RETURNS TO EDUCATION: THE GREEK EXPERIENCE, 1988-1999

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Journal:	*Applied Economics*
Manuscript ID:	APE-05-0521.R1
Journal Selection:	Applied Economics
JEL Code:	I21 - Analysis of Education < I2 - Education < I - Health, Education, and Welfare
Keywords:	demand for education, earnings equation, private rates of return, wage premium, work experience

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Abstract

The paper provides estimates of private rates of return to education in Greece derived from Mincerian-type earnings equations. The data come from the latest three household surveys of the country covering the 1988-1999 period. The empirical evidence suggests that: rates of return associated with female high school- and university graduates exceed the respective rates for male graduates; rates of return pertaining to tertiary education graduates are increasing over time, whereas the corresponding rates for secondary education graduates follow an inverted U-shaped pattern; and dropouts from any education degree end up with rates of return lower than the rates associated with the immediately preceding education level.

JEL classification number*:* I21.

Keywords: demand for education, earnings equation, private rates of return, productivity, returns to education, wage premium, work experience.

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1. Introduction

A low standard of living and the large numbers of illiterates, the hangovers from World War II and the Civil War in Greece in the 1940s, have prompted a high demand for education at all levels in the following decades, on the expectation that education brings with it higher skills, a higher lifetime income and a higher social status. It is well known that, in general, an educated labor force has a comparative advantage in learning, adopting, creating, and implementing new technologies, thereby generating growth (Benhabib and Spiegel 1994). Formal schooling helps develop an individual's vocational skills, which, in conjunction with general and liberal arts education, can increase the efficiency with which new skills are acquired in the labor market (Rosen 1977, and Blau 1996 and the literature cited therein). Higher levels of education may allow workers to accomplish more with the resources at hand (the marginal product of education is higher than otherwise); accumulate more human capital on the job than otherwise; and enhance their 'entrepreneurial' ability (Welch 1970, Choi 1993). As a consequence, returns of investment to education tend to increase when technology changes, provided that educated persons are employed in suitable positions (Cattan 1985, Choi 1993). Nonetheless, investment in education implies foregone labor earnings on the part of the persons involved, since these are directly related to the level of human capital invested (Mankiw et al. 1992). In terms of measurement, and regardless of shortcomings, the average number of years in school of an individual has been used as a proxy for human capital (Mankiw et al 1992, Mulligan and Sala-i-Martin 1995).

The rest of the paper deals with the evolution of returns to education in Greece. Methodological issues are discussed in Section 2 and the data employed in the empirical analysis are presented in Section 3. Section 4 is concerned with the empirical findings and the last section concludes.

2. Methodological Issues

In this paper, we set forth to estimate rates of return associated with different levels of education. We assume that the holder of a degree is expected to be more productive in a particular profession than an individual with a lower degree and so will be the corresponding rates of return. To compute these rates, we first run a semi-logarithmic regression of the average real earnings per educational level, W, in terms of years of work experience, X, the square of that variable, X^2, to account for the parabolic relationship between earnings and age; the hours of additional (re-)training, H, and the gender of the employee, S.[1] Work experience is defined as the difference between the age of an employed person and the sum of the number of years formally required for the completion of his (her) degree plus the number of years needed for his (her) admission to primary school. Young persons are admitted to the elementary school in Greece at the age of six. Next, we compute the rates of return by means of appropriate ratios based on the estimated regression coefficients. The general form of the earnings equation is

$$\ln W = a + b_{ill}D_{ill} + b_P D_P + b_S D_S + b_H D_H + c_1 X + c_2 X^2 + d_1 \ln H + d_2 S + \varepsilon \qquad (1)$$

where D_{ill}, D_p, D_s and D_h are dummies standing for persons with no education

[1] The original equation specified by Mincer (1974) expresses earnings as a function of years of schooling. Psacharopoulos (1979) and Psacharopoulos and Laylard (1979) elaborate further on the original Mincerian equation. The theoretical reasoning for its semi-logarithmic specification is given in Becker (1971).

(illiterate workers), primary, secondary and higher education, respectively, and ε is the error term. Since, however, we want to gain insights into the various education subcategories, we run a more disaggregated version of (1), namely

$$\ln W = a + b_i D_i + c_1 X + C_2 X^2 + d_1 \ln H + d_2 S + \varepsilon \qquad (2)$$

where dummies i = 1,…,16 denote the various education levels associated with three Household Surveys (HSs hereinafter). The definitions of the dummy variables employed and additional details on the HSs are given in Section 3.

Associated with the various education degrees are the corresponding rates of return. These rates pertain to the various education categories and are estimated from expression (2) by means of the ratio

$$r_i = (b_i - b_{i-1})/(V_i - V_{i-1}) \qquad (3)$$

where b_i, all i, is the estimated regression coefficient from equation (2), the subscript -1 stands for the immediately preceding education level, and V_i indicates the number of years required for the completion of a degree in the i^{th} education level. In the case of Greece, four years are required for a higher education degree, and six years for each of the remaining two categories. Moreover, the secondary education is split into two subcategories, namely Gymnaseum and Lyceum, each consisting of three years.

To further examine the potential effects of higher vis-à-vis secondary education on earnings, we run a modified version of equation (1), i.e.

$$\ln W = a + b_H D_H + c_1 X + c_2 X^2 + dH + eD_H X + \varepsilon, \qquad (4)$$

which also contains an interaction term between the higher education dummy and work experience. The combined effect of the above variables should be positive if individuals have to choose higher than secondary education.

3. Data and Variables Used

The data used in this analysis come from the latest three HSs conducted by the National Statistical Service of Greece throughout the country over the twelve month periods November 1987-October 1988, October 1993-September 1994 and October 1998-September 1999, respectively (hereafter HS-I, HS-II and HS-III). These surveys covered 6,489, 6,756 and 6,258 households corresponding to 20,036, 19,882 and 17,677 individuals, respectively. The breakdown of these individuals in terms of employment and gender is reported in Table 1.[2] The employed persons belong in the age group 14 to 65; they are either self-employed or in dependent employment.

Table 1. Main Characteristics of Three Household Surveys

	Nov.1987-Oct.1988 (HS-I)			Oct.1993-Sept.1994 (HS-II)			Oct.1998-Sept.1999 (HS-III)		
	Total	Males	Females	Total	Males	Females	Total	Males	Females
1. Households	6,489			6,756			6,258		
2. Individuals	20,036	9,598	10,438	19,882	9,583	10,299	17,677	8,443	9,234
3. Employed persons	3,639	2,405	1,234	4,130	2,544	1,586	4,126	2,442	1,684
4. Ratio: row 3/row 2	0.183	0.251	0.118	0.208	0.265	0.154	0.233	0.289	0,182

Notes: The employed persons are in the age group 14 to 65.
The figures in rows (1) and (2)-(3) denote numbers of households and persons, respectively.
Source: National Statistical Service of Greece, *Household Surveys*, *1987-88, 1993-94* and *1998-99*, Athens.

The variables used in this analysis are listed below. The dummy variables D_1-D_{16} are proxies for the educational levels of individuals as reported in the three household surveys. In particular, dummies D_1-D_{13} refer to the 1994-1995 and 1998-1999 HSs, and D_{14}-D_{16} to the 1988-1989 HS. Numbers in braces next to the definitions of dummy variables D_2-D_{16} indicate the number of years required for the completion of the corresponding degree.

[2] The average earnings per educational level, regardless of gender and by gender taken separately, are presented in an Appendix, which is available upon request.

W = annual earnings of households (wages + salaries + bonuses + overtime employment) in 1994 prices.

X = Work experience (ages: 14-to-65).

H = Hours of work per year.

S = Sex {1 = male, 0 = female}.

D_1 = {1 = did not go to school, 0 = otherwise}.

D_2 = {1 = primary 6 years no degree, 0 = otherwise}.

D_3 = {1 = primary 6 years graduate, 0 = otherwise}.

D_4 = {1 = secondary 3 years (gymnasium) no degree, 0 = otherwise}.

D_5 = {1 = secondary 3 years (gymnasium) graduate, 0 = otherwise}.

D_6 = {1 = secondary 6 years (lyceum) no degree, 0 = otherwise}.

D_7 = {1 = secondary 6 years technical-vocational lyceum no degree, 0 = otherwise}.

D_8 = {1 = secondary 6 years (lyceum) graduate, 0 = otherwise}.

D_9 = {1 = secondary 6 years technical-vocational lyceum graduate, 0 = otherwise}.

D_{10} = {1 = Technological Institute 3 years no degree, 0 = otherwise}.

D_{11} = {1 = Technological Institute 3 years graduate, 0 = otherwise}.

D_{12} = {1 = university 4 years no degree, 0 = otherwise}.

D_{13} = {1 = university 4 years graduate (including MA & Ph.D.), 0 = otherwise}.

D_{14} = {1 = secondary 6 years graduate, 0 = otherwise}.

D_{15} = {1 = Technological Institute & University no degree, 0 = otherwise}.

D_{16} = {1 = Technological Institute & University graduate, 0 = otherwise}.

4. Empirical Results

The estimates of the earnings regression (2) needed for the calculation of the rates of return to education for (a) individuals regardless of gender, and (b) males and females, taken separately, are given in Tables 2, and 3 and 4, respectively. All education coefficients should be read with respect to the omitted D_2 dummy (primary education, no degree).

Table 2. Estimates of Earnings Regression (2), Entire Sample

	Household Surveys					
	HS-1 (1988-89)		HS-II (1993-94)		HS-III (1998-99)	
Variable	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
Constant	11.035	61.29	8.620	32.98	9.488	39.51
X	0.00522	-17.08	0.00868	21.00	0.00947	20.89
X^2	-0.00008	-13.65	-0.00013	-15.79	-0.00013	-15.58
ln H	0.292	12.47	0.531	15.88	0.378	12.64
S	0.216	12.34	0.254	11.87	0.285	13.06
D_1	na	na	-0.268	-2.17	0.257	0.75
D_2	–	–	–	–	–	–
D_3	0.264	6.81	0.106	1.94	0.293	3.49
D_4	na	na	-0.160	-0.43	-2.474	-3.68
D_5	0.417	9.28	0.330	5.60	0.502	5.73
D_6	na	na	0.573	1.53	1.102	1.64
D_7	na	na	0.00041	0.02	0.662	3.87
D_8	na	na	0.514	9.22	0.672	7.99
D_9	na	na	0.488	7.62	0.607	6.89
D_{10}	na	na	0.293	1.57	0.400	1.84
D_{11}	na	na	0.641	10.43	0.889	10.09
D_{12}	na	na	0.264	1.42	0.173	0.95
D_{13}	na	na	0.768	13.41	1.031	12.15
D_{14}	0.478	11.88	na	na	na	na
D_{15}	0.531	9.64	na	na	na	na
D_{16}	0.665	16.25	na	na	na	na
Statistics						
R^2	0.250		0.304		0.328	
F	134.412		112.198		125.411	
N	3639		4130		4126	

Notes: - denotes that D_2 is the reference dummy. All education coefficients associated with the D_i, variables, $i = 1,3,...,16$, should be read with respect to the omitted D_2 dummy (primary education, no degree). *na* = not available or applicable. For the size of our samples, t-values greater than 2.58 indicate statistical significance at the 1% level or better.

On the basis of the estimated regression coefficients we derive the private rates of return to the various education categories via expression (3).[3] These rates are reported in Table 5. The estimates referring to the entire sample (column T) indicate that the highest rates

[3] Magoula and Psacharopoulos (1999) provide estimates of social rates of return consistent with the 1993-1994 Household Survey. These estimates are somewhat lower than the corresponding private rates because they include the full resource cost of education.

Table 3. Estimates of Earnings Regression (2), Males

	Household Surveys					
	HS-1 (1988-89)		HS-II (1993-94)		HS-III (1998-99)	
Variable	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
Constant	11.757	46.17	9.458	24.53	11.226	34.28
X	0.00563	14.51	0.00927	18.8	0.00926	16.73
X^2	-0.00009	-11.41	-0.00013	-14.37	-0.00013	-12.38
ln H	0.22	6.71	0.448	9.09	0.205	5.1
D_1	na	na	-0.147	-0.92	0.368	0.81
D_2	-	-	-	-	-	-
D_3	0.25	4.89	0.13	2.03	0.192	1.7
D_4	na	na	-0.137	-0.38	na	na
D_5	0.402	7.02	0.312	4.55	0.392	3.37
D_6	na	na	0.586	1.34	0.963	1.53
D_7	na	na	-0.00901	-0.49	0.424	1.86
D_8	na	na	0.44	6.64	0.51	4.49
D_9	na	na	0.407	5.51	0.502	4.28
D_{10}	na	na	0.122	0.39	0.365	1.32
D_{11}	na	na	0.527	7.02	0.671	5.65
D_{12}	na	na	-0.549	-1.74	0.00661	0.22
D_{13}	na	na	0.693	10.11	0.814	7.07
D_{14}	0.436	8.16	na	na	na	na
D_{15}	0.494	6.95	na	na	na	na
D_{16}	0.592	10.89	na	na	na	na
Statistics						
R^2	0.182		0.298		0.281	
F	66.605		71.416		67.632	
N	2,405		2,544		2,442	

Notes: See Table 2.

of return pertain to those who have completed primary education (HS-I, HS-III) or had some years of primary education rather than not going to school at all (HS-II). The next highest rates concern technological institute- and university graduates (HS-I, HS-III) as well as secondary-gymnasium education graduates (HS-II). They also confirm the ascertainment that those who have failed to graduate or dropped out of the procedures leading to the degree they had registered to, ended up with either lower rates of return than those pertaining to the immediately lower degree or their respective rates were not different from zero. The estimates associated with the gender (columns M and F) emphasize that the rates of return for secondary education-lyceum graduates and tertiary education graduates concerning females exceed, in general, the corresponding rates for males. Next, the rates of return for university- and technology institute graduates, re-

gardless of gender, have exhibited an increasing pattern over time (higher values have been observed in the HS-III survey), whereas the corresponding pattern for secondary school graduates has had the shape of an inverted letter U, the respective peak being associated with the HS-II survey. These findings are in agreement with the views of Cattan (1985) and Choi (1993).

Table 4. Estimates of Earnings Regression (2), Females

	Household Surveys					
	HS-1 (1988-89)		HS-II (1993-94)		HS-III (1998-99)	
Variable	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
Constant	10.35	42.45	8.335	22.31	8.137	22.52
X	0.00533	11.04	0.00850	11.29	0.105	13.41
X^2	-0.00009	-9.08	-0.00013	-8.43	-0.00016	-10.29
ln H	0.39	12.43	0.571	12.23	0.541	12.07
D_1	na	na	-0.352	-1.79	0.00948	0.18
D_2	-	-	-	-	-	-
D_3	0.224	3.91	0.00204	0.21	0.264	2.06
D_4	na	na	na	na	-2.233	-3.06
D_5	0.373	4.96	0.327	2.97	0.509	3.756
D_6	na	na	0.555	0.81	na	na
D_7	na	na	0.583	1.19	0.854	3.29
D_8	na	na	0.591	5.89	0.755	5.99
D_9	na	na	0.656	5.36	0.615	4.54
D_{10}	na	na	0.376	1.52	0.428	1.24
D_{11}	na	na	0.75	6.97	1.032	7.77
D_{12}	na	na	0.604	2.45	0.262	1.08
D_{13}	na	na	0.84	8.23	1.181	9.31
D_{14}	0.483	8.04	na	na	na	na
D_{15}	0.547	6.44	na	na	na	na
D_{16}	0.726	11.89	na	na	na	na
Statistics						
R^2	0.305		0.27		0.334	
F	67.268		41.446		59.883	
N	1,234		1,586		1,684	

Notes: See Table 2, notes.

The estimates of regression (4) are given in Tables (6) and (7) for males and females taken together and separately, respectively. The regression coefficients of the composite variable are positive and significant for all three surveys regardless if the two genders are taken together or separately. These findings are in agreement with findings of earlier studies confirming the positive contribution of education to productivity (see also Magoula and Psacharopoulos 1999, and the literature cited therein).

Table 5. Three Household Surveys,
Private Rates of Return by Educational Level and Gender
(percentages)

Educational level (*control group*)	HS-I			HS-II			HS-III		
	M	F	T	M	F	T	M	F	T
1. Primary, no degree (*no schooling*)	-	-	-	-	*	8.9	-	-	*
2. Primary, graduate (*no schooling*)	8.3	2.9	8.8	4.3	na	3.5	*	8.8	9.8
3. Secondary 3 years, no degree (*primary graduate*)	-	-	-	*	*	*	na	*	*
4. Secondary 3 years, graduate (*primary graduate*)	5.1	5.0	5.1	6.1	5.4	7.5	13.1	8.2	7.0
5. Secondary-lyceum, no degree (*2ary 3 years, graduate.*)	-	-	-	*	*	*	*	na	*
6. Secondary-tech./voc., lyceum, no degree (*2ary 3 years, graduate.*)	-	-	-	*	*	*	*	11.5	5.3
7. Secondary-lyceum, graduate (*2ary 3 years, graduate*)	-	-	-	4.3	8.9	6.1	3.9	8.2	5.7
8. Secondary-tech./voc., lyceum, graduate (*2ary 3 years, graduate*)	-	-	-	3.2	11.0	5.3	3.7	3.5	3.5
9. Technological Institute 3 years, no degree (*2ary-tech/voc. lyceum, graduate*)	-	-	-	*	*	*	*	*	*
10. Technological Institute 3 years, graduate (*2ary-tech/voc. lyceum, graduate*)	-	-	-	4.0	3.1	5.1	5.6	13.9	9.4
11. University, no degree (*2ary-lyceum, graduate*)	-	-	-	*	0.4	*	*	*	*
12. University, graduate, including MA & Ph.D (*2ary-lyceum, graduate*)	-	-	-	6.3	6.2	6.3	7.8	14.1	9.0
13. Secondary, 6 years, graduate (*2ary 3 years, graduate*)	1.1	3.7	2.0	-	-	-	-	-	-
14. Technological Institute & University, no degree (*2ary-lyceum, graduate*)	1.7	1.8	1.5	-	-	-	-	-	-
15. Technological Institute & University, graduate (*2ary-lyceum, graduate*)	4.5	6.9	5.3	-	-	-	-	-	-

Source: All estimates are based on the earnings regressions reported in Tables 2 - 4.
Notes: M = males, F = females, T= total, - = not applicable. na = not available * = Meaningless; the respective regression coefficients in Tables 2 - 4 are statistically insignificant.

Table 6. Estimates of Earnings Regression (4), Entire Sample

	HS-I (1988-89)		HS-II (1993-94)		HS-III (1997-98)	
Variable	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
Constant	11.451	63.01	9.100	34.69	10.128	43.28
T	0.00523	16.85	0.00957	22.97	0.106	23.29
T^2	-0.00009	-15.34	-0.00016	-19.63	-0.00017	-19.34
lnH	0.294	12.25	0.516	15.05	0.366	11.94
S	0.219	12.34	0.230	10.54	0.269	12.02
D_{13}	na	na	-0.131	-1.60	0.00035	0.04
D_{16}	0.00711	1.32	na	na	na	na
$T*D_{13}$	na	na	0.00220	7.20	0.00172	5.97
$T*D_{16}$	0.001001	4.79	na	na	na	na
Statistics						
R^2	0.213		0.255		0.284	
F	163.430		234.723		271.767	
N	3639		4130		4126	

Table 7. Estimates of Earnings Regression (4) by Gender

	HS-I (1988-89)				HS-II (1993-94)				HS-1997-98			
	Males		Females		Males		Females		Males		Females	
Variable	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
Constant	12.110	47.39	10.806	43.89	9.717	25.46	9.009	23.91	11.805	37.44	8.735	24.64
X	0.00569	14.18	0.00541	11.01	0.104	21.28	0.00882	11.51	0.00997	18.18	0.123	15.78
X^2	-0.00009	-12.57	-0.00011	-11.09	-0.00017	-17.71	-0.00017	-10.67	-0.00015	-14.67	-0.00021	-13.88
LnH	0.225	6.73	0.388	12.05	0.446	8.98	0.553	11.39	0.184	4.49	0.538	11.69
D_{13}	na	na	na	na	-0.134	-1.28	-0.259	-1.94	-0.00453	-0.42	-0.00652	-0.51
D_{16}	0.00067	0.09	0.00342	0.45	na	na	na	na	na	na	na	na
$X*D_{13}$	na	na	na	na	0.002	5.38	0.00303	5.533	0.00159	4.36	0.00244	5.03
$X*D_{16}$	0.00100	3.66	0.00162	4.86	na	na	na	na	na	na	na	na
Statistics:												
R^2	0.152		0.262		0.264		0.193		0.247		0.277	
F	86.100		87.488		181.834		75.522		160.016		128.648	
N	2405		1234		2544		1586		2442		1684	

5. Conclusions

In this paper we have examined the evolution of private rates of return to education in Greece during the 1988-1999 period. The respective estimates are based on household surveys data and Mincerian-type earnings regressions. The empirical findings indicate the following: Firstly, the rates of return associated with female high school- and university graduates exceed the respective rates for male graduates. Secondly, rates of return pertaining to tertiary education graduates follow an increasing trend over time, whereas the corresponding rates for secondary education graduates follow an inverted U-shaped path. Finally, dropouts from any education degree end up with rates of return lower than the rates associated with the immediately preceding education level.

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Acknowledgements

Thanks are due to my students Vassia Panoussi and Evangelia Vourvachaki for very competent research assistance. Financial support from the Center of Economic Research, Athens University of Economics and Business, is greatly acknowledged (grant for Project E806).

RETURNS TO EDUCATION: THE GREEK EXPERIENCE, 1988-1999

1. Introduction

A low standard of living and the large numbers of illiterates, the hangovers from World War II and the Civil War in Greece in the 1940s, have prompted a high demand for education at all levels in the following decades, on the expectation that education brings with it higher skills, a higher lifetime income and a higher social status. It is well known that, in general, an educated labor force has a comparative advantage in learning, adopting, creating, and implementing new technologies, thereby generating growth (Benhabib and Spiegel 1994). Formal schooling helps develop an individual's vocational skills, which, in conjunction with general and liberal arts education, can increase the efficiency with which new skills are acquired in the labor market (Rosen 1977, and Blau 1996 and the literature cited therein). Higher levels of education may allow workers to accomplish more with the resources at hand (the marginal product of education is higher than otherwise); accumulate more human capital on the job than otherwise; and enhance their 'entrepreneurial' ability (Welch 1970, Choi 1993). As a consequence, returns of investment to education tend to increase when technology changes, provided that educated persons are employed in suitable positions (Cattan 1985, Choi 1993, Taylor 2002). Nonetheless, investment in education implies foregone labor earnings on the part of the persons involved, since these are directly related to the level of human capital invested (Mankiw et al. 1992). In terms of measurement, and regardless of shortcomings, the average number of years in school of an individual has been used as a proxy for human capital (Mankiw et al 1992, Mulligan and Sala-i-Martin 1995).

The rest of the paper deals with the evolution of returns to education in Greece. Methodological issues are discussed in Section 2 and the data employed in the empirical analysis are presented in Section 3. Section 4 is concerned with the empirical findings and the last section concludes.

2. Methodological Issues

In this paper, we set forth to estimate rates of return associated with different levels of education. We assume that the holder of a degree is expected to be more productive in a particular profession than an individual with a lower degree and so will be the corresponding rates of return. To compute these rates, we first run a semi-logarithmic regression of the average real earnings per educational level, W, in terms of years of work experience, X, the square of that variable, X^2, to account for the parabolic relationship between earnings and age; the hours of additional (re-)training, H, and the gender of the employee, S.[1] Work experience is defined as the difference between the age of an employed person and the sum of the number of years formally required for the completion of his (her) degree plus the number of years needed for his (her) admission to primary school. Young persons are admitted to the elementary school in Greece at the age of six. Next, we compute the rates of return by means of appropriate ratios based on the estimated regression coefficients. The general form of the earnings equation is

$$\ln W = a + b_{ill}D_{ill} + b_P D_P + b_S D_S + b_H D_H + c_1 X + c_2 X^2 + d_1 \ln H + d_2 S + \varepsilon \qquad (1)$$

where D_{ill}, D_p, D_s and D_h are dummies standing for persons with no education

[1] The original equation specified by Mincer (1974) expresses earnings as a function of years of schooling. Psacharopoulos (1979) and Psacharopoulos and Laylard (1979) elaborate further on the original Mincerian equation. The theoretical reasoning for its semi-logarithmic specification is given in Becker (1971).

(illiterate workers), primary, secondary and higher education, respectively, and ε is the error term. Since, however, we want to gain insights into the various education subcategories, we run a more disaggregated version of (1), namely

$$\ln W = a + b_i D_i + c_1 X + C_2 X^2 + d_1 \ln H + d_2 S + \varepsilon \qquad (2)$$

where dummies i = 1,…,16 denote the various education levels associated with three Household Surveys (HSs hereinafter). The definitions of the dummy variables employed and additional details on the HSs are given in Section 3.

Associated with the various education degrees are the corresponding rates of return. These rates pertain to the various education categories and are estimated from expression (2) by means of the ratio

$$r_i = (b_i - b_{i-1})/(V_i - V_{i-1}) \qquad (3)$$

where b_i, all i, is the estimated regression coefficient from equation (2), the subscript -1 stands for the immediately preceding education level, and V_i indicates the number of years required for the completion of a degree in the i^{th} education level. In the case of Greece, four years are required for a higher education degree, and six years for each of the remaining two categories. Moreover, the secondary education is split into two subcategories, namely Gymnaseum and Lyceum, each consisting of three years.

To further examine the potential effects of higher vis-à-vis secondary education on earnings, we run a modified version of equation (1), i.e.

$$\ln W = a + b_H D_H + c_1 X + c_2 X^2 + dH + eD_H X + \varepsilon, \qquad (4)$$

which also contains an interaction term between the higher education dummy and work experience. The combined effect of the above variables should be positive if individuals have to choose higher than secondary education.

3. Data and Variables Used

The data used in this analysis come from the latest three HSs conducted by the National Statistical Service of Greece throughout the country over the twelve month periods November 1987-October 1988, October 1993-September 1994 and October 1998-September 1999, respectively (hereafter HS-I, HS-II and HS-III). These surveys covered 6,489, 6,756 and 6,258 households corresponding to 20,036, 19,882 and 17,677 individuals, respectively. The breakdown of these individuals in terms of employment and gender is reported in Table 1.[2] The employed persons belong in the age group 14 to 65; they are either self-employed or in dependent employment.

Table 1. Main Characteristics of Three Household Surveys

	Nov.1987-Oct.1988 (HS-I)			Oct.1993-Sept.1994 (HS-II)			Oct.1998-Sept.1999 (HS-III)		
	Total	Males	Females	Total	Males	Females	Total	Males	Females
1. Households	6,489			6,756			6,258		
2. Individuals	20,036	9,598	10,438	19,882	9,583	10,299	17,677	8,443	9,234
3. Employed persons	3,639	2,405	1,234	4,130	2,544	1,586	4,126	2,442	1,684
4. Ratio: row 3/row 2	0.183	0.251	0.118	0.208	0.265	0.154	0.233	0.289	0,182

Notes: The employed persons are in the age group 14 to 65.
The figures in rows (1) and (2)-(3) denote numbers of households and persons, respectively.
Source: National Statistical Service of Greece, *Household Surveys*, *1987-88, 1993-94* and *1998-99*, Athens.

The variables used in this analysis are listed below. The dummy variables D_1-D_{16} are proxies for the educational levels of individuals as reported in the three household surveys. In particular, dummies D_1-D_{13} refer to the 1994-1995 and 1998-1999 HSs, and D_{14}-D_{16} to the 1988-1989 HS. Numbers in braces next to the definitions of dummy variables D_2-D_{16} indicate the number of years required for the completion of the corresponding degree.

[2] The average earnings per educational level, regardless of gender and by gender taken separately, are presented in an Appendix, which is available upon request.

W = annual earnings of households (wages + salaries + bonuses + overtime employment) in 1994 prices.

X = Work experience (ages: 14-to-65).

H = Hours of work per year.

S = Sex {1 = male, 0 = female}.

D_1 = {1 = did not go to school, 0 = otherwise}.

D_2 = {1 = primary 6 years no degree, 0 = otherwise}.

D_3 = {1 = primary 6 years graduate, 0 = otherwise}.

D_4 = {1 = secondary 3 years (gymnasium) no degree, 0 = otherwise}.

D_5 = {1 = secondary 3 years (gymnasium) graduate, 0 = otherwise}.

D_6 = {1 = secondary 6 years (lyceum) no degree, 0 = otherwise}.

D_7 = {1 = secondary 6 years technical-vocational lyceum no degree, 0 = otherwise}.

D_8 = {1 = secondary 6 years (lyceum) graduate, 0 = otherwise}.

D_9 = {1 = secondary 6 years technical-vocational lyceum graduate, 0 = otherwise}.

D_{10} = {1 = Technological Institute 3 years no degree, 0 = otherwise}.

D_{11} = {1 = Technological Institute 3 years graduate, 0 = otherwise}.

D_{12} = {1 = university 4 years no degree, 0 = otherwise}.

D_{13} = {1 = university 4 years graduate (including MA & Ph.D.), 0 = otherwise}.

D_{14} = {1 = secondary 6 years graduate, 0 = otherwise}.

D_{15} = {1 = Technological Institute & University no degree, 0 = otherwise}.

D_{16} = {1 = Technological Institute & University graduate, 0 = otherwise}.

4. Empirical Results

The estimates of the earnings regression (2) needed for the calculation of the rates of return to education for (a) individuals regardless of gender, and (b) males and females, taken separately, are given in Tables 2, and 3 and 4, respectively. All education coefficients should be read with respect to the omitted D_2 dummy (primary education, no degree).

Table 2. Estimates of Earnings Regression (2), Entire Sample

	Household Surveys					
	HS-1 (1988-89)		HS-II (1993-94)		HS-III (1998-99)	
Variable	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
Constant	11.035	61.29	8.620	32.98	9.488	39.51
X	0.00522	-17.08	0.00868	21.00	0.00947	20.89
X^2	-0.00008	-13.65	-0.00013	-15.79	-0.00013	-15.58
ln H	0.292	12.47	0.531	15.88	0.378	12.64
S	0.216	12.34	0.254	11.87	0.285	13.06
D_1	na	na	-0.268	-2.17	0.257	0.75
D_2	–	–	–	–	–	–
D_3	0.264	6.81	0.106	1.94	0.293	3.49
D_4	na	na	-0.160	-0.43	-2.474	-3.68
D_5	0.417	9.28	0.330	5.60	0.502	5.73
D_6	na	na	0.573	1.53	1.102	1.64
D_7	na	na	0.00041	0.02	0.662	3.87
D_8	na	na	0.514	9.22	0.672	7.99
D_9	na	na	0.488	7.62	0.607	6.89
D_{10}	na	na	0.293	1.57	0.400	1.84
D_{11}	na	na	0.641	10.43	0.889	10.09
D_{12}	na	na	0.264	1.42	0.173	0.95
D_{13}	na	na	0.768	13.41	1.031	12.15
D_{14}	0.478	11.88	na	na	na	na
D_{15}	0.531	9.64	na	na	na	na
D_{16}	0.665	16.25	na	na	na	na
Statistics						
R^2	0.250		0.304		0.328	
F	134.412		112.198		125.411	
N	3639		4130		4126	

Notes: - denotes that D_2 is the reference dummy. All education coefficients associated with the D_i, variables, $i = 1,3,\ldots,16$, should be read with respect to the omitted D_2 dummy (primary education, no degree). *na* = not available or applicable. For the size of our samples, t-values greater than 2.58 indicate statistical significance at the 1% level or better.

On the basis of the estimated regression coefficients we derive the private rates of return to the various education categories via expression (3).[3] These rates are reported in Table 5. The estimates referring to the entire sample (column T) indicate that the highest rates

[3] Magoula and Psacharopoulos (1999) provide estimates of social rates of return consistent with the 1993-1994 Household Survey. These estimates are somewhat lower than the corresponding private rates because they include the full resource cost of education.

Table 3. Estimates of Earnings Regression (2), Males

	Household Surveys					
	HS-1 (1988-89)		HS-II (1993-94)		HS-III (1998-99)	
Variable	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
Constant	11.757	46.17	9.458	24.53	11.226	34.28
X	0.00563	14.51	0.00927	18.8	0.00926	16.73
X^2	-0.00009	-11.41	-0.00013	-14.37	-0.00013	-12.38
$\ln H$	0.22	6.71	0.448	9.09	0.205	5.1
D_1	na	na	-0.147	-0.92	0.368	0.81
D_2	-	-	-	-	-	-
D_3	0.25	4.89	0.13	2.03	0.192	1.7
D_4	na	na	-0.137	-0.38	na	na
D_5	0.402	7.02	0.312	4.55	0.392	3.37
D_6	na	na	0.586	1.34	0.963	1.53
D_7	na	na	-0.00901	-0.49	0.424	1.86
D_8	na	na	0.44	6.64	0.51	4.49
D_9	na	na	0.407	5.51	0.502	4.28
D_{10}	na	na	0.122	0.39	0.365	1.32
D_{11}	na	na	0.527	7.02	0.671	5.65
D_{12}	na	na	-0.549	-1.74	0.00661	0.22
D_{13}	na	na	0.693	10.11	0.814	7.07
D_{14}	0.436	8.16	na	na	na	na
D_{15}	0.494	6.95	na	na	na	na
D_{16}	0.592	10.89	na	na	na	na
Statistics						
R^2	0.182		0.298		0.281	
F	66.605		71.416		67.632	
N	2,405		2,544		2,442	

Notes: See Table 2.

of return pertain to those who have completed primary education (HS-I, HS-III) or had some years of primary education rather than not going to school at all (HS-II). The next highest rates concern technological institute- and university graduates (HS-I, HS-III) as well as secondary-gymnasium education graduates (HS-II). They also confirm the ascertainment that those who have failed to graduate or dropped out of the procedures leading to the degree they had registered to, ended up with either lower rates of return than those pertaining to the immediately lower degree or their respective rates were not different from zero. The estimates associated with the gender (columns M and F) emphasize that the rates of return for secondary education-lyceum graduates and tertiary education graduates concerning females exceed, in general, the corresponding rates for

males.[4] Next, the rates of return for university- and technology institute graduates, regardless of gender, have exhibited an increasing pattern over time (higher values have been observed in the HS-III survey), whereas the corresponding pattern for secondary school graduates has had the shape of an inverted letter U, the respective peak being associated with the HS-II survey. These findings are in agreement with the those of Cattan (1985), Choi (1993), Taylor (2002) and Chung (2003).

Table 4. Estimates of Earnings Regression (2), Females

	Household Surveys					
	HS-1 (1988-89)		HS-II (1993-94)		HS-III (1998-99)	
Variable	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
Constant	10.35	42.45	8.335	22.31	8.137	22.52
X	0.00533	11.04	0.00850	11.29	0.105	13.41
X^2	-0.00009	-9.08	-0.00013	-8.43	-0.00016	-10.29
ln H	0.39	12.43	0.571	12.23	0.541	12.07
D_1	na	na	-0.352	-1.79	0.00948	0.18
D_2	-	-	-	-	-	-
D_3	0.224	3.91	0.00204	0.21	0.264	2.06
D_4	na	na	na	na	-2.233	-3.06
D_5	0.373	4.96	0.327	2.97	0.509	3.756
D_6	na	na	0.555	0.81	na	na
D_7	na	na	0.583	1.19	0.854	3.29
D_8	na	na	0.591	5.89	0.755	5.99
D_9	na	na	0.656	5.36	0.615	4.54
D_{10}	na	na	0.376	1.52	0.428	1.24
D_{11}	na	na	0.75	6.97	1.032	7.77
D_{12}	na	na	0.604	2.45	0.262	1.08
D_{13}	na	na	0.84	8.23	1.181	9.31
D_{14}	0.483	8.04	na	na	na	na
D_{15}	0.547	6.44	na	na	na	na
D_{16}	0.726	11.89	na	na	na	na
Statistics						
R^2	0.305		0.27		0.334	
F	67.268		41.446		59.883	
N	1,234		1,586		1,684	

Notes: See Table 2, notes.

The estimates of regression (4) are given in Tables (6) and (7) for males and females taken together and separately, respectively. The regression coefficients of the composite variable are positive and significant for all three surveys regardless if the two genders

[4] Notice, however, that Hartog et. al. (2001) estimate lower rates of return for females than males in Portugal over the 1980s and early 1990s.

are taken together or separately. These findings are in agreement with findings of earlier studies confirming the positive contribution of education to productivity (see also Magoula and Psacharopoulos 1999, and the literature cited therein).

Table 5. Three Household Surveys,
Private Rates of Return by Educational Level and Gender
(percentages)

Educational level	HS-I			HS-II			HS-III		
(*control group*)	M	F	T	M	F	T	M	F	T
1. Primary, no degree (*no schooling*)	-	-	-	-	*	8.9	-	-	*
2. Primary, graduate (*no schooling*)	8.3	2.9	8.8	4.3	na	3.5	*	8.8	9.8
3. Secondary 3 years, no degree (*primary graduate*)	-	-	-	*	*	*	na	*	*
4. Secondary 3 years, graduate (*primary graduate*)	5.1	5.0	5.1	6.1	5.4	7.5	13.1	8.2	7.0
5. Secondary-lyceum, no degree (*2ary 3 years, graduate.*)	-	-	-	*	*	*	*	na	*
6. Secondary-tech./voc., lyceum, no degree (*2ary 3 years, graduate.*)	-	-	-	*	*	*	*	11.5	5.3
7. Secondary-lyceum, graduate (*2ary 3 years, graduate*)	-	-	-	4.3	8.9	6.1	3.9	8.2	5.7
8. Secondary-tech./voc., lyceum, graduate (*2ary 3 years, graduate*)	-	-	-	3.2	11.0	5.3	3.7	3.5	3.5
9. Technological Institute 3 years, no degree (*2ary-tech/voc. lyceum, graduate*)	-	-	-	*	*	*	*	*	*
10. Technological Institute 3 years, graduate (*2ary-tech/voc. lyceum, graduate*)	-	-	-	4.0	3.1	5.1	5.6	13.9	9.4
11. University, no degree (*2ary-lyceum, graduate*)	-	-	-	*	0.4	*	*	*	*
12. University, graduate, including MA & Ph.D (*2ary-lyceum, graduate*)	-	-	-	6.3	6.2	6.3	7.8	14.1	9.0
13. Secondary, 6 years, graduate (*2ary 3 years, graduate*)	1.1	3.7	2.0	-	-	-	-	-	-
14. Technological Institute & University, no degree (*2ary-lyceum, graduate*)	1.7	1.8	1.5	-	-	-	-	-	-
15. Technological Institute & University, graduate (*2ary-lyceum, graduate*)	4.5	6.9	5.3	-	-	-	-	-	-

Source: All estimates are based on the earnings regressions reported in Tables 2 - 4.
Notes: M = males, F = females, T= total, - = not applicable. na = not available. * = Meaningless; the respective regression coefficients in Tables 2 - 4 are statistically insignificant.

Table 6. Estimates of Earnings Regression (4), Entire Sample

	HS-I (1988-89)		HS-II (1993-94)		HS-III (1997-98)	
Variable	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
Constant	11.451	63.01	9.100	34.69	10.128	43.28
T	0.00523	16.85	0.00957	22.97	0.106	23.29
T^2	-0.00009	-15.34	-0.00016	-19.63	-0.00017	-19.34
lnH	0.294	12.25	0.516	15.05	0.366	11.94
S	0.219	12.34	0.230	10.54	0.269	12.02
D_{13}	na	na	-0.131	-1.60	0.00035	0.04
D_{16}	0.00711	1.32	na	na	na	na
$T*D_{13}$	na	na	0.00220	7.20	0.00172	5.97
$T*D_{16}$	0.001001	4.79	na	na	na	na
Statistics						
R^2	0.213		0.255		0.284	
F	163.430		234.723		271.767	
N	3639		4130		4126	

Table 7. Estimates of Earnings Regression (4) by Gender

	HS-I (1988-89)				HS-II (1993-94)				HS-1997-98			
	Males		Females		Males		Females		Males		Females	
Variable	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
Constant	12.110	47.39	10.806	43.89	9.717	25.46	9.009	23.91	11.805	37.44	8.735	24.64
X	0.00569	14.18	0.00541	11.01	0.104	21.28	0.00882	11.51	0.00997	18.18	0.123	15.78
X^2	-0.00009	-12.57	-0.00011	-11.09	-0.00017	-17.71	-0.00017	-10.67	-0.00015	-14.67	-0.00021	-13.88
LnH	0.225	6.73	0.388	12.05	0.446	8.98	0.553	11.39	0.184	4.49	0.538	11.69
D_{13}	na	na	na	na	-0.134	-1.28	-0.259	-1.94	-0.00453	-0.42	-0.00652	-0.51
D_{16}	0.00067	0.09	0.00342	0.45	na	na	na	na	na	na	na	na
$X*D_{13}$	na	na	na	na	0.002	5.38	0.00303	5.533	0.00159	4.36	0.00244	5.03
$X*D_{16}$	0.00100	3.66	0.00162	4.86	na	na	na	na	na	na	na	na
Statistics:												
R^2	0.152		0.262		0.264		0.193		0.247		0.277	
F	86.100		87.488		181.834		75.522		160.016		128.648	
N	2405		1234		2544		1586		2442		1684	

5. Conclusions

In this paper we have examined the evolution of private rates of return to education in Greece during the 1988-1999 period. The respective estimates are based on household surveys data and Mincerian-type earnings regressions. The empirical findings indicate the following: Firstly, the rates of return associated with female high school- and university graduates exceed the respective rates for male graduates. Secondly, rates of return pertaining to tertiary education graduates follow an increasing trend over time, whereas the corresponding rates for secondary education graduates follow an inverted U-shaped path. Finally, dropouts from any education degree end up with rates of return lower than the rates associated with the immediately preceding education level.

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Acknowledgements

Thanks are due to my students Vassia Panoussi and Evangelia Vourvachaki for very competent research assistance. Financial support from the Center of Economic Research, Athens University of Economics and Business, is greatly acknowledged (grant for Project E806).