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Economic Growth and Highly Educated Manpower Requirements in Iran*

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Abstract

The quantitative relationship between higher education and economic growth in the tradition of "growth accounting equations" and also "neoclassical production function" approach have occupied a pride of place in economics of education, particularly the literature on more developed countries. However, production function type models that allow for isolating the "indirect" (external) effects of higher education on economic growth and for measuring factor productivity differences between higher and non - higher education sectors appear to be lacking. This paper is a contribution towards filling this gap and also towards meeting the demand of Iranian educational planners for having educated manpower forecasts, based on alternative forecasting models including the more traditional "factor demand approach". The methodology of this paper might also be of use to other developing countries that might wish to endeavor educational programming.
Keywords: Economic growth; Higher Education; Externalities; Forecasting; Productivity; Iran.

I- Introduction

The economic impact of education has been the center of intellectual attention ever since the time of Plato, the Greek philosopher who considered education as essential for every "civilized society" because it made "rational human beings". A formal treatment of the relationship between education and economic growth, however, was first proposed by Adam Smith who is quite well

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known in the profession of economics, and then pursued by a long line of classical and neo-classical economists up to Marshall in the twentieth century who once said: "The most valuable of all capital is that invested in human beings" [1].

The pioneer studies of Schultz (1961 a and b) that introduced the concept of education as a productive investment, capable of producing human capital with effects comparable to those of physical capital, once again brought the economic impact of education to the forefront, with such a vitality that Bowan (1996) has referred to it as "human capital revolution in economic thought". This has essentially implied that education's contribution to economic growth is measurable independent of the contribution of the traditional inputs of capital and labor.

The "growth accounting equations", also known as Denison-Schultz's or, alternatively, the "growth" "residual" approach, has been among the earliest models used for measuring the contribution of education to economic growth, particularly in advanced countries. Thus, in applying this approach to USA {Denison (1979)} for 1948-1973 period, Kendrick (1977) for the1348-76 period, and Jorgenson (1984) for the 1948-73 period, it has been found that 21 and 15-25 percent of economic growth in USA might be accounted for by increased labor education and education respectively.

Similar studies have also been carried out with the purpose of making cross-country comparisons. For example, Psacharopoulos (1972) reports that the share of education in economic growth using a "growth residual" approach varies from 0.8 percent in Mexico to 25 percent in Canada. He also has noted that the share of education in economic growth is lower in higher income countries, compared to lower income countries. For example, it is about 17.2 percent in Africa, compared to 11.1 percent in Asia and 8.6 percent in North America and Europe. Studies carried out in Iran itself ((Hosseini Nasab, 1372(1993)) indicate that the residual growth in Iranian economy is more than fifty percent which in the light of the relatively slow speed of technological progress and fast speed of progress in education may be, at least in large part, attributed to education. In another study, Krueger (1968) found that between 1/3 -½ of the difference in incomes between USA and a group of 28 selected countries could be attributed to the difference in their respective educational attainments. In some cases, this difference was even 63 percent. The study has also highlighted that economic growth in countries endowed with the same resource base as USA frequently lagged behind the latter, because of their educational gap.

Studying the effect of different *levels of education* on economic growth has, however, been somewhat more problematic, in part because higher

education in many developing countries is a relatively new phenomenon and therefore inaccessible to research requiring time series data. Nevertheless, Harbison and Maryers (1964) have reported that the correlation between *higher education* and economic growth in a cross section of 75 countries in 1964 was relatively strong.

An important, yet almost neglected, aspect of the empirical relationship between higher education and economic growth is that higher education affects economic growth not only by its direct, but also by its indirect contribution via increasing production in non-higher education sectors. This phenomenon that falls under "externalities" of higher education seems to be one of the more urgent research agendas facing us today (Weado 1992). Considering that positive externalities from education in spatial terms (Jaffa, 1989 and Martin, 1992) and also in terms of new discoveries, invention, innovation and knowledge dissemination (Arrow, 1972; Stephan, 1996; Jaffa (1989 and Norman, 1993) are of paramount relevance to our modern economies, new empirical research to shed some light on the marginal externality effect of education seems quite warranted.

External benefits of university research are well exemplified by empirical findings related to the positive impact of universities on the development of Silicon Valley in California and Road 128 in the neighborhood of Boston (Jaffa, 1989). The observed phenomenon of firm-to-firm research" spillovers" is also definitive in the case of university –to- firm, because universities have less incentive to hide their research in confidential forms. The mechanism of these spillover effects is not, however, well understood.

On the other hand, it may be asserted that the more immediate concern of developing countries such as Iran is not the share of education in economic growth per se, but its implications for forecasting educated manpower requirements and planning in the tradition established by Parnes (1962) and Tinbergen (1965) [2].

A more flexible approach could be couched in terms of neoclassical production function. We concur with Johnson (1964) that the so called "human capital revolution in economic thought" may already have faced a "counter revolution" and that years of educated manpower planning in developing countries may have had only disappointing results, if and where there have been any results at all, but planners and policy makers of developing countries still opt more strongly for any array of forecasts and, even poor ones, than none at all.

A vivid exemplifier of this case is The Islamic Republic of Iran with its current heavy project work on highly educated manpower forecasting and planning concentrated in The Management and Plan Organization of The Islamic

Republic of Iran,[3] and also in The Institute for Research and Planning in Higher Education of The Ministry of Science, Technology and Research of The Islamic Republic of Iran[4].

The objective of this paper is two-fold:1) to measure the indirect effects of higher education on economic growth in Iran and also to calculate marginal productivity differentials between higher and non-higher education; 2) to forecast the highly educated manpower requirements of Iran up to the year: 1390(2011), and draw implications for higher educational policy making there.

Two different models are used here to achieve these objectives. The first model is based on the logic originally used by Feder (1982) and then by Ram (1986). Feder's approach in measuring the direct and indirect effects of exports on economic growth in a model allowing for explicit externality effects was later adopted by Ram to measure the direct and the indirect (internal and external) effects of government size on economic growth. Both of these studies have been highly instrumental as a logical base for the development of the approach used in this paper for analyzing the indirect effects of education on economic growth and also in measuring inter-sect- oral factor productivity differentials in Iran. The findings will have some bearing on other developing countries with comparable situations as well.

The models and data requirements are presented in section III below after a discussion about the settings of the study, which is presented in section II. Section IV is devoted to model estimates and discussions and finally section V summarizes the paper and brings it to a conclusion.

II- The Setting of the Study

a) Policies and Programs of Higher Education

Policies and programs of higher education in Iran are spelled out in the respective volume of the documents appended to The Economic, Social and Cultural Development Plan of Iran [5] (Currently The Third). These policies are formulated by The Ministry of Science, Research and Technology of The Islamic Republic of Iran, synchronized and supplemented by The Management and Plan Organization of The Islamic Republic of Iran, and finalized by the Board of Ministers. The documents appended to the Current Third Plan describe strategies and policies of higher education, some of which may be summed-up as follows:

Matching the plan's higher education development objectives with country's development needs.

Diversifying the sources for supplying higher educational services and allowing a more active role for "people's participation" in higher education.

Creating scientific poles at first-rate universities with the central task of carrying research.

The document also contains analysis and forecasting related to the number of higher education graduates required by economic sector for the coming years based on a target value for growth in value added of each sector [6]. According to these forecasts a total of 2473 thousand higher education graduates will be needed in 1383(2004)[7]. This figure, these studies show, is generally higher than various production activities can absorb and hence reflects a need to exercise restraints in order to avoid increased unemployment.

b) Student enrollment and graduates

The relatively rapid increase in higher education graduates in Iran in recent years presents a formidable task for trying to measure its economic growth impact. The number of higher education enrollments by fields of studies in the ending year compared to the beginning year of the 1368-77 (1989-98) periods shows an increase of almost two-folds (Table 1). With the exception of enrollment in medical schools, which less than doubled during this period, the average annual growth rate varied from 3.6 percent for medical students to 15 percent for students of humanities. Of the total number of students, about 37 percent enrolled in arts, 15 percent in basic sciences, 5 percent in agriculture, 20 percent in each of engineering and medical fields and 2 percent in arts.

The average growth rate of arts graduates in the 1368-77(1989-98) period was the highest, comprising about 25 percent and that of engineering graduates was the lowest comprising about 9 percent. In 1377(1998), the number of graduates in humanities was the highest with 27000 graduates.

The relative high increase in population and particularly in the young age group in the last tow decades has given rise to an increase in demand for all, especially higher, levels of education. The increase in demand for education may also be, at least in part, attributed to inadequacy of jobs and also to avoidance of conscription service. Military service in Iran presently runs as a compulsory two year program that calls to duty all 18 years old males, except those still in school or higher level education and also in certain other "waver" categories. Although tight annual competition for entering higher education usually eliminates candidates at a ratio of about four to five, the university drop out ratio is quite low and insignificant [8].

c) Students as percent of population.

In spite of the fact that the number of students in Iran in recent years has increased substantially, the student/population percentage is still below countries such as USA, Germany, Canada and Japan. For example, this percentage was 1.6

in Iran in 1966 compared to 7 in Canada three years earlier and 5 in USA in 1992 [(Salehi, 1376 (1997)].

Highly skilled labor as a percent of active population in Iran is also low (in fact the lowest), compared to countries such as South Korea, France, Australia, Canada and certain other countries (Salehi as cited above). Therefore the student/ population ratio in Iran is not yet as high as records achieved by developed and certain developing countries. This is partly because of recent rapid growth in cohorts and partly because of the slow pace in development of higher education institutional capacities. At present time, higher education is offered mostly by government universities and higher education institutions and with the exception of Islamic Free University (see below), private involvement in providing higher education still leaves much to be desired.

d) The Institutional setting of Higher Education

After The 1357(1979) Islamic Revolution all the educational institutions, run hitherto by a mixed public/private system, were constitutionally declared public. But nationalized educational institutions alone could not meet growing demand for higher education, particularly for easier and less competitive access to higher education. One solution offered was the establishment of the privately managed Islamic Free University to supplement the badly needed extra capacity for absorbing the rapidly increasing demand for higher and less stringent education. In the early days of this university, student admission did not even require complete high school credentials. As the number of applicants began to rise, the admission criteria became more stringent and it is now close to the standards set by public universities. Expansion of this university in various parts of the country has now caught up with the expansion of government universities and the quality of education is becoming more competitive to that of public universities, even though it still desires plenty of room for improvement.

The Ministry of Science, Research and Technology itself has also established certain less stringent universities in the form of long distance learning and technical vocational universities on a charge for services basis to absorb the balance in demand for higher education. In spite of all that, the number of all admittances (public or private) in every year is about one to five of the number of applicants, which puts higher education institutions under extreme strain for making the screening criteria more and more stringent.

III- The Model and The Data

The model used in this paper draws on the empirical studies concerning the sources of growth in such a framework that changes in output is linked to changes in capital and labor. Some researchers (for example: Woo, 1991) have

tried to explain economic growth via indices representing the performance of higher education.

In the following lines we develop a framework, which provides the formal justification for the need to include higher education variables among the sources of economic growth. Since the present analyses are concerned with un-optimal allocation of resources between higher education sectors on the one hand and non-higher education sector on the other, we have viewed economics as comprised of two sectors: One producing higher education services and the other producing other goods and services. Each sector's production is a function of inputs allocated to that sector. Moreover the non-higher education output is a function of higher education output. This formulation reflects the useful effects of higher education on other sectors, which cover effects such as: innovation of more efficient and internationally competitive management, invention and innovation, improved production methods and training of better quality manpower. These effects are usually referred to as "externalities" in economics because they are not usually truly reflected in the market process. These externalities are incorporated in the following formulation.

$$Z = Z(L_Z, K_Z, E) \quad (1)$$

$$E = E(L_e, K_e), \quad (2)$$

Where:

Z = output of non-higher education,

E = output of higher education,

K_e and Z_e = Capital stock in non-higher education and higher education, respectively,

L_e, Z_e = labor force in non-higher education and higher education, respectively.

Since the data on primary resource allocation between each sector is not readily available, the use of a formula that permits marginal productivity estimates using aggregate data becomes necessary. This formula may be written as follows:

$$(E_k / Z_k) = (E_l / Z_l) = 1+\delta \quad (3)$$

Where subscripts represent partial derivatives.

In the absence of external effects and given a set of prices, any situation with $\delta = 0$ reflects a situation in which resource allocation leads to production maximization. But for numerous reasons it may be said that factor productivities

is lower in non-higher education (that is $\delta > 0$). Taking partial derivatives in (1) and (2) above we arrive at:

$$\dot{Z} = Z_k . I_z + Z_l . \dot{L}_z + Z_e . \dot{E} \quad (4)$$

$$\dot{E} = E_k . I_e + E_l . \dot{L}_e \quad (5)$$

Where: I_z and I_e designate the corresponding gross investment and $\dot{L}_z$ and $\dot{L}_e$ represent changes in each sector and Z_e represents the externality effect of higher education on non-higher education. A dot over a variable designates changes.

Defining Gross Domestic Product as Y=Z+E, It follows that:

$$\dot{Y} = \dot{Z} + \dot{E} \quad (6)$$

Substituting equations (3)- (5) in (6) and considering the definition of total investment I ($=I_z+I_e$) and growth of total labor $\dot{L}(\dot{L}_z + \dot{L}_e)$ and after some substitution and manipulation, the following equation will result:

$$\dot{Y} = Z_k . I + Z_l . \dot{L} + \{\delta/(1+\delta) + Z_e\} . \dot{E} \quad (7)$$

Assuming a linear relationship between real marginal product of labor in each sector and average product of labor in the economy as a whole:

$$Z_l B . (Y/L), \quad (8)$$

An=d dividing (7) through by Y after some manipulation yields the following equation (9) below:

$$\dot{Y}/Y = \alpha . (I/Y) + \beta . (\dot{L}/L) + [\delta/(1+\delta) + Z_e] . (\dot{E}/E) . (E/Y) \quad (9)$$

If marginal productivity is assumed equal throughout all sectors (δ =o) and if intersect oral externalities are assumed zero (Z_e =o), then equation 9 will be reduced to the neoclassical model known as "sources of growth". In a general setting the expression $[\delta/(1+\delta)+ Z_e$ is expected to be non- zero.

The parameter α in the present formula should be interpreted as marginal product of capital in non-higher education, not as the marginal product of capital in total economy. Now we may designate the overall increase in GDP attributable to marginal increase in capital allocated to higher education as $TMPK_e$. This may be called as social marginal productivity of investment in

higher education. Similarly, we can show the effect on GDP of a marginal increase in labor allocated to higher education as $TMPL_e$. These will give us:

$$(TMPL - Z_l)/E_l = (TMPK_e . Z_k)/E_k = \delta/(1+\delta)+Z_e \quad (10)$$

The extreme right expression in (10) represents the difference in the marginal share of production factors in GDP in the two sectors relative to the marginal share of these factors in higher education output. Then the interpretation of the equation known as sources of growth (equation 9) is such that GDP is comprised of two elements, namely the share of the factor stocks (that is the growth of capital and labor) and the benefits resulting from the transfer of factors from the sector with lower productivity (non-education) to the sector with higher productivity (education).

Equation (9) may be estimated in the following form:

$$\dot{Y}/Y = \alpha.(I/Y) + \beta.(\dot{L}/L) + \gamma.(\dot{E}/E).(E/Y) \quad (11)$$

Where: the parameter γ represents the factors' productivity differential referred to above. The marginal product of capital in non- higher education (α) is expected to be positive. Because of the presumption that marginal product of capital in higher education is higher and higher education produces externalities, one should expect a positive and non-zero value for γ. The β parameter that is related to labor growth will be higher than zero provided that the population under study is not faced with any surplus labor during the period under study. Recalling that $TMPK_e = (1+Z_k). E_k$, we can write:

$$TMPK_e = Z_k. (1+Z_e)/(1- \gamma+ Z_e) \quad (12)$$

And estimates of Z_k and γ will provide via equation (12) a range of values for Z_e. To decompose the factor productivity differential into its various parts, one possible way is to identify intersect- oral externalities via employing a possible expression for Z_e by assuming that higher education affects non-education with a constant elasticity, That is:

$$Z = Z (K_z, L_z, E) = E^{\theta}. \psi (K_z, L_z) \quad (13)$$

Where: θ represents a parameter. Now it can be proved that:

$$\Pi Z / \pi E = Z_e = \theta. (Z/E) \quad (14)$$

Using this result and assuming that $\delta/(1+\delta)=\theta$, equation (11) can be shown to be reduced to:

$$\dot{Y}/Y=\alpha.(I/Y)+\beta.(\dot{L}/L)+\theta.(\dot{E}/E) \qquad (15)$$

The parameter θ in this formula is representative of inter sect oral externality effects and it is expected to be non-zero. The other productivity differential component (δ) can be obtained from an estimate of θ and the parameters accompanying ($\dot{E}/E$). (E/Y). But since (15) is premised on $\delta/1+\delta=\theta$, an estimate of θ also yields an estimate of δ.

Equation 15 was estimated using time series data {(1348-78)(1969-1999)} on each of the variables of the model where labor variable was confined to skilled labor as represented by employment of higher-level graduates. The equation was first reformulated in log form and then estimated by Ordinary Least Square Method. An AR1 term was added to account for the presence of autocorrelation as a result of which the Durban-Watson statistics substantially improved.

All the data used in estimating this model, except the data on value added of higher education, was directly taken from The Iranian Statistical Yearbook[7]. The data on value added of higher education was constructed by interpolation from a five year series {(1372-1377)(191992-1997)} available from The Iranian Statistical Center and the data on total expenditures on higher education. This constructed series was verified against the share of higher education value added in total value added for the years with actual data and also the trend in total value added for the whole period and the comparisons were reasonably close.

The estimated equation was then used to measure the externality effect of higher education on economic growth via an estimate of the θ parameter.

An alternative model follows the logic presented by "factor demand approach" {see: Intriligator *et.al.* (1996)}. In this approach, one can start with a production function of an assumed form, combine it with a labor adjustment model, which allows for adjustment of labor input to its equilibrium level and then derive an explicit function for desired labor. Following Denison in his treatment of highly educated manpower (or what he has called "educational deepening") as a separate input, comparable to capital and simple labor, into the production process and applying a criteria of highly educated manpower adjusting to its equilibrium level, the following steps will emerge:

$$Y=AL^{\alpha}K^{\beta}E^{\lambda} \qquad (16)$$

With Y, L, K representing output, labor, and capital as usual and E representing highly educated manpower.

Expressing equation (16) in logarithmic form and combining it with highly educated manpower adjustment model of the form:

$$E_t / E_{t-1} = (E^*_t / E_{t-1})^{\theta},\ 0 < \theta < 1 \qquad (17)$$

yields the following structural equation:

$$L_n E_t = \theta/\alpha\ L_n A - \alpha\theta/\lambda\ L_n L - B\theta/\lambda\ L_n K + \theta/\lambda\ L_n Y + (1-\theta)\ L_n E_{t-1} \qquad (18)$$

Once an estimate of (18) is obtained, we can forecast E conditional on assumptions about L, K and Y.

VI- Results and Discussions

The results of stationary tests performed on the series implied a preferable use of equation (15) in a First Difference Form (D) and the final estimated form after performing several trial estimations using other likely forms is reported below with "t" values in parenthesis:

$$\begin{array}{l} D((\log(Y)) = -.15 + .2\ D((\text{Log}(I/Y)) + 1.77 D((\text{Log } L)) + .15\ D((\text{Log}(E_{-1})) \\ \qquad\qquad (-2.77)\ (2.79) \qquad\qquad (3.05) \qquad\qquad (1.88) \\ R^2 = .66 \\ DW = 2.17 \\ F = 13.79 \\ N = 25 \end{array} \qquad (19)$$

The model statistics seem to confirm the good fit. Although a higher value for R^2 might have reflected a more explanatory power, it might also have arisen because of problems elsewhere with the model and therefore one could reasonably accept the explanatory power of the model at the present value of R^2, which is .66. The other statistics (F and t values) provide for relative assurance that the model is reasonably robust and reliable.

The coefficient of E_{-1} indicates that with most likelihood the externality effect of higher education is positive with the only provision that it has a lag effect of one year.

The difference in factor productivities between higher education and non-higher education sectors, using a point estimate as a basis for calculations, may be obtained by solving the following equation:

$$\delta/(1=\delta)=\theta \qquad (20)$$

Hence, substituting $\delta = .15$ from (19) into (20) and solving gives $\delta = .17$ and

$$E_k / Z_k = E1 / Z_1 = 1+\delta = 1.17 \qquad (21)$$

Based on these calculations it may be concluded that the productivities of factors in higher education is somewhat higher than the productivities of factors in non-higher education.

This model was used to forecast the highly skilled labor input (L) requirements based on growth objectives envisaged for GDP and Investment in the Current Development Plan and assumptions about the growth in value added of higher education [9]. These forecasts, which are reported in table (6), are of course made under the condition that we can abstract from the direct effects of education and consider only the external effects. Therefore the forecasts might underestimate the actual situation to the extent of ignoring the direct effect of education on economic growth. Since we have also tried to forecast highly educated manpower requirement using a "factor demand approach" as reported below, it is curious to see how these two forecast enterprises fare against each other.

The alternative specification, equation (18), was estimated using the time series data on capital, labor, GDP and number of higher education graduates obtained from the same sources as mentioned above. The following final estimate, after exhausting several form trial estimates was adopted for the purpose of this study:

D (LOG (ES))=.02 + .99D(LOG (L) 2) .05(D (LOG (GDPF)) + .78D(LOG (ES (-1)))
(2.16) (2.19) (22) (7.38)

R^2 =. 83
DW = 1.9
F= 40.o3
N=25

The variable K has been eliminated from this final estimation form, because of an extremely low "t" value, which could not be accepted at a reasonably high level of confidence. This does not, however, mean that capital is not important in the context of Iranian production. The reason for the insignificance of the capital coefficient in (22) may be inaccuracy of capital stock estimates, arising from a lack of direct data on capital stock in Iran. The AR (1) term is included to capture the effect of autocorrelation and this improved the estimation results considerably. The 'statistics' of the model point to its robustness and it would be relatively easy to forecast higher education manpower requirements conditional upon assumed target values for GDP and simple labor.

Comparing the two sets of forecasts (Tables 2 & 3) we can see that they are very close at an assumed GDP target growth of 3% and 6% per year, but somewhat apart at a target growth rate of 9%. Any rate the highly educated

manpower required by the year 1390(2011) will be more than twice the number of present graduates. Any shortcomings in employment could mean labor market frictions and dis-equilibrium situation, which might presumably need to be decided not by higher education policies, but by policies elsewhere in the economy.

V- Summary, Conclusions

To summarize, we used a supply side approach to measure the externality or indirect effects of higher education on economic growth in Iran within the framework of a two-sector economy comprising higher education and non-higher education. We found that at least the direction of this externality effect is positive and that the factor productivity is somewhat higher in higher education compared to non-higher education. The estimated model was then used to forecast the highly educated manpower requirements of Iran given the target growth rates of GDP and investment ratio. These forecasts fare well with the forecasts obtained from a more traditional factor demand approach, which was also used in this study. Our forecasts are also reasonably close to the forecasts made by The Management and Planning Organization, although the latter forecasts end in 1383(2004) compared to ours, which end in 1390(2011). Even with our higher forecasts of highly educated manpower requirements the number of highly educated graduates per population would still be below the corresponding figure for most of developed countries.

We suggest that avenues for increasing higher education enrollment capacities in Iran should be sought seriously. One way would be to allow more active role for the private sector to engage in higher education enterprises. The required growth in higher education capacity in the immediate years to come will be at least twice as great it has been in recent past.

Table 1: The number and annual average growth rate of student population [(and in Parenthesis) graduates] by field over the period of 1368-77(19993-1998).

	Humanities	Basic sciences	Agriculture & animal Husbandry	Engineering	Medicine	Arts
Beginning period numbers (Heads)	80634 (8244)	42080 (2600)	14370 (2317)	67015 (8607)	71041 (9721)	6251 (420)
Ending period numbers (Head)	267844 (26749)	92379 (9437)	38112 (5807)	120800 (18678)	97826 (22532)	18736 (2700)
Annual average (%)	14.95 (12.80)	9.21 (10.76)	10.9 (10.18)	6.60 (8.60)	3.56 (9.24)	13.71 (24.9)
Field average as percent of total	36.73 (10.17)	14.57 (10.06)	5.08 (16.38)	20.08 (14.70)	20.08 (19.60)	2.10 (6.54)

Source: Compiled from: The Islamic Republic of Iran, Ministry of Science and Technology, " Statistics of Iranian Higher Education (Various Years) and also Management and Planning Organization, Iranian Statistical Center, "annual Statistical Yearbook (1377 or 1988), and also from The Iranian Statistical Center, " Annual Statistical Yearbook"(various years).

Table 2: Projection of higher education graduate requirements based on three different GDP target growth rates (Equation 19).

GDP Growth (%)	Required Graduates (Million Persons) in Target Years		
	1383(2004)	1388(2009)	1390(2011)
6	2.60	4.02	4.81
3	2.56	3.98	4.74
9	2.59	4.12	4.94

Table 3: Forecast of higher educated manpower requirements, based on selected target growth for GDP (Equation 22)(million persons).

GDP growth %)	Required Graduates (million Persons) in Target Years		
	1383(2004)	1388(2009)	1390(2011)
3	2.623	4.065	4.848
6	2.668	4.25	5.128
9	2.977	4.858	5.937

Notes

1- For an in depth review of the literature on economics of education, see: Elchanon Cohn & Geriant Johnes, Eds, (1994).

2- For a summary view of Parnes-Tinbergen refer to Gills et al (1992, p. 228) as cited in bibliographical citations to this paper.

3- The management and Planning organization previously known as The Plan and Budget Organization is assigned with the duty for reviewing, coordinating and financing all the projects received from the various Ministries in Iran. It also engages in research projects at its own initiative and publishes The Quarterly Journal of Plan and Budget- Research & Extension.

4- The Institute for Research & Planning in Higher Education of The Ministry of Science, Research & Technology sponsors research projects on various aspects of higher education. It also engages in research projects at its own initiative and publishes The Quarterly Journal of Research & Planning in Higher Education.

5- See: Islamic Republic Of Iran, the Management and Budget Organization, "the Law of the Third Economic, Social and Cultural Development Plan of the Islamic Republic of Iran (1378-1383) or (1999-2004)

6- The average annual growth targets are variants of the annual average figures recorded in table 5.

7- See: The Documents appended to The Third Development Plan (1378-1383(1999-2001), Numbers 32 &33. The Forecasts are based on an econometric model of the following general form:
$LH = f(y, k)$

Where: LH= highly educated manpower; y = value added in each economic sector; and k = capital stock in each economic sector.

However. depending on the economic sector under study, various other variables such as sector specific real wages, number of student enrollment, an index of sector specific total factor productivity and a price index of sector specific raw materials have also been added to the right hand side variables. (See: Islamic republic of Iran, The Plan & Budget Organization (now renamed as: The management and Planning Organization) Documents Appended to The Third Development Plan in the bibliographical citations to this paper.

Other forecasts made by The Deputy Directorate for Cultural, Educational and Research Affairs of The Plan & Budget Organization(now renamed as: Management and Planning Organization) employ an econometric model of the following general form:

$Y= g(x_1, x_2)$,

Where: x_1= the ratio of highly educated employed to non-highly educated Employed; x_2= capital stock per head of non-highly educated employed; and y=Gross Domestic product per head of non-highly educated employed, However these forecasts project a total requirement for highly educated labor of about 1.6 million compared to about 2.5 of the previous study. (See: Islamic Republic of Iran, The Plan & Budget Organization, Deputy Directorate for cultural, educational and research Affairs in bibliographical citations to this paper. Yet another more conservative forecast is provided by Islamic Republic of Iran, Plan & Budget Organization, The Deputy Directorial for Cultural, Educational and Research Affairs, Under The Comprehensive Project for Providing and Training The Country's Expert Manpower Requirements(the subject of note 36 of the Law of the second Plan), " Estimation of The expert Manpower Requirements in Iran," based on The International Model Project No. 6,Preliminary Report, Researcher: Paridokht Vahidi. According to this estimates the Total expert manpower requirement in 1383(2004) with an annual GDP growth rate of 5% in a model with population and GDP, as independent variables will be fewer than two million.

8- For an amusing story about the quality of higher education, particularly, medical education in Iran and the relevant issues, see: Malek (1991) as cited in bibliographical citations to this paper.

9- Because of the lack of time series data on value added of education except for the years 1373-1375(1994-1996) given by the Iranian Statistical Center, we had to reconstruct the series based on total costs of the higher education, the value added of higher education for the aforementioned years and Economy's performance relationship to GDP. A constant growth of value added of education, based on past performance, was assumed for the years up to 1391(2011).

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