What accounts for the increase in college attainment of women?

Virginia Sánchez-Marcos[1]

Universidad de Cantabria

March 2004

Abstract

The objective of this paper is to explain the reduction in the U.S. sex college attainment ratio (SCAR) from 1.57 to 1.19. over the last decades. We use a model where altruistic parents make decisions on daughters and sons' education taking into account the effect of education on earnings, marriage opportunities, fertility and home production. The main finding is that observed changes in earnings and fertility explain part of the decrease in the SCAR, while observed changes in marital status and marital sorting imply a decrease in college attainment of women.

JEL Classification: J24, J16, I20

---

[1]Virginia Sánchez-Marcos. Facultad de CCEE y EE, Departamento de Economía, Universidad de Cantabria, Avda. de los Castros s/n, 39005 Santander, Spain. Telph: 34 942 202025. Fax: 34 942 201603.

1 Introduction

This paper measures the contribution of changes in the main determinants of the education decision to explain the reduction in the U.S. sex college attainment ratio (SCAR) from 1.57 in the mid seventies to 1.19 at the beginning of the nineties. Specifically, we focus on earnings, fertility, marital status and marital sorting changes as potential explanations of the observed changes in college attainment by sex.

We build on Ríos-Rull and Sánchez-Marcos (2002) model of the college attainment decision. They shows that a model in which altruistic parents make decisions on daughters and sons education based on returns to investment (in terms of earnings and marriage), curvature in the utility function and no differences in the educational attainment opportunities between the sexes, is not able to account for the observed SCAR in the mid seventies. They find that two alternative theories, that rise the returns to college for men relative to women, can account for the data: (i) higher cost of education for females than for males and (ii) altruistic individuals that care about their number of descendents.

As far as we know, there is no other paper accomplishing a quantitative exercise as the one we present in this paper. A related paper is Goldin (2002) that argues that the diffusion of the birth control pill among young single women from 1960s had a direct positive effect on women´s career investment by almost eliminating the chance of becoming pregnant and thus the cost of having sex.

The paper is organized as follows. Section 2 reports changes in the determinants of education over the last decades. Section 3 shows the implications of such changes for the education distribution. Finally, Section 4 concludes.

2 Data

We use the Panel Survey of Income Dynamics Public Release II 1976 and 1990.

Education   The fraction of men with four or more years of college has gone from 0.31 in the mid seventies to 0.41 in 1990. The same figure for women went from 0.20 to 0.34. So the probability of men to complete college education relative to women decreased from 1.6 in 1976 to 1.2 in 1990.

Earnings   Table 1 reports life-cycle earnings by education, sex and marital status. In each year we normalize by the life-cycle earnings of married college males. Changes of earnings are the result of changes in both wages and employment rates. Two well known phenomena are worth to mention: first, the increase in the skill premia[2], that increases the incentives to complete college education for both men and women; second, the increase of married women´s employment rate over the last decades[3].

Table 1: **Individual life-cycle earnings by education, sex and marital status, 1976 and 1990**

	1976				1990			
	Males		Females		Males		Females	
	Single	Married	Single	Married	Single	Married	Single	Married
Four years of College	0.68	1.00	0.53	0.26	0.73	1.00	0.59	0.41
High or some college	0.50	0.65	0.33	0.13	0.49	0.56	0.28	0.19
Elemental	0.30	0.48	0.11	0.10	0.25	0.25	0.05	0.10

Fertility   Table 2 shows differences in fertility across education and sex for those 25-35 years old in 1976 and 1990[4]. In each year we normalize by the average fertility of dropout women. There are two issues here: *(i)* the negative correlation between fertility and education, specially for women, and *(ii)* the negative relationship for women is less striking for the nineties. As we do not observe total fertility of women between 25-35 in 1990 and first maternity age is negatively correlated with education, the numbers overestimate differences in fertility across educational groups in 1990.

---

[2]See for example Krussell, Ríos-Rull and Violante (2000).

[3]See for example McGrattan and Rogerson (1998)

[4]We use the 1993 Individuals File from the PSID, that have additional information on births to individuals.

Table 2: **Fertility by sex and education, 1976 and 1990**

	Males		Females	
	1976	1990	1976	1990
Four years of College	0.61	0.56	0.57	0.63
High or some college	0.71	0.66	0.72	0.90
Elemental	0.73	0.85	1.0	1.0

Marital status The fraction of single women increased 52% for college educated, 106% for high educated and 72% for dropouts between 1976 and 1990 among those 25-35 years old. As the fraction of single across older women remains stable [5] and divorce rate increased slightly[6], we conclude this is due to a delay of marriage decision. This is also pointed out by Goldin (2000).

Marital sorting A common feature to both periods is that education is crucial to determine the probability distribution of women´s husband. The probability of getting married with someone with the same educational level is 0.71 for college educated women, 0.63 for high educated and 0.57 for dropouts in 1976. The same figures for 1990 are 0.80, 0.84 and 0.31, respectively. Marital sorting increased due to the change in the education distribution. [7].

3   Results

We use the decision model in Ríos-Rull and Sánchez-Marcos (2002) to provide a measure of the effects on the SCAR of changes in the determinants of the education decision. In their baseline model altruistic parents make decisions on daughters and sons education based on returns

---

[5]Also reported in Caucutt, Guner and Knowles (2001).

[6]It increased 19% for college educated womenn and 12% for high educated women and and it decreased 40% for dropouts.

[7]Consistency requires that the two transition matrices across marital status yield that the number of males in education group $\hat{e}$ married to females in education group $\tilde{e}$ is equal to the number of females in education group $\tilde{e}$ married to males in education group $\hat{e}$. Unfortunately, this is not likely to be the case because of sampling error in the data, and because the distribution of education in the data is not stationary (so estimates of marriage transitions need not be consistent). To deal with this issue, we take the educational distribution for males and females from the data as well as the transitions for females. We then adjust when required the transition of males so that the consistency requirement is satisfied.

to investment (in terms of earnings and marriage), curvature in the utility function and no differences in the educational attainment opportunities between the sexes. They show that the baseline model is not able to account for the SCAR in the mid seventies and they find two alternative theories that can: (*i*) females face a higher cost of education in terms of forgone homeproduction when they attend college (*Benchmark I*); (*ii*) altruistic individuals care about their number of descendents, so, the relatively sharper decline of fertility implied by education for females than for males is relevant for the education decision (*Benchmark II*)[8].

In what follows we introduce observed changes in the determinants of education decision in the two *Benchmarks* explained above and we measure its ability to explain the decrease in the SCAR observed in the data.

Changes in earnings　The SCAR decreases from 1.57 to 1.31 under *Benchmark I* and to 0.93 under *Benchmark II* as a result of relative changes in life-cycle earning by sex and education. So observed increases in female´s relative earnings are enough to offset home production by daughters in the first case, and the lower number of descendants associated with college education in the second case. However, the quantitative implications are different, *Benchmark II* accounts for a larger decrease of the SCAR.

Changes in the fraction of single females　The SCAR increases under *Benchmark I* as a result of the increase in the fraction of single women. In the model it is assumed that children are attached to the mother upon divorce, then single motherhood makes women very poor and parents have an extra incentive to invest in daughters education to avoid their poverty, even if the return in terms of earnings is very low. As the number of periods that women spend single before the first marriage increased, the expected number of periods that women face as single mothers is reduced. This reduces the incentives to invest in women´s education.

---

[8]They find that the simplest theory that parents prefer boys over girls is not able to properly account for the SCAR. Relaxing the income pooling assumption that is made in the base model is neither able to account for the SCAR.

Qualitative results go in the same direction under *Benchmark II*, however, they are quantitatively larger, implying that women are not attending college at all. There is an additional reason in this Benchmark to expect a decrease in women's college attainment: the increase in the fraction of single men across dropouts relative to other educational levels, creates an incentive to invest in son's education, because men enjoy offspring only through marriage.

Changes in marital sorting   The education distribution by sex remains unchanged under *Benchmark I*. So changes in returns to education by sex through the marriage market are such that the relative incentives to invest in men versus women remain the same.

However, the implications are different under *Benchmark II*: the fraction of women completing college education decreases as we impose marital sorting of the nineties. The probability of a dropout male to get married with a dropout female (the one with the highest fertility) is much lower in 1990 than in 1976 and then the potential benefit of lower education for males (a large offspring) decreases.

Changes in fertility   This can only be accomplished under *Benchmark II*, where individuals care about the number of descendants they have. Differences in fertility across education groups are much lower in 1990 than in 1976, specially for females. So one of the incentives to do not invest in women' education disappears as now low education doesn't mean many more descendents.

All Changes   When all of the observed changes in the determinants of the education decision are introduced the SCAR decreases to 1.36 under *Benchmark I* and to 0.10 under *Benchmark II*. So in both cases changes in the inputs of the model, that we think are the main determinants of education decision, provide a plausible explanation for the decrease of the SCAR. Clearly, under *Benchmark II* the decrease in the SCAR is overpredicted.

4 Conclusions

We conclude from our analysis that observed changes in earnings are able to explain a considerable reduction in the SCAR and that the reduction in fertility differences across educational groups induce parents to invest more in daughters' education. The effect of changes in marital sorting and marital status have the opposite effect on women´s college attainment.

The results obtained here could be though as a way for selecting between the two potential theories of the SCAR until the mid seventies according to Ríos-Rull and Sánchez-Marcos (2002): that theory that provides closer predictions to the observed education distribution changes, given the observed changes in those we think are the main determinants of education decisions. The more suitable theory in that sense would be the one that relies on the fact that women have an extra cost of getting educated than men in terms of forgone home production.

5 References

Behrman, J.R.and Pollak, R.A. and Taubman, P. (1986), "Do parents favor boys?", *International Economic Review, 27(1), 33-54.*

Behrman, J.R. and Rosenzweig, M.R. (2001), "Does Increasing Women's Schooling Raise the Schooling of the Next Generation?", *American Economic Review, 92 (1), 323-34.*

Caucutt, Guner and Knowles (2002), "The Timing of Births: A Marriage Market Analysis", *Review of Economic Dynamics*, 5(4), p.815-855.

Echevarria, C. and Merlo, A. (1999), "Gender Differences in Education in a Dynamic Household Bargaining Model", *International Economic Review, 40(2), 265-86.*

Goldin, C. (1992), "The meaning of college in the lives of American women: the last one-hundred years", *NBER* WP 4099.

Goldin, C. (1995), "Career and family: college women look to the past", *NBER* WP 5188.

Goldin, C. and Katz, L. (2002), "The power of the pill: oral contraceptives and women´s career and marriage decisions", *Journal of Political Economy, 110, 730-60.*

Haveman, R. and Wolf, B.(1995), "The Determinants of Children's Attainments: A Review of Methods and Findings", *Journal of Economic Literature, 33, 1829-78.*

Heckman, J. (1979), "Sample Selection Bias as Specification Error", *Econometrica,* 14, 153-62.

Krussel, P., Ohanian, L., Ríos-Rull, J.V. and Violante, G. (1999). "Capital-Skill Complementarity and Inequality". *Econometrica.*

McGrattan, E. and Rogerson, R. (1998), "Changes in Hours Worked Since 1950", Federal Reserve Bank of Minneapolis Quarterly Review, 22 (1), pp 2-19.

Panel Survey of Income Dynamics, 1976. Family Public Release II.

Ríos-Rull, J.V. and Sánchez-Marcos, V. (2002), "College attainment of women", *Review of Economic Dynamics*, 5 (4), 965-998.