

Why Have Girls Gone to College? A Quantitative Examination of the Female College Enrollment Rate in the United States: 1955-1980^{*}

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Abstract

This paper documents a dramatic increase in the college enrollment rate of women from 1955 to 1980 and asks a quantitative question: to what extent can such change be accounted for by the change in the female cohort-specific college wage premium? I develop and calibrate an overlapping generations model with discrete schooling choice. I find that changes in the life-cycle earnings differential can explain the increase in female college enrollment rate very well. Young women's changing expectations of future employment opportunity also played an important role in driving their college attendance decision from the mid 1950s to the early 1970s.

Key Words: female college enrollment rate, college wage premium, life-cycle

JEL Classification: J24, J31, I21, E24

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1 Introduction

In 2001, 56.3% of college students were women; men accounted for only 43.7% of higher education enrollments (National Center for Educational Statistics, *Digest of Education Statistics* 2003, Table 174). Five decades ago, the pattern was exactly the opposite. In 1955, this figure was around 65.3% for men and 34.7% for women. The major reason behind this dramatic reversal of the gender gap in college enrollment is the increasing college enrollment rate of women over the past five decades. As shown in Figure 1, the female college enrollment rate of recent high school graduates (individuals age 16 to 24 who graduated from high school or completed a GED during the preceding 12 months) was only 34.6% in 1955 (male counterpart was

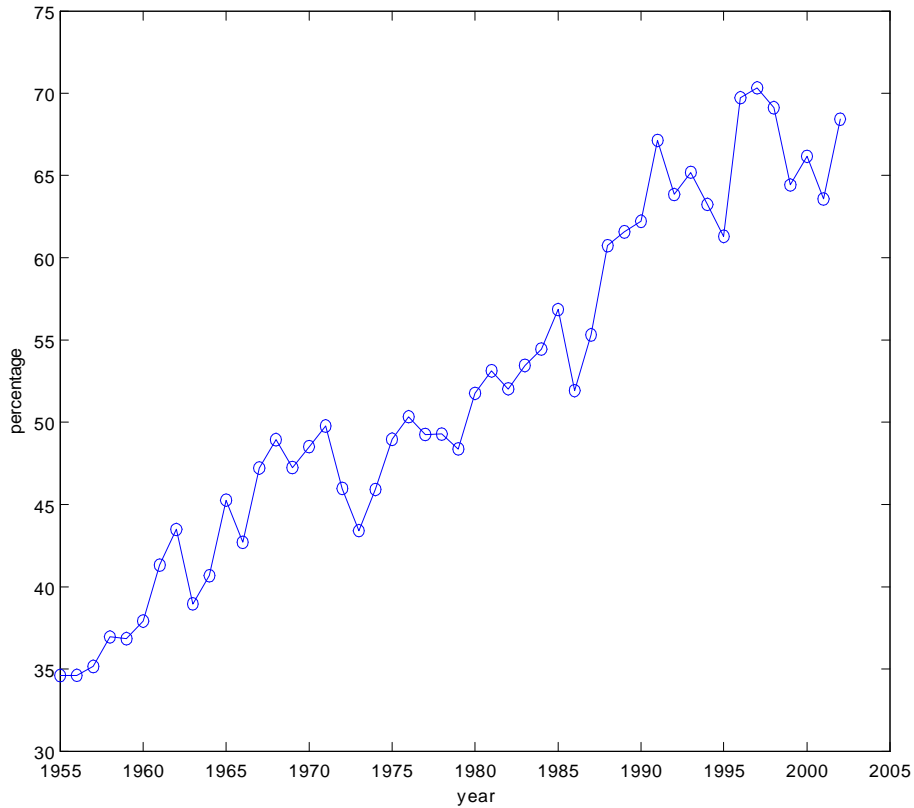


Figure 1: Female college enrollment rate of recent high school completers

59.1%, 24.5% higher than females!) However, the female college enrollment rate has been increasing since then. In 1980, this rate increased to 51.8%, and it was 5.1% higher than the rate for males. In 2002, 68.4% of female high school graduates went to college, while only 62.1% of male high school graduates did so.¹

¹College enrollment rates for the 1960-2002 period are taken from the National Center for Educational Statistics, *Digest of Education Statistics* 2003, Table 186. The data for 1955-1959 were calculated by the author. See He (2009) Appendix A for the data construction.

Why have girls gone to college more than boys? What is the driving force behind the rising female college enrollment rate? Several empirical studies have documented the stylized facts mentioned above and attempted to give an answer. Among them, Averett and Burton (1996) try to link the gender differences in college attendance to the gender differences in the college wage premium. They use a human capital model to examine gender differences in the college attendance decision, positing that this decision is a function of family background characteristics and the expected future earnings differential between college and high school graduates. Using the NLSY79 data set, they study how one cohort (those ages 14 to 21 in 1979) has responded to the jump in the college wage premium after 1980. For men, they find that the effect of the college wage premium is positive and statistically significant, while for women, it is much smaller and statistically insignificant. Therefore, they conclude that, for women, the college wage premium is not nearly as important to the decision to attend college as it is for men. But they focus only on one cohort, and the future earnings cover a short time horizon. More specifically, they include only people who were interviewed subsequently in 1981 and 1991, which means the oldest age in the data set is 33; so at best, people can predict their future wage only up to age 33. Therefore, as they claim in the paper, “...we cannot interpret our results as reflecting the impact of life-cycle earnings on education choice.”

Jacob (2002) uses the National Educational Longitudinal Study (NELS) 1988 data set to study why women have higher college attendance rates than men. He focuses on two explanations: the college wage premium which is proxied by the earnings differential of 25- to 34-year-old full-time workers; and non-cognitive skills, which are measured by middle school grades and the number of hours spent on homework per week in eighth grade, a composite measure of disciplinary incidents, and an indicator of whether the child had ever been left back during elementary school. Using the Oaxaca decomposition method, Jacob shows that higher returns to college education and the greater non-cognitive skills among women account for nearly 90 percent of the gap. But due to the limitation of data availability, his research still focuses on cross-sectional patterns, hence cannot examine the time trend of the college enrollment rate.

Anderson (2002), however, tries to answer the same question by looking at different cohorts over time. Using the CPS data set, she constructs five cohorts who were born during 1953-1957, 1958-1962, 1963-1967, 1968-1972, and 1973-1977. She looks at male-female differences both within and across cohorts for 20 year olds. She also employs the standard Oaxaca method to decompose within and across cohort enrollment. She finds an important component of the increase in female enrollment is the behavior of older women, who enrolled less frequently than males when young,

but who later make up for this lack of higher education. Other important factors are that males have higher dropout rates in high school and are more likely to be in prison or the military and social changes in the form of women delaying marriage for careers.

Charles and Luoh (2003) argue that the reason why the standard approach with its focus on the college wage premium cannot explain very well the pattern of male and female schooling outcomes is that it misses an important aspect of the educational decision, namely the uncertainty of two investment options. Inheriting the idea from Altonji (1993), they claim that risk-averse students also care about the riskiness of these different options when choosing between them. In other words, in an extended human capital investment model, not only the expected earnings differential but also the anticipated *dispersion* of future earnings determine people's educational investment decisions. Using the CPS data, Charles and Luoh show that, over time, these anticipated future dispersions have evolved very differently for men and women. For women, the dispersion of future college earnings decreased over the past three decades; it is the opposite for men. Therefore, this trend would encourage women to go to college.

Differing from all the works mentioned above, this paper develops and calibrates an overlapping generations model with endogenous discrete schooling choice to ex-

plain what drives the female college enrollment rate for the 1955-1980 period. It is well known that the Korean and Vietnam wars (through the GI Bill and the military draft) had a significant impact on male college attendance during this period (Bound and Turner 2002; Card and Lemieux 2001). That is the reason why this paper focuses only on female college-entry decisions. Specifically, this paper asks a question: *to what extent can the changes in the female college enrollment rate be explained by the changes in the female cohort-specific life-cycle college wage premium?* In this sense, my work is quite close to the original idea proposed in Averett and Burton (1996), but deeper in two aspects. First, my model is a full-blown life-cycle model: women enter into the model at age 18 and face the choice go to college or not. After completing their education, they work until age 65. Within this framework, we can analyze the effect of *life-cycle* earnings on educational choice. Second, Averett and Burton (1996) analyze the impact of the college wage premium on college-entry decision for only one cohort, while this paper examines the time trend of the college enrollment rate. Different from Charles and Luoh (2003), this paper sticks to the standard human capital investment approach. Instead of focusing on the effect of a second-order (e.g., dispersion) dimension of future earnings on education choice, this paper examines the effect from the first-order dimension of future earnings on college enrollment behavior within a standard life-cycle framework.

The remainder of the paper is organized as follows. Section 2 presents a simple model of the college attendance decision and lays out the theoretical foundation for the later data analysis and calibration exercise. Section 3 describes the data and analyzes some findings from the data. Section 4 presents the quantitative results of the model. Section 5 concludes.

2 Model

In this section, I present the economic model that will be used later for calibration. The framework is similar to the one used in He (2009). It is a discrete time overlapping generations (OLG) model. Individuals make the schooling choice in the first period. There is only one good in the economy, which can be used either for consumption or for investment. There is no uncertainty in the model. Individuals have perfect foresight.

2.1 Demographics

The economy is populated by overlapping generations of finite-lived women with total measure one. Women enter into the economy (or are “born”) with zero initial assets when they are age 18, which is the common age of high school graduates. I call them the birth cohort and model age as $j = 1$. They then live and work up to

age J . To distinguish between the age of a cohort and calendar time, I use j for age, and t for calendar time.

2.2 Preferences

Each individual female born at time t wants to maximize her discounted life-time utility

$$\sum_{j=1}^J \beta^{j-1} u(c_{j,t+j-1}).$$

The period utility function is assumed to take the CRRA form

$$u(c_{j,t+j-1}) = \frac{(c_{j,t+j-1})^{1-\sigma}}{1-\sigma}, \quad (1)$$

where $c_{j,t+j-1}$ is consumption for the age- j woman at time $t + j - 1$. σ is the coefficient of relative risk aversion. $\frac{1}{\sigma}$ is the intertemporal elasticity of substitution.

Since leisure does not enter into the utility function, each women will supply all of her labor endowment, which is normalized to be one.

2.3 Budget Constraints

A woman chooses go to college or not at the beginning of the first period. I use $s \in \{c, h\}$ to indicate this choice. If an individual chooses $s = h$, she ends up with a

high school diploma and goes on the job market to work as an unskilled laborer and earns high school graduate wage sequence $\{w_j^h\}_{j=1}^J$. Or she can choose $s = c$, spend the first four years in college as a full-time student, and pay the tuition. I assume that she can always successfully graduate from college (there is no some college or college dropout in the model). After that, she goes on the labor market to find a job as a skilled worker and earns college graduate wage sequence $\{w_j^c\}_{j=1}^J$. I assume there is no unemployment.

For $s = c$, the budget constraints of an individual born at time t are

$$c_{j,t+j-1} + tuition_{t+j-1} + a_{j,t+j-1} \leq (1 + r_{t+j-1})a_{j-1,t+j-2} \quad \forall j = 1, 2, 3, 4 \quad (2)$$

$$c_{j,t+j-1} + a_{j,t+j-1} \leq (1 + r_{t+j-1})a_{j-1,t+j-2} + w_{j,t+j-1}^c \quad \forall j = 5, \dots, J$$

$$c_{j,t+j-1} \geq 0, a_{0,t-1} = 0, a_{J,t+J-1} \geq 0.$$

In the first four periods, she pays tuition $tuition_{t+j-1}$, consumes $c_{j,t+j-1}$, and saves $a_{j,t+j-1}$. After graduation, she earns wage $w_{j,t+j-1}^c$ at age j and consumes and saves subject to what she earns and accumulates. Notice that there is no borrowing constraint in this economy. Since they do not have any initial assets, college students need to borrow money for consumption and pay tuition during the first four periods, and they pay back the loans later.

For $s = h$, the budget constraints of an individual born at time t are

$$\begin{aligned}
c_{j,t+j-1} + a_{j,t+j-1} &\leq (1 + r_{t+j-1})a_{j-1,t+j-2} + w_{j,t+j-1}^h \quad \forall j = 1, \dots, J & (3) \\
c_{j,t+j-1} &\geq 0, a_{0,t-1} = 0, a_{J,t+J-1} \geq 0.
\end{aligned}$$

2.4 Schooling Choice

I assume that different individuals within the birth cohort are endowed with different levels of ability. And ability affects only individuals' disutility cost of schooling. I assume that the disutility cost of schooling is a strictly decreasing function of ability. Higher ability implies lower disutility cost.

Individuals are indexed by their ability level $i \in [0, 1]$. The CDF of ability distribution is denoted by F , $F(i_0) = \Pr(i \leq i_0)$. $DIS(i)$ represents the ability-related disutility cost for individual i . Notice that $DIS(i) \geq 0$ and $DIS'(i) < 0$. An individual i born at time t thus has the discounted life-time utility

$$\sum_{j=1}^J \beta^{j-1} u(c_{j,t+j-1}) - \mathcal{I}_i DIS(i), \tag{4}$$

where

$$\mathcal{I}_i = \begin{cases} 1 & \text{if } s_i = c \\ 0 & \text{if } s_i = h \end{cases}.$$

She maximizes her life-time utility subject to the budget constraints (2) or (3) conditional on her educational choice. If an individual chooses to go to college, she has to bear the idiosyncratic disutility cost. Notice that the disutility cost $DIS(i)$ does not enter into the budget constraint; therefore, everyone with same educational achievement from the same birth cohort has the same life-time utility derived from physical consumption. I use $UTIL^c$ to denote the discounted life-time utility for college graduates; $UTIL^h$ denotes the discounted life-time utility derived from physical consumption for high school graduates. $UTIL^c - UTIL^h$ represents the utility gain from attending college. Obviously, individual i will choose to go to college if $DIS(i) < [UTIL^c - UTIL^h]$, not to go if $DIS(i) > [UTIL^c - UTIL^h]$, and is indifferent if $DIS(i) = [UTIL^c - UTIL^h]$.

Notice that since the borrowing constraint does not exist, the model implies

$$UTIL_t^c - UTIL_t^h \begin{matrix} \geq \\ \leq \end{matrix} 0 \text{ iff } NPV_t \begin{matrix} \geq \\ \leq \end{matrix} 0,$$

where

$$NPV_t = \sum_{j=1}^J \frac{w_{j,t+j-1}^c - w_{j,t+j-1}^h}{\prod_{i=2}^j (1 + r_{t+i-1})} - \sum_{j=1}^4 \frac{tuition_{t+j-1}}{\prod_{i=2}^j (1 + r_{t+i-1})}.$$

Here NPV stands for the net present value of higher education. Since $w_{j,t+j-1}^c = 0, \forall j = 1, \dots, 4$, students never work when they stay in college, and I can further

decompose NPV into three components

$$NPV_t = \sum_{j=5}^J \frac{w_{j,t+j-1}^c - w_{j,t+j-1}^h}{\prod_{i=2}^j (1 + r_{t+i-1})} - \sum_{j=1}^4 \frac{w_{j,t+j-1}^h}{\prod_{i=2}^j (1 + r_{t+i-1})} - \sum_{j=1}^4 \frac{tuition_{t+j-1}}{\prod_{i=2}^j (1 + r_{t+i-1})}. \quad (5)$$

The first term represents the benefits of schooling: college graduates can earn more through the earnings differential. The second term represents the opportunity cost of schooling: it is the present value of four years of forgone wages for college students. The third term is the present value of tuition paid during the college years, which represents the direct cost of schooling. From this representation it is very clear how the cohort-specific life-time college wage premium $\left\{ \frac{w_{j,t+j-1}^c}{w_{j,t+j-1}^h} \right\}_{j=1}^J$ is going to affect people's schooling decision. Other things being equal, an increase in the life-time college wage premium raises the benefits of schooling, hence NPV . Higher NPV induces a higher utility gain from schooling $UTIL_t^c - UTIL_t^h$. Given the stationary distribution of the disutility cost, a higher utility gain from schooling means more likely $DIS(i) < [UTIL^c - UTIL^h]$, which implies a higher enrollment rate.

The basic intuition of this model can also be seen from Figure 2. In this figure, the x-axis measures ability i . Women are ranked from zero to one by their ability. The disutility cost $DIS(i)$ is a decreasing function of the ability index i . VD represents utility gain from attending college $UTIL^c - UTIL^h$. The cut-off ability (or

indifference level) i^* is determined by

$$DIS(i^*) = [UTIL^c - UTIL^h].$$

Therefore, women with ability $i < i^*$ will choose not to go to college, while women with $i > i^*$ will choose to go. The enrollment rate thus is equal to the probability when $i > i^*$. If the college wage premium increases over the life-cycle, so does the *NPV*; therefore, the utility gain VD increases to VD' , and this will decrease the cut-off point to i^* . Since $\Pr(i > i^*) > \Pr(i > i^*)$, more women go to college. A higher life-cycle earnings differential thus encourages college attendance.

2.5 Dynamic Programming Representation

For purpose of computation, it is easier to write an individual's schooling decision problem in terms of dynamic programming language. Let $V_{t+j-1}^c(a_{j-1,t+j-2}, j)$ denote the value function of an age- j woman with asset holding $a_{j-1,t+j-2}$ at beginning of time $t + j - 1$ who chooses to go to college at age $j = 1$. It is the solution to the dynamic problem

$$V_{t+j-1}^c(a_{j-1,t+j-2}, j) = \max_{\{c_{j,t+j-1}, a_{j,t+j-1}\}} \{u(c_{j,t+j-1}) + \beta V_{t+j}^c(a_{j,t+j-1}, j + 1)\} \quad (6)$$

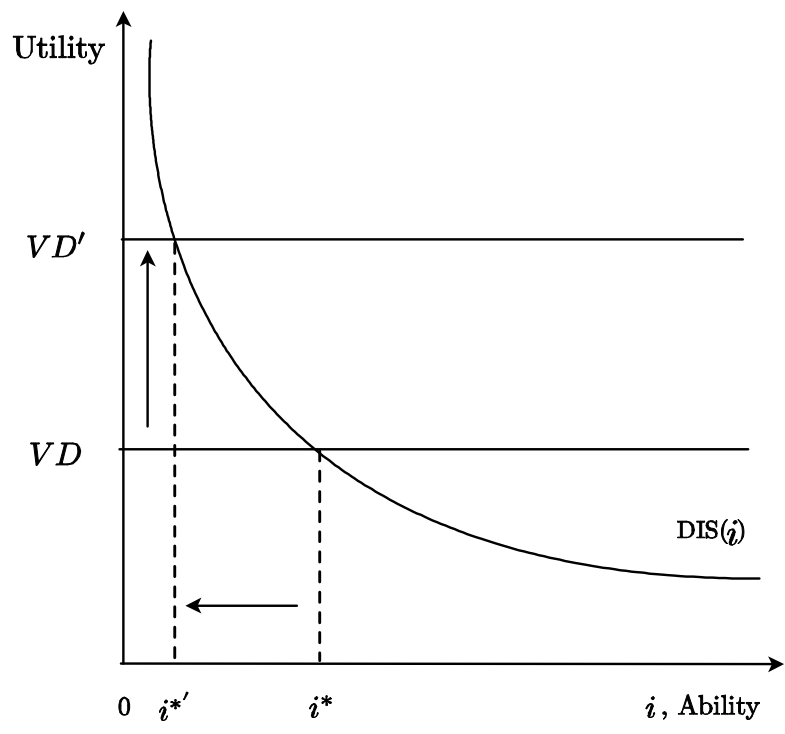


Figure 2: The determination of college enrollment rate

subject to the budget constraint (2).

For a woman who chooses not to attend college, the corresponding value function is given by

$$V_{t+j-1}^h(a_{j-1,t+j-2}, j) = \max_{\{c_{j,t+j-1}, a_{j,t+j-1}\}} \{u(c_{j,t+j-1}) + \beta V_{t+j}^h(a_{j,t+j-1}, j+1)\} \quad (7)$$

subject to budget constraint (3).

Individuals solve their perfect foresight dynamic problem by using backward induction. Back to age 1 at time t , a woman with ability index i will make her schooling decision $s_{i,t}$ based on the criteria below

$$\begin{aligned} s_{i,t} &= c && \text{if } V_t^c(a_{0,t-1} = 0, 1) - DIS(i) > V_t^h(a_{0,t-1} = 0, 1), \\ s_{i,t} &= h && \text{if } V_t^c(a_{0,t-1} = 0, 1) - DIS(i) < V_t^h(a_{0,t-1} = 0, 1), \\ s_{i,t} &= \text{indifferent} && \text{if } V_t^c(a_{0,t-1} = 0, 1) - DIS(i) = V_t^h(a_{0,t-1} = 0, 1). \end{aligned} \quad (8)$$

3 Data

I use the March Current Population Survey (CPS) from 1962 to 2003 to construct the data counterparts in the model. I choose the sample restrictions to follow those used in Eckstein and Nagypál (2004) except I further restrict the data to include only

high school graduates (HSG hereafter) between age 18 and 65 and college graduates (CG) between age 22 to 65 in the sample. As in their paper, I restrict my attention to full-time full-year (FTFY) workers. The wage here is the annualized wage and salary earnings. I use the personal consumption expenditure deflator from NIPA to convert all wages in terms of constant 2002 dollars.

3.1 Cohort-Specific Wage Premium

In the model, women in different cohorts make the educational decision based on the expected earnings differential specific to their cohort. The perfect foresight assumption allows me to use *actual* observed future earnings in the CPS as the measure of expected future earnings. Since the CPS is a repeated cross-sectional data set, I use a so-called “pesudo-cohort construction method” to construct the cohort-specific expected wage profiles.² For example, the 1962 cohort’s (18-year-old HSG in 1962) life-time (18-65 years old) female HSG wage profile $\{w_{j,1961+j}^h\}_{j=1}^{48}$ is constructed as follows: I take 18-year-old female HSGs in 1962, calculate their mean wage, then 19-year-old female HSGs in 1963, calculate the mean wage, then 20-year-old female HSGs in 1964, 21-year-old female HSGs in 1965, and so on, until I reach 58-year-old

²It is a pseudo-cohort because the CPS is not a panel data set. It does not track people over life-times. Heckman, Lochner, and Todd (2003) use a similar method to estimate the cohort-based return to schooling.

female HSGs in 2002, which is the end year of my CPS data set.

I use a similar approach to construct the 1962 cohort's female CG wage profile $\{w_{j,1961+j}^c\}_{j=1}^{48}$. But I start from 1966 because if someone from the 1962 cohort chooses to go to college, she needs to spend four years in college. She graduates in 1966 and starts to earn CG wages from that year. Therefore, I take 22-year-old female CGs in 1966, calculate their mean wage, then calculate the mean wage for 23-year-old female CGs in 1967, and so on.

Figure 3 shows the life-cycle wage profiles for six cohorts. They are the 1955, 1960, 1965, 1970, 1975 and 1980 cohorts. For each cohort, the wage profile of CGs is significantly higher than that of HSGs. Two facts about the life-cycle wage profiles need to be mentioned here: (1) Earnings rise with age, but at a decreasing rate; (2) Earnings increase faster for more educated workers, which implies CGs have a steeper hump-shaped (or increasing but concave) wage profile than that of HSGs. Notice that for the 1955 and 1960 cohorts, the late-age earnings for CGs become quite noisy. This is due to the smaller sample size for CGs at the later age.

The college wage premium over the life-cycle $\left\{\frac{w_{j,t+j-1}^c}{w_{j,t+j-1}^h}\right\}_{j=1}^{48}$ exhibits some interesting patterns for these cohorts. Due to data availability, I calculate the wage premium only from age 22 to age 40. The average college wage premium from age 22 to age 40 for the 1955 cohort was 1.45. For the 1960 cohort, it was 1.48. It then decreased

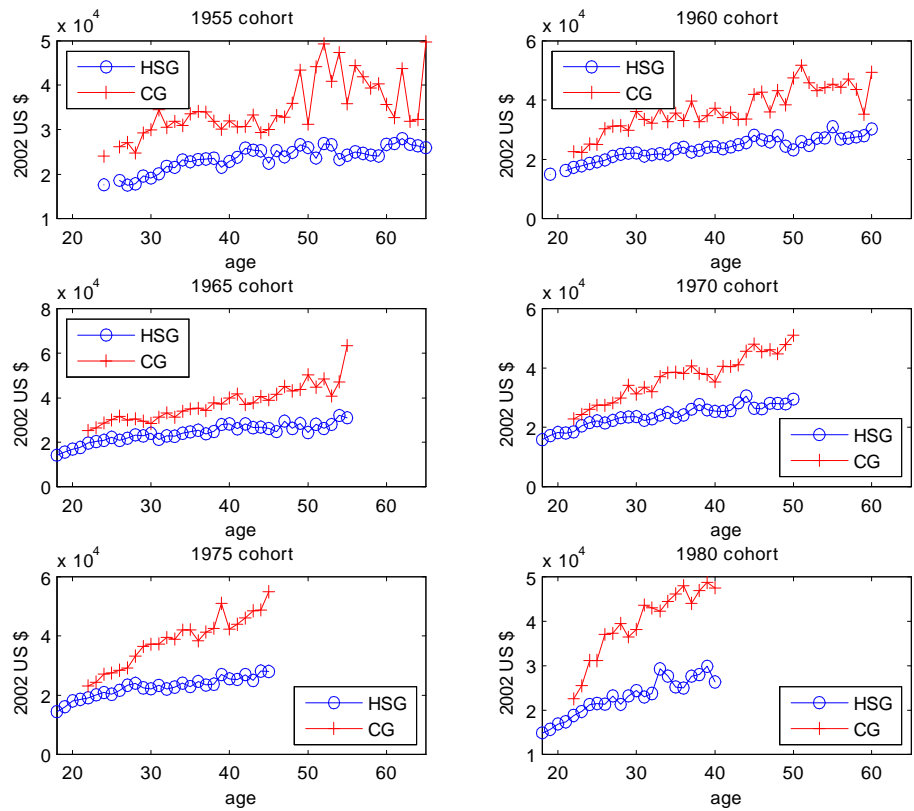


Figure 3: Life-cycle wage profiles for six cohorts

significantly to 1.38 for the 1965 cohort and 1.39 for the 1970 cohort. For these two cohorts, the compressed college wage premium in the 1970s significantly reduced their earnings differential at their prime age when the CG wage profile is in a stage of steep ascent. In contrast, the rising college wage premium starting from 1980 helped to increase the average college wage premium from age 22 to age 40 for the 1975 and 1980 cohorts to 1.56 and 1.63, respectively.

3.2 Missing Data

Following the pseudo-cohort construction method, I am able to construct life-cycle wage profiles for HSGs and CGs from the 1955 to the 1980 cohort. However, due to the time range of the CPS data, I do not have a complete life-cycle wage profile for any cohort. For example, some cohorts miss the later age data points (cohorts after 1961), and some miss the early age data points (cohorts between 1955 and 1960). I use the econometric method to predict the mean wage at that specific age to extrapolate the missing data. I predict them by either second- or third-order polynomial specification or a conditional Mincer equation as follows:

$$\log[\text{HSGwage}(\text{age})] = \beta_0^h + \beta_1^h \text{experience}_h + \beta_2^h \text{experience}_h^2 + \varepsilon^h, \text{ experience}_h = \text{age} - 18$$

$$\log[\text{CGwage}(\text{age})] = \beta_0^c + \beta_1^c \text{experience}_c + \beta_2^c \text{experience}_c^2 + \varepsilon^c, \text{ experience}_c = \text{age} - 22$$

The criterion of selection basically is the goodness of fit. I also check with the neighboring cohorts to make sure the predicted value is reasonable and consistent. The “rule of thumb” of hump-shaped profile applies here too. For example, if an estimation gives me an exponential trend of the life-cycle wage profile, I cannot accept it. This exercise ends up that for most of the cohorts I use a second-order polynomial method to extrapolate (essentially it is similar to the Mincer equation). My extrapolation stops after the 1980 cohort because after this cohort, a lack of data points creates trouble; hence, I do not have a reliable prediction.³ By filling in the missing data, eventually I obtain complete cohort-specific life-cycle wage profiles for HSGs and CGs from the 1955 to the 1980 cohort. Cohorts in the 1950s have the best data quality because they have the fewest missing data points.

These cohort-specific life-cycle wage profiles provide the information needed in the first two terms of equation (5). To fully understand the higher education choice over time, I also need information about tuition, which is the direct cost of college education as in the third term of equation (5). In Figure 4 I report the real tuition, fees, room and board (TFRB) per student charged by an average four-year institution in terms of constant 2002 dollars.⁴ TFRB increased over time except in the 1970s,

³The 1980 cohort has life-cycle wage profiles only up to age 40 from the CPS data. Heckman, Lochner, and Todd (2003) also notice this problem and stop in 1983 for their cohort-based estimates.

⁴See He (2009) for the explanation to construct this data sequence.

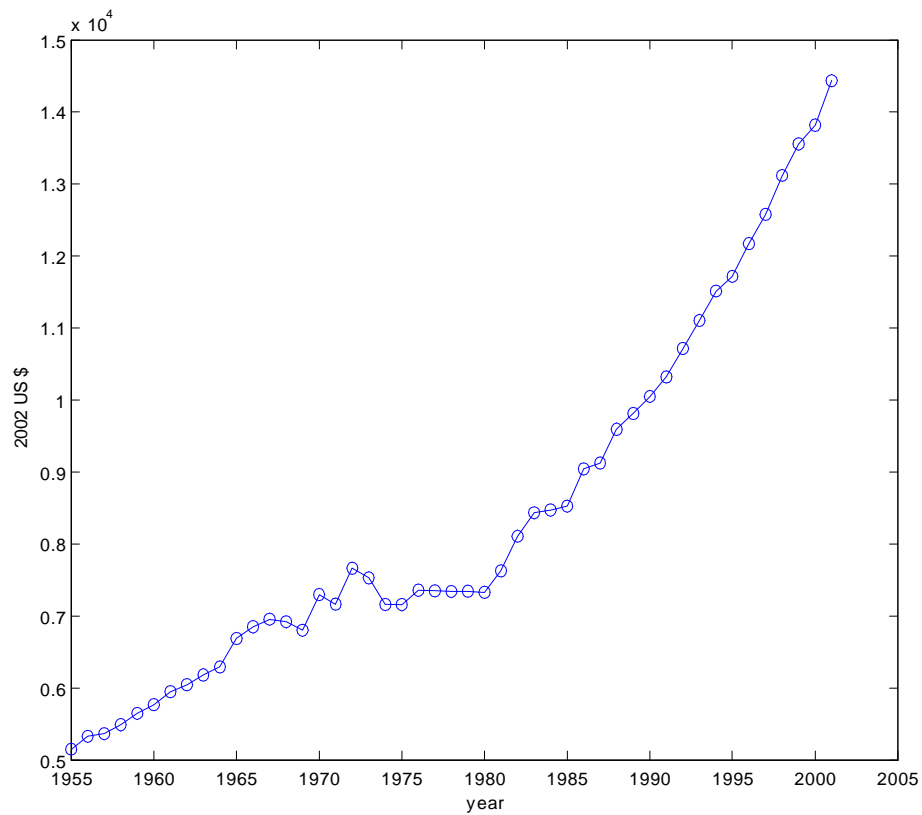


Figure 4: Real tuition, fees, room and board charge per student

when it became stable. Starting from 1980, real TFRB raised dramatically. Different cohorts face different TFRB charges based on the years during which they attended college.

4 Results

In this section, the economic model in Section 2 is calibrated to generate the female college enrollment rates. The calibration strategy I employ here is to adopt the common values widely used in the literature for the preference parameters. For the model-specific disutility parameter b (see equation (9) below), I calibrate it to match the enrollment rate data of the initial cohort (HSGs in 1955). Under these calibrated parameter values, I then input the data of cohort-specific life-cycle wage profiles and real TFRB in Section 3 into the model. Given that I have enough information about individuals' budget constraints, I am able to solve their dynamic programming problem as in (6) and (7). Finally, I use the criterion in (8) to determine the enrollment rate in different years.

4.1 Calibration

The value of discount factor β is taken to be 0.99, which is quite close to the one used in Auerbach and Kotlikoff (1987) for a representative agent, life cycle model with certain lifetimes (they use 0.9852). The value of CRRA coefficient σ is 2, which is taken from İmrohorođlu, İmrohorođlu, and Joines (1995), and it is also widely used in the life-cycle literature. The interest rate r is set to 4%.

For simplicity and for purposes of calibration, I assume the ability level i is

uniformly distributed among women and the ability-related disutility cost takes the form

$$DIS(i) = b\left(\frac{1}{i} - 1\right). \quad (9)$$

I assume that this cost function is also time invariant. For the lowest ability individual ($i = 0$), $DIS(i) = \infty$, so she will never go to college. On the other hand, for the highest ability individual ($i = 1$), $DIS(i) = 0$. Since the present value of the life-cycle wage profile of CGs is higher than that of HSGs (see Figure 3), she will certainly choose to go to college. Given this functional form, as is shown in Section 2, the college enrollment rate at time t is determined by the threshold level i_t^* as in the following equation

$$DIS(i_t^*) = V_t^c(a_{0,t-1} = 0, 1) - V_t^h(a_{0,t-1} = 0, 1).$$

Since ability level is uniformly distributed and $DIS'(i) < 0$, the enrollment rate at time t is equal to $\Pr(i > i_t^*) = 1 - F(i_t^*) = 1 - i_t^*$.

I calibrate the scale factor of disutility cost function b to match the female college enrollment rate data in 1955, which is 34.6%. This ends up with $b = 7.15$.

Table 1 summarizes the parameter values used in the model.

Parameters	Description	Value
β	discount factor	0.99
σ	CRRRA coefficient	2
b	scale factor of disutility cost function	7.15
r	real interest rate	4%

Table 1: Parameter values of the model

4.2 Findings

Based on the parameter values shown in Table 1, at year t I solve the birth cohort's dynamic problem using a standard numerical method to obtain the difference in value function $VD_t = V_t^c(a_{0,t-1} = 0, 1) - V_t^h(a_{0,t-1} = 0, 1)$. This difference determines a unique threshold level i_t^* and hence the corresponding college enrollment rate at year t (e_t)

$$e_t = \Pr(i > i_t^*) = 1 - i_t^*.$$

Figure 5 compares the female college enrollment rates from the model with those in the data from 1955 to 1980. The model replicates the rising trend of college enrollment rates for females very well. In the data, the enrollment rate increased from 34.6% in 1955 to 51.8% in 1980; while in the model, it increased from 34.6% to 52.0%.

Looking at a detailed comparison, from 1955 to 1960, the model predicts that the enrollment rate increased from 34.6% to 39.2%; while in the data it increased from 34.6% to 38.0%. The model actually overshoots the data for this period. It

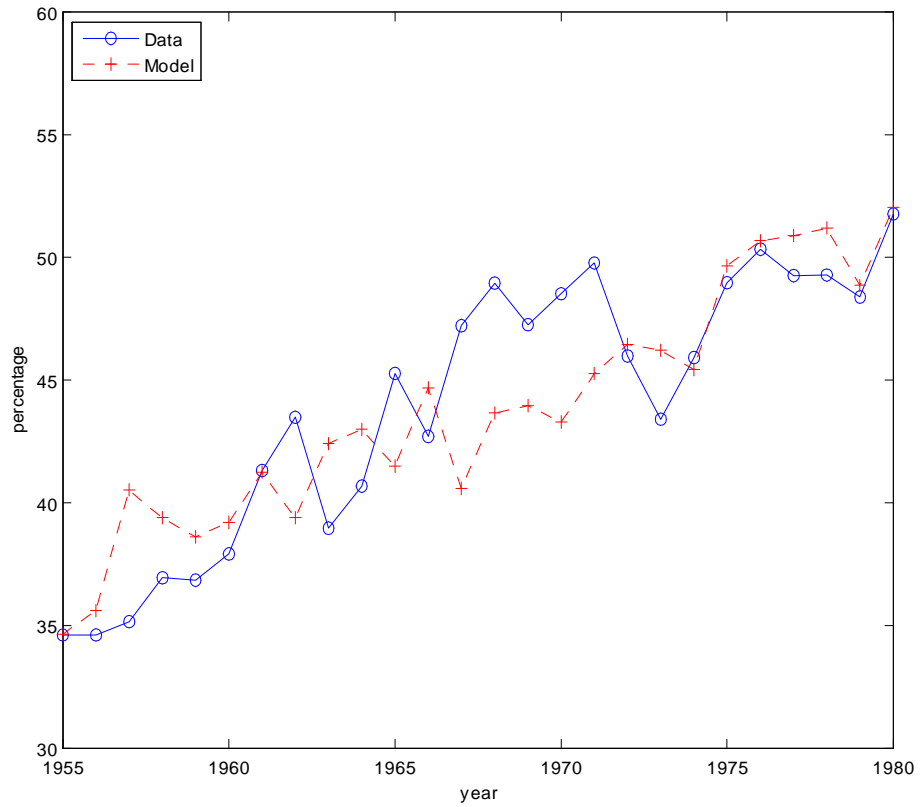


Figure 5: Female college enrollment rate: model vs. data

implies that some factor other than the life-cycle earnings differential was deterring women from going to college in that period. From 1960 to 1966, the prediction from the model is quite in line with the data. However, from 1967 to 1972, the model significantly underpredicts the college enrollment rate for females. In 1967, the enrollment rate was 47.2% in the data, while the model predicts a rate of only 40.6%, which was 6.6% lower than the data. Similarly, in 1970, the college enrollment rate was 48.5% in the data, while it was 43.3% in the model.

One possible reason for the underprediction of the female college enrollment rate in the model during that period is that the model does not capture the changing social norms and expectations about the role of work among young women in the late 1960s and early 1970s. As evidence of this changing social norm, Astin, Oseguera, Sax, and Korn (2002) report the results of the Astin Freshman Survey, which is a national sample of college freshmen, the vast majority of whom were 18 years old. In the survey, the freshmen agreed or disagreed with the statement: “The activities of married women are best confined to the home and family.” The fraction of female freshmen disagreeing with this statement increases dramatically from 59% in 1967 to 83% in 1973. The fraction, however, has been quite stable since then.

Rising expectations of future employment certainly encouraged girls to go to college. Based on the observation from the Astin Freshmen Survey and their own data,

Goldin, Katz, and Kuziemko (2006) estimate that the change in expectations about future labor participation would account for a 4.8 to a 5.7 percentage point increase in the female college graduation rate from 1968 to 1979. The college enrollment rate in the current model from 1967 to 1972 on average is below that in the data by 5 percentage points. Since in the model the college enrollment rate is equal to the college completion rate, changes in expectations among young women could capture the entire difference between the model's prediction and the data.

Based on this conclusion, a reasonable conjecture as to why the model overpredicts the female college enrollment rate from 1955 to 1960 is that teenage girls at that time did not see much chance for female employment and they were still quite attached to the family. Just as new social norms ten years later led to a rise in college attendance, the traditional social norms of earlier years deterred those women from going to college. And the effect of social norms is what is missing in the model.

Since 1972, the model has done a very good job of replicating the data. In the data, the female college enrollment rate increased from 46.0% in 1972 to 51.8% in 1980. The model counterpart was from 46.5% to 52%. Girls who graduated from high school around that time had already witnessed a drastic increase in the female labor force participation rate and formed their expectations accordingly; therefore, it is not surprising to see that the decision to go to college is entirely driven by

economic concerns. The higher college wage premium for females since 1980 has raised the benefits of attending college as shown in the first term of equation (5). It was a significant factor in encouraging girls to go to college.

To summarize, the results show that the human capital investment model works quite well to capture the rising female college enrollment rate from 1955 to 1980. The results also suggest that the changing expectations of future employment opportunity among young women may play an important role in driving this enrollment rate from the mid 1950s to the early 1970s.

4.3 Counterfactual Experiments

In the model, the college attendance decision is based on the exogenous life-cycle earnings differential and tuition cost. To check whether the results depend on factors other than life-cycle earnings differential, I run the following counterfactual experiments. For each experiment, I keep the parameter values unchanged except that I recalibrate the scale factor of the disutility cost function b to match the enrollment rate in 1955 if need be.

4.3.1 Fix tuition cost

In order to quantify the effects of changing tuition costs over the target period, I fix tuition costs at the level of the 1955 cohort. Therefore, the 1956-1980 cohorts face the same tuition cost as the 1955 cohort. Figure 6 shows the results. Compared to the benchmark case, when the tuition cost is fixed at level for the 1955 cohort, the female college enrollment rate increases only very slightly over the period. Therefore, the direct cost of schooling apparently is not a significant factor in determining women's college entrance behavior.

4.3.2 Shorter time horizon

In the benchmark model, women have perfect foresight about their life-cycle wage profiles. To check the importance of the life-cycle (ages 18 to 65) feature in shaping the results, I reduce the time horizon of each cohort from 48 periods (ages 18-65) to only 23 periods (ages 18-40). Therefore, I do not need to deal with missing data after age 40 for all the cohorts from 1955 to 1980. Given the change in life-cycle wage profiles, scale factor b is recalibrated to match the college enrollment rate in 1955.⁵

⁵The new value is $b = 2.27$. A shorter time horizon reduces the value of life-cycle earning differentials as in the first term of equation (5). The disutility cost has to be lower in order to match the enrollment rate in 1955.

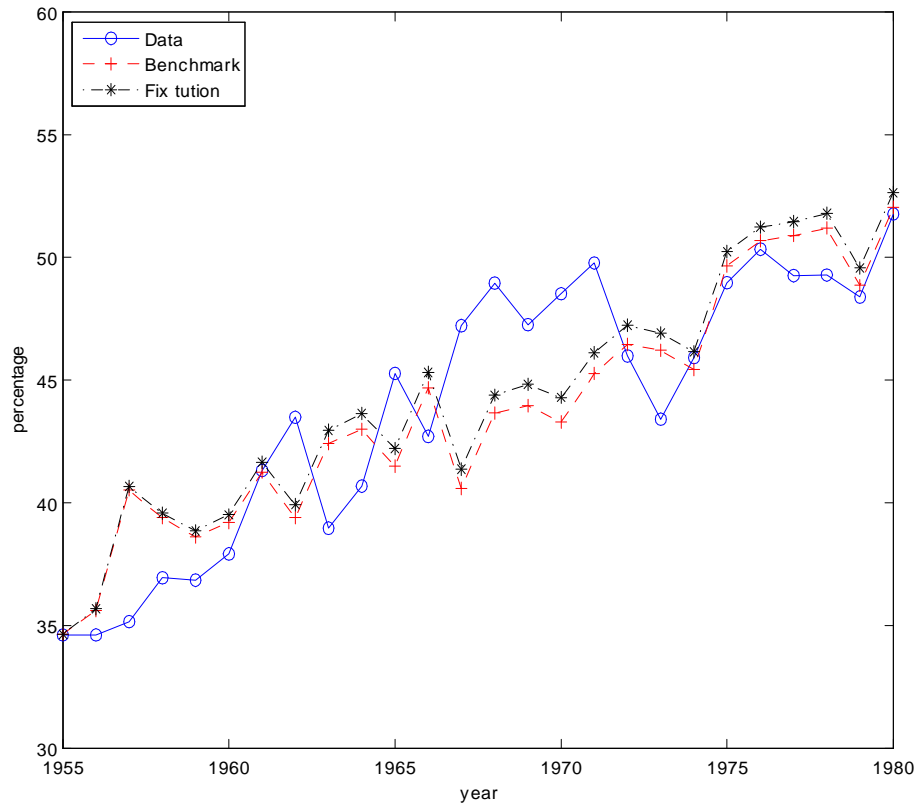


Figure 6: No change in tuition cost

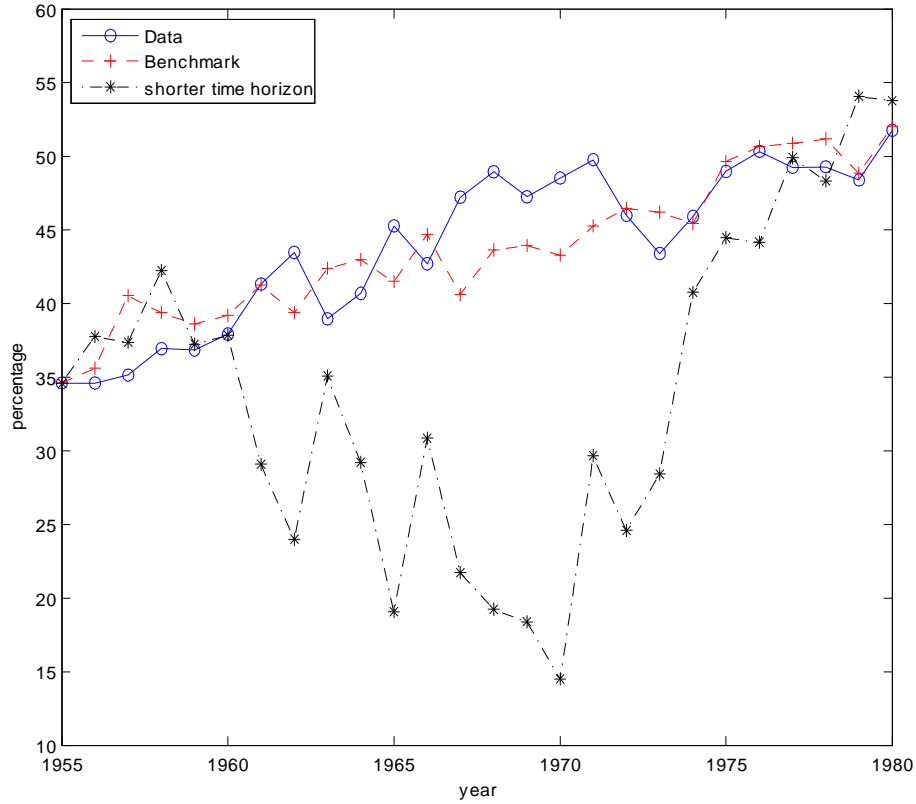


Figure 7: Shorter time horizon

The results are shown in Figure 7. For most of the period 1955-1980, the model with shorter time horizons generates a significantly lower college enrollment rate, which is a complete divergence from the data. As individuals face shorter time horizons, the discounted present value of the life-cycle earnings differential (first term in equation 5) decreases. Lower benefits of college education thus discourage college attendance.

This experiment might help us to understand why Averett and Burton (1996) concluded that the effect of the college wage premium is very small and statistically insignificant for women. Given that in their work women can forecast their wage only up to age 33, it is not surprising to see that the human capital model they use shows a much smaller effect of the college wage premium on the college enrollment rate than the full-blown life-cycle model used in this paper.

5 Conclusion

This paper develops a discrete time overlapping generations model with an endogenous college-entry decision. The decision is based on the cost-benefit analysis implied by the standard human capital investment theory. Two key features are exogenous choice-dependent life-cycle wage profiles and an idiosyncratic disutility cost of a college education. Using this model, I quantitatively examine the driving force behind the dramatic increase in the female college enrollment rate from 1955 to 1980. I find that the model works quite well in capturing the rising female college enrollment rate during this period. The rising college wage premium is the major driving force. The results also suggest that the change in expectations of future employment opportunity among young women may play an important role in driving the enrollment rate from the mid 1950s to the early 1970s.

Recent literature shows that the marriage market may also be an important determinant in women's schooling decision. And education might also affect women's fertility and marriage decision. This paper does not address these issues. However, it would be an interesting extension to include endogenous marriage and fertility choice in the current model to analyze the interaction among these choices. This extended model surely will provide a platform for understanding not only the changes in women's college-entry decisions, but also the evolution of the marriage rate and fertility decisions over time. I leave that for future research.

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