source for X is the same as in Table 11-1.

these results are presented in Table 11-2. Our estimates seem thoroughly confirmed. The life-cycle wage effect is in the order of .5, and the differences by schooling group are not very large.

I also present some estimates of the elasticity of substitution in household production between goods and husband's time. For this purpose, I have used data processed by Gary Becker for a companion project on hours of work over the life cycle.[10] These data are taken from the 1/1,000 sample of the United States population, 1960, and pertain to males. They permit construction of a wage rate variable for males. Consumption time is estimated as total time available, other than that employed for rest and personal care, net of hours of work. The data were partitioned in a manner conformable with the cross-classification used in the BLS survey. Mean consumption time of males L_m, mean wage rate of males w_m, and mean family size Z were computed for each cell. The coefficient of log w_m, in a regression of log consumption relative to L_m on log w_m, is designed to measure the elasticity of substitution in production. Results, presented in Table 11-3, show that it is equal to .77 for the

[10] See Ghez and Becker (forthcoming). Contrary to Becker's treatment of the data, I did not take moving averages of series.

group "all education" and that this estimate is relatively stable across education groups.

To recapitulate, the model summarized in this chapter seems to stand up fairly well in relation to the data. Variations in the price of time over the life cycle, which are basically the result of investments in human capital, influence consumption behavior in a very systematic way. A rise in the price of time raises the consumption of goods and also the amount of goods used relative to time spent at home. On the other hand, there are no important differences in the responsiveness of consumption to the wage rate by level of schooling. What this means is that a relatively stable function exists and therefore that inferences about the effects of education on consumption can be made through its effect on the price of time, since education does not seem to alter the basic response of consumer behavior to the price of time.

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