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An Option for Financial Aid

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Abstract - The variety of financing plans for higher education now includes income contingent repayment plans, pre-paid tuition plans, savings plan trusts, and state college savings bonds. None of these plans hedge against the uncertainty of gaining human capital by investing in a college education. I investigate using a European call option, with income as the underlying asset, to hedge the risk of gaining human capital by investing in a college education. I also discuss how the option can be used to increase access to higher education for minority and disadvantaged groups.

I Introduction

Gaining human capital is a risky investment that requires the outlay of time, money and forgone wages; therefore, the analysis of human capital is approached in the same manner as investments in the stock market. Economists have analyzed the 1) private returns to human capital investments - benefits enjoyed by student and family, 2) net present value of human capital investments - the discounted value of economic benefits less cost of investing in human capital, and 3) the returns to human capital investments - increase in economic benefits received for investing in an additional year of education.¹ Investments in human capital can be done either by employers through on the job training programs or by the individual through obtaining a vocational or college education.

Like investing in the stock market, gaining human capital has no guaranteed return. When an investor buys stock, there is no guarantee that the company will use the new capital to produce profitable products and services. Changes in market demand between the time the capital was generated and the product produced can cause unsuccessful ventures. Similarly, a student may find the market demand for a given college major has decreased; hence the expected returns from obtaining a college education are not realized. Since market demand can not be controlled, although market research can anticipate trends, returns to investment that are not risk-free, can not be guaranteed. However, there are financial instruments that investors can use to hedge investment risk. Historically, investors have used security derivatives, such as options, warrants, futures and swaps, to hedge a position in the stock market.

In the late 1990s, the use of security derivatives and “equity like” contracts were explored as means to hedge the risk of investing in and alternative methods for financing gains in human capital. Palacios (2002) provides four reasons why human capital contracts would be of interest to students and investors: 1) loan payments are not fixed but a proportion of income, 2) the probability of repayment default is substantially reduced, 3) these contracts are need and means blind, and 4) they provide subsidies those most in need during the repayment periods. It is important to note that these contracts may take into account merit and ability factors. In fact, Palacios, states, “pricing of human capital contracts will be based on the investors expectations...those expectations will depend on the school that the student is attending the

¹ See U.S. Bureau of the Census, “Present Value Of Estimated Lifetime Earnings”, Technical paper 16, U.S. Government Printing Office, Washington, DC., 1967. For studies on returns to education see Becker (1960), Freeman (1975), Mincer (1974), Ashraf (1994), Duncan (1996) and Rouse (1996) to name a few.

student's field of study and other factors considered relevant to the student's future earnings." He posits that the comparison of human capital contracts and education cost would improve the efficacy of the higher education market resulting in lower relative costs and a greater incentive to pursue higher future earning opportunities. The belief that human capital contracts would encourage pursuing higher earning opportunities is problematic. For example, if human capital contracts deter students from K-12 teaching careers to more financially lucrative careers, the shortage of quality school teachers will be exacerbated even more. However, if there are as Palacios proposes several funds – by field of study, types of students or school, purely economic or altruistic grounds, the incentive effect will be minimized.

While human capital contracts may indeed accomplish all that Palacios suggests, students are obligated to repay some portion of their earnings. It is this feature that makes human capital contracts as unattractive as student loans. This paper explore (1) how a European call option can be used to hedge against risk associated with gaining human capital by investing in a college education, i.e., the risk that a student will not obtain a job that offers earnings substantial enough to offset the cost of investing in a college education and (2) provide a mathematical formula for pricing the call option. What distinguishes this financing scheme from human capital contracts and student loans is the option has the potential to void all financial obligations to the holder of the option without tax penalties. This could make the option useful in attracting students who have historically not had access to higher education.

II Financing Education

In the past, students have taken out loans, either conventional or guaranteed by the federal government, to pay college expenses not met by scholarships, grants or personal savings. In 1969, Wiesbrod and Hansen asked, "Why has there been a limited development of an organized private capital market to finance student loans for higher education? Several reasons emerge:

1. Higher education unlike ordinary commodities is intangible.... since education is embodied in the individual; such repossession is impossible in a free society. Thus give the difficulty of assessing individual integrity and of gaining access to a claim on the borrower's income, the lender's risk in making loans to finance higher education is raised.
2. Higher education is also embodied in a highly mobile form. Because people especially the better educated are highly mobile geographically a private lender finds it risky to finance higher education, subsequent collection is difficult (costly) if the individual moves and is especially hard to locate. This situation is in naked contrast with the case of many categories of physical capital which are usually more difficult to move.
3. There is an additional lack of certainty that higher education actually will bring financial benefits of any particular individual. The individual may die prematurely, become disabled or fail to find regular employment of his skills. (Wiesbrod and Hansen pg. 91-92)

The US government, commercial banks, and credit unions have successfully found ways to reduce their risk associated with financing higher education such that the average student loan amount has increased from \$518 in 1980 to nearly \$20,000 in 2007. In addition, students may

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take advantage of Income Contingent Loan Repayment Plans (ICLRP) on direct student loans.² Under the Federal government's ICLRP a student pays either 20 percent of his/her disposable income³ or the yearly amount if the loan is repaid in 12 years multiplied by an income percentage factor (that varies with income, marital status, and family status), which, ever is the lesser. If the loan is not repaid within 25 years, the loan is forgiven and the forgiven amount becomes taxable income.⁴

Other countries such as Australia and New Zealand have Income Contingent Loan programs that are run by their governments. The Australian government offers as part of the Higher Education Contribution Scheme (HECS) the Higher Education Loan Program (HELP) which is recorded with the national tax office. Recipients have two repayment options: 1) compulsory repayment through the tax office if income exceeds the threshold or 2) voluntary repayments, with a 10% bonus on voluntary repayments of \$500 or more. For 2005-06, income below AUS\$36,185 (approximately USD\$27,000), required no repayment. Repayments amounts vary from 4% for income between AUS\$36,185-\$40,306 to 8% for income between above AUS\$67,200. Loan payments are not tax deductible, the interest rate is adjusted by the consumer price index (zero real interest), the plan has no grace period, time limit for repayment, and is not cancelled if the recipient files bankruptcy. If the recipient should die before the debt is repaid, the estate or trustee is responsible for the payments for that tax year after which the debt is void.

New Zealand's threshold is NZD\$16,588 (\$USD11,600 or AUD\$15,483) more than half the threshold of Australia. New Zealand's repayment formula is straight forward: (Annual Income – repayment threshold) x 10%. New Zealand defines income sources as salary, wages, a benefit, Accident Compensation Corporation, superannuation, or student allowance. Interest on the loans is the sum of the cost of funds the government has to pay to borrow the money (base interest) plus an inflation adjustment. Recipients are allowed to make additional payments to reduce the interest charged and are penalized 2% a month for outstanding balances from a previous year. It is expected that the majority of New Zealand loans will be repaid in 15 years and debt is cancelled at death.

In 1971, Nobel Prize winner James Tobin proposed the "Yale Tuition Postponement Option" (YTPO), which allows student to defer paying cost increases of a Yale education until their earning years. Students then would repay these costs in proportion to their income.⁵ "The purposes of the Plan are (1) to enable students to defer part of the expense of education, (2) to enable students to contribute to the support of the University in approximate proportion to their ability to do so and to the economic benefit they have derived from their Yale education, and, (3) to help meet Yale's immediate need for increased funds to defray sharply rising cost." The YTPO requires students to repay .04% of their earnings for 35 years or a minimum of \$29/\$1000 borrowed, unless the student could prove the payments caused financial hardship. Payment

² Direct student loans are funded by the Department of Education versus a commercial bank.

³ Disposable in is the difference between report adjusted gross income and the poverty of a given family size and state of residence.

⁴ There is currently legislation to remove the tax liability for loan forgiveness associated with the ICLRP.

⁵ The plan only allows students to defer increase in University charges from one year to the next. For more details, see "Yale Tuition Postponement Option", Background Detail for Release Morning Papers, Yale University, February 6, 1971.

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begins the following year in which the student ceases to be a full-time student and continues until the cohort debt is repaid or the student can purchase his loan for 150 percent of the combined total of the principal and accrued interest. Payments can be deferred if the student becomes a full-time student or disabled after separation from the University. Unlike the income contingent loan programs financed by governments, Yale's plan includes an insurance premium for life and disability insurance in the interest rate. This insurance protects Yale against losses due to a student's death or disability. Yale estimates \$8 million in loans were made under the YTPO and that \$11 million is owed including principal and interest. However in 1999, the *Wall Street Journal* reported that several takers of the YTPO were angry over still owing Yale.⁶

In 2001, www.myrichuncle.com, (MRU) went into business providing student with educational investments to cover educational expenses traditionally covered by student loans, parents or savings and the website clearly stated they did not issue loans. When MRU offered educational investments, students agreed to pay a percentage of their earning ranging from .2% to .4% to MRU for a specified length of time, submitted tax returns by May of each year for payments to be adjusted, and satisfied their obligation when the number of payments had been completed independent of the value of the stream of payments. The website does not disclose repayment amounts for the loans, but offers several repayment plans: traditional – interest and principal; interest only; or to defer while in college. Like the contracts described by Palacious, MRU allows students to get lower interest rates if the merit history part of the application is completed or there is a co-signer. In 2001, 65 students were took advantage of the MRU.⁷

In 2004, MRU went public and trades on the NASDAQ under UNCL. A year later, MRU began offering an array of student loan products, which include loans for undergraduate, professional degrees, studying abroad board or bar exam and residency and relocation. MRU competes with the loan programs of the Federal government. But unlike the Federal government, students can be approved for loans based on merit if there is no credit history. Loans offered based on merit are called PrePrime student loans and are underwritten by Universal Finanz Holding AG. The evolution of MRU has made them another supplier of the traditionally structured education loans.

Instead of the traditional student loan, income contingent repayment plans, Yale's Tuition Postponement Option, or the human capital contracts offered by www.myrichuncle.com, I propose offering students the Education Call Option (EdCO) to cover unmet educational expenses. The EdCO, a European call option, gives the buyer the right, not an obligation, to purchase an asset for a specific price if the market price exceeds the exercise price at and only at expiry, the date the call expires. Why would anyone buy a call? The buyer of a call believes the probability of the asset price exceeding the exercise price at expiry is approximately one. The writer of the call believes the probability of the asset price exceeding the exercise price at expiry is infinitesimally small. The student is the writer of the EdCO and believes the economic returns from investing in college will not be substantial enough to cover living expenses and the repayment of education costs. The college/university or third party is the buyer of the call and believes 1) the economic

⁶ “Old Blues: Some Alumni of Yale Realize That They Owe College a Lasting Debt --- Plan Has Them Remitting A Share of Their Income Decades After Graduation --- ‘Noble Experiment’ Gone Awry” By William M. Bulkeley. *Wall Street Journal*, (Eastern edition). New York, N.Y.:Feb. 23, 1999. pg. A.1

⁷ “Student-loan twist: you owe if you earn”, <http://www.csumonitor.com/2003/0317/p16s02-wmpi.html>.

returns from obtaining a college education will meet or exceed the student's expectation and 2) meet or exceed the returns of alternative investment opportunities.

In the case of the EdCO, the asset is income – namely labor market earnings. If the asset price (income) is not greater than the exercise price at expiry, then all obligations to the holder are voided. Such a contract eliminates concerns of paying back school loans when income is not substantial enough to cover loan payments and basic living necessities. Given this, it is important that the holder of the option select an expiry time that reduces the probability of having a worthless contract. The EdCO gives the holder the right to begin collecting at expiry the future value of unmet financial need at a specified percentage of the student's future income per year for a specified number of years if the market value of human capital, income, exceeds the calculated exercise price. Financial obligations are not payable before expiry of the option. The option will cover educational expenses incurred during the pursuit of the bachelor's degree not covered by financial aid. The student is the writer of the option and the University the buyer. The student is free to use the revenue from the call as he/she wishes.

The EdCO has the following advantages over the current higher education financing mechanisms. First, the EdCO maybe more attractive to economically disadvantaged students for whom (1) the yearly student loan amount is approximately equal to current household income and/or (2) the loan balance for financing four years of higher education is approximately equal to current household. For these students taking out student loans of nearly \$7,600 for their first year of college and that could exceed \$20,000 by their senior year, makes investing in higher education an unbearable risk. Since the EdCO has the potential to expire worthless, it reduces the risk of investing in higher education and may therefore make higher education a more attractive investment for economically disadvantaged students. The addition of these students adds to the diversity of the student body, which is believed to have positive externalities on learning. Institutions with a preference for such externalities would substitute away from buying the EdCO from students who offer pure economic returns. The EdCO written by the disadvantaged students has higher returns in that the positive externalities from a diverse student body has multiple effects that the college can capitalize on now in addition to the value of future revenue streams.

Second, the EdCO provides incentives for colleges and universities to monitor the quality and quantity of graduates produced. Since the EdCO will expire worthless if the student's income does not exceed the exercise price, an institution that produces too many graduates of a given discipline will have graduates who are unemployed in the short-run. In the long-run, the labor supply will shift outward reducing wages for students in this discipline until this labor market is back at equilibrium. How far wages decline depends on the ability of these students to substitute for workers being demanded in other labor markets. Similarly, if the quality of the graduates is low the demand for these students will shift inward causing some students to be unemployed and others to receive lower wages. Therefore, either producing excess quantity or low quality students reduced student's income and increasing the probability of the EdCO expiring worthless. The threat of having the option expire worthless should serve as an incentive for colleges and universities to regulate both the quantity and quality of the graduates produced.

III Data and Methodology

Data available from the Integrated Public Use Microdata Series raw data files of the 1970, 1980, 1990 and 2000 Decennial Census are utilized for the analysis in this study. The sample is limited to individuals who self identified as either Asian, black, Native American or white and reported the bachelors as the highest level of educational attainment. The sample consists of individuals who reported their age as 25-34 in 1970, 35-44 in 1980, 45-54 in 1990, and 55-65 in 2000. Lifetime earnings profiles were created using cohort analysis. The advantage of this method is that it allows for analysis on a large sample. The draw back is that each cohort is not likely to consist of the same individuals due to response rates and death. Summary statistics are reported in Table 1.

The education call option gives the holder the right to begin collecting at expiration the future value of unmet financial need if the market value of human capital, income, exceeds the calculated exercise price. The student will repay the future value of the loan in equal installments. Repayment of the student's obligation is not allowed before the expiration date. The contract would look something like:

I (student's name) give (university's name) the right to \$(future value of loan amount at a given interest rate) worth of my future earnings to be in equal installments over (years) if my annual earnings exceed (formula for exercise price) exercisable at (years) after graduation or separation from the institution.

Why would any one enter into such a contract? The contract is attractive to the writer, the student, if she does not believe her future earnings are going to be greater than the calculated exercise price. Why then would the student invest in a college education? Pascarella and Terenzini (1991) have suggested that a college education provides benefits such as access to better health care, lower mortality rates, stable employment, control over family size (through better information about contraceptives), and increased leisure time spent enjoying cultural activities to name a few. The student may invest in a college education to have access to these benefits. The option will be attractive to the buyer, college/university or third party, if he believes future earnings will exceed the calculated exercise price and therefore, is willing to pay the student for the opportunity to claim a percentage of future income if contract conditions are met.

Deriving the Option Pricing Formula

Deriving a fair market price for the education call option requires an asset model that describes the evolution of the underlying asset and knowledge about the probability distribution of the underlying asset. The underlying asset for the education call option is income. The Black-Scholes formulas used to price call and put options or forward contracts are inappropriate to price an option with income as an underlying asset. Black-Scholes models assume the underlying asset follows a stochastic process similar to the evolution of stock prices. The evolution of a stock price is usually described by the Ito stochastic differential equation:

$$\begin{aligned} \frac{dS}{S} &= \mu dt + \sigma dX \\ \text{or} \\ dS &= \mu S dt + \sigma S dX \end{aligned} \tag{1}$$

If the stock price ever hits zero, it will remain there. On average the stock price grows exponentially. Income does not grow at an exponential rate, and if income is zero at some point in time, it not likely to remain there.

Since the evolution of income does not follow (1), let $\{W(t), t \geq 0\}$ denote the student's income process. A reasonable model to describe the evolution of the student income $\{W(t), t \geq 0\}$ is

$$dW(t) = [\theta(t) - \alpha W(t)] dt + \sigma dX(t)^7 \quad (2)$$

where $\{X(t), t \geq 0\}$ is a standard Brownian motion, $\sigma > 0$ is a volatility parameter, $\theta(\cdot)$ is a non-anticipating, non-negative, mean square integrable random process, $\alpha > 0$ is a constant, and W and describes the rate of change of income growth at time t to be proportional to the amount by which the present income $W(t)$ is less than some ceiling given by **Error! Bookmark not defined.** $\frac{\theta(t)}{\alpha}$ plus some random noise. If $\theta(t)$ is constant and payoff function takes the form:

$$h(W) = \max L I_{\{W \geq E\}} \quad (3)$$

where

$$I_{\{W \geq E\}} = \begin{cases} 1 & \text{if } W \geq E \\ 0 & \text{if } W < E \end{cases}$$

L - future value of the loan.

This option pays nothing if the income at expiration is less than the exercise price and pays L , the future value of the loan, if income at expiration exceeds the exercise price. In a risk-neutral world, the probability of the income being above the exercise price is $N(-k_1)$ with $c=(0,1]$.⁸ The value of the cash-or-nothing call is:

$$V(W,t) = (L)e^{-r(T-t)} N(-k_1). \quad (4)$$

where

$$k_1 = \frac{\frac{E}{c} - We^{r(T-t)}}{\sqrt{\frac{\sigma^2(e^{2r(T-t)} - 1)}{2r}}}$$

$N(x)$ - cumulative standard normal distribution

L - future value of the loan.

T - date the option expires

t - date the option is written

r - risk-free interest rate.

⁸ Risk-neutral valuation requires that investors only agree on the assumptions of the volatility and the risk free rate; therefore he risk preferences of the investor irrelevant.

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The fair market price for the education call was found to be (4). The price of the option is calculated using:

$$V(W,t_0) = (L)e^{-r(T-t_0)} N(-k_1) \quad (5)$$

Equation (5) is the same as (4) except t is replaced by t_0 to denote that the option is written when the student enrolls in the institution. In the next sections, estimates for the input variables: $W(t_0)$ – initial income, T – time of Expiration, E – exercise price, and σ^2 – variance will be calculated.

Time to Expiration

The expiration time of the option, the age when the option is exercised, was found by regressing equation (6) by race for men and the full sample.

$$\ln wage = B_0 + B_1 \exp + B_2 \exp^2 + B_3 \ln yrhrs + B_4 marstat + u_1 \quad (6)$$

$\ln wage$ is the natural log of wages, $\exp = \text{age} - 23$ and is a proxy for experience, \exp^2 is the square of experience, $\ln yrhrs$ is the log of the hours usually worked in a week multiplied by weeks usually worked, and $marstat$ is a dummy variable taking value 1 if married. The Heckman two-step technique was used to correct for selectivity bias for women. The selection equation is:

$$z_1 child + z_2 marstat + u_{2j} > 0 \quad (7)$$

where $child$ is a dummy taking value 1 if any children and $u_2 \sim N(0,1)$. The regression equation is

$$\ln wage = B_0 + B_1 \exp + B_2 \exp^2 + B_3 \ln yrhrs + B_4 child + u_{1j} \quad (8)$$

where $u_{1j} \sim N(0,1)$, $u_{2j} \sim N(0,1)$, $corr(u_{1j}, u_{2j}) = \rho$. Regression results are reported in Table 2.

Since earning profiles are concave (See Becker (1975) and Mincer (1974)), maximum earnings are obtained where the slope of the earnings profile is zero. The time to expiration should be chosen as the slope of the earnings profile approaches zero as to maximize payments collected during the specified time of the option; therefore, the results from (6) and (8) were used to identify the time expiration by race and gender. Table 3 shows two alternative expiration dates. The first column gives the age when earnings peak and an additional expiration time, the age when wage peaks minus 6 years.

Exercise Price

The exercise price, E, is the price at which the option can be exercised at expiration. The exercise price is:

$$E = \frac{FV(\text{loan amount})}{N} \quad (7)$$

where

$$FV(\text{loan amount}) = (\text{loan amount})(1+r_E)^{(T-s)}$$

T – expiration date of the option (years of loan)

s – separation year from the university

r_E – the interest rate for calculating the future value of the loan

N – years of repayment

The future value is calculated based on the term of the option; therefore, this is the only time

period in which interest is accrued. Hence when the student begins repayment, the repayment amount is fixed. The values reported in Table 3 are based on loan amounts of \$20,000 and a maximum of twelve years for repayment.

Interest Rate

The interest rate, r , used to price the option pricing equation must be the risk-free interest rate for an investment with a term comparable to the life of the option. However, the interest rate, r_E , used to calculate the future value of the loan should at least cover financing costs incurred by the holder. The college/university has three ways of generating funds for the option. First, funds can be obtained through fundraising campaigns. Second, revenues from tuition can be used to finance the option. The cost of funds in these cases is the cost of administering the program. Finally, the college/university could sell securities, like bonds, to generate revenue to finance the option. If the institution does not want to calculate administrative cost of the program, using the interest rate for an alternative investment is appropriate. For this paper, the alternative to investing in students is investing in corporate bonds. Therefore, the interest rate used to calculate the future value of the loan is the rate of return on 30-year corporate bonds. The quality of corporate bonds can be varied to reflect belief about risk associated with the student.

Volatility of the Underlying Asset

The volatility of stock prices is usually found by analyzing historical data. Using the process outlined in Sharpe (1998) values for alpha and volatility were calculated (See Table 1). White females had the largest volatility in expected annual earnings, \$50,951. Native American males had the smallest volatility, \$6,444. If all input variables of the option are the same except volatility, the price of the option for the white female will be higher. (See Table 3) Since volatility is a measure of risk and the white female's earnings fluctuate more, there is more uncertainty about the value of her earnings at any time. However, relative to the white female, there is less uncertainty about the earnings of the Native American male. An option with his earnings as the underlying asset is less risky as indicated by a lower price. All input variables necessary to the price option have now been calculated. In the next section, prices for the education call will be derived.

Value of the Option

To illustrate how the cash-or-nothing call option is priced, consider the following example. Assume that a student from each of the racial groups analyzed is planning to enroll at All American University where tuition, room and board costs \$10,500 annually. Each is offered \$8,000 in scholarships and grants. Assuming a constant financial aid to tuition ratio and graduation in four years, the unmet financial need totals \$20,000 for all four academic years for each student. AAU wants to offer each the following call option to meet his/her educational expenses.

I (name) give All American University the right to \$(future value of loan amount at a given interest rate) worth of my future earnings to be for 12 years in equal installments if my annual earnings exceed (formula for

exercise price) exercisable at (years) after graduation or separation from the institution.

The prices of the options will be calculated using equation (4) and are reported in Table 3. The option is priced using the student's income at age 18 and c valued at .10. All students are assumed to be dependents of their parents; therefore, student earnings are assumed to be zero at $W(18)$. Option prices range from \$3,913 for Native American males to \$11,558 for white males. For the Women, prices range from \$5,981 for Native American females to \$11,428 for White women. If the market cannot be segmented by a race and gender, the prices for females ranged from \$11,400 to \$12,005; the prices for males ranged from \$11,614 to \$12,167; and prices for the full sample ranged from \$12,367 to \$12,870..

Assume AAU has a policy of not paying more than 50 percent of the student's unmet financial need for the option. Then AAU would not be willing to pay more than \$10,000 for the option. Given this, the option would only be purchased from Native American female and male and from black male students if the expiration is peak-wage less 6 years. Selecting the expiration time as the age when earnings peak consistently yields the highest price for the option. Interpretation of the returns to AAU should be done with caution for two reasons: moral hazard and adverse selection.

IV Implementation and Policy Effects

The Education Call Option has the potential to change the behavior of the university/college and the student. Possible solutions to the problems of moral hazard and adverse selection will be offered in this section. Implementing a financing plan offering the EdCO would require gathering data on the graduate's income. Some methods for collecting these data will be offered.

Students may choose to retire early, exit the work force temporarily, or take other actions that might cause the EdCO to expire worthless, giving rise to moral hazard. For example, if student's expiration date is age 55, he may try to maximize his wealth so that he can retire at age 54. Consequently, this minimizes the income compared with the exercise price at expiration and increases the probability that the EdCO expires worthless. Or the student may minimize income by exiting the work force temporarily just the before expiration of the EdCO. Again, this behavior increases the probability of having the EdCO expire worthless.

The exercise price for the EdCOs is generally below \$12,000. (See Table 3) Therefore, in order to have the EdCO expire worthless all other groups would have to have income below the 2007 poverty threshold for households greater than one.⁹ Because the EdCO expires at an age when most people still have mortgage payments or children in college, the ability to take advantage of the actions described is limited. Future research will explore using the student's net worth instead of income and the combined income for the student and spouse to address the work disincentives.

Possible solutions to the problem of moral hazard are to structure the option as an American or Bermudan option. Unlike the European call option, which can only be exercised on

⁹ <http://aspe.hhs.gov/poverty/08computations.shtml>

a specific date, the American option can be exercised at anytime between the date the option is written and the expiration date. The Bermudan option can be exercised at series of specified dates. AAU may choose to offer students a Bermudan option that has an initial exercise date of five years after separation from the University. The Bermudan option would allow the option to be exercised on a specific date every year there after until the option expires. Therefore, the student ability to plan for early retirement and temporary exits from the labor market is diminished.

It has also been suggested that using aggregate measures of human capital by designing securities tied to the income of race, educational-level and gender would greatly reduce the moral hazard created with the proposed structure of the Education Call Option. Such structures will be considered for future research. For example, Davis and Willen (2000) created artificial securities using the S&P 500 and job creation and destruction rates and Athanasoulis and Shiller (1995) using world and country incomes. In both papers, the securities are used to minimize variance in income due to labor market shocks. Since minimizing the variance in earnings essentially creates a low bound on earnings, it is a concept that most would embrace. However, it does nothing for the graduate who month after month is forced to choose between rent, utilities, food, childcare, medical care and transportation or student loan payment.

The university/college may be tempted to offer the EdCO to only students from categories, which, when the EdCO is exercised, the returns consistently outperform, the market. However, the EdCOs are investments and investment theory states a diversified portfolio yields the maximum return. If the category of students is broadly defined, engineering majors versus mechanical engineering majors, the portfolio is automatically diversified. It is unlikely that changes in the market will affect all engineering majors in the same manner. But if the categories are so narrowly defined that students are virtually identical, then the holder of the portfolio is exposed to the unique risk of those majors. If market demands for these majors decline, the return on the portfolio decreases. Even in periods of recession, some fields enjoy increased employment opportunities. Therefore, the owner of the portfolio could reduce the risk of the portfolio by diversification of majors. Given this, it is irrational for the university/college to invest in students of a particular category if the category is narrowly defined.

Assume the college/university has decided to purchase the EdCO only from students in category A. Category A's returns consistently outperform the market. If students can freely move between category A and category B, returns perform below the market, a student from category B may temporarily become a member of category A to reap the benefits of selling the EdCO. This self-selection process is call adverse selection. Because students may change their major at any time prior to graduation, there are two ways to minimize adverse selection. The holder of the option could restrict mobility between categories or offer the EdCO to all categories of students. Restricting students to category A could lead to students "flunking out" and never receiving a college degree. As evident from earnings profiles, those without a college degree earn less. Therefore, the probability of the EdCO expiring worthless is increased. Offering the EdCO to all categories of students is a better solution than restricting mobility between categories because the owner of the portfolio is more informed about the risk of the portfolio. The college/university may choose to distinguish between students of different

categories using pricing mechanisms. For example, the interest rate used to price the option would be lower for category A than for category B.

Implementation

A crucial step in implementing the Education call option is to create a market for trading. An obvious starting place is in the over-the-counter market, which has been the birthplace of weather derivatives. Weather derivatives are similar to the Education call in that the underlying asset cannot be purchased and held in a portfolio. Weather derivatives were traded on the Chicago Mercantile Exchange. It is conceivable that the Education call option could follow the same evolution process as weather derivatives. In addition, it is conceivable that www.myrichuncle.com has already created a market for trading the EdCo.

Tobin suggested in his plan for a national deferment plan, the state or federal government would be excellent candidates to offer such an option or guarantee the option if offered by third party. The holder of the option needs to receive accurate information on a student's annual income. Therefore, a student must allow the IRS to report annual earnings to the holder of the option. The ICLR plan that is offered with a Federal student loan has the same requirement. Tobin also suggested using an interest rate that was two percentage points above the current rate to account for inflation and productivity gains.

However, before the option is purchased, information on graduates from specific institutions should be gathered. The selectivity of a school influences the companies that recruit at that institution and thereby affects the first jobs where graduates are likely to be employed. Career Planning and Placement offices can assist in gathering information about employment rates through surveys that inquire about employment strategies and success rates. The Alumni office could periodically survey graduates about accomplishments, family life, or other issues that would provide information about life styles and wage levels.

Policy Implication

This option offers a win-win situation to both students and colleges/universities. The institution could use the option to finance the education of under-represented minorities, the economically disadvantaged and other groups that do not have a history of receiving a college education. By providing an opportunity for education to these groups, the institution is closer to full filling its social obligation to society and increasing the spill over effects of more educated communities.

The college/university must construct a portfolio of students that has risk comparable to a portfolio constructed using stock, bonds, and other derivative securities available. In doing so, the college may not be able to use a 'need blind' admissions policy. As Edlin suggested, this does not have to have an adverse effect on diversity or qualities of the student body. In fact, the need to construct a diversified portfolio could provide some college/universities with types of students desired. Because the risk-free interest rate used to price the option is less than the interest rate on school loans, it has been suggested that the option would be attractive to *all* students regardless of attitude about risk. Such a conclusion ignores that the future value of the

loan is calculated using the interest rate of an alternative investment, which unlike the standard school loan does not have an upper bound.¹¹

An important issue to be addressed regarding the option is the legality of awarding aid based on sex and race. The ruling of the state supreme courts in Maryland and Texas has said it is unconstitutional to award scholarships based on race. However, the United States Supreme Court has not ruled on the legality of such programs. Financial aid offices have suggested that private funds earmarked solely for financial support of specific groups is acceptable, but that using public funds could encounter problems in the future given the nation's climate on affirmative action. It is unclear if the options will violate fair credit laws. It is believed that an option of this type has not been offered in the past because the private market for financial aid has been slow to offer innovative products.

V Summary

The skyrocketing cost of a college education has lawmakers, parents and students concerned about the student loan repayment burden graduates face at graduation. The introduction of new tax credits for education, educational savings plans, and increases in federal financial aid are attempts to keep higher education affordable. These plans do not hedge students against the uncertainty of the returns to education. While income contingent repayment plans reduce a student's monthly obligation, the possible tax liability face if the loan is not repaid may cause problem with the IRS.

The education call option proposed in this paper is an alternative to current higher education financing methods. The primary benefit and differs from the other higher education loan financing options discussed in this way: if the asset price, income, is not greater than the exercise price at expiration, then all obligations to the holder are voided. Selection of the expiration date is critical to ensure the maximum returns to the holder of the option and minimizing the probability of worthless contract. The premium received for the option can be used to offset other educational expenses such as books, computers, and transportation costs. But there are no benefits to applying that premium to the balance owed the institution

Interpretation of the returns to a holder of the option should be done with caution due to the potential presence of moral hazard and adverse selection. Moral hazard arises if the student changes his/her behavior to increase the probability of the option expiring worthless. Structuring the option as an American or Bermudan may solve this problem. The buyer of the option could minimize adverse selection by restricting mobility between categories of students or by offering the option to all categories of students. Restricting mobility between categories has the potential to increase the probability of the option expiring worthless and is not a practical solution. The incentive to self-select could be reduced by offering the option to all groups of students and then using interest rates to reflect the risk of each category. The benefits of a diversified portfolio should discourage the university/college from investing in narrowly defined categories of students.

¹¹ The maximum rate currently charged on standard school loans is 8.25 percent.

^Ω For exact values of the education call option see Table 9. The maximum repayment time for the standard school loan in 10 years and 25 years for the income contingent loan repayment plan.

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VI Future Research

Future research possibilities include: developing a pricing formulas for European options with income as the underlying asset that have other payoff structures and path dependent and American-type options with income as the underlying asset. American option pricing methods will allow the pricing of more exotic options such as a Bermudan option. In addition, using the option to finance advanced degrees, and running simulations to gather information about expected returns on the options, deriving better methods to estimate the volatility of income and better models for $\theta(t)$ (instead of $\theta(t)$ constant) are also possibilities.

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Table 1. Summary Statistics

Variable	White		Black		Asian		Native American		All-Women		Full Sample	
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
Age	39	11	38	10	38	9	39	9	39	10	39	10
	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$
Wage	17,890	17,603	21,159	14,738	18,527	17,346	17,697	17,107	19,048	16,778	25,692	24,819
Lnwage	9.68	1.06	9.86	0.82	9.81	0.92	9.62	1.02	9.77	0.95	10.01	0.94
Experience	16.16	10.52	14.91	9.73	15.41	9.32	15.82	9.31	15.55	9.92	16.15	10.14
Experience ²	371.76	432.72	316.96	386.49	324.30	359.44	336.69	366.25	340.21	397.08	363.67	411.76
Year Hours	7.23	0.84	7.40	0.60	7.35	0.71	7.25	0.80	7.32	0.74	7.45	0.66
Cohort	593.68	216.30	511.03	198.34	530.12	176.02	23.50	8.77	1647.52	595.76	3056.48	1059.90
Children	0.86	0.35	0.88	0.32	0.85	0.36	0.90	0.31	0.86	0.35	0.86	0.35
Marital Status Expiration Date	0.69	0.46	0.48	0.50	0.74	0.44	0.57	0.50	0.64	0.48	0.66	0.47
	47	0	50	0	43	0	48	0	47	3	53	4
	\$		\$		\$		\$		\$		\$	
Wage Ceiling	18,894	0	24,480	0	18,974	0	19,329	0	20,575	0	29,874	0
Alpha	0.0129	0	0.0261	0	0.0152	0	0.0163	0	0.0187	0	0.0195	0
	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$
Volatility	52,951	29,306	35,412	16,762	50,632	16,992	9,084	4,284	103,963	54,358	161,472	73,130

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Table 1. Summary Statistics cont.

	Men									
	White		Black		Asian		Native American		All-Men	
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
Age	40.61	10.77	38.52	9.60	39.51	10.16	40.28	9.52	39.79	10.34
	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$
Wage	37,892	34,133	27,393	20,873	29,532	26,982	26,692	20,575	32,797	29,596
Lnwage	10.38	0.85	10.09	0.82	10.17	0.86	10.07	0.90	10.25	0.86
Experience	17.61	10.77	15.52	9.60	16.51	10.16	17.28	9.52	16.79	10.34
Experience ²	425.95	455.61	333.08	381.62	375.82	406.42	388.97	383.12	388.75	425.46
LnYear Hours	7.62	0.50	7.53	0.55	7.54	0.57	7.49	0.63	7.57	0.54
Cohort	619.93	195.74	373.17	135.05	417.41	133.95	22.53	7.68	1419.66	468.56
Marital Status	0.71	0.45	0.59	0.49	0.71	0.45	0.64	0.48	0.68	0.47
Expiration										
Date	54	0	51	0	47	0	50	0	52	0
	\$		\$		\$		\$		\$	
Wage Ceiling	56,848	0	36,466	0	39,224	0	36,758	0	47,523	0
Alpha	0.0199	0	0.0256	0	0.0215	0	0.0204	0	0.0211	0
	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$
Volatility	38,937	30,527	23,863	14,805	34,686	22,713	6,444	5,115	68,168	49,796

Table 2. Regression Results

	Native American					
	White Men	Black Men	Asian Men	Men	Men	Sample
Lnwage						
Experience	0.039*** (0.002)	0.035*** (0.002)	0.036*** (0.002)	0.038*** (0.011)	0.035*** (0.001)	0.028*** (0.001)
Experience ²	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001* (0.000)	-0.001*** (0.000)	-0.000*** (0.000)
Year Hours	0.941*** (0.011)	0.899*** (0.012)	0.936*** (0.011)	0.738*** (0.044)	0.936*** (0.006)	1.028*** (0.004)
Marital Status	0.201*** (0.011)	0.138*** (0.013)	0.116*** (0.015)	0.211*** (0.060)	0.169*** (0.008)	0.090*** (0.005)
Constant	2.647*** (0.079)	2.903*** (0.088)	2.714*** (0.084)	4.046*** (0.340)	2.685*** (0.048)	2.006*** (0.027)
Observations	19373	10221	11908	623	42125	83678
r ²	0.361	0.409	0.413	0.357	0.391	0.509

	Native American				
	White Women	Black Women	Asian Women	Women	Women
Lnwage					
Experience	0.021*** (0.002)	0.036*** (0.002)	0.023*** (0.002)	0.037** (0.011)	0.026*** (0.001)
Experience ²	-0.000*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001* (0.000)	-0.001*** (0.000)
Year Hours	1.057*** (0.007)	0.959*** (0.009)	0.980*** (0.008)	0.978*** (0.038)	1.012*** (0.004)
Children	-0.120*** (0.017)	-0.038* (0.018)	-0.052** (0.020)	-0.087 (0.107)	-0.064*** (0.010)
Constant	2.034*** (0.058)	2.360*** (0.089)	2.516*** (0.069)	2.164*** (0.360)	2.230*** (0.037)
Selection Equation					
Children	0.054 (0.029)	-0.099* (0.044)	0.220*** (0.029)	0.096 (0.177)	0.098*** (0.018)
Marital Status	-0.575*** (0.025)	-0.120*** (0.028)	-0.500*** (0.028)	-0.281* (0.116)	-0.487*** (0.015)
Constant	1.172*** (0.035)	1.386*** (0.046)	0.948*** (0.038)	1.008*** (0.191)	1.142*** (0.021)
Lambda	-0.239*** (0.053)	0.493 (0.313)	-0.136* (0.066)	0.278 (0.550)	-0.133*** (0.036)
Observations	19285	15004	16152	703	51144
chi ²	25920	12766	15781	710	56323

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Table 3. Loan Values, Exercise Price and Option Prices

	All-Women		All-Men		Full Sample	
	Peak Wage	Peak Wage -6	Peak Wage	Peak Wage -6	Peak Wage	Peak Wage -6
Exercise Price	\$7,553.50	\$5,503.13	\$10,028.39	\$7,306.23	\$10,571.93	\$7,702.22
FV of Loan	\$90,641.97	\$66,037.60	\$120,340.66	\$87,674.71	\$126,863.13	\$92,426.68
Option Price	\$12,004.61	\$11,440.46	\$12,167.40	\$11,614.48	\$12,870.00	\$12,267.00
	Asian Women		Asian Men			
Exercise Price	\$6,236.26	\$4,543.45	\$7,702.22	\$5,611.49		
FV of Loan	\$74,835.09	\$54,521.43	\$92,426.68	\$67,337.85		
Option Price	\$11,023.14	\$10,500.38	\$11,370.56	\$10,849.65		
	Black Women		Black Men			
Exercise Price	\$9,023.71	\$6,574.26	\$9,512.80	\$6,930.59		
FV of Loan	\$108,284.52	\$78,891.15	\$114,153.54	\$83,167.05		
Option Price	\$11,054.10	\$10,573.12	\$10,203.49	\$9,791.57		
	Native American Women		Native American Men			
Exercise Price	\$8,119.68	\$5,915.63	\$9,023.71	\$6,574.26		
FV of Loan	\$97,436.20	\$70,987.57	\$108,284.52	\$78,891.15		
Option Price	\$5,981.05	\$5,814.23	\$3,913.01	\$3,887.02		
	White Women		White Men			
Exercise Price	\$7,702.22	\$5,611.49	\$11,144.93	\$8,119.68		
FV of Loan	\$92,426.68	\$67,337.85	\$133,739.11	\$97,436.20		
Option Price	\$11,427.53	\$10,902.85	\$11,558.22	\$11,063.35		

The interest rate used to price the option is the 30-Year U.S. Treasury Bond. <http://research.stlouisfed.org/fred2/data/DGS30.txt>.

The interest rate used to calculate the future value of the loan is the 30-Year DAAA Moody's Seasoned Aaa Corporate Bond Yield. <http://research.stlouisfed.org/fred2/data/DAAA.txt>

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