Higher Education 18: 137–147 (1989)

The economics of higher education and tests of equity criteria in Turkey

NEJAT ERK

Department of Economics, Faculty of Economics and Administrative Sciences, Cukurova University, Adana, Turkey

Abstract. Unequal opportunities are a fact of life in most societies. Imbalances exist in each society under all conceivable economic environments. To alleviate these imbalances, most governments tend to interfere in the market. In this respect Turkey is no exception. Thus, the government established the Turkish Higher Education Council in 1982 with the hope of improving educational resource allocation. This paper investigates the private costs of public higher education in Turkey. It also tests whether a structural cost difference exists between the universities in the three biggest cities of Turkey and the rest of the country's fifteen Universities. Does the highly subsidized Turkish Higher Education ensure equity of resource allocation? The findings show that, among the factors contributing to higher education, the number of faculty members has the lowest price elasticity of demand. In the case of assessing whether there are structural cost differences between the universities in developed and underdeveloped regions the findings show that imbalances between the two regions still exist.

Introduction

If a university could be defined as a multiproduct firm, the higher education sector of a country would be an industry. The main distinction between investment in physical capital and investment in human capital is that the former is inheritable. However, like investment in physical capital, investment in the higher education industry also makes significant contributions to economic growth. In Japan, education of employed persons, during the 1953-71 period, made a 34 percent significant contribution to the national income. A similar result has been observed in the United States where, since the end of World War II, a 38 percent increase in the national income has been attributed to a better educated labor force.[1] During the past few decades, high and low income countries on the path to modernization also have experienced a gradual rise in human development investment while enduring a steady decline in the economic value of farm land.[2] This increase in human development investments has been observed in the field of health, education, nutrition, on the job training and in the internal and external migration, each of which carries a cost to the nation.

While generally all universities claim to offer as their products such tangible and intangible goods and services as education degrees, research and publications (new ideas, concepts and solutions to problems), and politico-cultural

socialization, both their inputs and outputs are highly differentiated. On the input side, a large number of universities in the industrialized countries have managed to obtain educators of high caliber, large endowments, huge governmental grants for research and the cream of the crop of the university age student population. On the output side, these universities have been extremely successful in graduating specialists or generalists who are eagerly sought after by both public and private sector employers. Universities in the industrialized countries have achieved their lofty positions after many generations of hard work and public and private support for their endeavors. Although the standard of higher education in the United States and several European countries is reported to have been on the decline, especially in the fields of natural sciences, universities there are still producing sufficient number of highly qualified university graduates to meet the needs of their respective countries.

While universities in the industrialized countries have been recipients of large amounts of private and public funds, their counterparts in the developing world are receiving rather negligible amounts (less than 20% of the total educational budgets).

Table 1. Third level educational expenditure share in GNP, in public educational budgets and third level education cost per student borne by public in 1984

Countries	Percentage share in GNP	Percentage share in educational budgets	Cost per student ($)
Argentina	0.8	19	1689
Bangladesh	0.4	19	85
Hongkong	0.7	25	20
Sweden	1.0	13	3794
Austria	0.9	16	3264

Sources: UNESCO Statistical Yearbook, Belgium, 1986.
EUROSTAD., External Trade, Series 6B, Luxembourg, 1. 1986, p. 201.

In the case of Turkey, we observe that while the higher education budget share showed an overall improvement, there was a temporary setback in 1983. (Table 2) The structural changes that took place in the Turkish higher education in 1982, such as giving the university enrollment decision to the Turkish Higher Education Council (YOK), led to an increase of 46.2 percent in the total university enrollment during the 1982-84 period, while the increase in the number of faculty members was only 22.7 percent for the period. Apart from the enrollment policy, new standards have been enumerated in the promotion policy of the academic personnel. Besides these changes a "free university education" has been changed to a "tuition paying" system, although the tuition does not cover even a small fraction of the total university cost.

Table 2. Percentage of state education budget devoted of higher education

Year	Higher education budget share (%)
1980	28.3
1981	25.5
1982	33.5
1983	27.0
1984	34.6

Sources: UNESCO, Statistical Yearbook, 1984, p. IV.41.
State Planning Organization, Pub. No: 1975, Ankara, 1980, p. 220.
State Planning Organization, Pub. No: 2026, Ankara, 1986, p. 215.

This paper aims to analyze the private costs (neglecting the shadow price of higher education expenditures) of public higher education in Turkey. We examine the various major costs related to university education: instructional salaries, fixed investment costs and management costs. We analyze the cost of each "production factor". We measure elasticity of substitution of inputs juxtaposed against the number of students being graduated. We are excluding other outputs of the universities due to data unavailability. Further in the paper we test whether a structural cost difference exists among the universities in the biggest three cities of Turkey (Ankara, Istanbul, Izmir) and the rest to show whether or not highly subsidized Turkish Higher Education ensures equity of allocation of public resources allocated for this purpose.

We have used a series of terminologies generally employed for production analyses. We found this method useful because it can provide us with a more accurate estimation and projection system for forecasting input demands in higher education. While necessarily ignoring the "qualitative factor" of the final product, this analytical method could enable us to make quantitative projections for our input needs.

Table 3. Basic indicators of Turkish higher education 1984

Number of students in higher education	322.320
Number of teaching staff	20,223
Enrollment ratio of eligible population (%)	9.0 %
Total expenditure on higher education as a percentage of state education budget	19.0 %
Annual cost per student for 1984 (1$=444.74 TL)	$ 532

Sources: Saim Kaplan, Turkish Higher Education, State Planning Organization, Pub. No: 2026, 1986, pp. 215-24.
State Planning Organization, Main Economic Indicators, July 1986, p. 6.
State Planning Organization, Pub. No: 1975, p. 224.

Table 3 shows other basic indicators of Turkish higher education.

In the Model section we describe the translog cost model and the estimation procedures. The following section contains a discussion of the Translog Cost Function (TCF) model, while reporting our translog results. Further in the section we test whether a structural difference exists among the universities in the biggest three cities of Turkey (Ankara, Istanbul and Izmir) and the rest. Finally the study concludes with a recapitulation of our results and their implications for Turkish higher education.

The model

The TCF is being applied econometrically to the existing 27 universities in Turkey. The TCFs belong to the category of the so-called flexible forms, since they serve as a second order approximation to an arbitrary technology.[4] Due to the changes in the higher education system, insufficient statistical data exists for time series analysis; our inability to aggregate and quantify all university outputs, is because some data is not conducive to quantification. The model being used in our analysis is, therefore, restricted to a cross section analysis.

In this analysis, another technical difficulty comes from the determination of university output. Apart from the enrollment figures and the data pertaining to total numbers being graduated each year, it is impossible to obtain reliable information for other types of outputs generated by the universities. This problem, of course, will create a bias and inflate the per student cost.

The Turkish universities are grouped as a single system, because cross section analysis does not enable us to reflect technological differences. For the existing 27 universities in 1984, output is limited to university enrollments in the undergraduate and graduate programs which are corrected by the number of dropouts and failures.[5] For the general TCF-model, statistical data is grouped under the following headings; data on professors include the number of full professors, associate, and assistant professors; the research assistant category includes the number of research assistants and specialists; staff data reflect the number of university line personnel and librarians; and the investment data reflect the TL-value of net physical investment by the universities. In finding a price for professors, research assistants and staff, their average salaries are used.

Under these assumptions n factor translog cost function will look like.

$$\log c(w, y, i) = a_0 + \sum_{k=1}^{3} a_k \log w_k + b_1 \log y + c_1 \log i$$

$$+\sum_{k=1}^{3}\sum_{j>k}^{3} a_{jk} \log w_k \log w_j$$

$$+ 1/2 \sum_{k=1}^{3} a_{kk} (\log w_k)^2 + 1/2\, b_{11} (\log y)^2$$

$$+ 1/2\, c_{11} (\log i)^2$$

$$+\sum_{k=1}^{3} d_k \log w_k \log y$$

$$+\sum_{k=1}^{3} e_k \log w_k \log i$$

$$+ f_{11} \log y \log i$$

where,
$\log w_k$ = log of price of professors, research assistants and university staff.
$\log y$ = log of output as the number of graduates
$\log i$ = log of investment.

In the standard TCF-model estimate, a robust technique has been used assigning higher weights to the observations nearer to the estimate.[6]

$$U = \frac{\text{observed value} - \text{estimate location}}{\text{estimate of dispersion}}$$

Out of the 21 parameter estimates by the Zellner technique, Seemingly Unrelated Regression, the first 6 estimates belonging to the main variables were statistically significant, they also have the correct sign.[7] This implies that, for the sample mean, cost function is an increasing function and convex with respect to prices. We worked with a four input-one output model; the final output is the number of university graduates and primary inputs are professors, research assistants, staff and investment, a_1, a_2, a_3 and b_1. Analysis being cross sectional, TCF does not refelct change in technology in time; it just reflects the given technology in 1984. Concentrating on the demand elasticities, we see that professor, research assistants and staff data have the correct sign. Clearly, the finding of a negative price elasticity of demand shows that the demand functions have a negative slope and cost function is convex with respect to prices. Inelastic demand elasticity for research assistants shows that institutional practices are also backed up by econometric findings. In most universities research assistants directly contribute to teaching.

Table 4. Estimates of the coefficients of the TCF and T rations for Turkish Higher Education

Variable	Coefficient	Estimate	T-Statistic
Constant	a_0	−0.7584E−01	−14.6005
Professor	a_1	0.4771E−01	3.6022
Research Assistant	a_2	0.2974E−01	2.3789
Staff	a_3	0.3760E−01	5.5953
Investment	b_1	0.8354	146.9044
Graduates	f_1	0.1618	25.6805
	a_{12}	0.6775E−02	0.2668
	a_{13}	−0.3399E−01	− 1.8831
	e_1	0.3649E−01	1.5339
	d_1	0.2228E−01	2.0943
	a_{23}	0.7215E−02	− 0.4223
	e_2	−0.1042E−01	0.2336
	d_2	0.4011E−02	0.2336
	e_3	−0.5734	− 3.7881
	d_3	0.5298E−01	4.2833
	f_{11}	−0.6372E−01	−11.3479
	a_{11}	0.4412E−01	2.6548
	a_{22}	0.2327E−02	0.8138E−01
	a_3	0.2417E−01	3.7447
	b_{11}	0.2596E−01	3.1573
	c_{11}	0.5557E−01	10.6370

Observations: 27, D.F. = 6, D.W. = 2.038, SSR = 0.67052499E−03, SSE = 0.10571384E−01, Significance level: 0.7924, R**2 = 0.99.

Demand Elasticity

Professor	$E_{B1} = -0.0276$
Research Assistant	$E_{C1} = -0.8920$
Staff	$E_{D1} = -0.3196$

The Allen Elasticity of Substitution values are positive for substitutes and negative for complements. Findings are consistent, showing professor-staff, research assistant-staff variables to be complements and professor-research assistant variables to be substitutes which further support the findings related to the inelastic demand for research assistants.

Allen Elasticity of Substitution

	Professor	Research Assistant	Staff
Professor	–	5.778	−17.950
Research Assistant	–	–	− 5.458
Staff	–	–	–

Average and Marginal Cost Relationship

$$MC = 0.1618\ AC$$

Finally, we want to test whether or not there are significant cost structure differences between the big city universities in Ankara, Istanbul and Izmir, and the rest of the universities in the country. Henceforward we will refer to these universities in Ankara, Istanbul and Izmir as Developed region universities (DRU). In analyzing the differences between the DRU and the rest of the universities in Turkey, we used the show test.[8] Due to the degrees of freedom problems, further aggregation of cost data is needed. To accomplish this the "new faculty data" includes professors, research assistants and specialists working in different universities. The staff data for this comparison is the same as previously used. The investment data has been dropped, because it does not reflect the overall physical endowments of the universities and it requires higher degrees of freedom. Under these assumptions our translog function will look like,

$$C = a_0 + \sum_{k=1}^{2} a_k \ln w_k + b_1 \log y$$

$$+ \sum_{k=1}^{2} \sum_{j>k}^{2} a_{kj} \log w_k \log w_j$$

$$1/2 \sum_{k=1}^{2} a_{kk} (\log w_k)^2 + 1/2 b_{11} (\log y)^2$$

$$+ \sum_{k=1}^{2} d_k \log w_k \log y$$

$\log w_k$ = log or price of faculty and university staff.

$\log y$ = log of output as the number of students graduates.

Table 5. Estimates of the coefficients of the TCF and T rations for developed regions universities

Variable	Coefficient	Estimate	T-Statistic
Constant	a_0	0.2143	4.7869
Faculty	a_1	0.3901	5.1082
Staff	a_2	0.4032	5.6380
Production	b_1	2.4560	10.1710
	a_{12}	1.4513	8.7864
	d_1	1.5918	5.0214
	d_2	−0.8537	− 4.3910
	a_{11}	−0.0281	− 7.8655
	a_{22}	−0.3230	− 2.7442
	b_{11}	2.0268	8.1556

Observations: 12, D.F. = 2, D.W. = 2.29, SSR = 0.21877386E−01, SSE = 0.104578821, Significance level: 0.260032, R**2 = 0.99.

Table 6. Estimates of the coefficients of the TCF and T rations for underdeveloped regions universities

Variable	Coefficient	Estimate	T-Statistic
Constant	a_0	0.1616	3.0166
Faculty	a_1	−0.6614	−1.9203
Staff	a_2	−0.0393	0.2449
Production	b_1	0.1448	1.2215
	a_{12}	2.3393	2.2766
	d_1	−1.0391	−1.6919
	d_2	0.2002	0.5686
	a_{11}	−5.8723	−2.5725
	a_{22}	−1.1258	−2.4445
	b_{11}	−0.0958	−0.5974

Observations: 15, D.F. = 5, D.W. = 2.863, SSR = 0.12715346, SSE = 0.15947004, Significance level: 0.5339, R**2 = 0.885.

Table 5 and Table 6 show the TCF estimates of the universities in three big cities, labeled as "DRU's" and universities in other parts of Turkey labeled as "universities in underdeveloped regions".

Average and Marginal Cost Relationship

$$MC = 2.456\ AC$$

The computed Chow test value shows that we can reject the null hypothesis. This means that at 0.05 confidence interval level, there exists a structural cost difference between the DRU's and the rest.

$$F = \frac{[SSE_N - (SSE_1 + SSE_2)] / k}{(SSE_1 + SSE_2) / N - 2k}$$

F(10, 7) = 4.646813
Critical Value at 0.05 level = 3.63
Significance level = 0.2667201E–01

Average and Marginal Cost Relationship

$$MC = 0.1948\ AC$$

Conclusion

We began this paper with a modest goal, namely, to estimate the cost structure of Turkish higher education in 1984. Findings suggest that our model provides

a reasonable alternative to time series analysis mainly in situations where reliable time series data is not available. The main TCF/estimate shows us that the dominant cost factor is the investment component followed by professor, staff and research assistant data respectively. A negative constant term in the main TCF indicates that technology in the Turkish higher education is appropriate to the needs.

For policy implications, we should like to suggest that for the existing 27 Universities in Turkey, in the short run an increase in student numbers is reducing the average cost if the quality factor is ignored. The universities outside the three big cities are "less saturated" *vis-à-vis* the production cost. Although average cost per student increases as enrollment increases, this does not hold true for the universities outside Ankara, Istanbul and Izmir. Also, the same finding can be interpreted to mean that the three big city universities are using higher education technology that tends to increase the per student cost as output increases. Our findings at this point assert that the provision of free or heavily subsidized education does not ensure equity of the public resources used for this purpose.[9]

These findings show us that it is important to rationalize university expenditure in the developing countries, where a large portion of the population is illiterate and a considerable number of university graduates remain unemployed for an indefinite time.

Notes

1. Edward F. Denison and William K. Chung, *How Japan's Economy Grew So Fast.* Washington D.C.: The Brookings Institution, 1976, p. 42.
2. Theodore W. Schultz, "Economics of Being Poor," *Journal of Political Economy* (1980; Vol. 88, N0: 4) p. 642.
3. George Psacharopoulos, "The Economics of Higher Education in Developing Countries," *Comparative Education Review* (June 1982; Vol. 26, No: 2) p. 139.
4. Laurits Christensen, Dale Jorgenson and Lawrence Lau, "Transcendental Logarithmic Production Functions," *The Review of Economics and Statistics* (Feb. 1973; Vol. 55) pp. 28–45.
5. J. K. Sengupta, *Analytical Models in Education Planning and Administration.* Newyork: David Mc. Kay Co. Inc., 1975, p. 263.
6. W. J. Dixon, *BMDP Statistical Software*, Berkeley, University of California Press, Revised Printing 1983, p. 82.
7. Robert S. Pindyck and Daniel L. Rubinfeld, *Econometric Models and Economic Forecasts.* Newyork: Mc. Graw Hill Book Co., 1981, pp. 347–49.
8. George C. Chow, "Test of Equality between Sets of Coefficients in Two Linear Regressions," *Econometrica* (July 1960: Vol. 28) pp. 591–605.
9. Alain Mingat and Jee-Peng Tan, "Who Profits from the Public Funding of Education: A Comparison of World Regions," *Comparative Education Review* (May 1986; Vol. 30, No: 2) p. 269.

Appendix A

	Professor	Students	Research Assistants	Staff
*	57.0000	4724.0000	95.0000	610.0000
*	181.0000	48901.0000	230.0000	1420.0000
*	286.0000	11086.0000	370.0000	2001.0000
*	92.0000	2316.0000	130.0000	690.0000
*	210.0000	8024.0000	281.0000	1889.0000
*	120.0000	5480.0000	222.0000	1213.0000
*	104.0000	3439.0000	152.0000	634.0000
*	66.0000	3219.0000	149.0000	464.0000
*	31.0000	1180.0000	43.0000	190.0000
*	177.0000	7115.0000	170.0000	921.0000
*	128.0000	9813.0000	153.0000	447.0000
*	75.0000	4739.0000	59.0000	377.0000
*	223.0000	11169.0000	244.0000	1953.0000
*	13.0000	776.0000	18.0000	57.0000
	6736.0000	28699.0000	7933.0000	5096.0000
	144.0000	3993.0000	70.0000	492.0000
	270.0000	23948.0000	292.0000	1731.0000
	519.0000	12250.0000	569.0000	5401.0000
	243.0000	31325.0000	420.0000	5052.0000
	771.0000	16622.0000	817.0000	5600.0000
	1113.0000	35306.0000	1044.0000	9359.0000
	448.0000	15352.0000	430.0000	1468.0000
	129.0000	14066.0000	237.0000	833.0000
	79.0000	2233.0000	93.0000	247.0000
	118.0000	5129.0000	77.0000	673.0000
	441.0000	14825.0000	543.0000	2438.0000
	170.0000	9839.0000	212.0000	610.0000

* Show universities in underdeveloped regions.

Sources: Turkish Ministry of Education, *1983-84 Statistics*, Ankara 1984, p. 90.
Saim Kaplan, *Turkish Higher Education*, State Planning Organization, Pub. No: 2026, 1986, p. 210-19.

Appendix B

	Price Investment	Price Professor	Price Research Assistants	Price Staff
*	905.0000	1116.83	1662.20	3135.26
*	1410.0000	335.343	396.430	690.140
*	1085.0000	2337.33	2068.37	4270.91
*	440.0000	3267.32	2117.36	2961.43
*	800.0000	3598.96	3724.27	7076.62
*	950.0000	2371.14	2048.79	5585.34
*	790.0000	1983.94	2547.97	5243.57
*	1000.0000	2739.87	2905.44	4366.89
*	720.0000	1857.60	3024.42	3431.05
*	920.0000	2380.17	2713.98	3828.09
*	970.0000	2253.86	1842.43	3071.34
*	900.0000	1181.78	1810.17	1079.71
*	1025.0000	1433.85	1180.35	1886.41
*	1320.0000	1808.92	1735.68	4141.77
*	450.0000	1517.78	1540.72	1767.65
	1690.0000	21264.9	19733.4	4207.70
	920.0000	1021.46	1233.86	1713.41
	620.0000	3838.48	2471.37	10438.8
	1150.0000	702.819	1712.09	3816.46
	1450.0000	4202.42	3629.83	7989.10
	2200.0000	2856.11	1607.33	6270.54
	650.0000	2643.88	1782.88	2266.10
	690.0000	830.897	2076.41	1402.25
	425.0000	3205.28	3231.66	2647.78
	1140.0000	2084.38	1640.07	3107.84
	660.0000	2695.08	2534.64	3933.96
	395.0000	1565.40	1631.79	1468.66

* Show universities in underdeveloped regions.

Sources: Turkish Ministry of Education, *1983-84 Statistics*, Ankara 1984, p. 90.
Saim Kaplan, *Turkish Higher Education*, State Planning Organization, Pub. No: 2026, 1986, p. 210-19.