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Explaining the Worldwide Boom in Higher Education of Women

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Explaining The Worldwide Boom in Higher Education of Women*

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Abstract

The last forty years have witnessed a remarkable boom in higher education around the world. Importantly, the boom in higher education has been concentrated among women, such that today in most higher-income countries, and many lower-income countries, more women than men attend and complete tertiary education. We present a model that explains the increase in higher education, particularly among women, in terms of a market for college graduates in which the supply of college graduates is function of the distribution of the costs and benefits of higher education across individuals. Examining evidence on these costs and benefits, we find no clear evidence that benefits are greater for women than men. Instead, it appears that differences in the total costs of college for women and men—primarily due to differences in the distributions of non-cognitive skills for women and men—explain the overtaking of men by women in higher education.

1. Introduction and Evidence of the Boom

All over the world, higher education is booming. While men and women in poorer countries are much less likely to get a higher education than persons in richer countries, both richer and poorer countries have witnessed sharp growth in higher education since 1970. Figure 1 divides a sample of 120 countries into the top and bottom halves in terms of per capita incomes and measures the growth in higher education from 1970 to 2010. In 2010, 27 percent of persons 30–34 years old in richer countries have college education, up from 12 percent in 1970; for poorer countries, the share is 11 percent in 2010, up from less than 3 percent in 1970.

Even more remarkable than the breadth and magnitude of this boom in higher education is how it is coming about: most of the growth in higher education is due to women, so much so that in most countries, women have not only matched but surpassed men in college attainment. In the United States in the 1970s, male college graduates outnumbered female college graduates 3-to-2; today, the ratio is reversed. See Figure 2.¹ And this phenomenon is worldwide. Using the same sample of 120 countries from Figure 1, Figures 3 and 4 plot the gender difference (women minus men) in the fraction of 30- to 34-year-olds with college attainment against per capita GDP. A positive gender difference was a novelty in 1970, essentially reserved for a few of the wealthiest countries. By 2010, women surpassed men in higher education

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¹ In 2007, over 57 percent of bachelor's degrees were awarded to women. NCES (2008a).

in 67 of 120 of the countries, including countries from every populated continent and more than a quarter (17/60) of countries with below-median per capita GDP.

In this article, we present a model of supply and demand in the market for college-educated workers. We then marshal available evidence on the costs and benefits of higher education, and show how our model explains both the phenomenon of a worldwide boom in higher education and women surpassing men in higher education.

In Section 2, our account begins with a simple model of the education decision of an individual who weighs the costs and benefits of college attendance. The most obvious benefit relates to earnings, and many studies have shown that the earnings premium from a college education increased during the past several decades in many countries. Other benefits from going to college include better health, better marriage prospects, more effective investments in children, and more effective responses to unexpected events, such as a devastating hurricane or greater employment risk due to global competition. As these benefits of higher education rise over time, we expect the propensity of individuals to attend college to rise. The incentive to go to college also depends on the costs of college, incorporating forgone earnings as well as tuition, the difficulty of financing these costs, and the ease or difficulty of performing well in college.

We then extend our model from the individual to the market for college-educated workers. In many respects, of course, the model of market equilibrium contains the same insights as a model of individual choice; a rise in the benefits or a fall in the costs of college will increase attendance. But thinking in terms of supply and demand also allows us to study heterogeneity among workers, and how this heterogeneity affects women's and men's responses to changing demand for college-educated workers. As we will argue, the phenomenon of women surpassing men in higher education can best be explained by considering the *distribution* of individuals' total costs of higher education.

Past studies have implicitly relied on a model of individual choice, as they have focused on changes in *average* costs and benefits of education for men and women over time. See Goldin, Katz, and Kuziemko (2006); Buchmann and DiPrete (2006); DiPrete and Buchmann (2006); Jacob (2002). These studies go a long way towards explaining the boom in higher education and the increasing share of women in higher education.

Our contribution, by focusing on the market for college-educated workers, is to emphasize the *variation* across individuals in the costs and benefits of education. The key observation is that the elasticity of supply of women and men to college depends on the amount of heterogeneity across women or across men in the cost of attending college. If women have a higher elasticity of supply to college, then even for *equal* changes in the benefits of college for men and women, women can overtake men in college attainment.

Section 3 then presents evidence relevant to our model. We begin by reviewing evidence on benefits of college. The evidence is strong that the benefits of college for

men and women increased over time in essentially all the dimensions that we measure. Although some of the college benefits increased faster for women than men, the benefits from college still appear lower for women in most dimensions. This fact would explain the convergence between women's and men's college attainment that we have witnessed over the last 40 years, but it alone cannot explain the higher rates of college completion for women than men.

In Section 4, we then examine evidence on the costs of college, and use our model to show how these facts allow us to account for the overtaking of men by women in higher education. In our assessment of the evidence, we focus on the “non-traditional” costs of college, such as the difficulty of college for men and women, rather than the college costs traditionally measured, such as tuition and forgone earnings. Non-traditional costs are determined by differences across individuals in (especially) non-cognitive skills. See Cunha and Heckman (2008); Cunha and Heckman (2007). We present evidence on both gender differences in levels of non-cognitive skills and in heterogeneity across individuals within gender in non-cognitive skills.

We find that both of these factors, taken together, may explain women overtaking men in college completion. First, women on average find school less difficult than men. This factor will tend to raise the *net* benefit of college for women relative to men, helping to explain how more women than men could now attend college, even when the (gross) benefits of college remain greater for men. Second, inequality of total costs of education appears to be lower among women than among men. This factor is the key to understanding the reversal of men's and women's shares in higher education over the last 40 years. Less inequality in total costs among women means that, as the benefits of college rose in recent decades, the supply of women to college was more elastic than that of men.

In short, as the demand for college graduates has grown over time and the college earnings premium has grown substantially, these two factors explain why the response in increased college attendance has been overwhelmingly female, leading to women overtaking men in higher education.

In Section 5, we conclude.

2. A Model of the Equilibrium Number of College Graduates

2.1 Optimal Investment in College Education by an Individual

This section considers the optimal investment in college education, S , by different individuals. We partly go over known territory to set the stage for the market analysis. The production of S is determined by

$$1) \quad S = F(h, H, A_c, A_n)$$

where h is the time spent at college, H measures the stock of human capital prior to any investment in S , A_c and A_n measure cognitive and non-cognitive skills. H , A_c , and A_n are parameters when investing in college that vary among individuals

depending on their earlier education and their abilities. The output of S is increasing in all these predetermined inputs into the production of S , so that F_h , F_H , F_c , and F_n are all >0 . F may not be everywhere concave in h , or even continuous in h because of graduation premia. However, we assume that around the optimal level of h , $F_{hh} < 0$. The cost of the time spent on S depends on the earnings forgone per hour of h .

We assume reasonably that all the inputs into S are complements. This implies, in particular, that F_{hH} , F_{hc} , and F_{hn} are all greater than zero. That is, more skilled students are more efficient at using their time to produce a college education, and hence they have stronger incentives to continue in school. We ignore any effects of skills on how much students like college, although analytically such effects would be largely subsumed under the effects of skills on the productivity of investments in college.

Investments in college take place in the initial period only, and produce benefits in a single future period. College education S has many future benefits that compensate for the investment costs. We divide these benefits into raising earnings, improving survival rates, raising the utility from consumption, and improving marital prospects. Raising utility from consumption includes the effects of college education on quality of health, investments in children, management of financial assets, adjustment to shocks, and on other forms of consumption.

Each individual chooses an investment in college education that maximizes his discounted expected utility, given by

$$2) \quad V = U_1(x_1, l_1; H) + p(S; H)\beta U_2(x_2, l_2, S; H),$$

where β is his discount rate. The coefficient p is his probability of surviving to the end of period 2, where p is assumed to depend positively on his human capital, as measured by both S and H . The variable x measures the consumption of goods, and l measures household time. Utility is assumed to be increasing and concave in x , l , and S .

Utility is maximized subject to resource constraints, and these constraints are crucial to the analysis. To simplify the discussion we assume there is full annuity insurance, so that expected discounted consumption, including spending on S , will equal expected discounted income. Subject to this equality, individuals can borrow and lend at the interest rate r . We ignore any difficulties in using investments in college as collateral to finance consumption. The full wealth budget constraint over the two periods is then

$$3) \quad x_1 + \frac{px_2}{1+r} + w_1l_1 + \frac{pw_2(S,H)l_2}{1+r} + T(h) + w_1h = w_1 + \frac{pw_2(S,H)}{1+r} + \frac{pM(S)}{1+r} = W,$$

where W is expected full wealth, w refers to hourly earnings, and the total time in each period is normalized to 1. The LHS shows how full wealth is spent, where T is tuition and fees (which may also depend on H , A_c , and A_n), and w_1h is the earnings forgone from being in college.

Since college education raises hourly earnings in the second period, the derivative $w_{2s} > 0$. This derivative measures the hourly earnings returns per increment of college education, and may vary with the amount of college education. College education also improves well-being by raising the likelihood of marrying persons with greater education and other attractive characteristics. The expected gain from marriage in the second period is treated as an increment to expected wealth, $p(S)M(S)$. Since the gain from marriage is generally greater for those with a college education, $M_s > 0$.

Individuals maximize the value of their discounted utility V in eq. 2, subject to the full wealth constraint in eq. 3. The variables of interest are investments in college human capital (S), the time spent investing in this capital (h), consumption in each period (the x 's), and hours spent in household production (the l 's). The FOCs for consumption are the usual ones

$$4) \quad U_{1x} = \mu, \quad \text{and} \quad p\beta U_{2x} = \frac{\mu p}{1+r}$$

The assumption of full annuity insurance means that the probability of surviving the second period (p) drops out of the FOC for x_2 , so that uncertainty nowhere enters these conditions. Hence the usual arbitrage condition

$$5) \quad \beta U_{2x} = \frac{U_{1x}}{1+r}$$

The FOCs for time spent in the household are also standard, as in

$$6) \quad U_{1l} = \mu w_1, \quad \text{and} \quad p\beta U_{2l} = \frac{\mu p w_2}{1+r}$$

The probability of survival in period 2 also drops out of these time allocation FOCs. The LHS of these FOC's give the marginal utility of allocating more time to the household sector, while the RHS gives the marginal cost of taking time away from earnings.

We are mainly interested in the FOCs for investments in college education. If e_2 is hours worked in period 2, the FOC for the optimal time spent in college is given by

$$7) \quad \frac{\mu p e_2 w_{2s} F_h}{1+r} + \beta p_s F_h U_2 + \frac{\mu p_s F_h [e_2 w_2 - x_2]}{1+r} + \frac{\mu p M_s F_h}{1+r} + \frac{\mu p_s F_h M}{1+r} + p\beta F_h U_{2s} = \mu(w_1 + T_h)$$

If we divide through by μ , the marginal utility of consumption in period 1, and by F_h , the marginal productivity of the time spent investing in college, we get

$$8) \quad \frac{p e_2 w_{2s}}{1+r} + \frac{\beta p_s U_2}{U_{1x}} + \frac{p_s [e_2 w_2 - x_2]}{1+r} + \frac{p M_s + p_s M}{1+r} + \frac{p\beta U_{2s}}{U_{1x}} = \frac{w_1 + T_h}{F_h}$$

Note that the probability of surviving through the second period does not drop out of the FOC for investments in education since the survival probability affects expected future benefits. This is the source of the well-known complementarity between life

expectancy and investments in schooling, so that an increase in the probability of surviving in the future raises the incentive to invest in schooling.

The first term on the LHS of eq. 8 gives the discounted expected increase in earnings from greater college education. This is the term that dominates discussion of “rates of return” to education in the economics of education literature. This measure of the “rate of return” to college education increased greatly in the United States and many other countries during the past 40 years. The wage premium for college graduates compared to high school graduates increased since 1980 from about 40% to about 80%. The total benefits from college also increase with hours worked (e_2), while they decrease with the interest rate (r).

The second term on the LHS of eq. 8 measures the increase in expected utility due to the effect of greater education on the probability of surviving in the future. Using the FOC for x_2 , this term can be written as

$$9) \quad \frac{p_s \beta U_2}{U_{1x}} = \frac{p_s \beta U_2}{\beta (1+r) U_{2x}} = \frac{p_s U_2}{U_{2x} (1+r)}$$

A generalization to multiple periods of the term $U_2/U_{2x}(1+r)$ is called “the statistical value of life,” for it measures how much an individual is willing to pay for a unit increase in his probability of surviving in the future. This value is in monetary units; for a young male in the United States it is estimated to be in the \$3-7 million range.

The third term in eq. 8 measures the benefit from an increased probability of survival in the future if future earnings exceed future consumption. This is a benefit since an increase in the probability of survival when future earnings exceed future consumption raises possible consumption in the initial period. This difference between earnings and consumption was the main effect emphasized in early studies of the value of life since it was supposed to measure the net contribution of an individual to the resources of society. Clearly, that analysis was misguided since the contributions of education to earnings and utility, and to the statistical value of life, could be highly important even if spending in each post-investment period equaled income in the same period.

The fourth term on the LHS of eq. 8 measures the effect of a college education on benefits in the marriage market. These benefits include the effects of college education on the probability of marriage, and the effects of marriage on utility and earnings. The latter effects occur because marriage is a productive activity that directly raises the combined full wealth of spouses. The sharing of this greater full wealth between them depends on various individual characteristics and marriage market conditions, such as the number of men and women seeking to get married, how many men and women have a college education, the demand for children, and many other variables (see Becker 1991 and Chiapporri, Iyigun, and Weiss 2009). Marital benefits are usually neglected in studies of the returns to education, even though they are often important.

The fifth term on the LHS of eq. 8 gives the effect of greater college education on the expected increase in utility from future consumption. If college raises utility by

raising the efficiency of household time—just as college raises hourly earnings by raising the efficiency of market time—the effect of greater time in college on future utility can be written as

$$10) \quad \frac{\partial U_2(x_2, \varphi(H, S)l_2)}{\partial h} = \varphi_s F_h l_2 U_{2l},$$

where φ converts S (and H) into effective household time. Then the effect on utility is determined by the product of three forces: the amount of household time, the increase in the effective amount of each hour of household time due to college education, and the marginal utility of effective household time. In this case, the effects on earnings and utility of greater college education are a weighted average of the increases in earnings and the utility, with the weights being the time allocated to the market and household sectors, respectively. Allocating more time to the market sector increases overall returns to education only if earnings benefits from greater education exceed household benefits.

The RHS of eq. 8 gives the marginal cost of producing an additional unit of a college education, S . The numerator equals the hourly earnings forgone when spending an additional hour at college plus the tuition cost of this time, and the denominator equals the marginal product of this time. The marginal cost of producing an additional unit of college also depends negatively on cognitive and non-cognitive skills, and past investments in schooling and other human capital because of the complementarity among the inputs used to produce college human capital. This is a crucial point we will emphasize throughout our analysis: cognitive and non-cognitive “skills” can be understood as components of the *cost* of higher education—lower productivity in producing S implies higher marginal cost to produce a unit of S . A student with poor non-cognitive skills (e.g., little self-motivation or dislike of homework) will find school more “difficult,” or in economic terms more costly. This is true even if their tuition and forgone wages are no higher than for others.

In short, optimal schooling choice for an individual depends on a number of benefits of education:

- 1) in the labor market (the first term in eq. 8),
- 2) in health and longevity (the second and third terms),
- 3) in the marriage market (the fourth term), and
- 4) in the household (the fifth term).

Schooling also depends on costs: most obviously on forgone wages and tuition (the numerator on the RHS of eq. 8), but crucially also on the productivity of time spent in school (the denominator). In Section 3, we will examine the extent to which these factors explain the boom in higher education of women. First, however, we turn to our model of the market for college graduates.

2.2 The Market for College Graduates

To better understand why women are now much more likely to graduate from college than men, we place the college decisions of individual men and women within

the context of market equilibrium for college graduates. The demand side of our model is very simple. The demand for college educated workers is a function of the relative wages of college educated and high school educated workers. The measure of the relative wage R_t that we use is the college wage premium, or log ratio of the hourly wages for college graduates to the hourly wages for high school graduates. As the subscript t indicates, the college wage premium may vary over time. We assume that the economy's demand for the effective number of college graduates is negatively related to the college wage premium. The demand equation is

$$11) \quad Q_t^D = D(R_t, P_t),$$

where Q_t^D is the effective number of college graduates demanded at time t , and P_t represent technological progress and other forces that shift demand for college graduates over time. Note that we assume that there is a single college wage premium that applies to both male and female workers; we will show in Section 3.1 that this in fact the case, at least in the United States.

The supply side of the model is slightly more complicated. The effective number of college graduates supplied equals the number of male graduates plus the equivalent number of female graduates, where female graduates would be converted into male graduates at the ratio a_t of their average hourly earnings to that of males. The coefficient a_t is less than one; although the ratio of college to high school wages is approximately the same for men and women, the wage levels within any education category have historically been higher for men than for women. The effective number of college graduates supplied is

$$12) \quad Q_t^S = C_{mt} + a_t C_{ft}$$

Where C_{mt} and C_{ft} are the numbers of male and female college graduates, respectively, at time t , and these quantities are determined by supply functions

$$13) \quad C_{mt} = S_m(R_t, N_{mt}, A_{cm}, A_{nm})$$

$$14) \quad C_{ft} = S_f(R_t, N_{ft}, A_{cf}, A_{nf})$$

where the supply of both male and female college graduates is positively related to the common earnings benefit R_t and the gender-specific non-earnings returns from college to men and women N_{mt} and N_{ft} . These factors capture the same benefits of college that are captured in the LHS of equation 8. In our model, we assume that these benefits are common across individuals of the same gender, but these benefits may rise or fall over time.

The supply of college educated workers also depends on the costs of college. As noted above, the cost of college for any individual depends crucially on the productivity of time spent in school; individuals with higher cognitive or non-cognitive skills have lower costs of schooling. A_{cm} , A_{nm} , A_{cf} , and A_{nf} refer to the distributions of cognitive and non-cognitive skills among men and women. In our model, the distribution of cognitive and non-cognitive skills is the source of heterogeneity across individuals, and we assume that these distributions do not change over time. Of course, tuition

and forgone wages are also costs of college that affect the supply of college graduates. We do not emphasize them here because, as we will discuss later, changes in tuition costs and forgone wages cannot explain the phenomena we observe.

Equilibrium in the market for college graduates requires aggregate demand to equal aggregate supply of effective college graduates, so that $Q^{D_t} = Q^{S_t}$ or

$$15) \quad D(R_t, P_t) = S_m(R_t, N_{mt}, A_{cm}, A_{nm}) + a_t S_f(R_t, N_{ft}, A_{cf}, A_{nf})$$

Given P_t , the N 's, and the A 's, equality between D and S determines the equilibrium monetary benefit from going to college, R_t , and the number of persons of each gender that go to college, C_{mt} and C_{ft} . Figure 5 provides a graphical example of equilibrium in the market for college graduates.

Because the supply curve of college graduates maps the relationship between quantity supplied and the college wage premium, which is the earnings benefit of college education, the non-earnings benefits of college education act as shifters of the supply curve. Likewise, higher or lower costs of college education would shift the supply curve to the right or left, respectively. If the non-earnings benefits of college for women, net of costs, are greater than for men, the supply curve of women to college will be to the right of the supply curve of men, and vice versa. One possible explanation for the overtaking of men by women in higher education is that non-earnings benefits of college, net of costs, used to be higher for men, but are now higher for women.

The supply and demand framework, however, reveals a second possible explanation, which is absent from the model of individual schooling choice. Differences in the variation in costs (and benefits) across individuals of a given gender determine the elasticity of supply. If women have more elastic supply than men, an identical increase in the earnings returns to education could, standing alone, induce women's college participation to overtake men's. (Figure 5 is drawn to allow for this possibility.) This link is often made in labor economics generally, but has not previously been deployed to explain the different trends of men and women in college attainment over time.

In our model, we assume that individuals of a given gender face a common set of earnings and non-earnings benefits from college. Let B_{gt} be the total benefits for gender g at time t ; B_{gt} is simply a function of the earnings benefits of college (represented by the college wage premium R_t) and the non-earnings benefits N_{gt} . Because individuals vary in their cognitive and non-cognitive skills, however, different individuals face different costs of completing college. If we label the total cost of completing four years of college c_{gi} for individual i , then the cumulative distribution of total costs $F_g(X; A_{cg}, A_{ng})$ (herein, $F_g(X)$ for brevity), is determined by the distribution of cognitive and non-cognitive skills.

Every individual for whom the benefits of college B_{gt} is greater than their cost c_{gi} will complete college. If we normalize the population to 1, then the supply of college graduates, as a function of the benefits of college, is

$$16) \quad C_{gt} = S_g(R_t, N_{gt}, A_{cg}, A_{ng}) = F_g(B_{gt}),$$

where $F_g(B_{gt})$ is the share of individuals completing college.

Thus we see that the responsiveness of college graduation rates to the benefits of college depends on the distribution of costs, which itself is determined by the distribution of cognitive and non-cognitive skills.

To be more concrete, consider two distributions of costs, represented by the density functions in Figure 6. (The shape and units of the distributions are solely for illustrative purposes.) Relative to the higher-peaked distribution, the lower-peaked distribution has higher costs on average, and a higher variance in costs across individuals. If the benefits of college are very low, then of course the share of individuals in either distribution attending college is close to zero. Now let's say B rises to 2, as shown in Figure 7. In this range of low benefits of college, we see that the high-variance distribution of individuals responds more elastically, and a greater share of that distribution attends college. This follows directly from the fact that the cost distribution with higher variance will have more mass in the lower tail.

But if the benefits continue to rise, say to 3.5 as shown in Figure 8, we now see that the response in college completion is greater in the high-peaked, low-variability distribution. This follows from the facts that (1) the benefits approach the mean of the lower-average-cost distribution first, and (2) because this distribution has lower variance, a relatively large part of this distribution is concentrated near the mean.

In short, the elasticity of each gender's supply response to changes in the benefits of higher education depends on gender differences in both the levels of costs and the heterogeneity in costs for each gender.

3. Gender Differences in the Benefits of College

Our model of investment in college education suggests that differences in the propensities of men and women to go to and graduate from college depend in part on gender differences in the magnitude of total benefits from college relative to the full cost of college. In this section, we discuss benefits. Indeed, it is difficult to mention any type of behavior or any kind of activity where college educated persons do not have a considerable advantage over persons who did not go to college. The differences between the haves and the have-nots, especially in richer countries, in good part come down to whether a person went to college or not.

We concentrate our attention on differences between men and women in the benefits of college itemized above in Section 2.1: (1) earnings, (2) life expectancy, (3) the propensity to marry and to stay married, and (4) household production (we focus on the effects of parental education on children's education). Unsurprisingly, the high and rising benefits of college provide a natural explanation for the worldwide boom in higher education. But these facts alone cannot explain women surpassing men in higher education. The evidence below indicates that the benefits of college have risen, in some cases dramatically, for women, but that the benefits for men have been, and remain, even higher.

One might add to this list young people's expectations about future career opportunities, taking note of the extraordinary rise in young women's expectations of labor force participation and professional opportunities in recent decades. See, e.g., Goldin, Katz, and Kuziemko (2006). While this is an important phenomenon, we do not include it in our model for two reasons. First, it is not clear that changing expectations of labor force participation are a *cause* or an *effect* of higher benefits to higher education for women. Second, such changing expectations, even if a cause of women's college participation, cannot themselves explain women overtaking men in higher education; after all, young men still have higher expectation of future labor force participation than young women.

3.1 College Wage and Earnings Premiums

Presumably, men and women are substitutes in the labor market, so that an increase in the supply of either male or female college graduates would lower the earnings of both male and female graduates. This does not mean, however, that their working times substitute hour for hour. Since women earn less than men at each education level, labor markets are valuing an hour of women's time at less than that of men, although this gap has declined greatly during the past several decades. The earnings gains from a college education have grown since 1980 for both men and women. The usual explanation is technological change that favors more educated workers, a shift of output toward more education-intensive goods, growing globalization that added to the demand for more skilled workers, and perhaps too declining discrimination against women.

Figure 9 plots the college and post-college earnings premiums for full-time, full-year men and women in the United States starting in 1970. There has been little difference in the premiums for men and women since the 1980s; before then, the premium was higher for women. Both premiums grew sharply over time, but at about the same rate. The premium for women is less representative of all women since it may depend on which married women participate in the labor force. Any bias from this source, however, probably declined over time as a much larger fraction of married women began to work. Further, as the labor force participation rates of men and women have been relatively stable since about 1990 (see Figure 10), the trends in wage premiums over the last 20 years should be unaffected by gender differences in selection into the labor force.

The earnings benefits from college depend not only on the college earnings premium, but also on labor force participation and hours worked. Over the last forty years, the labor force participation and hours worked of married women has risen, but men remain more attached to the labor force. And as figure 10 shows, the gender gap in labor force participation has remained relatively stable for two decades. While the college wage premium to workers may be the same for men and women, college men are still more likely than college women to reap this benefit.

Finally, the monetary benefits from college are higher when mortality rates during working years are smaller. In this dimension women have an advantage since mortality rates at every age are lower for women than for men, although the effect of

these differences on the present value of earnings may not be large since mortality differences becomes important only after about age 50. The expected earnings benefits of college are still lower for women than for men, although this difference narrowed appreciably over time.

3.2 College Education and Mortality

Women have lived longer than men on average ever since deaths during childbirth were reduced to very low levels. Mortality rates of both men and women are affected by education, but the education effects are larger for men. Using OLS regressions of mortality on education, gender, income, and other controls, Sanchez (2010) finds that an additional year of education is associated with a reduction in 11-year mortality for individuals age 51-82 by 0.7 percentage points for males and 0.5 percentage points for females. It appears, too, that this relationship may be causal. Lleras-Muney (2005) finds that OLS and IV estimates of the effect of education on health are not statistically different from each other.

In data on life expectancy at age 25, Meara, Richards, and Cutler (2008) find the same type of education effects on mortality. The authors find that during 1981-88, their earlier time period, the difference in life expectancy between high and low educated white men was 3.6 years, while it was only 1.3 years for white women, even though white women had considerably higher life expectancy than white men at all education levels. In fact, at age 25, low-educated white women could expect to live more than 3.5 years longer than high-educated white men. Ten years later, the effect of education on life expectancy increased compared to the earlier period for both men and women, so that the gap in life expectancy by education widened to 4.4 years for white men and to 2.5 years for white women. The gender difference in the effect of education declined from 2.3 to 1.9 years, but it did not disappear. Of course, improvements in the probability of surviving to different ages need to be valued by the statistical value of life to get the monetary value of the effect of college education on life expectancy. We have found very little evidence on how the statistical values of life compare for men and women of different education levels.

The increased effect over time of education on life expectancy may be related to the increased effect over time of education on earnings—shown in Figure 9—since persons with higher incomes live longer. However, that does not seem to be a likely explanation for the decline in the gender gap in the effect of education on life expectancy since the relative earnings of highly educated women grew about at the same rate as the relative earnings of highly educated men.

This evidence on the relation between life expectancy and education indicates that the effect of college on this measure of health is more important for men than for women, although these gender differences in the health effects of college education narrowed over time. This narrowing of the gender gap in the effects of college education on mortality rates would increase the incentives for women to go to college relative to the incentives for men. However, since the effect of college on life expectancy is still greater for men, this narrowing of the gender gap would not give women a greater incentive than men to go to college.

3.3 College Education and Marriage

Marriage, especially a stable marriage, tends to raise the utilities of both spouses, which explains why marriage has been such a pervasive institution for thousands of years in different cultures in all parts of the world. Unfortunately, direct evidence on the size of the benefits to men and women from marriage is not available, although there is abundant evidence on the propensities of men and women of different education levels to marry and stay married. Figure 11 plots the fractions of men aged 40-44 currently married by education at twenty-year intervals between 1967 and 2007, while Figure 12 shows the same data for women.

Figure 11 shows that in each period, college-educated men are more likely to be married than are men with a high school education. Moreover, while the effect of education on whether males aged 40-44 were currently married was weak through the 1980s, the education-marriage advantage for males got considerably stronger since then. By 2007, the fraction of men aged 40-44 who had college degrees and were married was about fifteen percentage points higher than the fraction of male high school graduates who were married. The gap between men with graduate degrees and high school dropouts was still larger, at twenty percentage points.

The results for women in Figure 12 are even more interesting. While the fraction of women aged 40-44 who were married was always higher for high school graduates than for high school dropouts, a dramatic reversal took place in the marriage market fortunes of women with higher education. Until the 1980s, the fraction married was higher for high school graduates than college graduates and it even was higher for women who were high school *dropouts* than for women with advanced degrees. Yet by the late 1990s this large marital disadvantage for women with graduate degrees had largely disappeared. In 2007, women with graduate degrees were at least as likely to be married as were women with a 4-year college degree, and both groups were considerably more likely to be married than women who graduated high school.

The marital disadvantage to women from going to college in earlier years was changed into a strong advantage in more recent years. The reasons for this turnabout relate to declining fertility, the increased relative earnings of college-educated women, and the growing value to health and other aspects of life of having a greater command of knowledge and information. Declining fertility and growing importance of knowledge and information decreased the role of reproduction in marriage, and increased the significance of companionship. Since college-educated women earn much more, have fewer children, and have a greater command of knowledge than other women, educated women have become much more attractive as spouses than they were in the past.

Only limited evidence is available on the increase in the real full wealth of married men and women due to the productivity of their marriages. Chiappori, Salanie, and Weiss (2010) use a structural model and find that the utility gains from marriage for college educated men and women, relative to high school educated men and women, have risen over time, and that the rise may be larger for women. Very rough approximations to the benefits from college education that come through marriage are also available from differences in family income by education level. Although the

shares of family income that husbands and wives receive (i.e., consume) are not known, the percentage difference in family incomes by education levels for each gender would equal their percentage increase in their monetary benefits from college if high school and college men, and high school and college women, receive the same shares of their marital incomes. The shares of men and women do not have to be equal for this to be true.

Table 1 presents the ratio of average family incomes between married college and married high school graduates for regular intervals from 1967-2007. Family incomes rise with education for both men and women, and they are much higher for college graduates than for high school graduates. These differences are substantial—in 2007, about 90 percent—but like the earnings benefits they are not much different for college educated women and college educated men. Further, while the number of college educated women who marry has increased over time, the difference in the marriage rate for college educated men relative to high school educated men still exceeds the difference for women.

The improved marriage market for college educated women has increased the incentive for women to go to college. The marriage market for educated men also increased, presumably because of the previously discussed greater earnings and health of college educated men relative to other men, and the growing emphasis on knowledge and information. Educated men also became more attractive in the marriage market as providers and companions; this gave men an additional incentive to go to college. As Figures 11 and 12 show, while the marriage market for college educated individuals improved, it is not clear that the improvement was greater for women than men. Changes in marriage and divorce rates do not explain why women now are more likely than men to go to college.

3.4 College Education and Children's Human Capital

Another potential benefit of college education is to increase a parent's skill in developing his or her children's own human capital. Numerous studies indicate that the children of parents with a college education are much more likely to go to college, even when family income is held constant (see Haveman and Wolfe 1995). Several studies show that mothers generally put greater emphasis on their children's education than fathers do (see, e.g., Duflo 2000; Lundberg, Pollack, and Wales 1996), and time use studies show that mothers spend more time on child care, and more total time with their children, than fathers do (see Guryan, Hurst, and Kearney 2008).

When we focus on how *college education* affects mothers' and fathers' contributions to their children's human capital, however, the picture is much less clear. Various studies have reached divergent conclusions on whether mother's education has a greater, equal, or smaller effect on children's education than father's education does (see Farré, Klein, and Vella 2009 and studies cited therein). Perhaps surprisingly, some studies find a large effect of father's education, with a small effect of mother's education (see Behrman and Rosenzweig 2002; Plug 2004).

We note that the unclear relationship between mother's and father's education and children's human capital (proxied by education) relates to the complex relationship between parental education and parental investments of time with children. On the one hand, maternal education may benefit children more, because mothers spend more time than fathers with children and higher education may increase the productivity of that time. On the other hand, higher education has a greater effect on the labor force attachment of women than men; this will tend to decrease time spent with children for college educated women relative to college educated men. Time use studies indicate that college education increases parental time spent on child care (the increase is larger in absolute terms, though smaller in percentage terms, for women); but for men higher education increases total time spent with children, while for women it is associated with a decrease in total time spent with children (see Guryan, Hurst, and Kearney 2008).

Hence, it is not unambiguously clear that the benefit to a mother from college, in terms of her children's human capital formation, is sufficiently greater than the benefit to a father, to explain the overtaking of men by women in college completion.

4. Gender Differences in the Full Cost of College

The total benefits from college are high for both men and women, and they have risen during the past 40 years. While benefits for women appear to have increased relative to those for men, total college benefits appear to remain lower for women than men. Hence, gender differences in benefits alone cannot explain why a much larger fraction of women than men graduate college not only in the United States, but also in many other countries. The most likely explanation depends on gender differences in the total cost of going to college. Below, we discuss both traditional costs and non-traditional costs. Traditional costs include tuition and forgone wages while in school. Non-traditional costs refer to the increased "difficulty" of school that results from poor cognitive and/or non-cognitive skills related to performance in school.

We argue that changes in the costs of college as traditionally measured cannot explain why women have overtaken men in college completion. Non-traditional costs—and in particular the effects of non-cognitive skills on costs—appear to be key to understanding this phenomenon. There appear to be two important gender differences in non-cognitive skills: First, women have *on average* higher non-cognitive skills along many dimensions. This translates to lower total costs of schooling for women, even if traditional costs of schooling for men and women are identical. This helps explain why women now complete college at higher rates than men, even though the benefits of college still appear to be higher for men than women.

Second, among women there appears to be lower variability in many non-cognitive skills than among men. This translates into lower variability in the total costs of college for women. As we argue below, this fact is crucial to understanding the *change over time* in the gender difference in rates of college attendance.

4.1 Traditional Costs of College

While the traditional costs of college are likely an important component of any individual's schooling decision, we largely ignore them in our analysis. At least for the United States, they cannot explain the trends in higher education we observe. Regarding tuition costs, we first note that tuition costs have been rising over time, even as college attendance has consistently increased.² This strongly indicates that changes in tuition costs are an effect, not a cause, of changes in college attendance. Second, we do not have any evidence on gender differences in either tuition or difficulties in financing a college education; we assume that the tuition and student loans offered to women and men are comparable for men and women of equal skills.

For most students, the main monetary cost of college is the forgone earnings from being in college rather than working. Forgone earnings, like tuition, cannot explain the trends we observe. High school educated women's wages have risen relative to high school educated men's wages over the last 40 years, which means that the opportunity cost of college—forgone wages—has *risen* for women relative to men, even as college attendance of women has eclipsed men. And as noted above, the cost in forgone wages relative to the gain in wages from college (i.e., the college wage premium) has been the same for men and women over time.

4.2 Non-Traditional Costs of College

We direct our attention, then, to the other costs of college. Both cognitive and non-cognitive skills affect the cost of schooling, partly by increasing scholarships and lowering tuition and other fees, but mainly by lowering the psychic or non-monetary costs of schooling. Higher cognitive and non-cognitive skills make the accumulation of human capital in college "easier," as reflected in higher grades and other measures of school performance. College performance in turn affects how long a student continues in college, including whether they graduate from a four-year college, and how long it takes for them to graduate.

Indeed, there is an emerging body of literature supporting the connection between cognitive and non-cognitive skills and measures of school performance such as probability of high school graduation and enrollment in college. See Cunha and Heckman (2008); Cunha and Heckman (2007). These effects of cognitive and non-cognitive skills on the production of human capital from college imply that persons with greater skills receive higher *net* returns from college even when total benefits from college are the same. Therefore, gender differences in the distributions of cognitive and non-cognitive skills might be important in explaining gender differences in the propensities to attend and graduate from college.

Although both cognitive skills (like IQ) and non-cognitive skills (like self-motivation) affect the cost of college, we believe that non-cognitive skills are the key to explaining the fact that the growth in college attendance in the United States has

² This factor may not operate in the same way internationally. As institutions of higher education expand in many developing countries, the monetary costs of higher education may in fact be falling in some regions.

been an overwhelmingly female phenomenon. Gender differences in the means and variances of cognitive measures like IQ appear to be minor. For example, Bound, Griliches and Hall (1986) report IQ scores from high school intelligence tests for boys and girls. The means for boys and girls are essentially identical (101.4 and 102.3, respectively). Note, however, that this result is in some sense uninformative: the scoring of IQ tests is calibrated so that men's and women's average scores are equal. (The variances are not calibrated in this way.) The standard deviations are close as well, although note it is slightly higher for boys than girls (15.9 and 15.2, respectively).

The main skill differences between men and women are in the non-cognitive arena. Importantly, non-cognitive skills are at least as important as cognitive skills in determining academic success and life outcomes. Heckman, Stixrud, and Urzua (2006) find that non-cognitive skills are as important as, if not more important than, cognitive skills in determining many aspects of social and economic success including the probability of being a 4-year-college graduate at age 30. Non-cognitive skills affect grades and test scores by affecting how much attention students pay to instruction from their teachers, how organized they are in doing homework and preparing for exams, whether they get disciplined for inappropriate behavior at school, and in various other ways.

This suggests that differences in average non-cognitive skills of males and females should show up as differences between women and men in different measures of performance in school. In fact, it appears that a large body of evidence (which we discuss below) supports the conclusions that (1) women, on average, have higher non-cognitive skills than men along many dimensions, and (2) across women there is less inequality in non-cognitive skills than across men. We take these gender differences as given, and do not try to explain where they come from.

4.2.1 *Grades*

We begin with grades, a crude but broad measure of non-cognitive skills relevant to schooling. We find that women earn consistently higher grades than men in primary, secondary, and tertiary schooling in the United States. Table 2 shows that girls earn higher grades than boys in elementary and middle school. Girls' high school GPAs average approximately 0.2 points higher than boys' (NCES 2009). The mean first-year undergraduate GPA for women is 3.02 and for men is 2.84 (Beginning Postsecondary Students Longitudinal Study; see NCES 2008b). The mean cumulative undergraduate GPA for women is 2.72 and for men is 2.63 (High School & Beyond; see NCES 2008b). Most recently, Conger and Long (2010) examine a sample of 16 universities in Florida and Texas and find that women earn GPAs about 0.2 higher than men on average.

Concomitant with higher average grades for women is lower variability among women than men in grades. Table 2 reports higher standard deviations in grades among boys than girls in all elementary school and middle school groups. Figure 13 illustrates the typical distributions of GPAs for male and female college students; although the upper tail of grades is censored at a GPA of 4.0, the thicker lower tail of the male distribution is visible.

4.2.2 *Measures of Achievement*

If we look at measures of achievement, we find the same pattern. Table 2 demonstrates this pattern for positive measures such as time spent on homework and achievement of goals as well as negative measures such as disruptive behavior, behavioral problems, and repeated grades. Girls have higher means for positive measures, lower means for behavioral problems, and lower variance across all categories than boys.

4.2.3 *Achievement and Aptitude Test Scores*

The evidence from achievement and aptitude tests provides less support for the claim that women have higher average non-cognitive skills. Of course, these results may simply reveal that grades involve greater non-cognitive inputs than do test scores. Kenney-Benson et al. (2006) find no significant difference in achievement test scores for boys and girls in their sample of Illinois middle-school students. Rodgers and Spriggs (1996) examine the AFTQ scores of black, white, and Hispanic men and women and find virtually no difference in average scores between males and females in any group.

Similarly, in the international context, we see no consistent pattern in the gender difference in average PISA test scores. Figure 14 shows differences between average scores of girls and boys in 4 subjects in the PISA tests administered in 2003 to teenagers in 41 countries.

In striking contrast to the evidence on *average* test scores is the evidence on *variation* in test scores. Figure 15 shows the gender differences between the standard deviations of girls and boys in the 2003 PISA tests. Here we see the unmistakable pattern from before: variance is almost uniformly smaller for girls across all 41 countries and 4 subject areas. Table 3 provides more support for the claim that women have lower variance in non-cognitive skills. It compares the variance in women's and men's scores across a wide range of achievement and aptitude tests and measures. Almost without exception, men's variance exceeds women's variance, often by a wide margin.

As discussed in Section 2.2, lower variability of non-cognitive skills implies higher responsiveness to the benefits of schooling among individuals close to the mean of the distribution of total costs. Given the evidence that women have lower variability in non-cognitive skills than men, we would predict women are more likely to respond to incentives to increase schooling. This is what studies, both in the United States and abroad, find. Dynarski (2008) examines the effect of the introduction of large-scale merit aid programs in Arkansas and Georgia in the 1990s and concludes that “[t]he effects are strongest among women.” Angrist and Lavy (2009) conduct an experiment with cash incentives for achievement in secondary schools in Israel, and find a substantial response among girls—but not among boys. See Angrist, Lang, and Oreopoulos (2009) for similar evidence on Canadian university students.

In sum, women appear to have higher average non-cognitive skills and lower inequality in the distribution of non-cognitive skills than men. This suggests lower average total costs of schooling, and a lower variability in these costs for women than men.

The better performance in grade school of girls than boys appears to explain much of the growing female advantage in higher education, as Golden, Katz, and Kuziemko (2006) and Jacob (2002) have noted. Golden, Katz, and Kuziemko (2006, Tables 1 and 2), for example, show that part, perhaps a large part, of the improvement in female college completion rates relative to male completion rates are due to gender differences in average math and reading scores, and to rank in high school class.

The evidence for countries outside the United States consistently supports the conclusion that women have less inequality in non-cognitive skills than men. This leads us to emphasize that the lower heterogeneity in total costs among women than among men, and thus higher elasticity of supply of women to college, is likely a key explanatory factor in the greater worldwide boom in higher education of women than of men.

4.3 Explaining the Reversal of the Gender Gap in College Completion

We now apply this evidence to our model to explain the overtaking of men by women in higher education. Even though total benefits from college are no higher for females than males, and very probably are lower, the net returns might be higher for the average female than the average male since, as we have indicated, the full costs of attending college are likely to be lower for the average female. In the past, although non-cognitive skills and grades in school were higher for females than males, women used to greatly lag men in college attendance because their total benefits from college were then much lower than were college benefits for men.

Figure 5 graphs the equilibrium number of male and female college graduates and the equilibrium return, R , for the period before the mid-1970s. At this equilibrium return to both men and women, the number of women going to college is significantly below that of men: $C_m > C_f$.

During the past 40 years monetary returns to college have risen substantially in the United States and many other countries. Since the fraction of high school graduates who go to college has also risen, quite sharply in many countries, the rise in returns combined with increased supply would indicate that the demand for college graduates shifted outward. Presumably, the reason for this shift is technological change that favored college graduates, changes in output mix toward college-intensive industries, globalization, and other shifts in favor of college graduates (see, e.g., Katz and Murphy 1992).

If the supply curves of men and women to college were stable, the increase in demand for college graduates would increase the number of both sexes that go to college by increasing the labor market return from college. Given the increase in labor market returns from college, the percent increase in college attendance of each gender would be positively related to the supply elasticity of that gender. These

supply elasticities are negatively related to the degree of heterogeneity among men and women in total costs and in total returns. As shown in Section 2.2, the supply curve of each gender would be the cumulative distribution of the net benefits—that is, net of total costs—for all members of each gender. Those persons with low costs of attending college would be willing to go to college even with low monetary benefits, while those with the highest costs would require high monetary benefits to induce them to go to college.

The evidence we presented in Section 4.2 indicates that the variability in non-cognitive skills is greater for men than for women. As discussed in Section 2.2, this implies that as the benefits of college rise, the elasticity of supply to college is greater for women than for men, so that the increased demand for college graduates would induce a greater increase in the number of women going to college.

The greater response of women to the upward shift in demand could readily imply that the number of women going to college would overtake that of men. This possibility is illustrated by Figure 16, which shows equilibria before and after a shift outward in demand for college graduates. Demand has shifted from D to D' , the wage gain increases from R to R' , and the number of men going to college increases from C_m to C'_m , while the number of women going to college increases by much more, from C_f to $C'_f > C'_m$.

This explanation is also consistent with the observation that in the past, when very few individuals from low socio-economic status (SES) backgrounds went to college, the vast majority of college graduates from low SES families were men. Today, as larger numbers of low SES individuals attend college, their numbers are disproportionately women. In fact, the female-favoring gender imbalance in college attendance is highest among low SES families. See Goldin, Katz, and Kuziemko (2006). Since we expect low SES families to have the highest non-monetary costs of college, our model would indicate that as the benefits of college rise, the marginal individuals will increasingly be from low SES families—and marginal individuals will be disproportionately female.

Figure 16, however, does not tell the whole story. Supply curves to college did not remain constant as monetary returns increased since we have shown that various non-monetary benefits of a college education also increased, such as the effects of going to college on the propensity to marry and stay married. Moreover, as argued earlier, the gap between the non-monetary benefits from college of men and women narrowed, as the labor force participation and propensity to marry of college women sharply increased, along with perhaps other non-monetary benefits of college. Even though men on average appear to still get larger non-monetary benefits from college than women do, the substantial narrowing in the gender non-monetary benefit gap could have shifted the supply curve of women to the right of that of men. The reason is that the average level of non-cognitive skills is greater for women than for men, so that the average full cost of going to college is smaller for women.

This is shown in Figure 17, where the supply curve of men shifts over time from S_m to S'_m , while the supply of women shifts from S_f , which is to the left of S_m , to S'_f , which is to the right of S'_m . As the figure shows, even if demand did not shift

outward, these shifts in supply would have induced the fraction of women going to college to surpass the fraction of men going. However, given the supply shifts induced by the convergence between men and women in the non-monetary benefits of college, the outward shift in demand produces an even greater positive gap between the proportion of women and men who go to college.

The fraction of women with a college education exceeds the fraction of college men not only in most rich countries, but also in many developing countries, such as Brazil and Iran. In developing countries, non-monetary returns in the form of labor force participation, propensity to marry, and in other dimensions, appear to still be much lower for college women than men. Since monetary benefits from college have risen in many developing countries as well as developed countries, including Brazil, China, and India, this evidence suggests that gender differences in elasticities of supply are important contributors to why the propensity to go to college is now greater for women than for men in many developing as well as developed countries.

5. Conclusion

We showed that gender differences in the earnings, health, marriage, and other returns from college greatly narrowed after the 1970s. Therefore, even if the means and distributions of the costs of attending college had been the same for males and females, the male advantage in college attendance would have narrowed considerably over time. However, if total costs were the same, gender differences in college attendance would not have changed in so many countries in favor of females since their returns from college, both monetary and non-monetary, are still generally lower, or at least no higher, than those of males. This reversal in the gender gap in college attendance occurred presumably because females have an advantage in the total costs of attending college.

Differences in gender means and distributions of skills, especially non-cognitive skills, affect the supply of college educated women compared to college educated men since the full cost of college is lower for persons with greater non-cognitive skills. We show that the average non-cognitive skills of women are higher than the average for men, as measured by average grades in school and assessments of achievement and behavior problems. We also show that the inequality in non-cognitive skills is lower for women, as measured by variances in grades, achievement and behavior problems, and test scores.

Lower inequality of non-cognitive skills among women than men imply that, for the currently relevant portion of the supply curve, elasticities of supply to college would be greater for women than men since heterogeneity in total costs of college attendance would be lower for women. Greater average non-cognitive skills of women than men imply that the supply of women to college would be greater than that of men when their total benefits were the same. The gender differences in mean non-cognitive skills implies that as total benefits from college narrowed over time between men and women, the lower average full college cost of women could help explain why women overtook men in their likelihood of graduating from college. The gender differences in supply elasticities implies that the increased demand for college graduates that occurred in most countries during the past 40 years would

have increased the supply of women to college by more than the supply of men. This too contributed to women's college attendance surpassing that of men, probably in an important way.

Data Appendix

Figures 2 and 8-12 use the 1963-2007 March CPS data series from King et al. (2008). The CPS data was processed as follows: we include adult civilians who were age 25 to 64 at the time of survey. We drop observations flagged as containing "allocated" (i.e., imputed) education data. For Table 1 and Figure 9, we also drop observations flagged as containing allocated wage and income data. We exclude observations with negative CPS sample weights. (Fewer than 230 out of nearly 2.9 million observations in the main sample have negative weights.) All observations are weighted by their CPS sample weights. Upper-tail wage observations were corrected to account for topcoding of wages in CPS public-use files; see Hubbard (forthcoming).

Observations coded as married with spouse present and married with spouse absent are recoded as "married"; all other observations are recoded as "not married." Hours worked per year are calculated as usual hours worked per week times weeks worked. Share of married men or women working is defined as the share of all married men or women reporting non-missing usual hours who worked greater than zero. Family income is measured with the Total Family Income variable (FTOTVAL in IPUMS).

The coding of educational variables in the CPS data changed between 1990 and 1991. For 1963-1990, the education variable is the number of whole and partial years of education completed (topcoded at 18). For 1991-2007, the education variable is coded as intervalled years of schooling for observations with less than a high school degree, and as the highest degree obtained, with a separate category for some college with no college degree, for those with at least a high school degree. We use the following educational category recodes (we do not use the educational category recodes provided by IPUMS):

Dropout

- 1963-1990: Less than 12 years of schooling completed
- 1991-2007: Less than High School Diploma or GED

High School Graduate

- 1963-1990: 12 years of schooling completed and no time in college
- 1991-2007: High school diploma or GED

Some College

- 1963-1990: More than 12 years and less than 16 years of schooling completed
- 1991-2007: Associate Degree or Some College, No Degree

Bachelor's Degree

- 1963-1990: 16 or 17 years of schooling completed
- 1991-2007: Bachelor's Degree

Advanced Degree

- 1963-1990: 18 or more years of schooling completed
- 1991-2007: Masters, Professional, or Doctorate Degree

College Graduate

- 1963-2007: Any observation that is either Bachelor's Degree or Advanced Degree, as defined here

Figures 1 and 3-6 use projections backward of numbers of men and women with tertiary education completed by five-year age category provided by Lutz et al. (2008) and the corresponding projections forward from K.C. et al. (2008). We use purchasing power parity (PPP) GDP data from the Penn World Table (PWT) version 6.3. We use the GDP measure RGDPL2, which is intended to address some of the concerns raised about the stability of GDP growth estimates used in PWT 6.2. See Heston, Summers, and Aten (2009). (Our results are not sensitive to the choice of GDP measure.) We compute per capita GDP using population data from the World Development Indicators Online (World Bank 2008). The sample of countries with non-missing observations for these measures includes 104 countries in 1970 and 1980, 112 countries in 1990, and 120 countries in 2000 and 2010. (Because data for per-capita GDP in 2010 is not available, we use the groupings from 2000 for 2010.)

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Tables

TABLE 1:
RATIO OF AVERAGE FAMILY INCOME OF MARRIED COLLEGE GRADUATES
TO AVERAGE FAMILY INCOME OF MARRIED HIGH SCHOOL GRADUATES, BY SEX

	1967	1977	1987	1997	2007
Men	1.455	1.408	1.603	1.851	1.889
Women	1.416	1.337	1.542	1.752	1.859

Source: Analysis of King et al. (2008).

TABLE 2A:
MEASURES OF NON-COGNITIVE SKILLS, EIGHTH GRADE NELS RESPONDENTS

	Means		Standard Deviations	
	Boys	Girls	Boys	Girls
Positive Measures				
Middle School Grades	2.932	3.065	0.741	0.704
Hours Worked on Homework per Week	5.877	6.208	4.962	4.890
Negative Measures				
Behavior Problem	0.405	0.195	n/a	n/a
Behavior Composite Score	0.296	-0.435	1.801	1.250
Repeated Grade in Elementary School	0.175	0.115	n/a	n/a

Source: Jacob (2002).

Note: "Behavior Problem" and "Repeated Grade in Elementary School" are indicator variables, and thus standard deviations are not reported here.

TABLE 2B:
MEASURES OF NON-COGNITIVE SKILLS, FIFTH AND SEVENTH GRADERS

	Means		Standard Deviations	
	Boys	Girls	Boys	Girls
Positive Measures				
Grades, 5th Grade	8.51	8.88	2.03	1.90
Grades, 7th Grade	8.47	9.49	2.97	2.72
Achievement Goals, 5th Grade	-0.28	0.25	1.58	1.31
Achievement Goals, 7th Grade	-0.20	0.23	1.24	1.30
Learning Strategies, 5th Grade	3.69	3.99	0.76	0.62
Learning Strategies, 7th Grade	3.18	3.53	0.86	0.67
Negative Measures				
Disruptive Behavior, 5th Grade	1.98	1.40	0.99	0.56
Disruptive Behavior, 7th Grade	2.41	1.50	1.20	0.68

Source: Kenney-Benson et al. (2002).

Note: All differences in means are significant at the 5% level.

TABLE 3:
VARIANCE RATIOS (VRs) OF MALES' AND FEMALES' PERFORMANCE ON VARIOUS ACHIEVEMENT AND APTITUDE TESTS

Test	VR	Test	VR	Test	VR
PSAT		WAIS/WAIS-R		DAT	
Verbal	1.05	Information	1.16	Numerical Ability	1.11
Mathematics	1.24	Digit Span	1.11	Mechanical Reasoning	1.28
SAT		Vocabulary	1.06	Space Relations	1.21
Verbal	1.05	Arithmetic	1.18	Spelling	1.12
Mathematics	1.20	Comprehension	1.02	Verbal Reasoning	0.96
CAT		Similarities	1.04	Abstract Reasoning	1.01
Vocabulary	1.27	Picture Completion	1.08	Language	0.99
Reading Comprehension	1.34	Picture Arrangement	1.07	Clerical Speed and Accuracy	0.94
Language	1.18	Block Design	1.12		
Spelling	1.30	Object Assembly	1.03		
Arithmetic	1.34	Digit Symbol	0.91		

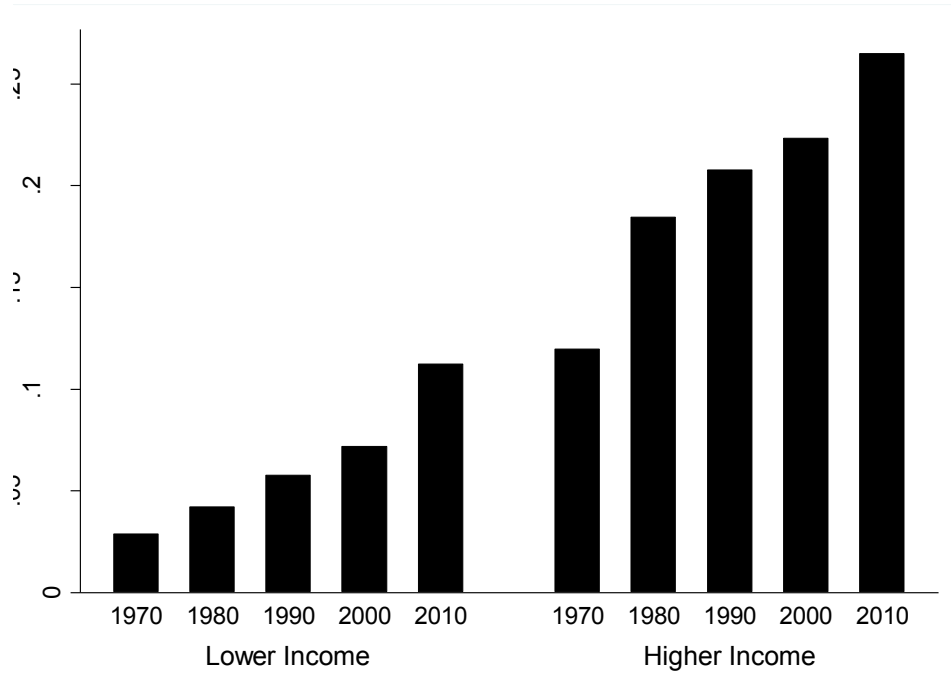
Source: Feingold (1992). See also Kenney-Benson et al. (2006) and Rodgers and Spriggs (1996).

Note: VRs above 1.00 indicate boys' performance was more variable than girls' performance, and VRs less than 1.00 indicate that girls varied more than boys. All VRs reported are grand medians across sampled grade levels and test years.

PSAT = Preliminary Scholastic Aptitude Test, SAT = Scholastic Aptitude Test, CAT = California Achievement Tests, WAIS = Wechsler Adult Intelligence Scale, WAIS-R = Wechsler Adult Intelligence Scale-Revised, DAT = Differential Aptitude Tests.

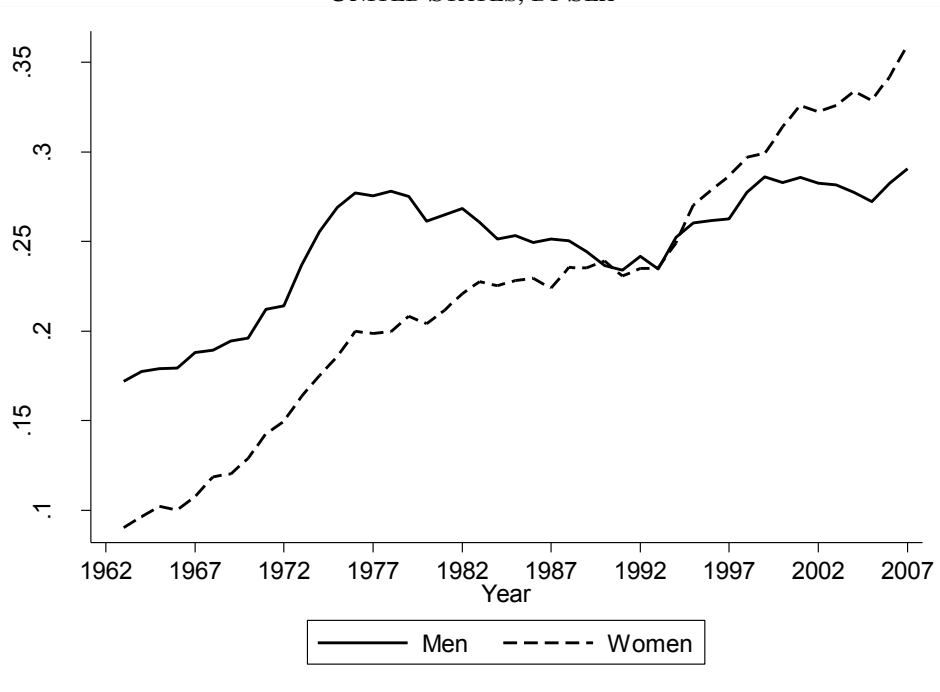
Figures

FIGURE 1: FRACTION OF 30- TO 34-YEAR-OLDS WITH COLLEGE EDUCATION, COUNTRIES ABOVE AND BELOW MEDIAN PER CAPITA GDP



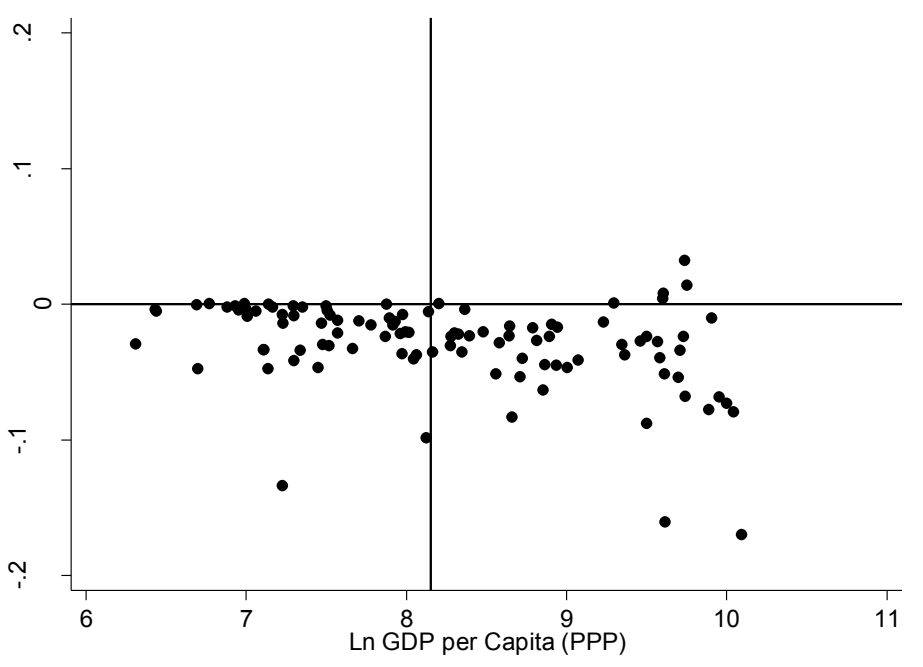
Source: Analysis of K.C. et al. (2008), Lutz et al. (2008), and Heston et al. (2006). See Data Appendix.

FIGURE 2: FRACTION OF 25- TO 34-YEAR-OLDS WITH COLLEGE EDUCATION, UNITED STATES, BY SEX



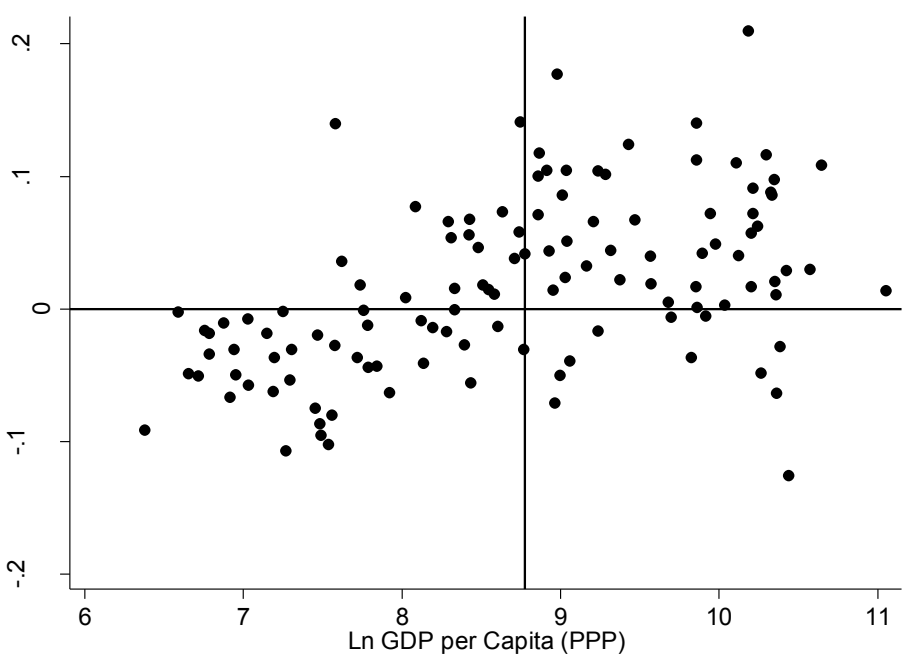
Source: Analysis of King et al. (2008). See Data Appendix.

FIGURE 3: GENDER DIFFERENCE AMONG 30- TO 34-YEAR-OLDS IN SHARE WITH COLLEGE EDUCATION, BY PER CAPITA GDP, 1970



Source: See Figure 1. Note: Vertical line represents median log per capita GDP.

FIGURE 4: PROJECTED GENDER DIFFERENCE AMONG 30- TO 34-YEAR-OLDS IN SHARE WITH COLLEGE EDUCATION, BY PER CAPITA GDP, 2010



Source: See Figure 1. Note: Vertical line represents median log per capita GDP (2000).

FIGURE 5: SUPPLY OF AND DEMAND FOR COLLEGE-EDUCATED WORKERS IN 1970S

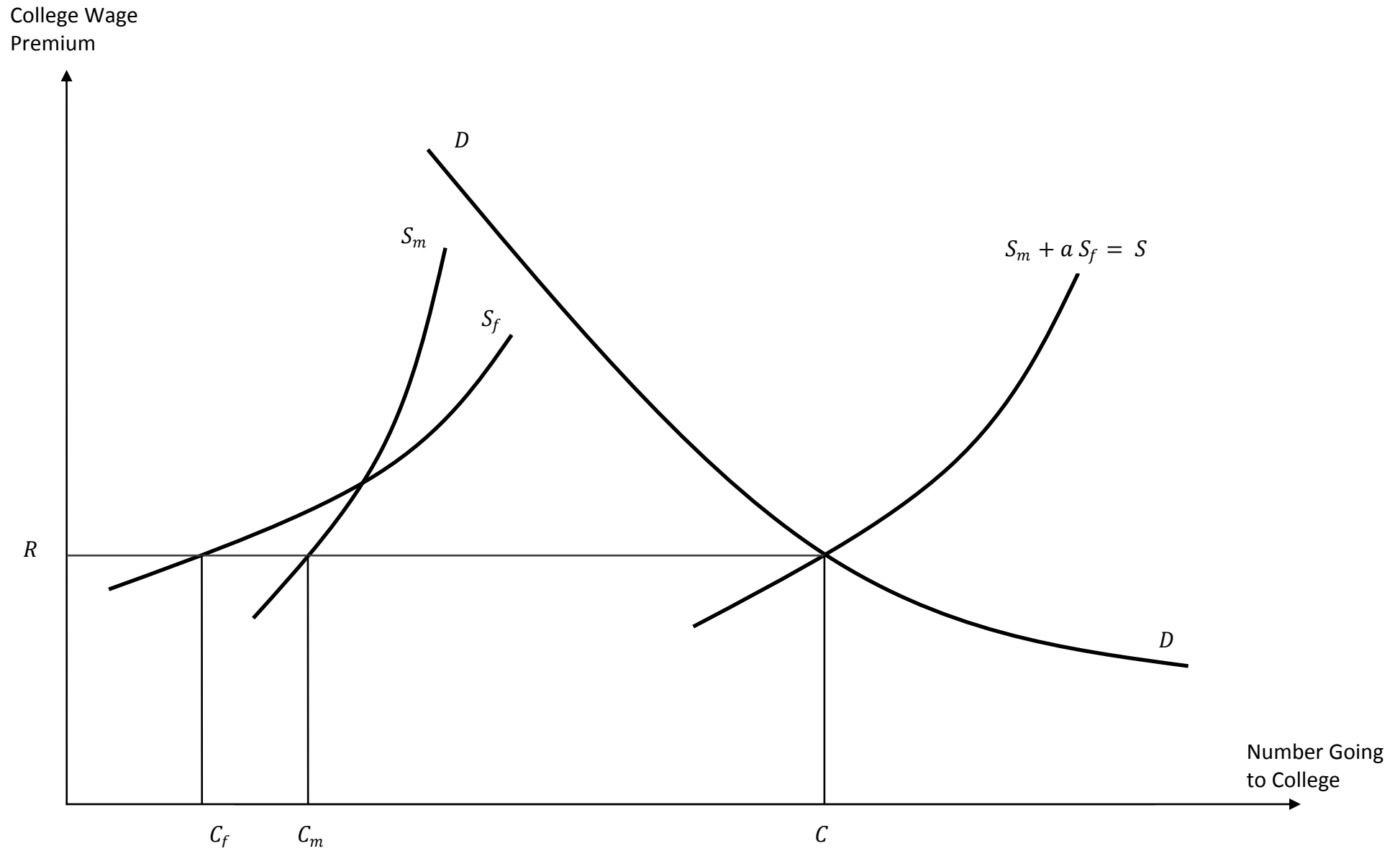


FIGURE 6: TWO DENSITY FUNCTIONS FOR DISTRIBUTIONS OF COLLEGE EDUCATION COSTS

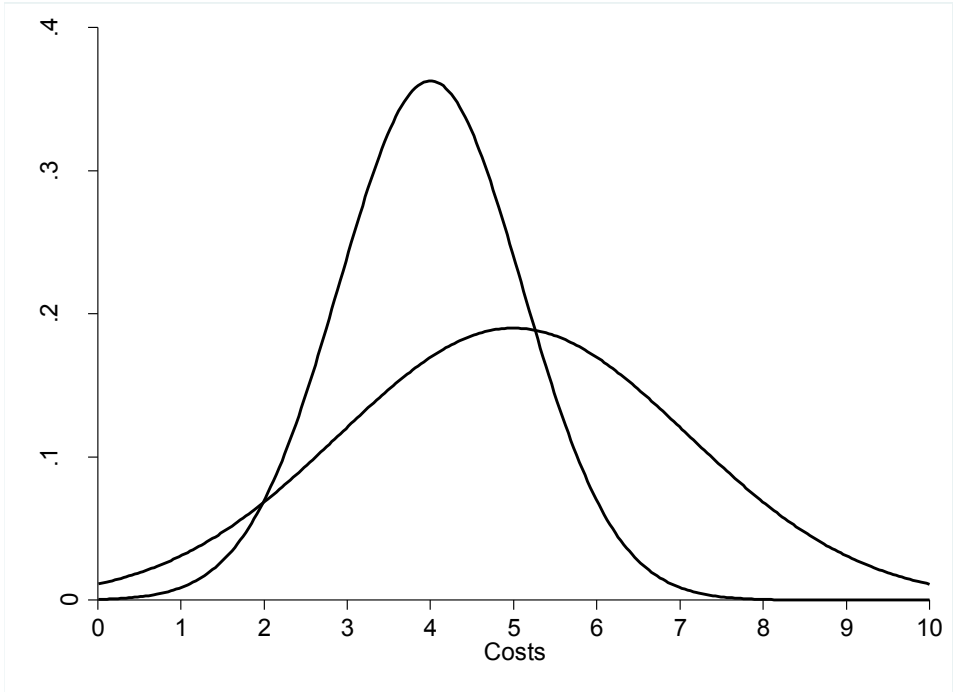


FIGURE 7: SHARE OF COST DISTRIBUTIONS WITH BENEFITS EXCEEDING COSTS WHEN BENEFITS ARE LOW

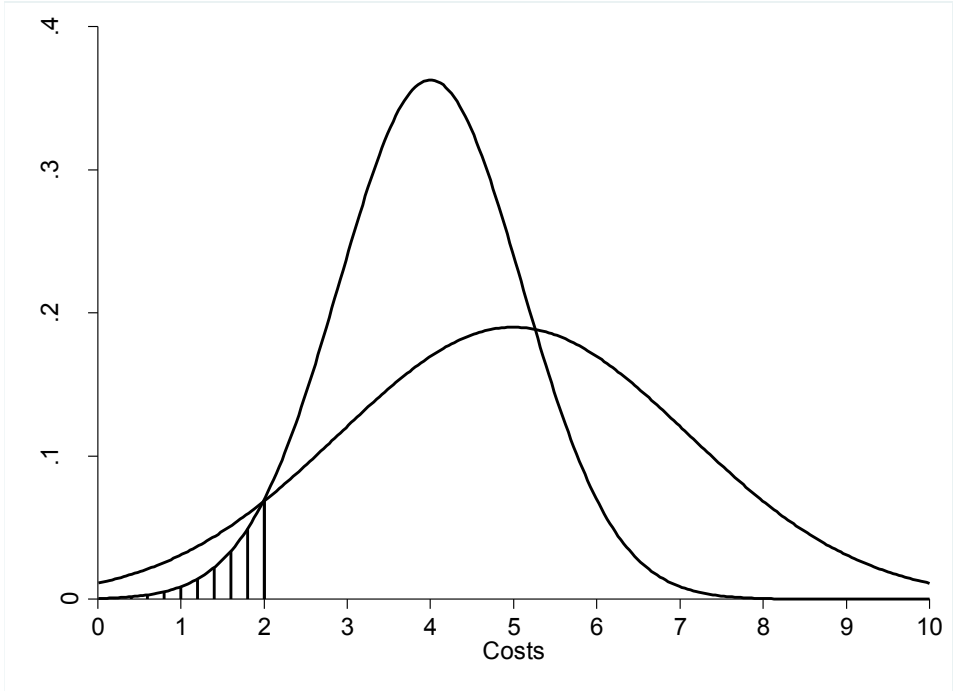


FIGURE 8: SHARE OF COST DISTRIBUTIONS WITH BENEFITS EXCEEDING COSTS WHEN BENEFITS ARE HIGHER

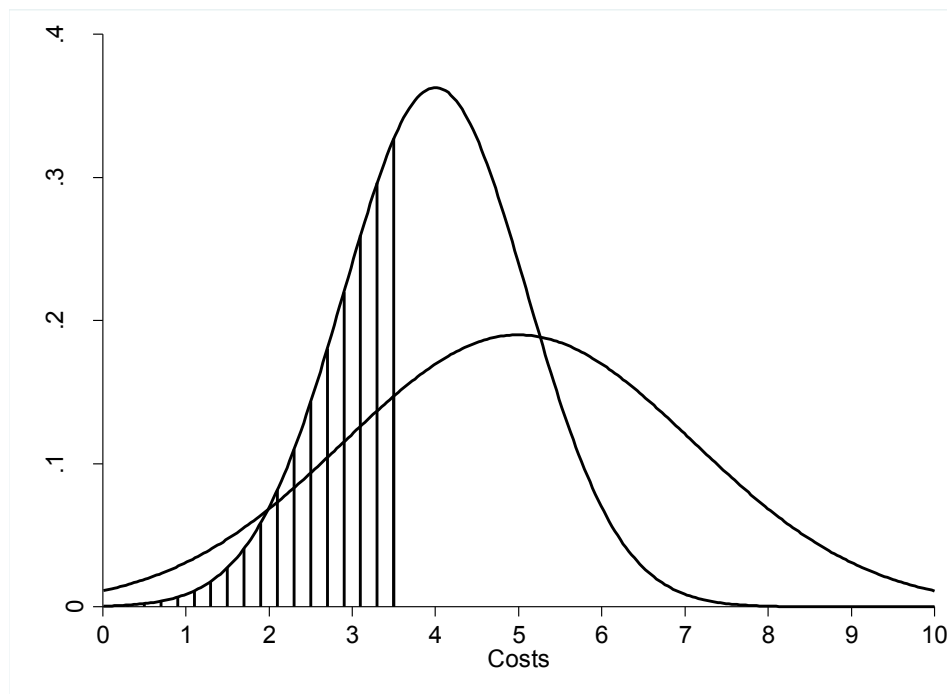


FIGURE 9: COLLEGE WAGE PREMIUMS IN THE UNITED STATES, BY SEX



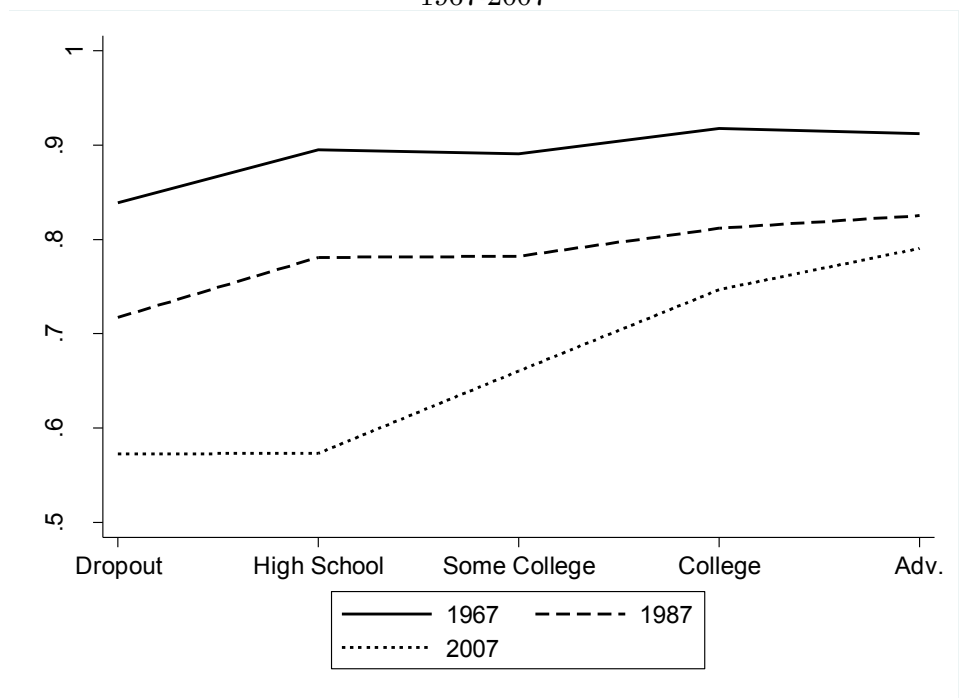
Source: Hubbard (forthcoming).

FIGURE 10: SHARE OF MARRIED MEN AND WOMEN WORKING IN THE UNITED STATES



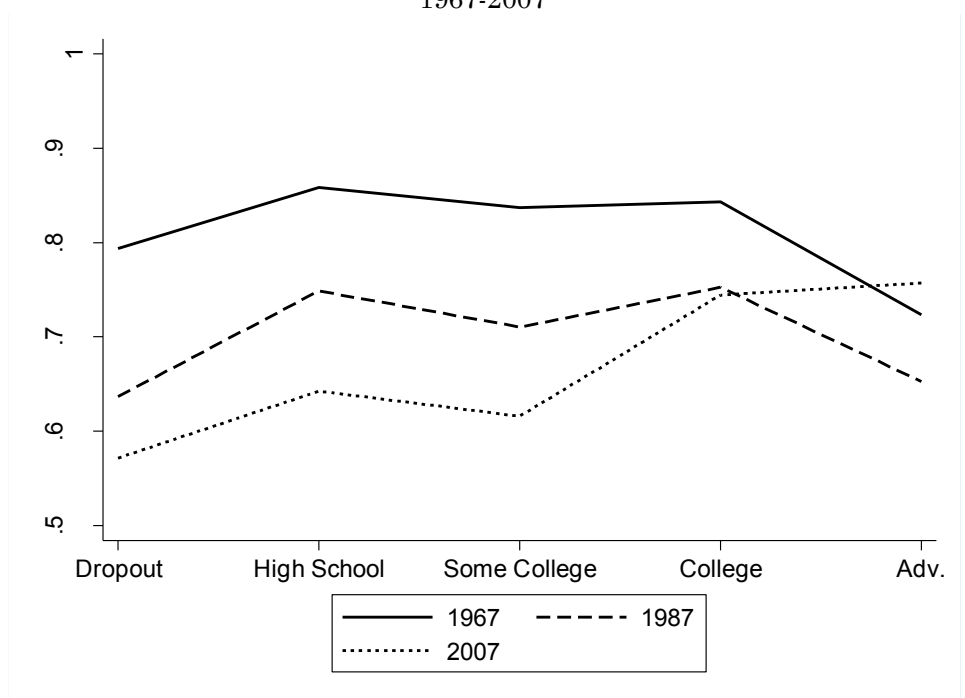
Source: See Figure 2.

FIGURE 11: FRACTION OF MEN AGE 40-44 CURRENTLY MARRIED IN THE UNITED STATES, 1967-2007



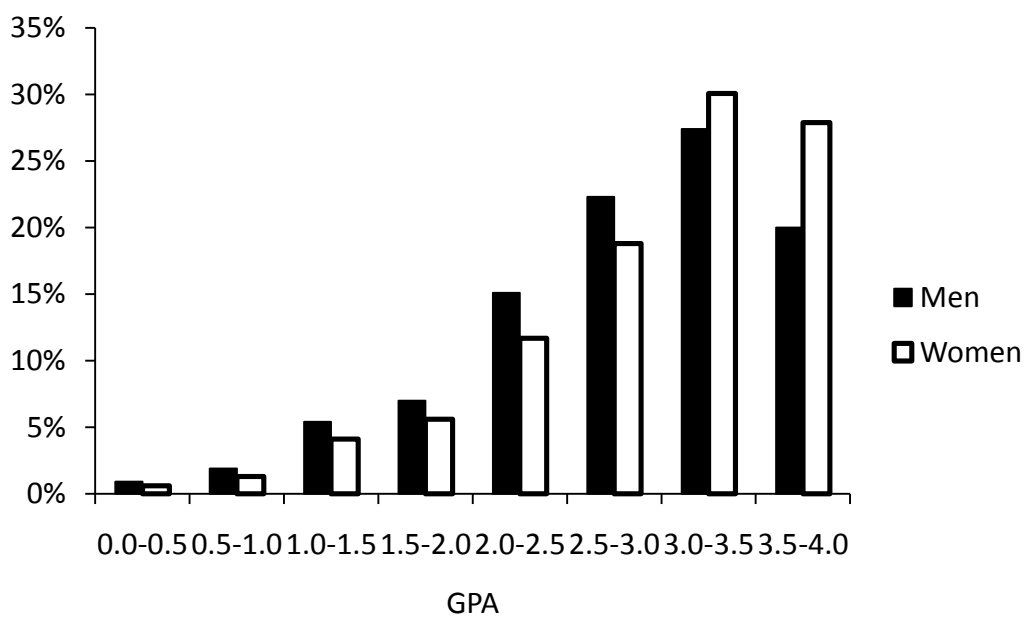
Source: See Figure 2.

FIGURE 12: FRACTION OF WOMEN AGE 40-44 CURRENTLY MARRIED IN UNITED STATES, 1967-2007



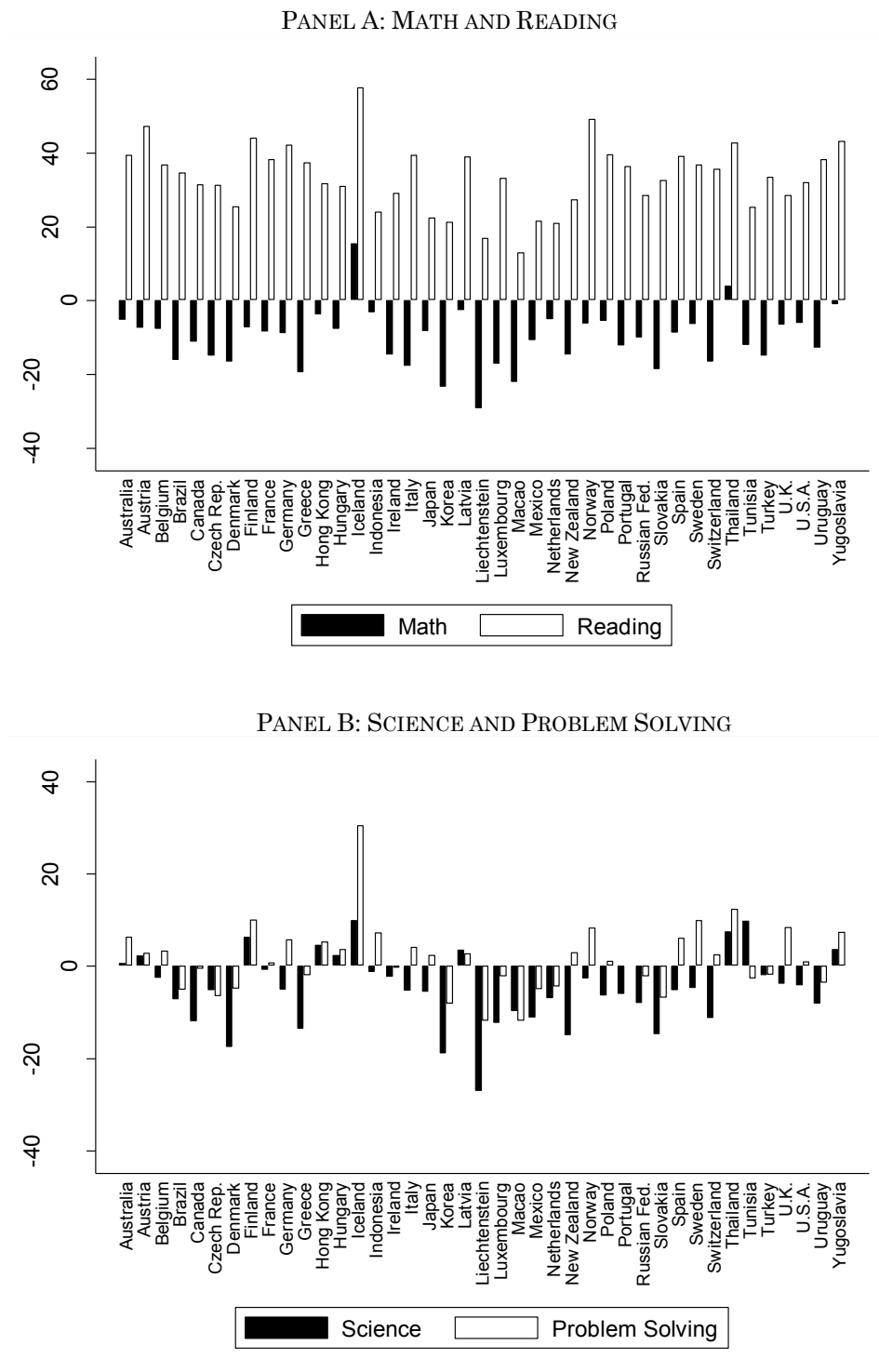
Source: See Figure 2.

FIGURE 13: DISTRIBUTION OF FIRST-YEAR UNDERGRADUATE GPA, BEGINNING POSTSECONDARY STUDENTS LONGITUDINAL STUDY



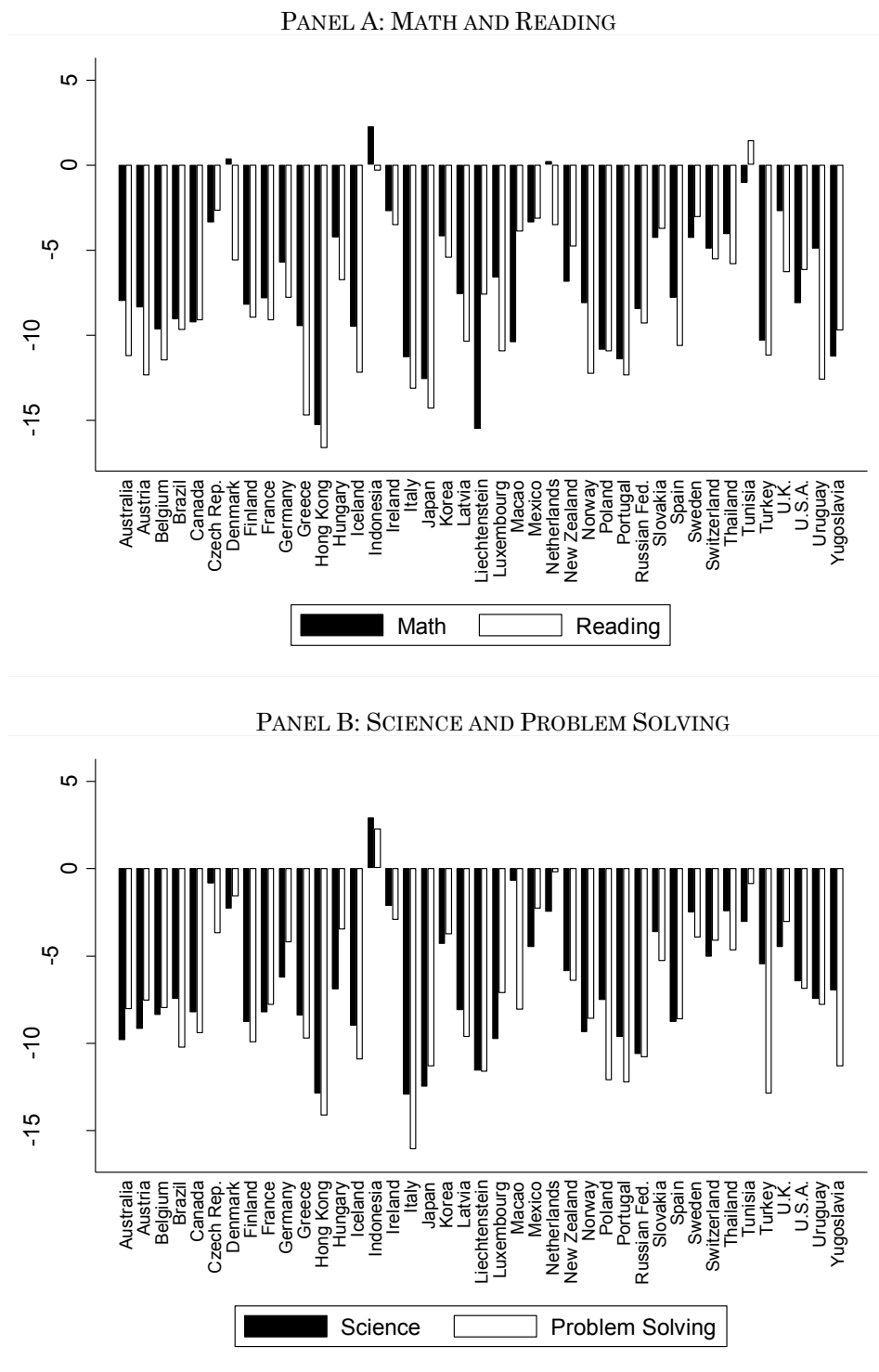
Source: NCES (2008b).

FIGURE 14: FEMALE – MALE DIFFERENCE IN MEAN PISA SCORES BY SUBJECT AND COUNTRY, 2003



Source: Analysis of OECD (2005).

FIGURE 15: FEMALE – MALE DIFFERENCE IN STANDARD DEVIATION OF PISA SCORES BY SUBJECT AND COUNTRY, 2003



Source: Analysis of OECD (2005).

FIGURE 16: SUPPLY OF AND DEMAND FOR COLLEGE-EDUCATED WORKERS,
GIVEN A SHIFT IN DEMAND ONLY

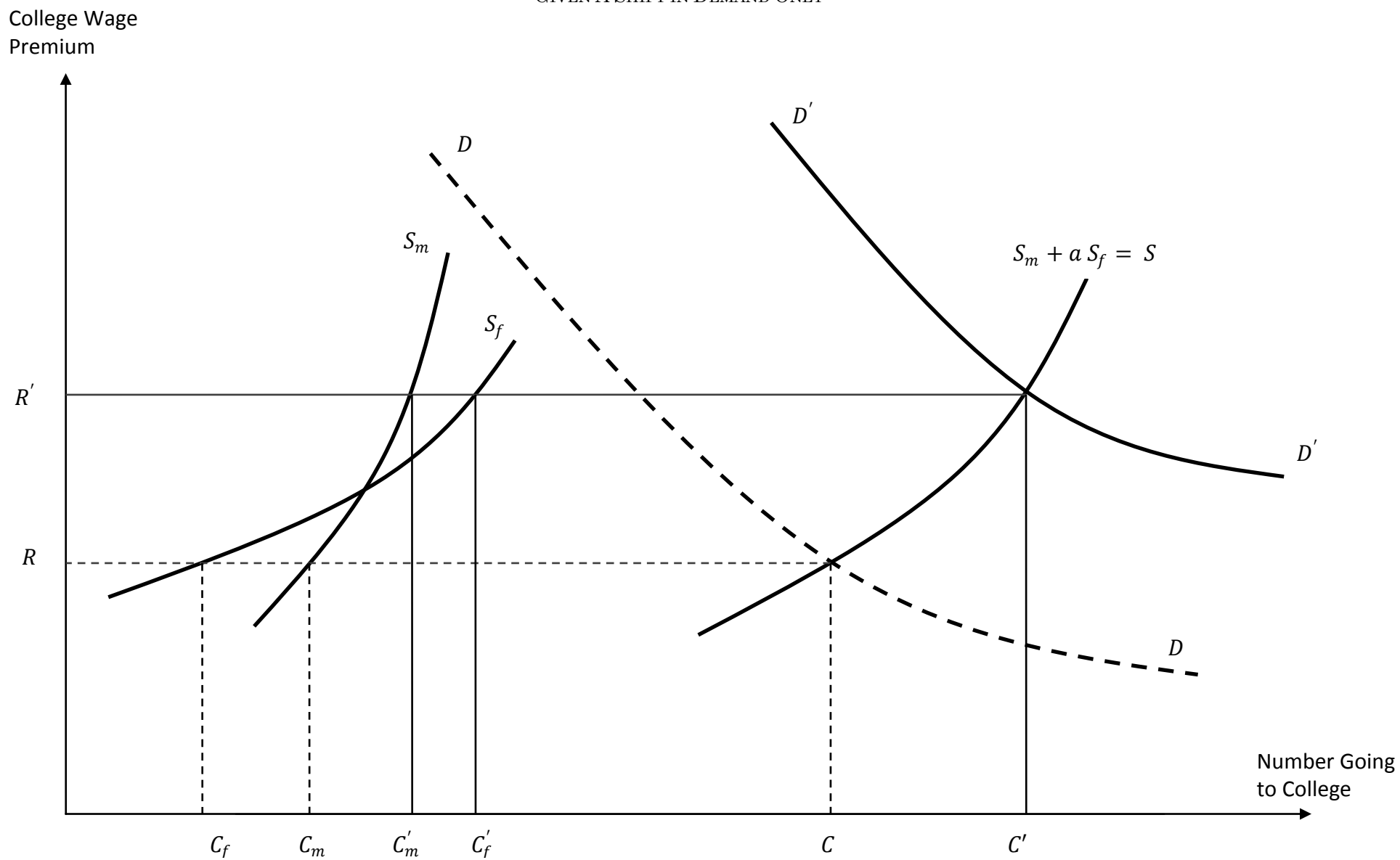


FIGURE 17: SUPPLY OF AND DEMAND FOR COLLEGE-EDUCATED WORKERS,
GIVEN SHIFTS IN BOTH DEMAND AND SUPPLY

