The social rates of return on investment in tertiary technological education by faculty as a guide for educational planning : the case of Greece

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Abstract

Education, according to human capital theory, means consuming but mainly investing. In Greece, Tertiary Technological Education is a sub-system of Higher Education. This study estimates the rate of return to social investment in Tertiary Technological Education by field of study. The study uses the cost-benefit analysis method, more specifically the elaborate and the short-cut methods. The earnings data are from a cross-sectional survey of hired labor of tertiary technological education and secondary education graduates. Data was collected using stratified sampling throughout the entire country. The study also uses data of social cost. The main finding is that, in general, social investment in Tertiary Technological Education is profitable. In particular, social investment is more profitable in the faculties of technological applications and food-nutrition while it is less profitable in the faculties of health and caring professions, graphic arts-design and administration – economy. On the other hand, investment in the agricultural technology has low return. These findings may constitute a useful guide for educational planning.

Keywords : Education, human capital, investment, cost-benefit analysis, rates of return, educational planning.

1. Introduction

Education, according to human capital theory constitutes both consumption but also and mainly investment. The creation, accumulation and diffusion of «human capital» or «knowledge capital» takes place, mainly but not exclusively, through the typical education and training system. During the last four decades, it has been theoretically supported and empirically proved that «human capital»/«knowledge capital» cons-

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titutes a basic factor of economic, social, cultural and political development.

The basic objective of public activity should be the maximization of social prosperity. The allocation of available social resources – which are insufficient in relation to the needs – on the part of public authorities should take place on the basis of the evaluation concerning their contribution to social prosperity [Mergos (2003)]. Cost-benefit analysis/rates of return analysis is potentially a very powerful tool which can be used to allocate government resources between different programmes, and even between the various functions of government, of which education is but one. Cost-benefit analysis is a form of marginal analysis and does not offer an automatic solution to problems of resource allocation. It provides a conceptual framework for the examination of the costs in relation to the relative benefits.

Educational planners constantly face the problems of allocating resources to education and to different levels or types of education, in order to maximize society's goals [Woodhall (1992)]. The calculation of rates of return is an important prerequisite of successful planning – both by individuals and by the authorities – in the market for education. The estimation of social rates of return on investments in education in total, by level, type and studies' orientation offers indicators for the rationalisation of social choices. It offers indicators of the relevant value of public investments in education in contrast with investments in other sectors of public action as well as for the selection of priorities among levels, types and orientations of studies.

In Greece, Tertiary Technological Education (TTE) is a sub-system of Higher Education. The tertiary technological education institutions act under the supervision of the State, which finances their operation and determines their status within a legal framework. Nowadays there are 14 Technological Education Institutions (TEI) located in various parts of country. Each TEI comprises at least two faculties or schools which are sub-divided into departments. Nowadays there are 176 departments. The department is the main academic unit, offering studies in a specific scientific or technological field leading to a degree. The faculties of the TEI focus on applied technology, administration and economy, agricultural technology, health care professions, food and nutrition technology, graphic arts and graphic design. Studies at the TEI last 8 semesters (in some cases 7 semesters), including the last

semester for the compulsory professional placement and the completion of a graduation project (Dissertation), which is evaluated separately. Greece is a country characterized by a "high" demand for higher education. There is a significant social demand for studies in tertiary education despite the expansion of the system by the State. During the 1975-1999 period, the number of candidates for Higher Education (UNIV, TEI) have increased by 107% and that of successful candidates by 262%. The number of entrants in 2002 amounted to 77,960 (37,240 UNIV and 40,720 TEI). The increase has been observed not only in the number of students and graduates who get employed, but also in the portion of those who remain unemployed. Equally important, the number of tertiary technological education students who do not eventually graduate is also significant- almost one third of the aggregate figures [Tsamadias (2000)]. Greece has an almost world record of higher education students studying abroad (brain drain), given its population size (Greece: 4,042 Students/1,000,000 habitants, Korea: 1,242 St/1,000,000 habitants, etc) [Psacharopoulos (2003)]. During 1997-1998, 63,000 Greek students were studying in other countries and, out of that part of students 49,500 were studying in European Union (EU) countries other than Greece [Eurostat Yearbook, 2001]. It is also true that the percentage of TE graduates in relation to the total population remains lower in comparison with the average in other EU countries (Greece: 15.5%, EU-11: 22.0%, USA: 34.9%, etc). This reality has essentially generated quite idiosyncratic conditions in the TE (TE has been indirectly privatised). Equally important, the number of tertiary technological education students who do not eventually graduate is also significant [Tsamadias (2000)]. During 1998, Greece spent 6.9% of the state budget and 3.5% of the GNP for education (1.2% for TE). The average for OECD countries was 12.9% and 5.3% respectively [OECD, Indicators, 2001]. During 1997, in Greece, public expenditure per student amounted to 2,881euro, while in the EU-11 was 7,012 euro and in the EU-15 reached the level of 7,075 euro [Eurostat, Statistics in focus, Theme 3,8-13/2000 Brussels].

There have been many studies on the returns of investment in education in Greece and in other countries, which cover the period from 1960 to the present. The studies show that investments in education are "good" investments both from private and social point of view [Psacharopoulos (1999)]. In connection with to the Greek TTE, Psacharopoulos and Kazamias (1985) estimated social rate of return at the

level of 7.6% [data 1977]. Magoula and Psacharopoulos (1997) estimated the private rate of return, using the extended mincerian method, at the level of 6.9% [data: household survey 1993]. Tsamadias (2000) estimated, using all available methods, the private and social rates of return [see results: Appendix I, Table 1] and additionally the private rate of return by faculties [see results : Appendix I, Table 2]. The problem in comparing the returns over time is that they are all based on very different samples and methodologies.

In this paper we try to throw light on the debate evolving around the following central questions. Is TTE in general and by faculties a profitable form of investment for Greek society? Is the further expansion of TTE in general and by faculties desirable? An attempt is made to provide an answer by estimating the rates of return of social investments in TTE in general and by faculties. The social rates of return may constitute an economic criterion for the rational choice of such investments , further expansion or shrinkage by the state. To technocrats and politicians it only offers indicators on the orientation of priorities in investments and not numerical targets. It does not automatically provide solution to the problem of distributing economic resources. In a world of high uncertainty the «solution» offered by the method of cost-benefit analysis has the form of a proposal for the increase or decrease of the number of students/graduates of the various specialities, without being able to determine their precise number. However, despite its limitations and weaknesses, it is deemed that the estimation of rates of return of social investment in TTE by faculties is a useful "tool" for the educational planning. The study innovates in that it estimates the rates of return through the use of primary data collected from stratified sampling in the totality of the country. So far, the relevant studies used secondary statistical data springing from household surveys. The organisation of this paper is as follows: In section 2, we present the methodology and the models we use for the estimation of the returns from the social investments in TTE by faculties. In section 3, we present the sources of our collected data and the structure of samples. In the following section 4, we present earnings and cost data and we calculate the social rates of return of investment in TTE by faculties. We calculate these rates by implementating the elaborate and short-cut methods and we compare their results. Finally, in section 5, we summarise the main findings of the study and we provide the overall conclusions.

2. Methodology and models

The ex-post economic evaluation of social choices for investment in TTE by faculties is made in the context of human capital theory using the method of cost-benefit analysis, as the latter is specified in economics of education (elaborate and short-cut) [Schultz (1961, 1964, 1971), Becker (1964), Mincer (1974), Sweetland (1996), Psacharopoulos and Mattson (1998)]. The cornerstone for the estimation of the returns with the elaborate (full or complete) method is the monetary benefits which arise from the TTE and the social cost for the TTE. However, there are market and non-market benefits, as well as externalities and spill-overs from the education that are not covered in the model [see Haveman and Wolfe (1984), Wolfe and Zuvekas (1997), McMahon (1987a, 1987b), Psacharopoulos (1999)]. The main monetary or market benefit from the TTE derives from the earnings differentials between the tertiary technological education and the secondary education graduates. A key assumption in a social rate of return calculation is that observed wages are a good proxy for the marginal product of labor. In a competitive economy this is ensured by using data from the private sector of the economy. Here, the earnings differentials are used as a proxy to measure the difference in productivity of workers (human capital theory) [Woodhall (1992)]. The ex-post social rates of return, that is the traditional «narrow social rate of return», takes into account only the earnings differentials (market benefit) and not the non-markets benefits, the positive externalities and the spill-overs. For purposes of cost benefit analysis of investment in TTE, it is necessary to define costs in terms of the total opportunity cost, that is, all real resources that are used up by the project.

2.1 *Elaborate/Full method*

The estimation of the Internal Rate of Return (r_{TTE}) of the social investment in the TTE derives from the solution of the following general equation (1):

$$NPV = \sum_{t=1}^{43} (B)_t \cdot (1 + r_{TTE})^{-t} - \sum_{t=0}^{3} (C)_t \cdot (1 + r_{TTE})^{t} = 0 \qquad (1)$$

where: $B_t = (\widehat{E}_{G,TTE} - \widehat{E}_{G,SE})_t$ for $t = 1, \ldots, 43$ represents the difference of annual gross earnings (before taxes), between a tertiary technological education graduate (TTE) and a secondary school graduate (SE), $C_t = (ASC_{TTE})_t$, $t = 0, \ldots, 3$ stands for the annual average social cost, and NPV is the net present value.

The age-earnings function for the TTE and the SE graduates is specified as:

$$\hat{E}_G = a + b.Age_i + c.Age_i^2 + u_i \tag{2}$$

where, Age_i is the age of the individual i from the sample; a is a constant, b and c are regression coefficients, and u_i the disturbance term.

The estimate of the Annual Average Social Cost (ASC_{TTE}) is calculated from the formula:

$$\begin{aligned} ASC_{TTE} = {} & \text{Average Direct Private Cost}_{TTE} \\ & + \text{Average Public Exrenditure for TTE} \\ & + \text{Foregone Earnings of student in TTE}(\hat{E}_{G,SE}) \\ & + \text{Alternative Cost for Buildings and Equipment} \end{aligned} \tag{3}$$

The elaborate method is the most suitable method in order to estimate the rates of return because it takes into consideration the most important part of individuals' earnings history. However, it requires a significant amount of data to develop the construction of "well-behaving" of age-earnings profiles. Finally, information concerning the rates of return to TTE by faculties should be one element influencing government policy concerning the state aid to TTE.

2.2 *Short-cut method*

Ideally, in order to conduct a cost-benefit analysis on education/ specific age-earnings profiles of graduates are required. In some cases, however, only average (over all ages) earnings by level/types are available. Under these circumstances a rate of return could still be computed through the model (4) :

$$r_{TTE} = \frac{\bar{E}_{G,TTE} - \bar{E}_{G,SE}}{S_{TTE} \cdot ASC_{TTE}}. \tag{4}$$

Where, $\bar{E}_{G,TTE}$, $\bar{E}_{G,SE}$ are the annual mean gross earnings from hired labor of TTE graduates (in total and by faculties) and SE graduates. S_{TTE} represents the duration of studies in TTE. ASC_{TTE} is the annual average social cost.

The assumptions implicit in this formula are: First, the earning differential is constant throughout working life; second, the costs occur at one point in time and third, the benefits last for ever. Such assumptions are not crucial in obtaining a rate of return estimate. Although these

assumptions are not realistics, Psacharopoulos (1981) argues that they make little difference to the calculation and therefore this method is used to estimate rates of return in the absence of the detailed data required for the «elaborate» method. Mingat and Tan (1988) compared the pattern of rates of return derived from the «complete» and the «short-cut» methods and concluded: «The estimates from both the «complete» and «short-cut» methods show that all corresponding rates [of return] have the same order of magnitude and that the structure of returns – that is the way the rates relate to each other – is basically the same whichever method is used. The rates of return are not completely accurate, but for assessing investment priorities in education, precise figures are not essential».

3. Data and research design

The aim of our survey is to collect annual earnings from the hired labour of the TTE and SE graduates and data relating to both private and public cost in TTE education. Accordingly, we collected gross and net earnings data from a stratified survey based on questionnaires. We derived the cost data from the Ministry of National Education and Religious Affairs and TEI. We collected these questionnaires from TTE and SE graduates who do not have any additional education and full time work in the private or public sector. The productivity bonuses are included in the annual earnings. Earnings from overtime and additional education or training are not included. The TTE and SE graduates who have their own work are not included, since it is difficult to separate the part of income that comes from their personal employment from that arising from other factors which are used in the production process. The part time employees are also not included. We applied a cross sectional econometric analysis for the year 1997. The population is comprised of two subpopulations : sub-population I, which includes the TTE graduates who have full-time dependent employment in the private or public sector; and sub-population II, which includes the SE graduates who work as full time employees in the private or the public sector in Greece. According to the labour force survey of the National Statistical Services of Greece (NSSG), the size of the two sub-populations for 1997 is $N_I = 82,063$ individuals and $N_{II} = 686,147$ individuals, respectively. Based on the structure and the categorisation of the two sub-populations, these are diverted in six sub-groups (strata) according to the sector of production (primary, secondary, tertiary) and to the sector of employment (public, private). The stratified sampling not only gives increased accuracy, but

also provides separate estimates for each stratum [see Zairis (1991)]. We determine the minimum size of the sample which we take from each stratum according to the formula

$$n_{oh} = \frac{Z^2_{a/2} \cdot S^2_h}{d^2_0 + \frac{Z^2_{a/2} \cdot S^2_h}{N_h}} \tag{5}$$

where, Z is the statistic of the standard normal distribution; a is the level of significance; S^2_h is the real variance of stratum h (it is substituted from pilot estimation) and N_h is the size of stratum h. The random sample, which is extracted from each stratum of the two sub-populations, has been determined so that the estimation of mean $\bar{Y}_h$ to have maximum sampling error

$$d_0 = |y_h - \bar{Y}_h| = Z_{a/2} \cdot S \cdot F(y_h) = 200,000 \text{ drs.} \tag{6}$$

where $\bar{Y}_h$ and y_h are the average value of stratum h and the sample, respectively. The $\bar{Y}_h$ in practice is substituted with the value arised from the pilot survey.

Table 1 shows more analytically the structure of the total population. It also shows that the majority of the TTE graduates is working in the tertiary sector of the economy (most of them in the public sector) and the minority in the primary sector of the economy. The majority of those working in the secondary sector of the economy is employed in the private sector.

Tables 2 and 3 show analytically the structure of the sample.
The data about social cost collected from Ministry of Education and TEI are presented in Appendix II.

4. Empirical analysis and results

In this section, we first examine the descriptive statistics of earnings and subsequently we estimate the rates of return of social investment in TTE by faculties with elaborate and short-cut methods.

4.1 *Descriptive statistics*

Table 5 summarises the mean gross earnings of the TTE graduates by faculty, the SE graduates, working in the totality of the country and in the private sector.

Table 1

Structure of Population by Level of Education –
Sector of Employment – Sector of Production [Year 1997]

Education level	Population					
	N	%	N	%	N	%
	Public Sector		Private Sector		Overall	
	Primary Sector of Economy					
S.E Graduates	676	18.0	2,362	62.8	3,038	80.8
TTE Graduates	354	9.5	365	9.7	719	19.2
Country Total	1,030	27.5	2,727	72.5	3,757	100.0
	Secondary Sector of Economy					
S.E Graduates	30,247	16.3	140,161	75.5	170,408	91.8
TTE Graduates	3,425	1.9	11,609	6.3	15,034	8.2
Country Total	33,672	18.2	151,770	81.8	185,442	100.0
	Tertiary Sector of Economy					
S.E Graduates	239,081	41.3	273,617	47.3	512,698	88.6
TTE Graduates	38,562	6.6	27,748	4.8	66,310	11.4
Country Total	277,643	47.9	301,365	52.1	579,008	100.0

SOURCE : Population data are taken from NSSC, Labour Force Survey, 1997

Table 2

Structure of Sample by Level of Education – Sector of Employment – Sector of Production

Sector of Production/ Sector of Employment	Overall		Public Sector		Private Sector	
	TTE Grad./tes	SE Grad./tes	TTE Grad./tes	SE Grad./tes	TTE Grad./tes	SE Grad./tes
Primary Sector of Economy	103	119	33	32	70	87
Secondary Sector of Economy	333	474	134	156	199	318
Tertiary Sector of Economy	623	674	302	338	321	336
Total	1,059	1,267	469	526	590	741

SOURCE : Data from Sample [Tsamadias (2000)]

Table 3

Structure of samples TTE Graduates by Faculties and Sector of Employment

Faculties	Sector of Employment		
	Total	Public Sector	Private Sector
Applied Technology	402	180	222
Agricultural Technology	92	42	50
Health Care professions	185	129	56
Graphic Arts, Graphic Design	32	17	15
Administration and Economy	287	93	194
Food Nutrition Technology	61	8	53
TTE Graduates	1,059	469	590

SOURCE : Data from Sample [Tsamadias (2000)]

Table 4

Mean annual gross earnings of secondary and tertiary technological education graduates by faculty and sector of employment

Faculties	Public and Private sector Employees		Private sector Employees	
	N	Mean Gross Earnings (drs)	*N*	Mean Gross Earnings (drs)
SE Graduates	1,267	4,248,995	741	3,980,862
TTE Graduates	1,059	4,937,136	590	4,593,381
Applied Technology	402	5,430,522	222	4,939,341
Agricultural Technology	92	4,315,680	50	4,102,585
Health Care Professions	185	4,880,661	56	4,238,877
Graphic Arts Design	32	4,811,793	15	5,398,621
Administration and Economy	287	4,480,769	194	4,244,399
Food Nutrition Technology	61	5,007,119	53	3,031,349

SOURCE : Author's calculation

NOTE : *N* number of observations

Empirical findings show that : (a) The mean gross earnings of the TTE graduates is 16.05% higher than those of SE graduates. In private sector, workers who have completed TTE studies earn, on average, 16.19% more than workers with SE background. This finding is in accordance to the human capital theory and the findings of empirical

work which has been carried out in Greece and abroad. They can provide useful help in explaining why there is a social demand for tertiary technological education. (b) The mean earnings of the applied technology graduates are the highest, while that of the agricultural technology graduates are the lowest. (c) The mean gross earnings of TTE graduates by faculty in increasing order are in Public and Private sector, Agricultural Technology, Administration and Economy, Graphic Arts-Design, Health Care Professions, Food-Nutrition Technology and Applied Technology and in private sector, Agricultural Technology, Health Care Professions, Administration and Economy, Applied Technology, Food-Nutrition Technology and Graphic Arts-Design.

4.2 *Elaborate/Full method*

The social returns were estimated using the actual age-earnings profiles for each level/faculties of education, and estimates of annual social cost per student.

Table 5 presents the results of regression analysis of the age-earnings (2) for the country total and private sector and the two levels of education. The OLS method is used.

Table 5

Results of regression analysis of age-earnings function, [Model (2)]

Independent Variables	Public and Private Sector Employees		Private Sector Employees	
	TTE Graduates	SE Graduates	TTE Graduates	SE Graduates
	Dependent Variable (E_G)			
Age^2	−3.014	−2.065	2.6117	−1.699
	(5.026)	(−5.564)	(−2.779)	(−3.376)
	***	***	***	***
Age	358.035	244.243	339.766	219.743
	(7.583)	(8. 397)	(4.823)	(6.136)
	***	***	***	***
Constant	−3,822.122	−1,739.439	−3,624.17	−1,433.32
	(−4.270)	(−3.179)	(−7.854)	(2.221)
	***	***	***	**
R^1	0.302	0.255	0.318	0.312

(*Contd. Table 5*)

Adj.R^2	0.309	0.254	0.316	0.310
F	228.593	716.369	137.1783	167.269
Signif	***	***	***	***
Sample Size (N)	1,059	1,267	590	741

NOTE : 1. ***, ** denote statistical significance at the 1%, 5% level respectively
2. Numbers in parentheses show the t-statistic values

The findings are summarised as follows : In terms of overall explanation (R^2), the human capital model fits better to the private sector of the economy than to the public sector. This is in accordance with our expectations given the competitive behaviour of the private sector in contrast to the public sector's. It, therefore, seems that the private sector pays somewhat more attention to the productive potential of the employee. The results show that the age variable enters with linear and quadratic terms which are statistically significant ($a = 0.01$), with expected signs, while the impact is stronger for TTE graduates compared to SE graduates. These findings are consistent with the human capital theory.

Tables 6 and 7 presents the results of regression analysis of the age-earnings function (2) for the TTE graduates by faculties for the totality of the country and the private sector and the two levels of education.

The findings are summarised as follows: In terms of overall explanation (R^2), the human capital model fits better to the health care professions, administration and economy, applied technology and agricultural technology. The values of R^2 are considered satisfactory for cross-section data with the exception of graphic arts-designs, foods-nutrition.

The calculation of the average social cost of TTE is necessary for the estimation of the rates of return for the social investments in TTE. The calculations of cost per student for the year 1997 was carried out with the use of the equation (3) and are presented in Appendix II. It is clear from both that the direct public cost of education in tertiary technological education is very low compared to the indirect cost (foregone earnings). The public cost accounts for approximately 20% of the average total social cost. It is accepted that the average social cost is the same for all faculties.

Table 8 presents estimations of returns of social investments in TTE in general and by faculties (when this is statistically feasible), for duration of studies 3.5 or 4 years.

Table 6

Results of Regression Analysis of Age – Earnings Function [Model (2)]
(Public and Private Sector Employees)

Independent Variables	Applied Technology	Agricultural Technology	Health Care Professions	Graphic Arts-Design	Administration and Economy	Food-Nutrition Technology
	Dependent Variable (E_G)					
Age^2	-3.684	-1. 080	-3.792	-2.029	-1.298	-2.190
	(-2.621)	(-0.864)	(-5.091)	(-0.365)	(-1.376)	(-0.899)
	***	NS	***	NS	NS	NS
Age	436.923	158.032	391.985	228.878	227.753	77.425
	(4.039)	(1.623)	(6.446)	(0.558)	(3.058)	(0.396)
	***	*	***	NS	***	NS
Constant	-5,494.627	191.428	-4,056.041	-521.759	-1,778.090	5,146.591
	(-2.683)	(0.105)	(-3.431)	(-0.071)	(-1.261)	(1.355)
	***	NS	***	NS	*	NS
R^2	0.307	0.297	0.453	0.065	0.366	0.140
Adj.R^2	0.304	0.281	0.447	0.012	0.362	0.110
F	85.534	18.810	75.812	1. 003	81.172	4.724
Signif	***	***	***	NS	***	*
Sample Size (N)	402	92	185	32	287	61

NOTES : 1. ***, **, * and NS denote statistical significance at the 1%, 5%, 10% level and no-significance, respectively
2. Numbers in parentheses show the *t*-statistic values

Table 7

Results of Regression Analysis of Age - Earnings function [Model (2)]

(Private Sector Employees)

Independent Variables	Applied Technology	Agricultural Technology	Health Care Proffessions	Graphic Arts-Design	Administration and Economy	Food-Nutrition Technology
	Dependent Variable (E_G)					
Age^2	-5.607	-0.287	-3.215	-9.343	-2.295	-10.703
	(-3.420)	(-0.084)	(-1.471)	(-0.402)	(-1.706)	(-1.020)
	***	NS	*	NS	*	NS
Age	569.212	168.411	361.027	889.660	19.631	779.581
	(4.578)	(0.724)	(2.193)	(0.605)	(0.192)	(1.156)
	***	NS	**	NS	NS	*
Constant	-7,679.758	-665.727	-3,951.489	-12,000.000	2,346.507	-8,818.315
	(-3.380)	(-0.172)	(-1.351)	(-0.548)	(1.262)	(-0.816)
	***	NS	*	NS	NS	NS
R^2	0.344	0.275	0.425	0.255	0.431	0.072
Adj.R^2	0.338	0.244	0.404	0.130	0.425	0.035
F	57.321	8.920	19.970	2.049	71. 091	1.932
Signif	***	**	***	NS	**	NS
N	222	50	56	15	194	53

NOTES : 1. ***, **, * and NS denote statistical significance at the 1%,5%,10% level and no-significance respectively

2. Numbers in parentheses show the t-statistic values

Table 8

Social rates of return (%) of investment in TTE by faculties and years of studies

Faculties	Years of Studies	Public and Private sector Employees	Private sector Employees
TTE Graduates	3.5	4.91	6.00
	4	4.31	5.38
Applied Technology	3.5	6.22	5.84
	4	5.63	5.17
Agricultural Technology	3.5		–
	4		
Health Care Professions	3.5	3.66	2.79
	4	2.93	2.19
Graphic Arts-Design	3.5	4.80	
	4	3.87	
Administration and Economy	3.5	3.65	–
	4	3.18	
Food Nutrition Technology	3.5	–	
	4		

SOURCE Author's calculation

NOTE : Where – connotes the inability to estimate rates of return because the equivalent estimations of age-earnings functions are not statistically significant

We find that when the duration of studies becomes 6 months longer, all the social rates of return are diminished approximately by 0.61 % and by faculties : 0.63% for applied technology, 0.66% for health care professions, 0.93% for graphic arts-design and 0.47% for administration and economy respectively.

4.3 *Short-cut method*

Table 9 presents the rates of return of social investment in TTE in total and by faculties, for duration of studies 3.5 and 4 years. [Model (4). Data from Table 4 and Appendix II].

Table 9

Social rates of return (%) in TTE by faculties and years of studies

Faculties	Years of Studies	Public and Private sector Employees	Private sector Employees
TTE Graduates	3.5	3.79	3.56
	4	3.31	3.11

(Contd.-Table 9)

Applied Technology	3.5	6.51	5.57
	4	5.70	4.87
Agricultural Technology	3.5	0.37	0.71
	4	0.32	0.62
Health Care Professions	3.5	3.50	1.50
	4	3.05	1.31
Graphic Arts-Design	3.5	3.10	8.24
	4	2.71	7.21
Administration and Economy	3.5	1.28	1.53
	4	1.12	1.34
Food Nutrition Technology	3.5	4.18	6.11
	4	3.66	5.34

SOURCE : Author's estimation

It is observed that the estimates of returns of social investment in TTE, by faculties, in a declining order, are as follows : applied technology, food-nutrition technology, health care professions, graphic arts-design, administration and economy and agricultural technology.

It is also ascertained that the expansion of the duration of studies from 3.5 to 4 years results into a reduction of rates of return in TTE by 0.48% (country total) or 0.45% (private sector) and by faculties : 0.81% or 0.70% for applied technology, 0.52% or 0.77% for food-nutrition, 0.45% or 0.19% for health care professions, 0.39% or 1.03% for graphic arts-design, 0.16% or 0.19% for administration and economy and 0.05% or 0.09% for agricultural technology.

Table 10 shows the estimations of rates of return of social investment in TTE in general and by faculties with elaborate and short cut methods.

It is observed that the estimation of social rate of return with the elaborate method, when this is statistically feasible, is close to the equivalent estimations stemming from the short-cut method. The estimates from both the elaborate and the short-cut methods show that all corresponding rates of return, in general, have the same order of magnitude and that the structure of returns – that is the way the rates relate to each other – is basically the same independently of the method used. The rates of return are not completely accurate, but for assessing investment priorities in education, precise figures are not essential. The alternative real interest rate during 1997 has also been estimated for the economic valuation of the social investments in the system of the tertiary technological education by faculties. The real interest rate was 4.3% (the interest rate of the ten-year government bonds (1997) was 9.8% (Bank of Greece) and the inflation rate in 1997 was 5.5% (Ministry of National Economy).

Table 10

Social rates of return (% in TTE by faculties and years of sutides)

Faculties	Years of studies	Public and Private Sector Employees		Private Sector Employees	
		Short-Cut	Elaborate	Short-Cut	Elaborate
TTE Graduates	3.5	3.79	4.91	3.56	6.0
	4	3.31	4.31	3.11	5.38
Applied Technology	3.5	6.51	6.22	5.57	5.84
	4	5.70	5.63	4.87	5.17
Agricultural Technology	3.5	0.37	–	0.71	–
	4	0.32		0.62	
Health Care Professions	3.5	3.50	3.66	1.50	2.79
	4	3.05	2.93	1.31	2.19
Graphic Arts, Graphic Design	3.5	2.71	4.80	8.24	–
	4	3.10	3.87	7.21	
Management Administration	3.5	1.28	3.65	1.53	–
	4	1.12	3.18	1.34	
Food Nutrition Technology	3.5	4.18	–	6.11	–
	4	3.66		5.34	

SOURCE : Author's calculation

NOTE : Where – connotes the inability to estimate rates of return because the equivalent estimations of age-earnings functions are not statistically significant

5. Concluding remarks

In this paper, we have presented estimates (ex post) of the returns to education in Greek tertiary technological education by faculties with elaborate (where it is statistical possible) and short-cut methods. It is observed that the age-earnings profile with the use of cross-sectional data [year 1997] reflects past conditions of the work demand and supply. The basic conclusions that arise from our analysis are :

(1) Among the TTE graduates, applied technologists enjoy the higher gross earnings from hired labor while agriculture technologists the lower.

(2) The annual average direct social cost of education in TTE is very much lower compared to the indirect social cost/foregone earnings.

(3) The rates of return of social investment in TTE is quite satisfactory and justifies, from an economic viewpoint, the expansion of the TTE system by the state.

(4) The rates of return of social investments in TTE by faculties is higher for the investments in applied technology faculty and lower for the investment in agricultural technology faculty. More specifically, investments, in the applied technology faculty are particularly profitable, in the faculties of food-nutrition technology, health care professions, graphic arts-design, administration and economy are less profitable, while investments in agricultural technology faculty present low return. According to the human capital theory, these differences in the rate of return should make state investments in TTE more attractive for applied technology faculty.

(5) The returns of social investments, in total, in TTE and by faculties is lower than the corresponding of private investments, both in total and by faculties. The difference between the private and the social rate of return reflects the degree of public subsidization of TTE. It is stressed that differences are small in comparison to evidence from research in other countries.

(6) The social rate of returns for the expansion of the duration of studies for a semester is reduced by a percentage which depends upon the faculties and the method employed. This finding, which is for the first time derived from an applied scientific research, may constitute a useful «tool» for the planners of the educational system.

We must note that the rates of return have been underestimated. No attention has been paid to non -monetary benefits of TTE.

From all the above, it is inferred that there is still room for further expansion of the TTE system, in general, and, in particular, to the faculty of applied technology, while valid economic reasons do exist supporting the further shrinkage of the faculty of agricultural technology.

Appendix I

Table 1

Social and private rates of return of investment in TTE (%)

Years of Studies	Social rate of return (%)				Private rate of return (%)					
	Short-cut		Elaborate		Short-cut	Elaborate	Mincer Basic		Mincer extended	
	I	II	I	II	II	II	AE	PE	AE	PE
3.5	3.56	3.79	6.01	4.93	4.16	5.66			5.42	7.33
4	3.11	3.31	5.40	4.33	3.64	5.04	4.75	6.42	4.74	6.41

SOURCE : Tsamadias (2000)

NOTES Where, I : Private sector, II : Public and Private sectors

AE : Actual Experience, PE : Potential Experience

Table 2

Rate of return of Private investment in TTE by faculties and years of studies (%)

Faculties	Short-cut		Elaborate		Mincer (with AE)	
	$S_{TTE} = 3.5$	$S_{TTE} = 4$	$S_{TTE} = 3.5$	$S_{TTE} = 4$	$S_{TTE} = 3.5$	$S_{TTE} = 4$
TTE Graduates	4.16	3.64	5.66	5.04	5.42	4.75
Applied Technology	7.93	6.94	6.97	6.36	6.74	5.90
Agricultural Technology	0.82	0.71	-	-	3.17	2.78
Health Care Professions	4.41	3.86	4.57	3.81	4.72	4.12
Graphic Arts-Design	3.93	3.44	-	-	5.00	4.38
Management-Economics	1.61	1.41	-	-	3.77	3.30
Food-Nutrition Technology	5.49	4.80	-	-	10.45	9.15

SOURCE : Tsamadias (2000) NOTE : where AE, Actual Experience

Appendix II

Average Social Cost in TTE *(year 1997)*

- Average Direct Private Cost
  $(ADPRC_{TTE})_f = 400,000$ drs/student [see Tsamadias, 2000].
- Average Direct Social Cost

Table 1
Total Public Expenditures for TTE

Public Expenditures	Year 1997(drs)
A. Current Expenditures	51,763,700,000
B. Capital Expenditures	5,690,000,000
C. EPEAEK	3,800,000,000
Total : B + C	9,490,000,000
Total : A + 1/5. (B+C)	53,661,700,000
D. Alternative cost for Buildings*	4,000,000,000
TOTAL	57,661,700,000

SOURCE : Tsamadias (2000)

The total number of students in TTE was (1997) $N_{TTE} = 100,410$
Average Direct Social Cost $ADSC_{TTE} = 53,661,700,000/100,410 = 534,425$ drs/student

Table 2
Average Social Indirect and Total Cost by Sector of Employment

	AINDC (drs/student)		ATC (drs/student)	
	Private	Private and Public	Private	Private and Public
–3	2,168,295	2 195,550	3,102,720	3,129,975
–2	2,321,777	2,359,258	3,256,202	3,293,683
–1	2,471,861	2,518,836	3,406,286	3.453,261
	2618,547	2,674,284	3,552,972	3,608,709

SOURCE : Tsamadias (2000)

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