ON THE CYCLICALITY OF SCHOOLING: THEORY AND EVIDENCE

Harris Dellas
Catholic University of Louvain Belgium
and
Plutarchos Sakellaris
University of Maryland

Abstract

Economic theory indicates that opportunity- cost considerations tend to make schooling countercyclical whereas ability-to-pay considerations have the opposite effect. We examine the college enrollment decisions of individuals using the Current Population Survey and find that their propensity to enroll is countercyclical. There seems to be significant substitution during the business cycle between human capital investment and competing economic activities. The decision to enroll in college is related strongly to labor market conditions (measured by the state-level unemployment rate and earnings) and to the real interest rate. Furthermore, there are significant differences across demographic groups.

(JEL Classification: E32, J24)

We are grateful to Mark Bils, Chris Carroll, Allan Drazen, Bill Evans, Harry Kelejian, John Haltiwanger, Chris Pissarides and seminar participants at Georgetown, the Universities of Chicago, Cyprus, Macedonia, Maryland-College Park, Maryland-Baltimore County, and Rochester, the 1995 NBER Summer Institute, and the 1996 Winter meetings of the Econometric Society for helpful suggestions, to Sangloh Kim for expert research assistance, and to Shamaa Ghamka, Tom Kane, Jacob Mincer, and Ed Montgomery for providing some of the data used here.

Investment in physical and human capital plays a critical role in the augmentation of productive capacity. Interestingly enough the literature studying the determinants of physical and human capital accumulation exhibits an asymmetry in its treatment of these two categories of investment. This asymmetry pertains to the analysis of cyclical behavior. The relationship between physical capital and macroeconomic fluctuations has been one of the most popular subjects of investigation in macroeconomics. Starting with Burns and Mitchell's (1946) statistical analysis of the business cycle there has been constant preoccupation with the establishment and interpretation of the cyclical characteristics of investment in physical capital. No similar effort has been applied to the study of human capital accumulation, despite the fact that this factor claims the lion's share of national income. The question of how the state of the macroeconomy affects the quantity (and composition) of human capital and how it is in turn influenced by it is rarely posed formally.[1]

There are several important issues concerning the macroeconomics of human capital accumulation. One concerns the influence of the state and the characteristics (e.g. severity) of the business cycle on the decision to preserve or acquire skills and on the choice of the form of skill acquisition (formal or informal schooling, full or part time and so on). The conventional wisdom is that procyclicality in the opportunity cost of education induces a countercyclical pattern in educational attainment, while procyclicality in the ability to pay for education works in the direction of procyclical human capital accumulation. Establishing empirically the sign and the degree of cyclicality in net aggregate human capital investments, as well as in individual categories is the logical first step in addressing a series of issues.

Another issue regards the influence of human capital investment on the properties of the business cycle itself. Does it amplify or dampen cyclical movements in important economic variables such as employment and output? How does current investment affect the future amplitude of the cycle (for instance, through its influence on the incentive to hoard skilled workers)?[2] A third issue is whether the cyclical effects -whatever their sign and size- represent anything besides pure timing. In other words, if these effects were summed up over the business cycle, would they cancel out on average? An affirmative answer implies that the pattern of cyclical acquisition -or loss- of skills may not matter for their average level. Otherwise, macroeconomic fluctuations may give rise to permanent effects by influencing the average, long run stock -or even perhaps the rate of growth- of human capital. [3] To the extent that the stock of human capital affects the growth rate of an economy (see for example Azariadis and Drazen 1990, and Romer 1990),

[1] Drazen (1985) is an exception that concentrates on the second part of this question. He shows that in a model where human capital accumulation is a *passive* by-product of employment that temporary macroeconomic shocks may have permanent effects. The cyclical dimensions of human capital investment seem to have been neglected by labor economists too. For instance, the chapter on the demand for education in the Handbook of Labor Economics by R. Freeman (1986) does not contain a single reference to this. However, some existing work has examined the cyclical implications of differences in skill levels. For instance, Abowd and Ashenfelter (1984), relate the level of human capital to the probability of a cyclical layoff.

[2] Perli and Sakellaris (1996) formulate a dynamic stochastic general equilibrium model with a second sector that augments the stock of human capital in the economy. The process of human capital acquisition is shown to impart into the economy a strong propagation mechanism that can account for the observed persistence in U.S. business cycles.

[3] Dellas (1994) offers a model to examine this question. He shows that, under reasonable assumptions, schooling decisions should be procyclical; and that those cyclical effects do not offset one another but leave behind a permanent influence on the composition of the labor force and the average quality of labor. For up to moderate macroeconomic fluctuations the predicted impact is positive. For severe recessions, the predicted impact is negative.

human capital accumulation may provide a link between short run fluctuations and long run growth. Finally, a fourth issue pertains to the substitution between various economic activities over the business cycle. Popular theories of the business cycle require high substitution in and out of work activities in order to account for the variability of employment. While substitution towards leisure has been criticized as implausible, substitution towards educational activities may be an empirically relevant, promising alternative.

These are issues of importance to macro and labor economists alike. The latter group has studied extensively occupational and educational decisions[4] and has also related these decisions to variables that are affected by the business cycle (income and interest rates). Nevertheless, the *timing* of investment in schooling has not received much empirical scrutiny. The business cycle, due to its temporariness, is ideally suited to be used in the investigation of the intertemporal substitution, opportunity cost and income effects that seem critical in all investment decisions.

The objective of this paper is to study the demand for higher education paying special attention to cyclical elements. In the theoretical section of the paper we study the schooling decision within a setup with either homogeneous or heterogeneous labor. In the former case, all individuals select an optimal path for human capital acquisition throughout their lifetime where their earning opportunities vary as a function of both their skill level and of the business cycle. In the latter case, individuals decide which segment of the labor force to join ("skilled" versus "unskilled") and when. The ones who do acquire education subsequently select the timing and quantity of human capital maintenance and enlargement. We study the cyclical dimensions of both of these decisions.

Investment in human capital is affected by the interaction between the ability to pay and the willingness to purchase education (Becker, 1975). We show that, in the absence of borrowing constraints, the process of human capital accumulation is countercyclical. The pattern, however, can become procyclical with imperfectly functioning credit markets under some -rather restrictive- assumptions on the cyclicality of finance and on the correlation between individual talents and liquidity. We argue that strong procyclicality of student loans, of student aid and grants as well as of part time job opportunities together with a negative correlation between skills and liquidity may negate the opportunity cost effects and induce a procyclical enrollment pattern.

The theoretical analysis demonstrates that the direction of cyclicality of human capital accumulation is ambiguous thus underlying the importance of its empirical determination. In the empirical part of this paper we examine the cyclicality and the determinants of college enrollment decisions. [5] We use the school enrollment information in the Oc-

[4]Orazem and Krottila (1991), examine simultaneously the determinants of both educational and occupational decisions. They do not pay any attention to cyclical considerations though. Boskin (1974), Freeman (1975), Rosen (1976), Siow (1984), are among the many authors who have studied occupational decisions (see Willis, 1986, for more references), while Weiss (1986) (see also the references therein) examines the dynamics of human capital accumulation. Pissarides (1981, 1982) has studied the demand for education of the 16- and 18-year-old age groups in the UK (see also Rice, 1987). None of these studies has paid any explicit attention to cyclical considerations though.

[5]We focus on education as opposed to other forms of human capital investment such as on-the-job training. It seems that educational expenditures are considerably larger than other training expenditures. Clotfelter (1991) estimated total educational expenditures in the U.S. at $ 331 billion in 1989 whereas Mincer (1993) estimated expenditures on job training to about $ 165 billion in 1987. Among the many aspects of formal education we concentrate on college enrollments because of the availability of the relevant data set. Other forms of formal investment in human capital such as vocational school, training programs within and outside firms, adult education etc. are interesting too. They ought to become the subject of serious investigation. Dellas (1994) finds that the *aggregate* enrollment rates of various groups ranging in age from 16 to 35 years old tend to be countercyclical.

tober supplement of the Current Population Survey. We proceed in three steps. First, we establish the direction and the size of the cyclicality of enrollment decisions. Second, we examine the contribution of economic variables theoretically relevant to enrollment decisions. Finally, we examine whether empirical regularities and conclusions differ by demographic group.

Individuals' college enrollment decisions are found to be countercyclical after controlling for observable characteristics. The current state of the business cycle seems to be related to enrollment decisions even after controlling for other time-varying variables. We find no evidence of asymmetric impact on college enrollment decisions of variations in the unemployment rate during recessions. In simulations we find large swings in the enrollment rate associated with aggregate fluctuations. Depending on the measure of fluctuations used these can be as large as 2.5 percentage points, a 6.3 percent change.

The cyclicality of the enrollment rate is due to cyclical movements in the economic determinants of the enrollment decision. We find that this decision is related significantly to some but not all of the variables suggested by our model. Enrollment is related strongly to labor market conditions (measured by the state-level unemployment rate and earnings) and to the real interest rate. This is consistent with the importance of opportunity cost considerations. Our finding that the state unemployment rate has a positive impact on enrollment contradicts past studies that found no such impact (e.g. Venti and Wise, 1983). We find no evidence that the cost of tuition or the college "wage premium" affects enrollment decisions.

The impact of aggregate variables on the demand for college education is similar for men and for women. There are differences, however, across race. The enrollment decisions of blacks are not related to the state of the business cycle or the real wage. However, they are strongly related to the real interest rate. The findings in this paper pose the challenge of explaining these striking differences in human capital investment across individuals of different race.

Section 1 presents the theoretical and Section 2 the empirical analysis. We offer some conclusions in the final section.

1. THE MODEL

A. HOMOGENEOUS LABOR

In order to illustrate the role played by income and substitution effects in the demand for education we start with a specification in which the only available asset is human capital. We will discuss the role of additional assets later.

There is a unique, homogeneous good in the economy that is produced by a homogeneous labor input. Each worker is endowed in each period with one unit of time. The time endowment is rationed between directly productive activities and investment in human capital. There is no direct cost to human capital accumulation. Let u_t be the the fraction allocated to production. Income and consumption, c_t, are given by

$$c_t = w_t u_t H_t \tag{1}$$

where w_t, the wage rate faced in period t, follows an exogenous stochastic process. Human capital, H, evolves according to

$$H_{t+1} = (1-\delta)H_t + \vartheta(1-u_t)H_t \tag{2}$$

where δ is the rate of human capital depreciation ($0 < \delta < 1$) and ϑ is the marginal (and average) product of investment in human capital ($\vartheta > 0$). The value function in period t is

$$V(H_t, w_t) = \max\{v(c_t) + \beta E_t V(H_{t+1}, w_{t+1})\} \tag{3}$$

where v is the utility function, β is the discount factor and E_t is expectation taken in period t. The optimal (interior) choice for u_t satisfies

$$v_t^{'} w_t = \beta E_t v_{t+1}^{'} w_{t+1}(1 - \delta + \vartheta) \tag{4}$$

where $v^{'}$ denotes marginal utility. In order to be able to perform a useful analysis of the properties of equation (4) we will make the assumption that the utility function takes the form

$$v(c) = \frac{c^{1-\gamma}}{1-\gamma} \quad \text{for} \quad \gamma \neq 1 \quad ; \quad v(c) = ln(c) \quad \text{for} \quad \gamma = 1 \tag{5}$$

If the process for the wage rate is i.i.d. then it can be easily shown that the share of time resources that is allocated to human capital investment activities, $1 - u_t$, is procyclical[6] or countercyclical depending on the value of the intertemporal elasticity of substitution in consumption, $1/\gamma$. For $\gamma < 1$ the substitution effects that arise from changes in the real wage (work when the return to labor services is high) dominate over the income effects (smooth consumption across good and bad periods). In this case, the supply of work effort increases at the expense of educational activities during economic expansions; while it decreases during recessions thus inducing a countercyclical pattern of schooling. The opposite pattern obtains when $\gamma > 1$. The strong incentive to limit the decrease of consumption during recessions necessitates that people work more during recessions and build human capital up during expansions, thus generating a procyclical pattern for investment, and a countercyclical one for work. The latter implication is clearly counterfactual.

The key ideas about the cyclical pattern of education can be obtained from the examination of important special cases. To gain insights on how persistence in the business cycle affects the cyclical pattern of education we resort to a simple, two state, Markov specification for wages. Namely, we assume that w can take only two values[7] , a high one, w_H, and a low one, w_L. The probability transition matrix is given by

$$\Phi = \begin{pmatrix} p_{HH} & p_{HL} \\ p_{LH} & p_{LL} \end{pmatrix} \tag{6}$$

In the high wage state, equation (4) takes the form

$$u_H^{-\gamma} w_H^{1-\gamma} = \beta\{(1 - \delta + \vartheta)[1 - \delta + \vartheta(1 - u_H)]^{-\gamma}[p_{HH} u_H^{-\gamma} w_H^{1-\gamma} + p_{HL} u_L^{-\gamma} w_L^{1-\gamma}]\} \tag{7}$$

and in the low state,

$$u_L^{-\gamma} w_L^{1-\gamma} = \beta\{(1 - \delta + \vartheta)[1 - \delta + \vartheta(1 - u_L)]^{-\gamma}[p_{LL} u_L^{-\gamma} w_L^{1-\gamma} + p_{LH} u_H^{-\gamma} w_H^{1-\gamma}]\} \tag{8}$$

Combining equations (7) and (8) gives

$$\frac{p_{HH} + p_{HL} A}{p_{LL} + p_{LH} A^{-1}} = \frac{[1 - \delta + \vartheta(1 - u_H)]^{\gamma}}{[1 - \delta + \vartheta(1 - u_L)]^{\gamma}}; \qquad A = \frac{(w_L/w_H)^{1-\gamma}(u_H/u_L)^{\gamma}}{(w_H/w_L)^{1-\gamma}(u_L/u_H)^{\gamma}}. \tag{9}$$

[6]The cycle is defined according to the behavior of w_t. The degree of procyclicality of real wages with regard to economic activity has been frequently questioned in the literature. There is substantial evidence now that the real wage is procyclical (see Solon, Barsky, and Parker 1994, Abraham and Haltiwanger 1994).

[7]The assumption of an exogenous wage does not affect the qualitative properties of our results. Making the analysis general equilibrium carries limited value added in this case.

Proposition: When the transition matrix is symmetric ($p_{HH} = p_{LL}$) then investment in human capital is countercyclical when $\gamma < 1$ and procyclical when $\gamma > 1$.

Proof: $(w_L/w_H)^{1-\gamma} \lesseqgtr 1$ when $\gamma \lesseqgtr 1$. Let $\gamma < 1$. We will postulate that $u_H/u_L < 1$ and arrive at a contradiction. If $u_H/u_L < 1$ then $A < 1$ and, hence, the left hand side of (9) is less than unity. But if $u_H/u_L < 1$ the right hand side of (9) is greater than one. Hence human capital accumulation cannot be procyclical when $\gamma < 1$. An analogous argument can be used to establish that $1 - u_t$ cannot be countercyclical when $\gamma > 1$. Note that if the utility function becomes linear the solution takes a bang-bang form: work only in expansions and study only in recessions.

Hence with a symmetric Φ we obtain the same cyclical behavior as with white noise. It is of interest to ask whether this pattern is robust to the introduction of asymmetry. While we have not been able to construct an analytical proof that the above proposition does not always hold under asymmetry we have produced numerical examples that confirm this point.

Numerical analysis of (9) showed that for values of γ greater than 1 but close to it, the introduction of asymmetry in the business cycle in a way that *favored* recessions ($p_{LL} > p_{HH}$) could make investment in human capital *countercyclical* ($u_H > u_L$).[8] This pattern was more likely to emerge the smaller the size of the cyclical wage differential. A possible interpretation of this finding is that the fact that recessions are persistent and the wage differential small implies that the expected income differential between the current and the subsequent period may not be large enough to support a strong incentive for shifting resources into the present. Another noteworthy result from simulations is that making recessions more prolonged than expansions also led to an increase in the average share of human capital investment activities (in addition to making this share countercyclical).

More assets

The introduction of other assets which, like human capital, can be used in the intertemporal transfer of resources (see Weiss, 1986) alters the results reported above significantly. As our analysis is partial equilibrium it does not matter whether this asset is a bond or a stock as long as its rate of return is exogenous.

The budget constraint is now given by

$$c_t + B_{t+1} = w_t u_t H_t + R_t B_t \tag{10}$$

where B_t is the level of assets (liabilities) carried over from period $t-1$ into period t and R_t is their gross rate of return.

Maximization of (3) with regard to u_t and B_{t+1} subject to (2) and (10) leads to (11) and (12)

$$\begin{array}{rcll} & > & & u = 1 \\ w_t v_t^{'} & < & \beta E_t w_{t+1} v_{t+1}^{'}(1-\delta+\theta)] & u = 0 \\ & = & & 0 < u < 1, \end{array} \tag{11}$$

$$v_t^{'} = \beta R_t E_t v_{t+1}^{'}. \tag{12}$$

If w and R are exogenous and can take arbitrary values then the probability that both first order conditions will be satisfied in an interior solution for u and B is zero.

[8] When $\gamma > 1$ if $1-u$ is countercyclical ($u_H > u_L$) then $A > 1$ and the RHS of (9) is less then unity. The task then is to find p_{HH} and p_{LL} ($p_{HH} - p_{LL} < A^{-1}p_{LH} - Ap_{HL}$) such that the LHS of (9) be less than one and equal to the RHS.

Since u is restricted to vary between zero and unity while B is unrestricted, equation (12) will be satisfied as an equality but (11) will involve either full time work ($u = 1$) or full time schooling ($u = 0$). Moreover, under these conditions, u will be in a corner solution with probability one *independent* of the stochastic structure of the model. Without any loss of generality and for the sake of exposition we can postulate that w and R follow a deterministic pattern. In particular, select Φ in such a manner that w and R exhibit a one-period deterministic cycle ($p_{HH} = p_{LL} = 0$).[9] Combining (11) and (12) results in the following solution for u:

$$\begin{aligned} u_t &= 1 \text{ when } w_t R_t > \beta w_{t+1}(1 - \delta + \theta) \\ u_t &= 0 \text{ when } w_t R_t < \beta w_{t+1}(1 - \delta + \theta) \end{aligned} \tag{13}$$

The cyclical behavior of schooling activities is fully described by (13). In the presence of a bond, people are more inclined to substitute away from work towards educational activities when the current wage is low relative to future wages and the current interest rate is low. If the real wage is procyclical and the interest rate is not too countercyclical[10] then people will find recessions an opportune time for improving future earning capacity by investing in schooling *independent* of the value of γ. That is, under plausible conditions a procyclical pattern of education can be ruled out.

This is a strong result that raises questions of robustness. It can be easily shown that some sensible modifications will not affect the countercyclicality of education. For instance, allowing for leisure as an alternative margin of substitution away from work effort during recessions does not alter anything in the case of additively separable utility.[11] Making the wage a function of the stock of human capital only affects the size of the cyclical pattern. Other alterations are harder to investigate. Studying cyclical effects when the production function has both human and physical capital poses very difficult technical problems in general equilibrium.[12]

In the following section we extend the specification used above to include other elements that are commonly thought to matter for educational decisions. In particular, we incorporate labor heterogeneity, direct costs of education and credit constraints. We show that the cyclical availability of credit together with the cyclical behavior of the direct expenses are important for determining whether and *when* people will be able to shift future income to the present in order to finance current consumption and educational expenses. If the supply of credit varies procyclically and there exists a large segment of the prospective student population that is subject to borrowing constraints then school enrollment may prove procyclical.

B. HETEROGENEOUS LABOR

The model of the previous section did not distinguish between different categories of workers such as skilled and unskilled. Human capital was a perfectly homogeneous

[9] Use of a stochastic transition matrix with $p_{HH} = p_{LL} \neq 0$ instead of the deterministic one period cycle does not change the results.

[10] The ex ante real interest rate is difficult to compute. Nevertheless, various measures of it seem to be either acyclical or slightly procyclical.

[11] Consider the model of subsection A with the utility function given by $v_1(u_{nt} w_t H_t) + v_2(1 - u_{et} - u_{nt})$, where u_{et} and u_{nt} are the shares of the time endowment that are dedicated to education and work respectively (the time endowment has been normalized to unity). A temporary change in the wage rate affects the current relative price of leisure and consumption and the intertemporal price of current and future consumption. In both cases the value of γ relative to one determines the pattern of substitution. For instance, if $\gamma < 1$ and w_t goes up then both leisure and education activities decrease.

[12] The only case that has been treated in the literature involves Cobb-Douglas utility and production. This however, implies that the shares of the various activities pursued are invariant to the state of the cycle.

variable and workers may have differed only with regard to the number of efficiency units of labor they possessed. We now adopt a specification that allows for different *types* of human capital (or occupations) each one facing a different wage rate per *efficiency* unit of labor. Such differences may arise from imperfect substitutability between different types of labor within or across different economic activities.

All individuals start out as unskilled and need to decide whether and when they will become skilled (by going to school). Skilled workers also have the opportunity to further augment their human capital throughout their careers. Unskilled workers, on the other hand, are assumed to possess a fixed amount of human capital.

A skilled individual faces the following lifetime utility path

$$V(H_t, w_t, B_t, R_t) = \max\{v(c_t) + \beta E_t V(H_{t+1}, w_{t+1}, B_{t+1}, R_{t+1})\} \tag{14}$$

subject to (2) and

$$w_t u_t H_t + R_t B_t = c_t + B_{t+1}, \tag{15}$$

where V is the value function and w the wage per unit of effective labor -human capital- for the skilled workers. Note that $dV/dH > 0, dV/dw > 0, dV/dB > 0$ and $dV/dR > 0$ if $B > 0$ ($dV/dR < 0$ if $B < 0$).

Let us postulate that college education takes one period to be completed; that it results in the creation of H_0 units of human capital; that it can only be pursued full time; and that it carries a direct educational cost of Q_t.[13] An individual who has not yet gone to college faces the following utility path

$$V_N(w_{Nt}, B_{Nt}, R_t, Q_t) = \max\{[v(c_{Nt}) + \beta E_t V_N(w_{Nt+1}, B_{Nt+1}, R_{t+1})], \tag{16}$$

$$[v(c_t) + \beta E_t V(H_{t+1}, w_{t+1}, B_{t+1}, R_{t+1})]\}$$

where V_N is the value function of an unskilled person. His consumption is c_{Nt} if he forgoes education this period, c_t otherwise. Consumption in period t satisfies either

$$w_{Nt} + R_t B_{Nt} = c_{Nt} + B_{Nt+1} \tag{17}$$

or

$$R_t B_{Nt} = c_t + B_{t+1} + Q_t \tag{18}$$

where w_{Nt} is the wage per unit of raw labor (we have normalized labor endowment to unity), and B_{t+1} is the initial level of assets of a college graduate. Educational expenses and consumption while attending college have to be financed with either income accumulated beforehand or a loan.

The criterion employed for deciding whether to go to school or not depends on the difference between the two terms in the RHS of (16). Let Ω_t be equal to the second minus the first term. An individual pursues schooling if $\Omega_t > 0$. The decision to go to college depends on the expected relative path of wages for the skilled and unskilled, past economic conditions as reflected in the current level of assets, the direct cost of education, and the current level of wages for unskilled labor. If $\Omega_t > 0$ for all t, then there is no cyclical dimension in the schooling decision. People simply go to college when they come of age independent of the current economic conditions.

[13] Allowing schooling to last N periods or be part-time is straightforward at the cost of some additional technical complexity.

When $\Omega_t > 0$ for some but not all t then the cyclicality of college enrollment will depend on the cyclicality of Ω_t. It can be shown from (19) and (17) that $d\Omega_t/dw_{Nt} < 0$, from (19) that $d\Omega_t/\mathrm{dE}_t w_{t+1} > 0$ and from (19) and (18) that $d\Omega_t/dQ_t < 0$. Establishing the effect of the real interest rate on Ω is somewhat more complicated. Without loss of generality assume that individuals live for two periods only. The future consumption loss of forgoing work today in order to enroll in college is $R_{t+1}w_t$. The consumption gain is $w_{t+1}H_0 - R_{t+1}Q_t$. The difference between gains and losses is thus decreasing in R and so is the incentive to go to school. To summarize, the propensity to enroll in college is negatively related to the wage of the unskilled, the real interest rate, and the direct cost of education while it is positively related to expected future wages of college graduates.

The real interest rate, R, is acyclical whereas the real wage, w is procyclical. It seems, then, that unless the direct cost of education is strongly countercyclical the rate of school enrollment will be countercyclical.[14]

Credit constraints

It is of interest to examine whether the presence of credit constraints can overturn the countercyclicality of college enrollment. If credit is subject to a procyclical ceiling then there may be a procyclical bias in the enrollment rates of those individuals with insufficient initial wealth. [15]. If such individuals come of age for schooling during an expansion they will certainly enroll in college immediately. If they comesof age during a recession then they will not be able to undertake schooling. They may have to wait until their savings, supplemented by a loan, enable them to enroll.

It is important to stress, however, that the mere existence of credit market imperfections is not sufficient to support a procyclical pattern of school enrollment.[16] Two additional conditions are required. 1) In the absence of a borrowing constraint individuals would go to school independent of the state of the business cycle ($\Omega_t > 0$ for all t). 2) Borrowing constraints must be sufficiently procyclical to make externally financed schooling *feasible* only during an expansion. These are strong conditions. If the pursuit of education is feasible in either state of the business cycle -through external funds or individual savings- then education is likely to be countercyclical.[17]

In the model described above, differences in educational status are transitory. That is, in the end either everybody becomes educated or nobody does. In reality, however, different people attain different levels of education. In order for the model to become more realistic differences in ability and/or opportunities may be needed. For instance, individuals may differ concerning their "latent" ability to complete college (Q may represent a production function which is individual specific, a function of intelligence or breeding); or, they may differ in their level of initial assets and also in their ability to obtain credit. The insights developed above would still apply to this specification. A procyclical pattern would emerge if the majority of those whose college decision has a cyclical dimension are "high ability" individuals ($\Omega_t > 0$ for all t in the absence of liquidity con-

[14] Another important factor is the relative volatility of the wages of skilled and unskilled. If the wage of unskilled labor is more cyclical than that of skilled, as argued by Dellas (1994) (due to differences in hiring or firing costs that induce differences in labor hoarding practices for different types of labor) then the ratio w_{Nt}/w_t will be countercyclical. This, in turn, induces countercyclicality in Ω.

[15] There is some evidence that the ability to obtain credit is procyclical. This seems to be mostly due to the procyclicality of collateral.

[16] The existence of borrowing constraints may affect the average amount of investment in human capital (both the number of people going to college and the intensity of post- college educational activities) even when it does not affect its cyclical pattern. Weiss, 1986, argues that the rate of investment as well as the shape of the earnings profile will in general be affected but in ways that tend to be model specific.

[17] Our model has abstracted from the role of (procyclical) part time job opportunities in limiting the need for credit financed education. These would contribute to a procyclical college enrollment pattern.

straints) and at the same time these individuals also face significant, countercyclical, quantitative borrowing constraints. This requirement for procyclicality, namely that it is mostly the educationally-talented individuals who find it harder to finance education during recessions seems rather stringent.

2. EMPIRICAL RESULTS

A. THE DATA

We use the School Enrollment information available in the October tapes of the Current Population Survey (CPS) conducted by the Bureau of the Census. The October CPS is the most comprehensive source of data on college enrollment that we could locate spanning enough years to facilitate the study of enrollment behavior over the business cycle. We use data from 1968 to 1988. The time period covered includes four recessions: a) December 1969 to November 1970, b) November 1973 to March 1975, c) January 1980 to July 1980, and d) July 1981 to November 1982. Our sample consists of all high school graduates between the ages of 18 and 22 surveyed during each of these years. Individuals of age 18 to 22 constitute the bulk of enrollees in college. Because different individuals are interviewed (in general) in different years we cannot follow them through time, that is we do not have longitudinal data. Thus, we cannot address questions concerning the persistence of college enrollment decisions of individuals. We can examine, however, how these enrollment decisions of individuals vary over the business cycle after controlling for individual-specific demographic and other characteristics. The sample consists of 198,151 individuals. The minimum number of observations during a year is 7,815 and the maximum is 11,972 individuals.

We consider an individual enrolled if he/she attends a 2-year or 4-year college full-time or part-time. We use three measures for the cyclical state of the economy. The first two, the total civilian unemployment rate, and the first-difference in (log) real GNP are shown in Figure 1.[18] Using these measures is common practice in the literature that studies the cyclicality of real wages (e.g. Solon, Barsky and Parker, 1994, and Abraham and Haltiwanger, 1995). The third is a measure of the cyclical component of GNP constructed by Cochrane (1994), which we call the "Cochrane measure."[19]

The models presented in the previous section suggested several economic variables as important for the decision to enroll. We use a measure of the expected long term real interest rate to capture the opportunity cost of financing the college education. This is constructed as the difference between the nominal yield on new home mortgages and the expected inflation rate calculated as the average of the inflation rates in the last twelve quarters.[20] Following Mincer (1994) the prospective "wage premium" to

[18]We have also repeated the analysis with unemployment rates for 18-22 year old high school graduates that we constructed from the tapes and the qualitative nature of the results did not change.

[19]To obtain this "cyclical" component one removes the trend, which is constructed as log consumption less the mean log GNP/consumption ratio. Cochrane (1994) shows that if consumption were a pure random walk (as it would be according to the permanent income model) then this series would correspond to the Beveridge and Nelson (1981) trend in GNP. This is a good approximation, in practice, since consumption growth is not very predictable. The "Cochrane measure" we use is the average over the four quarters of the year. All reported results were qualitatively unchanged by using just its value in the third quarter. The correlation between the "Cochrane measure" and the detrended unemployment rate is high (-0.72).

[20]This is the method suggested in Gordon and Veitch (1986) and is widely used in studies of physical

college education is captured by the ratio of wages of college to high school graduates with 6-10 years of experience (i.e. about a decade after graduation). We augmented the CPS data with state-level time series data on other variables potentially relevant for the enrollment decision. The tuition and fees charged of in-state students in 4-year comprehensive public universities is used as the price relevant for students on the margin of enrolling in college.[21] Annual state unemployment rates and average weekly earnings in manufacturing are intended to capture the impact of (local) labor market conditions. The real earnings are a measure of the opportunity cost of acquiring human capital due to the alternative of working. Table 10 in the Appendix contains means of some of the explanatory variables.

Cross-sectional studies of college enrollment (using primarily the data set "High School and Beyond") have shown that parental background variables such as their level of education and income are important in predicting college enrollment (see Manski and Wise 1983). Unfortunately, the October CPS survey does not contain adequate information to recover parental background variables for our sample of students. This is a limitation in the empirical analysis that we will present.[22]

B. THE CYCLICAL BEHAVIOR OF COLLEGE ENROLLMENT

The total number of 18- to 22-year-old high school graduates over the years in our sample is contained in Figure 2. The number peaks in 1981 reflecting the impact of the "baby-boom." Figure 3 contains the college enrollment rates calculated from the CPS. The rate varies between about 37 and 47 percent and shows substantial changes over time.

It is of interest to check whether the aggregate enrollment rate displays a clear cyclical pattern. Table 1 contains the results of regressing this rate on aggregate variables. All regressions contain an intercept and cubic time trends. When only the unemployment rate is included we obtain significant evidence of countercyclicality of enrollment rates. An increase in unemployment by one percentage point is associated with an increase in the enrollment rate of about 0.57 percentage points./footnote Betts and McFarland (1995) examine data supplied by community colleges in the U.S. and find that their enrollments are negatively related to a variety of unemployment rates. When other variables are included, however, the unemployment rate does not seem to have a significant association to college enrollments. The key variable seems to be the real interest rate, which has a significantly negative effect on enrollment rates. In interpreting these results, one should keep in mind the low number of degrees of freedom (13 to 15). Let us now turn to the analysis of individual-level data. We model the individuals' college enrollment decisions using probit analysis. We examine the time variation of the enrollment decisions of U.S.

investment. An alternative would have been the Livingston survey of expected inflation. The correlation between the two series is 0.75.

[21]See Kane (1994) for a discussion and justification of using this measure.

[22]The information to map students to parents exists only after 1983. Even then this can be done only for individuals that lived with their parents while attending college, a small fraction of the sample. Kane (1994) obtains parental background information by limiting his sample to dependent 18- and 19-year-olds and by identifying the household head and spouse as the parents of the youth. We did not follow this approach for various reasons. We wanted to maintain as large and as representative a sample as possible so we did not drop individuals of ages 20 to 22. This resulted in the number of dependent youths dropping sharply. It is indicative that 23 percent of the youths in our sample are married and (most likely) independent. Furthermore, it is most likely that single young individuals who are independent are working and not enrolled in college. By excluding them on the basis of lack of availability of parental information we would be biasing our sample towards including more enrolled individuals. Finally, identifying the household head and spouse as the parents of the youth introduces a, potentially substantial, source of measurement error.

high school graduates after controlling for certain individual specific characteristics (age, gender, race, marital status, region and state of residence, and others). The values of the estimated coefficients on year effects are indicative of time variation in the propensity to enroll after controlling for individual characteristics. There is significant time variation in this propensity. [23] Figure 3 contains these year effects and the aggregate enrollment rates. The correlation between the two series is 0.46 (0.84 after detrending them). The main difference seems to be in years 1976 and 1977: whereas the aggregate enrollment rate remained steady during those years the propensity of individuals to enroll fell quite dramatically. During the preceding and following years the two series move in similar ways.

Replacing the year effects with trend terms and the total civilian unemployment rate we find evidence of a countercyclical pattern of college enrollment decisions.[24] The coefficient of the unemployment rate (see Table 2) is significantly positive. This indicates that the effect of the procyclical variation in the real wage and in other elements of the opportunity cost of education overwhelms the effect of the (possibly procyclical) variation in the ability to pay for education. The marginal effect on the average probability of enrollment in college of an increase in the unemployment rate by one percentage point is 0.77 percentage points (with a standard error of 0.12), approximately a 2% change.[25] This estimated association between the unemployment rate and enrollment rates is about 35 percent higher than found in Table 1 using only aggregate data. Using the other two cyclical measures we arrive again at the conclusion that college enrollment is countercyclical. An increase in the growth rate of GNP by 1 percentage point is associated with a drop in the average probability of enrollment in college by 0.16 percentage points (with a standard error of 0.05). A value of the "Cochrane measure" of 0.01, which corresponds to the level of GNP being 1 percent above its trend, is associated with a lower average probability of enrollment by 0.49 percentage points (with a standard error of 0.09). [26] Having established that the college enrollment decisions of individuals are responsive to the business cycle we examine whether the absolute magnitude of this response is different in expansions than in contractions. We classify a year as a contraction if the unemployment rate rose during that year. Table 2 (second column) contains the results of allowing the coefficient on the unemployment rate to differ in contractions. The exclusion restriction cannot be rejected at standard levels of significance. [27] It seems that the response of enrollment is symmetric to the stages of the business cycle.

Simulations:

It is interesting to examine how predicted aggregate enrollments, and therefore the acquisition of human capital, would change as a result of a decrease or an increase in the amplitude of the business cycle. We present here the results of a simulation where,

[23] The exclusion restriction of the year effects is overwhelmingly rejected with a $\chi^2(20)$ statistic of 440.44 .

[24] The restriction that the year effects can be expressed in terms of the unemployment rate and linear, quadratic, and cubic time trends cannot be rejected at the 1% level of significance. The value of the $\chi^2(16)$ statistic is 31.18 .

[25] All reported marginal effects are calculated at mean values of the covariates. The standard errors are obtained using the delta method.

[26] In order to compare the magnitude of the marginal effects implied by the three business cycle measures we multiply them by the standard deviation of the respective measure: 1 for the detrended unemployment rate, 0.016 for the "Cochrane measure", and 0.023 for the GNP growth rate. The associated marginal effects are, then, 0.77, 0.79, and 0.37 percentage points respectively. The fact that the GNP growth measure implies a different magnitude is not surprising since it captures changes in the level of economic activity whereas the other two measures capture the level. Finally, note that the unemployment rate is measured in percentage points (e.g. 6 percent) whereas the growth rate of GNP and the "Cochrane measure" are measured as a fraction (e.g. 0.04).

[27] We obtained similar conclusions about asymmetry using the GNP measure of the cycle.

in a sense, we "shut down" the business cycle. If the economy were growing at its trend level during these years as opposed to its observed cyclical deviation from its trend what would have been the differences in college enrollments? This simulation should be viewed as a means of assessing the magnitude of the average marginal effect reported above in terms of the observed cyclical fluctuations.[28]

Figure 4 contains the results of the simulation (the plot with squares).[29] The numbers are quite dramatic for certain years. Specifically, it is predicted that if the economic activity in 1979 had not been at its observed high level college enrollments would have been higher by about 204,000 students. This translates to a 1.3 percentage point increase in enrollment rates (a change of 3.4 %). In contrast, enrollments in 1975 would have been lower by about 193,000 students; a decrease in enrollment rates by about 1.3 percentage points.

A separate issue is the approximate impact of "shutting down" the business cycle on the part of human capital stock that is due to college education. We calculate this stock for 1988 from the enrollments of previous years using a "perpetual inventory" method and assuming various rates of depreciation.[30] Figure 5 compares the actual stock (first bar), the fitted stock (second bar), and the simulated stock when the business cycle has been eliminated (third bar). The predicted change in human capital stock is negligible (average enrollments increase by about 10,000 students). This is a result of three features of this simulation: 1) The response of enrollment decisions to the stages of the business cycle is symmetric with respect to "good" times and "bad" times. 2) The deviations from trend of the unemployment rate sum to zero, by construction. In a linear model, then, the average impact of expansions would cancel out the average impact of contractions. Since the model here is non-linear, this turns out to be only approximately true. 3) The aggregate amount of human capital is a linear function of investment in human capital.

We modify the second feature now by using the deviation of the unemployment rate from its natural level as the measure of the business cycle's impact on enrollment decisions. The natural level is captured here by Robert Gordon's NAIRU (non-accelerating inflation rate of unemployment), which ranges between 5.6 and 6.0 until 1980 and is 6.0 in the 1980's. The deviation ranges between -2.1 and 3.7 with an average of 0.61. The predicted differences in enrollments are now quite different and more dramatic (see Figure 4, the "ovals" plot). Enrollments would have been lower in 1982 by about 408,000 students; a difference in enrollment rates of about 2.5 percentage points. At the opposite end, had the economic activity been at trend in 1969 enrollments would have been higher by about 168,000 students; a 1.3 percentage point increase in the enrollment rate. As a result of the elimination of the business cycle the stock of human capital would decrease by 1.3% to 1.7%, depending on the assumed depreciation rate (see the the fourth bar in

[28]Several caveats are in order. We assume that the decrease in the amplitude of the business cycle does not alter the sensitivity of enrollment to the level of economic activity as measured by the coefficient on the unemployment rate in our probit. Clearly, that is not going to be the case since the relationship estimated here is not structural. Another assumption is that a change in the amplitude of the business cycle would not affect the trend growth rate of the unemployment rate. This might not be warranted. Drazen (1985) provides a mechanism for an interaction between fluctuations and the natural level of economic activity. Similar mechanisms have been suggested by models of "hysteresis."

[29]The results plotted there were obtained as follows. First, we detrended the unemployment rate by fitting cubic polynomial trends. Using quadratic trends did not alter the results significantly (these results are available from the authors upon request). Then, we calculated for each year the average treatment effect of removing the cyclical component in the unemployment rate. This was the change in the probability of enrollment as predicted by the probit, averaged over all individuals in a year.

[30]There are several maintained assumptions here. 1) The flow investment for human capital is the number of students enrolled during the period. 2) All types of study (e.g liberal arts versus engineering, 2-year versus 4-year institution) have the same marginal productivity. 3) The creation of human capital in different calendar years (e.g. 1968 versus 1988) has the same marginal productivity.

Figure 5). [31]

The precise impact, then, of the business cycle on the aggregate human capital stock in the above simulation depends on the measure of the cyclical component. However, we can firmly conclude that at any point in time during the business cycle there is significant substitution between human capital investment and competing economic activities. [32] In 1982 when the unemployment rate stood about 1.9 points higher than in the previous year, the changed aggregate economic conditions were associated with college enrollment that was higher by about 232,000. This number reflects movements into the education sector of 18- to 22-year-old high school graduates only but is, nonetheless, substantial when contrasted with the (net) change in total civilian employment observed between October of 1981 and October of 1982 of about 1.163 million.

A natural question to ask next is whether this represents substitution by individuals in education across time also. Does the cycle affect the level of a particular *individual's* human capital temporarily or permanently? Unfortunately, we cannot answer this question satisfactorily since we do not have longitudinal data. We note, however, that, other things equal, the expected probability of enrollment of a 19-year-old is about 5 points lower than that of a 18-year old. The corresponding difference is 9 points for 20-year-olds, 12 points for 21-year-olds, and 22 points for 22-year-olds. This indicates that youths that substitute away from college education in a boom year are less likely to go to college later on when economic activity falls. The increase in college enrollment during a subsequent recession seems to come from increased participation of new cohorts of high school graduates. This indicates that for some individuals the effect of cyclical fluctuations on their level of human capital is persistent.

Is there a change after 1978?

After examining the series of enrollment rates as well as that of the year coefficients it seems that their behavior changed dramatically around 1978. Before 1978 there seems to be a downward trend in enrollment which reverses itself to an upward trend after that. At the same time the variability of the series seems to have dropped substantially. Indeed, we can reject the null that the coefficients on the cubic trend terms and the unemployment rate did not change after 1978.[33] The responsiveness to the unemployment rate was considerably lower after 1978. The marginal effect of fell from 1.44 (with a standard error of 0.21) to 0.59 (0.20).

What could be underlying this change in trends and in volatility? It is easier to offer explanations for the change in trends. One potential explanation could be the changing behavior of the college "wage premium." It has been documented (see Katz and Murphy 1992 among others) that this "premium" fell steadily throughout the 1970's. The 1980's, however, brought a reversal of this trend and large increases in the returns to education. Another explanation involves the steady decreases in the net direct cost of college education in the 1970's followed by increases in the 1980's (Kane 1994 documents this trend as do other studies). Finally, the size of the cohort of high school graduates had been increasing until 1981. After the last "baby boom" cohort the number of high school graduates was trending downward. Stapleton and Young (1988) argue that the cohort size should be negatively related to educational attainment.

[31] The "Cochrane measure" of the cycle has an average very close to zero so it would not predict any effect on the human capital stock as opposed to GNP growth, which was positive on average.

[32] We confirmed this using the GNP growth rate. In this case the magnitude of the response was lower but still substantial. The growth rate of GNP would be the appropriate measure for the simulations if youths respond to the rate at which the economy grows (i.e. its vigor) rather than its current level.

[33] The estimates presented in Table 2 and the associated tests were not sensitive to shifting the break point one year earlier or later.

C. Economic Factors Affecting The Enrollment Decision

In the theoretical section of this paper we argued that certain economic variables should influence enrollment decisions. In this subsection we test the role of some of these. Where possible we use state level data so as to take advantage of additional variation between states at a given time period. The unemployment rate, the cost of tuition, and average weekly earnings are state-specific. Table 3 contains the results.

The coefficient on unemployment is significantly positive. An increase in the state unemployment rate by one percentage point increases the average probability of enrollment in college by 0.25 percentage points (with a standard error of 0.08). This finding is important as it contrasts sharply with past literature. Venti and Wise (1983), using cross-sectional data, find that the state unemployment rate is not related to the decision to apply to college. Kane (1994) found that the state unemployment rate was not significantly related to the enrollment decision of individuals. [34] It seems that there are two main reasons for our different result. First, we use time series of cross-sections, which allows us to exploit the time variation in the state unemployment rates. Second, we study a broad sample that includes older individuals of college age (specifically 18 to 22-year olds). The significance of the unemployment rate even when controlling for other cyclical variables may be due to any one of the following reasons. Increases in the unemployment rate increase expected unemployment insurance payments and, therefore, the benefit to pursuing activities competing with employment. In addition, it may be the case that the current unemployment rate contains information about future wages and interest rates not contained in the contemporaneous values of these variables.

Another variable related to local labor market conditions is earnings. The estimated sign is, as expected, negative and significant. An increase in the average weekly real earnings in manufacturing by $40 (roughly a $1 rise in the hourly real wage) is associated with a decrease in the average probability of enrollment by 0.78 points (with a standard error of 0.23).

The real interest rate has a significantly negative impact. An increase of the real interest rate by one point is associated with a decrease in the average probability of enrollment by 0.29 percentage points (with a standard error of 0.06). This conforms to the theory in section 1. It does contradict, however, Mincer's (1994) finding of no role for the interest rate using aggregate data. Much of this association is due to the negative values of expected real interest rates in 1976 and 1977, years when the propensity to enroll fell whereas observed enrollment rates remained steady (see Figure 1).

The third specification in Table 3 contains three more variables: the size of the cohort of high school graduates, the cost of tuition and other fees, and the college "wage premium." None of these variables are significant. Thus, our results cast doubt on the theory that the cohort size should be negatively related to educational attainment (see Stapleton and Young 1988 and references cited therein). They argue that larger cohorts reduce the economic rewards to education and discourage human capital acquisition. The lack of significance of tuition is in conflict with previous findings (see Leslie and Brinkman 1989 for a review). It seems that cross-sectional estimates of the effects of tuition are due to other fixed differences between high- and low-tuition states. [35] Finally, the rate of return to college education does not seem to be related to the propensity to enroll in college. This contradicts the findings of Mincer (1994) of a significant association between aggregate enrollment rates and this same measure of the "premium." [36]

[34] This was the case for all his estimated specifications for blacks and all but one of the specifications for whites. That specification, however, did not include state dummies.

[35] When we drop the state effects, tuition is estimated to have a strong negative effect. This confirms the importance of controlling for unobserved state effects.

[36] This "premium" is the percent wage differential between college and high school graduates, with 6-10

In summary, our findings are quite different than those of past studies on the subject. They indicate much stronger responsiveness of high school graduates to opportunity costs (variables capturing local labor market conditions) and to the financing costs (the expected real interest rate) of college education. We estimate a lower responsiveness to the direct costs and the "rate of return" to education than did some past studies. Finally, there does not seem to be evidence for theories of enrollment based on the size of the cohort. The main source of these differences seems to be our using combined time series of cross-sections data on enrollment in contrast to past studies that examine the time-series or cross-sectional dimension of data alone. We turn now to exploring differences in the time variation of individual enrollments by gender and race.

D. Differences across Gender

Figures 6 and 7 contain the enrollment rates and the estimated coefficients of the year effects for males and females respectively. College enrollment rates of men were at their highest in 1968 at 58 percent. They dropped in the 1970's to around 42 percent and then gradually increased to about 48 percent in 1988. In contrast, the enrollment rates of women started in 1968 at a low of 31 percent and by 1988 they had reached 46 percent. The bulk of this increase came in the 1980's. So the 1980's seemed to bring simultaneous increases to the labor force participation rates and the college enrollment rates of women. The coefficients of the year effects for men track the enrollment rates quite closely except in the period from 1973 to 1976. The coefficients for women track their enrollment rates less well especially in the period 1976 to 1978.

From the Figures and Table 4 we can conclude that the break in trend and cyclicality of enrollments that we documented earlier is mainly due to the behavior of males. The enrollment of males after 1978 does not display a cyclical pattern. Tables 5 and 6 relate the enrollment decision to pertinent economic variables. The main difference across gender seems to be in the response to earnings and tuition. Males are not responsive to the average wages in their (local) labor market or to tuition cost whereas females are.[37]

E. Differences across Race

Figures 8 and 9 contain the enrollment rates and the estimated coefficients of the year effects for blacks and whites respectively.[38] College enrollment rates for blacks were very variable during this period ranging from 29 percent to 39 percent. The most extreme changes occurred between the years 1973 and 1975 when the enrollment rate increased by about 10 percentage points. For the following decade the enrollment rate fell especially in the period from 1976 to 1980 and then rebounded in 1985 to 1988. The enrollment rates for whites ranged between 38 and 44 percent in the early part of the period and increased steadily in the 1980's to 48 percent in 1988. An interesting piece of information is that the total number of black high school graduates peaked in 1985 whereas that for white graduates peaked in 1981. This reflects the increase in high school completion rates by blacks in the early 1980's.[39]

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years of experience. Mincer (1994) argues that measures of the college "wage premium" at the end of the first decade of working life are least contaminated by differential job training. Thus, they represent a good measure of rates of return to college education as seen by young high school graduates deciding whether to enroll in college or not. Kane (1994) uses a measure of differences in income and finds it significant for whites, the vast majority of his sample.

[37]It is possible that changes in the variability of these two variables after 1978 accounts for the differences in the variability of enrollment after 1978. The average variation in earnings fell by about 13% both in the cross-section and in the time-series dimension. The average variation in tuition increased by 66% in the cross-sectional and by 13% in the time-series dimension.

[38]The category of whites includes everyone who is not classified as black.

[39]Kane (1994) documents that the completion rate among 18-19 year old blacks increased roughly from 75% to 80%. He notes that if this reflects a decrease in the threshold for high school graduation then later cohorts of high school graduates may have lower college enrollment rates simply because they have

The year effect coefficients for blacks track enrollment rates quite closely. There is evidence, however, that after controlling for observed individual characteristics blacks' propensity to enroll is not very variable over time. Only the year effects for 1971, 1975, and 1976 are significantly different than zero at the 5 percent level (the omitted year is 1968). In contrast, all year effects for whites are significant at the 5 percent level except for that of 1969.

The unemployment rate is not significant at the 5 percent level for blacks (see Table 7). This is due to non-cyclicality of their enrollment propensities after 1978. In the previous period these propensities are countercyclical. These findings are not surprising given the evidence in the previous paragraph about the year effects. In contrast, the college enrollment decisions of whites seem to be significantly related to the business cycle. The only time-varying variable relevant for the college enrollment decision of blacks is the expected real interest rate, which is commonly characterized as acyclical. To the extent that the real interest rate reflects the cost of financing one's education, we find that both groups' enrollment decisions are responsive to this cost. In fact, blacks are more responsive to this cost: compare a marginal effect of -0.70 (0.19) for them to -0.23 (0.06) for whites (see Tables 8 and 9). In contrast, neither group is responsive to tuition a result that contrasts with the findings of Kane (1994) (at least for blacks). [40]

3. CONCLUSION

Intertemporal macroeconomic theory suggests that people respond to changing cyclical conditions by engaging in intertemporal substitution of activities. During recessions individuals are thought to redirect activities away from work toward leisure (Kydland and Prescott, 1982), home production (Benhabib, Rogerson and Wright, 1991, Greenwood and Hercowitz, 1991). In Hall's (1991) framework labor is redirected from production to the formation of organizational capital. In this paper we have suggested an alternative substitution activity, namely schooling. We provided evidence that young individuals' propensity to enroll in college is strongly countercyclical. Severe recessions may have been associated with increases in college enrollment of up to 400,000 by some measures. The precise impact of cyclical economic activity on educational attainment does depend on the measure of its amplitude used. None the less, it is large for all the measures that we have employed. Our finding is important. It suggests the need for dynamic general equilibrium models of the economy, such as Real Business Cycle ones, to incorporate

a larger proportion of lower ability individuals. We control for such an effect partially with the cohort size variable in our probits.

[40] In trying to pinpoint the source of this discrepancy we omitted the real interest rate from a probit (Kane does not include the real interest rate in his analysis). This did not alter the estimated role for tuition (or any of the other variables). Perhaps, then, the discrepancy is due to our sample including 20 to 22-year olds. One could argue that these youths, when enrolled, are more likely to be mid-way through their schooling and are less sensitive to changes in tuition. The existence of fixed costs to restarting one's education would justify such a conclusion. However, tuition was still insignificant in a probit with 18- and 19-year olds only.

substitution between human capital accumulation and other economic activities. This may modify the predictions of these models regarding the nature of cyclical fluctuations. It may also clarify the importance of a potential link between short run fluctuations and long run growth: that of human capital accumulation.

REFERENCES

Abraham, K. and J. Haltiwanger, 1995, Real Wages and the Business Cycle, *Journal of Economic Literature,* September, v. 33, no. 3, pp. 1215-1264.

Azariadis, C. and A. Drazen, 1990, Threshold Externalities in Economic Development, *Quarterly Journal of Economics,* May, pp. 501-526.

Abowd, J. and O. Ashenfelter, 1981, Anticipated unemployment, temporary layoffs and compensating wage differentials," in S. Rosen, ed. *Studies in labor markets.* Chicago: University of Chicago Press.

Becker, G, 1975, *Human capital: A theoretical analysis with special reference to education,* New York: Columbia University Press.

Benhabib, J., R. Rogerson and R. Wright, 1991, Homework in Macroeconomics: Household Production and Aggregate Fluctuations, *Journal of Political Economy,* v. 99, no. 6, pp. 1166-87.

Betts, Julian R., and Laurel L. McFarland, 1995, "Safe Port in a Storm: The Impact of Labor Market Conditions on Community College Enrollments," *The Journal of Human Resources,* v. 30, no. 4, pp. 741- 765.

Beveridge, Stephen, and Charles R. Nelson, 1981, "A New Approach to Decomposition of Economic Time Series into Permanent and Transitory Components with Particular Attention to Measurement of the 'Business Cycle'," *Journal of Monetary Economics,* v. 7, pp. 151-74.

Boskin, M., 1974, A conditional logit model of occupational choice, *Journal of Political Economy.*

Burns, Arthur M. and Wesley C. Mitchell, 1946, *Measuring Business Cycles,* New York, N.Y.: National Bureau of Economic Research.

Clotfelter, C. T., 1991, Demand for undergraduate education, in C. T. Clotfelter et al., eds., *Economic Challenges in Higher Education,* University of Chicago Press.

Dellas, H., 1994, Schooling and the business cycle, *mimeo,* Catholic University, Leuven.

Drazen, A., 1985, Cyclical Determinants of the Natural Level of Economic Activity, *International Economic Review,* v. 26, no. 2, pp: 387-97.

Freeman, R., 1975, Supply and salary adjustments to the changing science manpower market, *American Economic Review.*

Freeman, R., 1986, The demand for education, in O. Ashenfelter and R. Layard, eds, *Handbook of Labor Economics,* North Holland.

Gordon, Robert, J., and John M. Veitch, 1986, Fixed Investment in the American Business Cycle 1919-83, in Robert J. Gordon ed.: *The American Business Cycle: Continuity and Change*, NBER vol. 25, University of Chicago Press, pp. 267-335.

Greenwood, J., and Z. Hercowitz, 1991, The Allocation of Capital and Time Over the Business Cycle, *Journal of Political Economy,* December, 99:2, pp. 1188-1214.

Hall, R., 1991, Labor Demand, Labor Supply and Employment Volatility, *NBER Macroeconomics Annual,* Cambridge, Mass.: MIT Press.

Kane, T., 1994, College Entry by Blacks since 1970: The Role of College Costs, Family Background, and the Returns to Education, *Journal of Political Economy,* v. 102, no. 5, pp. 878-911.

Katz, L., and K. M. Murphy, 1992, Changes in Relative Wages, 1963-1987: Supply and Demand Factors, *Quarterly Journal of Economics,* v. 107, no. 1, pp. 35-78.

Kydland, F. and E. Prescott, 1982, Time to Build and Aggregate Fluctuations, *Econometrica,* v. 50, November, pp. 1345-70.

Leslie, L. and P. Brinkman, 1988, *The Economic Value of Higher Education.* New York: Macmillan (for American Council of Education).

Manski, C. and D. Wise, 1983, *College Choice in America.* Cambridge, Mass.: Harvard University Press.

Mincer, J., 1993, *Studies in Human Capital,* E. Elgar.

Mincer, J., 1994, Investment in U.S. Education and Training, *Working Paper No. 4844,* NBER.

Orazem, P., and P. Krottila, 1991, Human capital, uncertain wage distributions and occupational and educational choice, *International Economic Review,* 103-22.

Perli, Roberto and Plutarchos Sakellaris, 1996, Human Capital Formation and Business Cycle Persistence, *mimeo*, University of Maryland, July.

Pissarides, C., 1981, Staying-on at school in England and Wales, *Economica,* 48, pp. 345-63.

Pissarides, C., 1982, From school to university: The demand for post-compulsory education in Britain, *Economic Journal*, 92, pp. 654-67.

Rice, J., 1987, The demand for post-compulsory education in the UK, *Economica*, 54, 465-76.

Romer, P., 1990, Endogenous Technological Change, *Journal of Political Economy.*

Siow, A., 1985, Occupational choice under uncertainty, *Econometrica.*

Solon, G., R. Barsky, and J. Parker, 1994, Measuring the Cyclicality of Real Wages: How Important is composition Bias?, *Quarterly Journal of Economics,* v. 109, no. 1, pp. 1-25.

Stapleton, D. and D. Young., 1988, Educational Attainment and Cohort Size, *Journal of Labor Economics,* v. 6, no. 3, pp. 330-361.

Venti, S. and D. Wise, 1983, Individual Attributes and Self Selection of Higher Education, *Journal of Public Economics,* v. 21. pp. 1-32.

Weiss, Y., 1986, The determination of life cycle earnings: A survey, in O. Ashenfelter and R. Laylard, eds, *Handbook of Labor Economics,* North Holland.

Willis, R., 1986, Wage determinants: A survey and reinterpretation of human capital earnings functions, in O. Ashenfelter and R. Laylard, eds, *Handbook of Labor Economics,* North Holland.