HUMAN CAPITAL and ECONOMIC GROWTH: THE CASE OF TURKEY

Thesis submitted to the

Institute of Social Sciences

in partial fulfillment of the requirements

for the degree of

Master of Arts

in

Economics

by

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July 2004

To my beloved Grand Father Prof. Mustafa KÖSEOĞLU

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ABSTRACT

MEHMET ADAK **July 2004**

HUMAN CAPITAL and ECONOMIC GROWTH:

THE CASE OF TURKEY

This thesis employs a structural equation model (SEM) so as to identify the "correlation based-determinants" of human capital in Turkey. It turns out that a set of determinants consisting of schooling, health expenditure and GNP per capita would be highly correlated with human capital in Turkey. We describe past and present "state" of these determinants in Turkey and use an augmented Solow model to determine the effects of human capital on GNP per capita (per working age person).

Key words:

Economic Growth Education Healthcare

Human capital

KISA ÖZET

MEHMET ADAK **Temmuz 2004**

BEŞERİ SERMAYE VE EKONOMİK BÜYÜME: TÜRKİYE ÖRNEĞİ

Bu tez, bir yapısal denklem modeli kullanarak Türkiye de beşeri sermayenin determinantlarını belirlemektedir. Yapılan analiz, okullaşma, sağlık harcamaları ve kişi başına düşen gayri safi milli hasıladan oluşan bir determinant kümesinin beşeri sermaye ile mükemmel bir ilişki içinde olduğunu göstermektedir. Tez bu determinantların Türkiye'deki "durumu" nu tasvir etmekte ve genişletilmiş bir Solow modeli kullanarak, beşeri sermayenin 1963 – 2002 döneminde Türkiye'de kişi başına düşen gayri safi milli hasılayı nasıl etkilediğini tespit etmektedir.

Anahtar Kelimeler:

Ekonomik Büyüme Eğitim Sağlık
Beşeri Sermaye

ACKNOWLEDGEMENTS

I would like to submit my sincere thanks to Assoc. Prof. Dr. Ahmet KARA, Assist. Prof. Ebru GÜVEN SOLAKOĞLU and Assoc. Prof. Dr. Selim ZAİM who were guiding me perfectly in order to complete this work.

Thanks to my grand father Prof. Mustafa KÖSEOĞLU for his support and consultancy.

Thanks to my father Assoc. Prof. Dr. İsmail ADAK for his help during the preparation of this thesis.

Thanks to my mother Dr. Ayşe Şeyma ADAK and my brothers.

And finally thanks to my wife and my children for their unconditional support.

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M. R.W.	Mankiw, Romer and Wiel
O. E. C. D.	Organization of economic Cooperation and Development
S. E. M.	Structural Equation Model
S. I. S.	State Institute of Statistics
S. P. O.	State Planning Organization

1.

INTRODUCTION: A Brief Description of The Initial Solow Growth Model

The initial formulation of the Solow Growth model involves two main independent variables capital (K) and labor (L) and one dependent variable, output (Y). He also includes an exogenous variable which is "effectiveness of labor" (A). The production function is:

$$Y = F(K, AL) \tag{1}$$

Rewriting the function, we get

$$\frac{Y}{AL} = \frac{1}{AL}F(K, AL) = F\left(\frac{K}{AL}, 1\right)$$

which leads to

$$y = f(k) \tag{2}$$

where $\frac{Y}{AL} = y$ and $\frac{K}{AL} = k$

Labor and knowledge (captured by A) grow at a constant rate. They grow exogenously. Let the growth rate of labor be represented by n and the growth rate of knowledge by g. The growth path of both variables can be shown as;

$$\frac{\partial L(t)}{\partial(t)} = nL(t)$$

$$\left(\frac{\partial L(t)}{\partial(t)}\right)\left(\frac{1}{L(t)}\right) = n$$

$$\frac{\partial A(t)}{\partial(t)} = gA(t)$$

$$\left(\frac{\partial A(t)}{\partial(t)}\right)\left(\frac{1}{A(t)}\right) = g$$

Aggregate output is the sum of total consumption and total investment. The variable s gives information about the share of output which was invested. It is constant and exogenous. δ is the depreciation rate of capital. The growth path of capital is:

$$\frac{\partial K(t)}{\partial(t)} = sY(t) - \delta K(t) \qquad (3)$$

To reiterate technological progress (A), population growth rate (n), depreciation rate of capital (δ) and saving rate (s) are assumed exogenous and constant. There is only one good being produced. In addition, there is no government intervention and no fluctuation in the economy.

Through algebraic manipulation of the relationships here, we get:

$$\frac{\partial k}{\partial t} = \frac{\left(s \cdot Y(t) - \delta K(t)\right)}{AL} - nk - gk$$

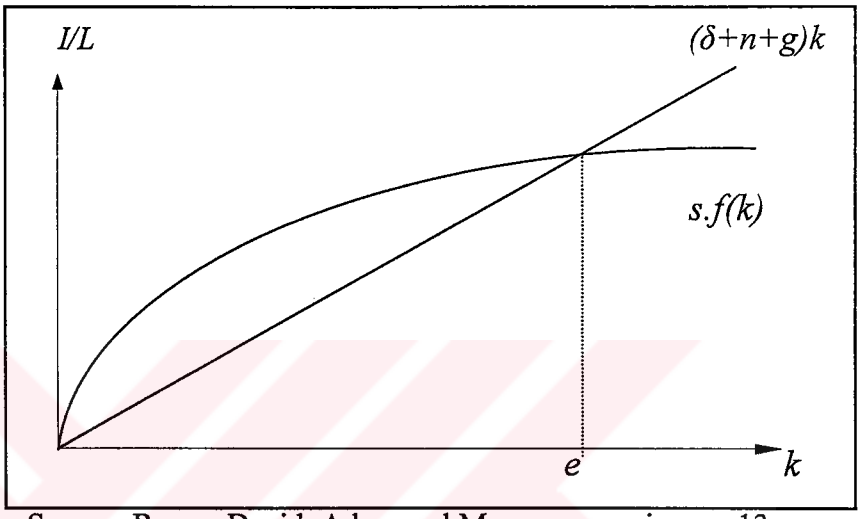
$$\frac{\partial k}{\partial t} = s\frac{Y(t)}{AL} - \delta k - nk - gk$$

$$\frac{\partial k}{\partial t} = s \cdot f(k) - (\delta + n + g)k \qquad (4)$$

$s \cdot f(k)$ is the amount of actual investment per unit of effective labor. $(\delta + n + g)k$ is exact amount of break even investment that should be under taken to

keep the equilibrium at steady state point. Figure 1 gives information about actual and break even investment in an economy. *e* is the point where actual and break even investments are equal. Economy grows with constant rate at point *e*.

Figure 1: Solow Growth Model



Source: Romer David, Advanced Macroeconomics, pp.13

2

SOLOW GROWTH MODEL versus ENDOGENOUS GROWTH MODEL

Solow model was the backbone of the growth theory until the beginning of the 1980s. Since then researchers explained growth rate differences of countries over the world by the conventional Solow model with the ratio of capital in production function as 1/3 and the labor force ratio as 2/3. However, Romer (1987) declared that the share of capital in production is more than 1/3 against the predicted Solow model. He proved that this value should be between 0,7 – 1 for U.S.. Thus, elasticity of final output with respect to physical capital is larger than the share of capital income in value added.

Mankiw, Romer and Weil (1992) also found that the growth rate of a country which converges to its steady state is slower than that predicted by the Solow model with a capital share of 1/3. They claimed that high capital-output ratio could be explained in an alternative way by adding human capital variable into equation (1).

$$Y = K^{\alpha} H^{\beta} (AL)^{1-\alpha-\beta} \tag{5}$$

In equation (5), Y stands for output, K stands for physical capital, L stands for labor and H stands for human capital. α, β and 1-α- β explain the shares of income of physical capital, human capital and labor, respectively.

2.1. Human Capital

After World War II researchers had paid more attention to the natural sources of growth following rapid growth of economies. In this period growth statistics showed higher growth ratio of output than that of capital and labor input. Therefore, researchers started to deal with an unknown residual. In attempt to define this unknown residual, Schultz (1961), Edward Denison (1962), John Kendrick (1976) and Herman Miller (1960) tried to prove that education and improvement on skills have positive effects on economic success.

In a recent study Lucas (1988) separated the human capital into two parts. One part stands for education and the other for 'learning by doing' or on the job training. Both Lucas (1988) and Becker (1964) defended the idea of income differences across countries depending on the different rate of human capital accumulation across countries.

Human capital has several definitions that are similar to each other; "The abilities, experience and skills which determine the production capacity of labor force[1]" or "Human capital are the stock of skills and productive knowledge embodied in people[2]". The recent empirical work proved that human capital has significantly improved the economic growth and income of countries. The influences of Human Capital on income per capita could be especially recognized in the economies of the world in the last forty year period. The countries that have a high income per capita also have higher human capital stock per capita. Countries started to support

[1] Gartner, Manfred, Macro Economics, Pearson Education Limited, 2003
[2] The new Palgrave A Dictionary of Economics, (1987) edited by John Eatwell, Murray Milgate and Peter Newman, Vol.2, p.682

education and other human capital sources with huge financial budgets. As a result, human capital became a necessity for development.

However, it is more difficult to analyze the total stock of human capital or return of human capital than the total stock of physical capital or return of physical capital. Return of human capital is included in labor incomes not in capital incomes by national statistical bureaus.[3]. Labor economists try to solve this problem by calculating return to schooling. They argue that each year of schooling makes the wage of workers' about 8 percent better. Therefore, the average worker earns three times as much as he would without any human capital[4]. George Psacharopoulos (1985) conducted a study about the return of schooling in more than 60 countries. He argued that return of schooling of low income per capita countries is higher than the high income per capita countries.

Mankiw, Romer and Weil (1992) researched human capital returns by cross country data and the results were optimistic. When the human capital is added to the Solow model as a production input, production function explains the cross country data by 78 percent, whereas it was only 59 percent when the human capital was not included.[5]

Barro (2001) also has an important contribution to the relation of human capital and Economic Growth. "*For a given level of initial per capita GDP, a higher initial stock of human capital signifies a higher ratio of human to physical capital. This*

[3] Different economists have some different methods to calculate the share of human capital. For example, if the minimum wage was accepted as a return to labor without any human capital, subtraction of this minimum wage from average wage of the country would give the return of human capital. Minimum wage is one third of the average wage in the United States now. It means that two thirds of the average wage in the United States is income of human capital. See more in Mankiw, N. Gregory, Growth of Nations, Brookings Paper on Economic Activity, Vol. 1995, No.1, (1995)275-326

[4] Mankiw (1995)

[5] N. Mankiw, Romer David, Weil, N. David, A Contribution to the Emprics of Economic Growth, The Quarterly Journal of Economics, Vol. 107, No.2 (1992)

higher ratio tends to generate higher economic growth through at least two channels. First, more human capital facilities the absorption of superior technologies from leading countries. This channel is likely to be especially important for schooling at the secondary and higher levels. Second, human capital tends to be more difficult to adjust than physical capital. Therefore, a country that starts with a high ratio of human to physical capital – tends to grow rapidly by adjusting upward the quantity of physical capital"[6]

2.2. A Model of Human Capital

Human capital variable could be added to the basic Solow model in the following manner:

$$Y(t) = K(t)^{\alpha} H(t)^{\beta} [A(t)L(t)]^{1-\alpha-\beta} \tag{6}$$

In equation (6), Y(t) stands for output, K(t) is stock of capital, H(t) is stock of human capital, and L(t) is the number of labor. Dynamic of capital, labor technology and human capital stock can be shown as follows;

$$\dot{K} = \frac{dK}{dt} = s_K Y(t),\ \dot{L} = \frac{dL}{dt} = nL(t),\ \dot{A} = \frac{dA}{dt} = gA(t),\ \dot{H} = \frac{dH}{dt} = s_H Y(t)$$

s_K and s_H are the fraction of output devoted to physical capital accumulation and human capital accumulation, respectively. Population growth and technological progress are constant and exogenous.

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[6]Barro, R. Education and Economic Growth, in J.F. Halliwell, ed., The Contribution of Human and Social Capital to Sustained Economic Growth and Well-Being, page 20, OECD, 2001

let;

$$y = \frac{Y}{AL},\ k = \frac{K}{AL} \text{ and } h = \frac{H}{AL}$$

then;

$$y(t) = k(t)^{\alpha} h(t)^{\beta}$$

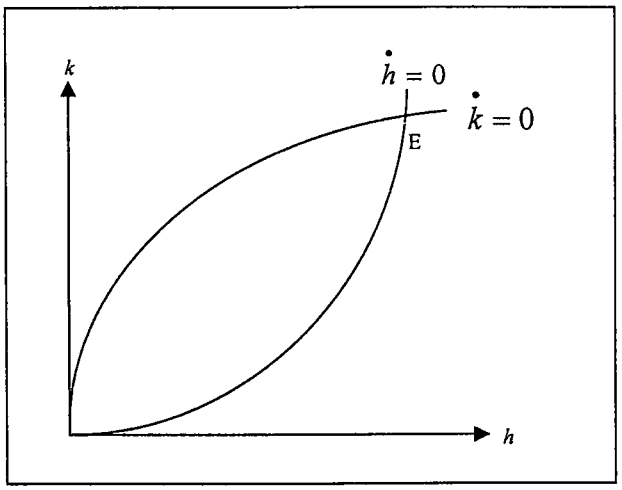
Time path of k and h can be found by the chain rule. Dynamic of physical capital per unit of effective labor and the dynamic of human capital per unit of effective labor can be expressed as follows;

$$\dot{k} = s_K k(t)^{\alpha} h(t)^{\beta} - (n+g)k(t)$$

$$\dot{h} = s_H k(t)^{\alpha} h(t)^{\beta} - (n+g)h(t)$$

$\dot{h} = 0$ and $\dot{k} = 0$, the dynamic equilibrium would be discovered and would remain there. Both dynamic paths of $\dot{h}$ and $\dot{k}$ can be seen in Figure 2. The dynamic equilibrium of economy can be recognized on point E.

Figure 2: The Dynamics of *k* and *h*



2.3. Education

Education has started to be analyzed in the economic literature at the beginning of 1980s. Most of the economists accept education as an indicator of human capital in economies. The first contribution came from Lucas (1988) regarding the positive effect of education on economic growth by an endogenous function. Edward Denison (1962) tried to prove that national income per capita growth rate improvement is because of improvements in the education of the labor force. Mankiw, Romer and Wiel (1994) added secondary school enrolments as a human capital variable to the Solow model. The results were significant in explaining output increases. There were some pessimistic ideas concerning the positive effect of education on growth by Benhabib and Spiegel (1994), but these arguments were responded to by different economists like Alan B. Kruger and Mikael Lindahl (2001).

Education is being classified in different categories by the development economists. One classification is based on formal education which is offered in schools and universities. Another classification takes into account that education

improves the skill of the labor force in the production process through "learning by doing". The last classification focuses on the effects of education on research and development and new technological progress.

As J. Barro (1998) explains, *"...with respect to education, growth is positively related to the starting level of average years of schooling attainment of adult males at the secondary and higher levels. Since workers with this educational background would be complementary with new technologies, the results suggest an important role for the diffusion of technology in the development process. Growth is significantly related to years of school attainment of females at the secondary and higher levels. This results suggest that highly educated women are not well utilized in the labor markets of many countries. Growth is insignificantly related to male schooling at the primary level. However, this level of schooling is a prerequisite for secondary schooling and would, therefore, affect growth through this channel. Education of woman at the primary level stimulates economic growth indirectly by inducing a lower fertility rate."*[7]

2.3.1. Lucas Approach in Formal Education

Robert Lucas is a pioneer growth economist who strongly emphasizes the effect of education on economic growth.

His model involves the following assumptions;

i. Life cycles of individuals were infinite.

[7]Barro, R. Education and Economic Growth, in J.F. Halliwell, ed., The Contribution of Human and Social Capital to Sustained Economic Growth and Well-Being, page 31, OECD, 2001

ii. Individuals were clearly dividing their time between working and learning.

iii. Benefit of all kind of learning for each individual was the same (primary, secondary, high education etc.).

iv. Learning capacity of all the individuals were same.

The model formed as;

$$Y = K^{\alpha}(u.h.L)^{1-\alpha}$$

Y is output, K is capital, u is the time which was separated for production by individual, h is human capital per stock of individual. L is labor. Human capital stock per capita grows over time as;

$$\dot{h} = w.(1-u)h \qquad (7)$$

where, (1-u) denotes time which is given for learning or schooling by individuals. w stands for productivity of learning or schooling. There is a constant return to stock of human capital. Rate of the h (human capital stock per capita) can be calculated by dividing equation (7) by h;

$$\frac{\dot{h}}{h} = w.(1-u)$$

Lucas' approach is a simple model and aims to explain the real world. The model did become a starting point for his followers. Twenty first century economists developed the Lucas model for different areas. The model allowed them to analyze

the different variables. For example Azariadis and Drazen[8] (1990) built over lapping model for individuals.

2.3.2. The Nelson & Phelps Model in formal education

Nelson and Phelps built a model which gives information about the direct effect of education on output productivity improvements[9]. These improvements can be explained by new technology inventions, developing these new technologies and applying them within the next periods. Education has a common role of speeding up technological development.

Education is the key factor in the model. If there is positive growth in education such as, increasing enrolment rates, it can be met with a high technological growth rate. There is a simultaneous relation between education and R&D sector. This process works with research and the development sector. Education level improvements coupled with new education potential develop new technology.

The Nelson and Phelps model can also explain secondary positive effects of education for developing countries. Developing countries can transfer new technological innovation to their country from developing countries at low costs. They do not need new rich R&D laboratories, experiments or investments.

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[8] Azariadis, C and Drazen, A (1990), Threshold externalities and economic development. Quaterly Journal of Economics, 501-526.

[9] Aghion Philippe and Howit Peter (1998), The MIT Press, Cambridge, Massachusetts. 1 st. Ed.

3

HUMAN CAPITAL IN TURKEY

3.1. Education in Turkey

The Turkish educational curriculum is being prepared by the Ministry of Education and this program is applied by all educational units. Formal education is compulsory for the first eight years which means that every Turkish child who is seven starts primary school and he or she has to complete the first eight years. Then, students are sent to either general high schools or vocational and technical high schools. Generally both schools are three years. Some of them include a one year preliminary preparation of a foreign language. There is a General university entrance examination which is compulsory for each student aiming to study at university[10].

The Turkish education system has tried to keep up with western developed countries' education standards after the declaration of the new Turkish Republic in 1923. The new education system law was accepted by the new parliament in 1924. This education law has been developed by new complementary laws. The education system was classified into two categories in 1973 with basic education law no. 1739. These categories were *Formal Education* and *Adult Education.*

Formal education is given in the national education ministry schools. It has four stages. These are preprimary education, primary education, secondary education and higher education.

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[10] T.C. Milli Eğitim Bakanlığı(2001), 2002 yılı başında milli eğitim, Aralık, Ankara

Preprimary education which is not compulsory, is provided in kinder gardens. Most of the kinder gardens are private but some of the primary school managements can open kinder garden according to their needs. Some of the public or private offices open kinder garden for their employees' children too. The aim of the preprimary education is to prepare the kids for primary education and to help the children in their personal development.

Primary education is compulsory for every Turkish child between the ages of 7-15. It was five years until it was increased to eight years in 1997. There are also private and public schools in the sector. Primary education is free in public schools. The primary education's main target is to teach the children national culture and patriotism. Reading, writing and minimum basic knowledge requirements are taught in primary schools.

The education period of the secondary education is three years after primary education. Some secondary schools educate in a foreign language. Some of these foreign schools were founded during the Ottoman Empire. Those schools whose education is in a foreign language have one year foreign language preparation at the beginning of the secondary education. Secondary education can be classified as general, technical and vocational education. General secondary schools prepare their students for the next step of higher education. Technical secondary schools specialize in industrial education, and educate the new labor force for industry. Vocational secondary schools help students to have job skills for the rest of their life.

Any student who graduated from secondary schools must take a general university entrance examination to have a higher education. Higher education is managed by the Council of Higher Education. Higher education is classified as undergraduate and

postgraduate. Undergraduate education usually takes four years and postgraduate period changes according to the performance of the students.

Adult education encompasses vocational training, guidance and practical training activities for those who have never had any formal education or for those who are still attending school or have already completed. Adult education services are provided to everyone and are organized in a beneficial way and in accordance with the needs of society. There is no age limit for participants, however there are some requirements for certain age and educational levels.[11]

Adults' education is given by several institutions. These are; practical trade schools for girls, domestic science schools, industrial practical trade schools, adult education training centers, professional training center, adult centers, activities of apprenticeship training centers, Quran courses, private teaching and courses, training and application schools, vocational schools and vocational training centers.

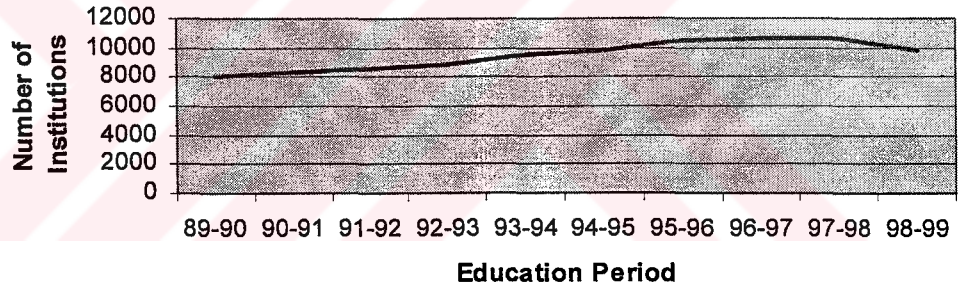
Number of adult institutions has been increased from 7990 to 9802 units between 1989 and 1999. That is to say, the number has increased by about 23% in ten years.

[11] National Education statistics, Adult Education 1998/99 Ankara

Table 1: Number of Adult Institutions:

Education Period	Number of Adult Institutions
1989-90	7990
1990-91	8251
1991-92	8525
1992-93	8930
1993-94	9505
1994-95	9815
1995-96	10486
1996-97	10596
1997-98	10571
1998-99	9802

Figure 3: Number of Adult Institutions:



3.2. Health Care in Turkey

A Country's human capital stock fundamentally related to the health of the population. A well covered health care system has a positive effect on the economic development of nations. It helps the labor force to work more efficiently.

3.2.1. Social Security in Turkey

The health care system has been developing very quickly in Turkey for the last fifty years. There are three separate public healthcare institutions with medical services.

The first one is Government Employees Retirement Fund which works for government employees. It was founded with the aim of providing social benefits within a retirement system for government employees entitling the contributors to the following benefits in accordance with law no. 5434. The retirement pensions are; job disability pension, disability pension, survivors' pension, retirement bonus, death grant, marriage bonus, lump sum payments and repayments and repayment of contributions.

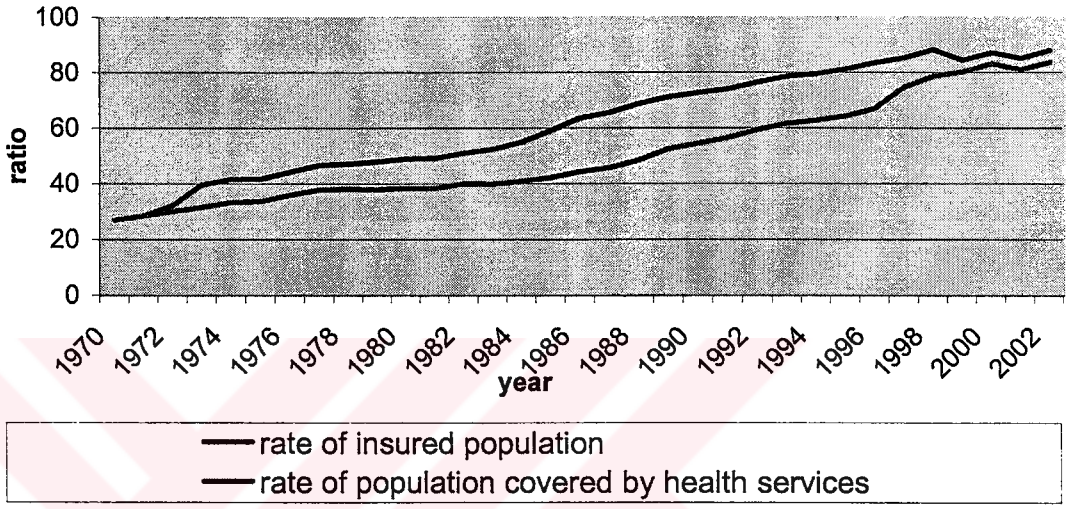
The second one is Social Insurance Institution which works for private sector employees. The social Insurance Law entitles the contributors to the following benefits; work injury and occupational disease insurance, health insurance, maternity insurance, disability insurance, old age insurance and death insurance.

The last one is the social security institution of craftsmen, tradesmen and other self-employed (BAĞ-KUR) which provides services for private business owners. It entitles the contributors to the following benefits; disability insurance, old age insurance, death insurance and health insurance.

In addition, these three associations provide free health services and discounted medicine to the labor's wife/husband and child or children. The governments' main target is to cover all the population with the social security curtain after 1980. Today 88.1% of the Turkish population is insured and 83.8% of the population is covered by health services. These ratios were 3.9% in 1950. The rest of the Turkish population (about 12%) who are not members of any social security institute can obtain a green card which provides them with free public hospitalization and free medicine, however, they have to declare and prove that they are not a member of any social security institute.

The three social institutions have been trying to become a union under one roof and to get rid of discrimination between public employees and private employees.

Figure 4: Population covered by Social Security:



3.2.2. Health Indicators in turkey

3.2.2.1. Hospitals

Hospitals are classified as inpatient and outpatient institutions in Turkey. Also inpatient institutions can be classified as maternity and infant homes, mental and neurological hospitals and health centers. Most of these hospitals are attached to the ministry of health. Rest of the public hospitals are associated with other ministries and institutions, universities, municipalities and social insurance institutions.

Table 2: Inpatient and outpatient Medical Centers

Year	Outpatient	Inpatient	Total
1963	1.497	638	2.135
1964	1.870	637	2.507
1965	2.085	626	2.711
1966	2.321	637	2.958
1967	2.627	664	3.291
1968	4.212	686	4.898
1969	4.543	729	5.272
1970	4.764	749	5.513
1971	4.962	758	5.720
1972	4.972	791	5.763
1973	5.340	791	6.131
1974	5.626	799	6.425
1975	6.161	798	6.959
1976	7.385	790	8.175
1977	7.172	772	7.944
1978	7.481	776	8.257
1979	9.579	822	10.40
1980	9.644	827	10.47
1981	9.757	831	10.58
1982	10.339	630	10.96
1983	10.355	646	11.00
1984	11.414	686	12.10
1985	11.633	722	12.35
1986	12.592	736	13.32
1987	13.665	756	14.42
1988	14.231	777	15.00
1989	14.732	812	15.54
1990	15.253	899	16.15
1991	15.674	941	16.61
1992	16.161	970	17.13
1993	16.650	1.004	17.65
1994	17.283	1.024	18.30
1995	17.668	1.051	18.71
1996	17.908	1.076	18.98
1997	18.162	1.120	19.28
1998	18.303	1.138	19.44
1999	18.303	1.171	19.47
2000	17.447	1.184	18.63
2001	17.510	1.240	18.75

Source: Health Ministry

3.2.2.2. Healthcare Providers

Turkish governments have given special attention to medical education. The number of doctors increased very quickly after the declaration of the new Turkish Republic in 1923. New institutes were founded and new students were sent to western countries, mostly to France, Switzerland, Austria and United States to have medical education.

Healthcare provider statistics are classified by the State Institute of Statistics as physician, dentist, health officer and midwife, the numbers of which are presented in Table 3 for the period 1963-2000.

To summarize;

1. Physicians: the number of physicians in 1963 was 11231 but in the year 2000 the number was 85116. This is a fairly satisfactory increase within 38 years.
2. Dentists: the number of dentists in 1963 was 1824 but in the year 2000 the number was 16002. There was an increase of 877%.
3. Nurses: the number of nurses in 1963 was 4736 but in the year 2000 the number was 71600.

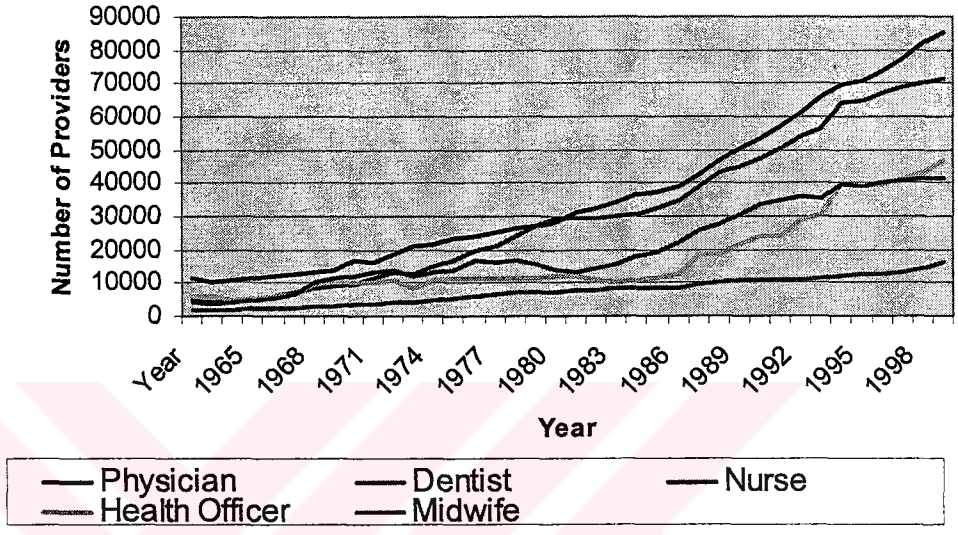
All these changes can be seen in figure 5.

Table 3: Number of Healthcare Provider:

Year	Physician	Dentist	Nurse	Health	Midwif
1963	11231	1824	4736	5738	4080
1964	10051	1769	4184	5809	3837
1965	10895	1932	4592	4676	4329
1966	11335	2140	5039	5180	4964
1967	11875	2246	6161	5897	5621
1968	12389	2381	7426	6494	6676
1969	13336	3025	8110	9461	10251
1970	13843	3245	8796	9954	11321
1971	16514	3517	9436	10285	12176
1972	16284	3789	11358	10426	13056
1973	18511	4279	13410	11025	13567
1974	20868	4269	12641	8479	12228
1975	21714	5046	14806	11021	12975
1976	23388	5379	16566	11517	13873
1977	23920	5954	19859	11183	16785
1978	25230	6826	20966	11141	16219
1979	26298	7021	23797	11606	16904
1980	27241	7077	26880	11664	15872
1981	28411	7186	29459	12226	13825
1982	30956	7525	29343	11830	13454
1983	32263	7763	29316	10704	14570
1984	34195	8133	30216	10456	15506
1985	36427	8305	30854	10525	17987
1986	37442	8410	32452	11684	19127
1987	38829	8589	34855	12352	21982
1988	42502	9639	38903	18831	25665
1989	46708	10132	43374	18869	27805
1990	50639	10514	44984	21547	30415
1991	53264	10623	47540	23813	33724
1992	56985	10703	50456	24160	35096
1993	61050	11069	54268	28776	36263
1994	65832	11457	56280	30811	35604
1995	69349	11717	64243	39342	39551
1996	70947	12406	64526	39075	38945
1997	73659	12737	67265	39658	40230
1998	77344	13421	69246	41461	41059
1999	81988	14226	70270	43032	41271
2000	85116	16002	71600	46528	41590

Source: Health Ministry

Figure 5: Number of Healthcare Providers



3.2.2.3 Number of Person per Healthcare Provider

Turkish population growth rate is the highest in European Union countries. Due to this high rate, medical services receive special attention from the local and central governments.

The progress in the health system of Turkey has a promising trajectory. The number of people per doctor was 12.842 in 1928. In the year 2000, this went down to 767. In 1928 the number of people per nurse was 106.485, per health officer was 13.072 and per midwife was 36.719. These numbers were 912 people per nurse, 1.404 people per health officer and 1.570 people per midwife, respectively, in the year 2000.

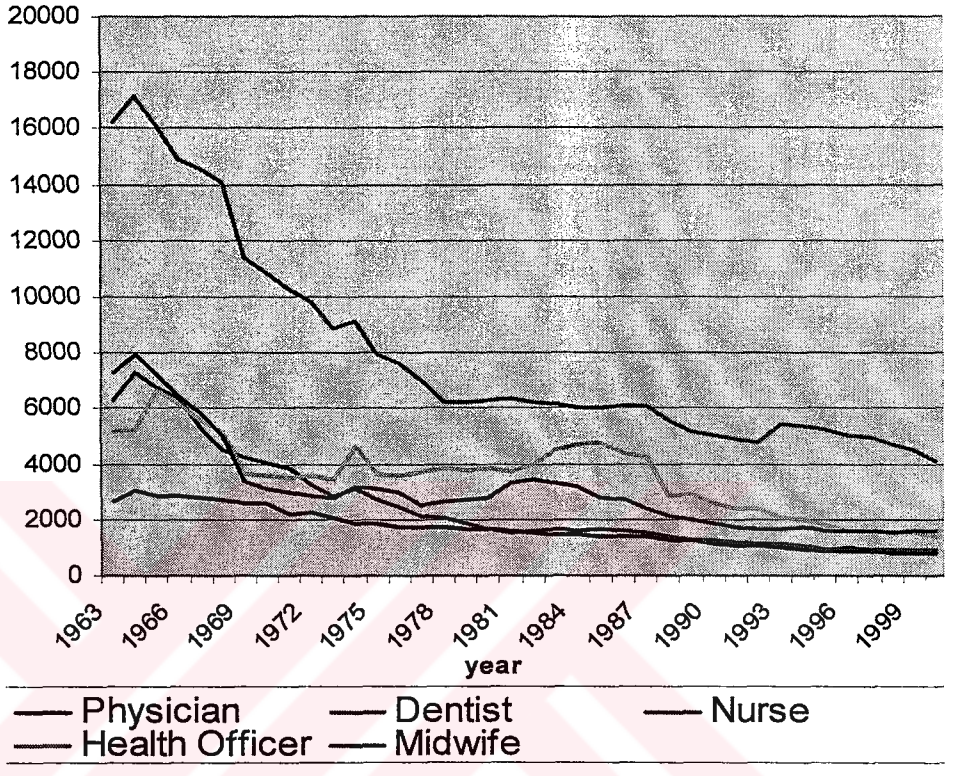
The total population of Turkey has increased around 2% per year between 1963 and 2000. On the other hand, if we look at Table 4 and figure 6, we can see that per capita healthcare statistics were getting better over the period in question.

Table 4: Number of Person per Healthcare Provider:

Year	Physician	Dentist	Nurse	Health	Midwife
1963	2640	16257	6261	5168	7268
1964	3024	17180	7264	5232	7921
1965	2859	16123	6783	6661	7195
1966	2817	14923	6338	6165	6434
1967	2758	14581	5316	5554	5826
1968	2711	14106	4523	5172	5031
1969	2583	11386	4247	3641	3360
1970	2552	10885	4016	3548	3120
1971	2193	10297	3838	3521	2974
1972	2280	9800	3269	3561	2844
1973	2057	8898	2839	3453	2806
1974	1871	9144	3088	4604	3192
1975	1843	7932	2703	3632	3085
1976	1749	7607	2470	3553	2949
1977	1746	7015	2103	3735	2488
1978	1690	6247	2034	3827	2629
1979	1655	6200	1829	3751	2737
1980	1631	6279	1653	3810	2800
1981	1603	6337	1546	3725	3294
1982	1508	6204	1591	3947	3470
1983	1484	6166	1633	4472	3285
1984	1435	6033	1622	4693	3165
1985	1391	6057	1630	4780	2797
1986	1387	6116	1585	4402	2689
1987	1361	6120	1508	4255	2391
1988	1276	5573	1381	2852	2093
1989	1270	5179	1266	2909	1974
1990	1115	5054	1247	2604	1844
1991	1076	4919	1200	2396	1692
1992	1028	4788	1148	2398	1651
1993	980	5409	1103	2081	1651
1994	929	5340	1087	1986	1718
1995	886	5261	960	1795	1559
1996	883	5054	972	1605	1610
1997	853	4939	935	1585	1563
1998	820	4728	916	1530	1545
1999	785	4526	916	1496	1560
2000	767	4081	912	1404	1570

Source: Health ministry

Figure 6: Number of Person per Healthcare Provider



3.2.2.4. Health Expenditures

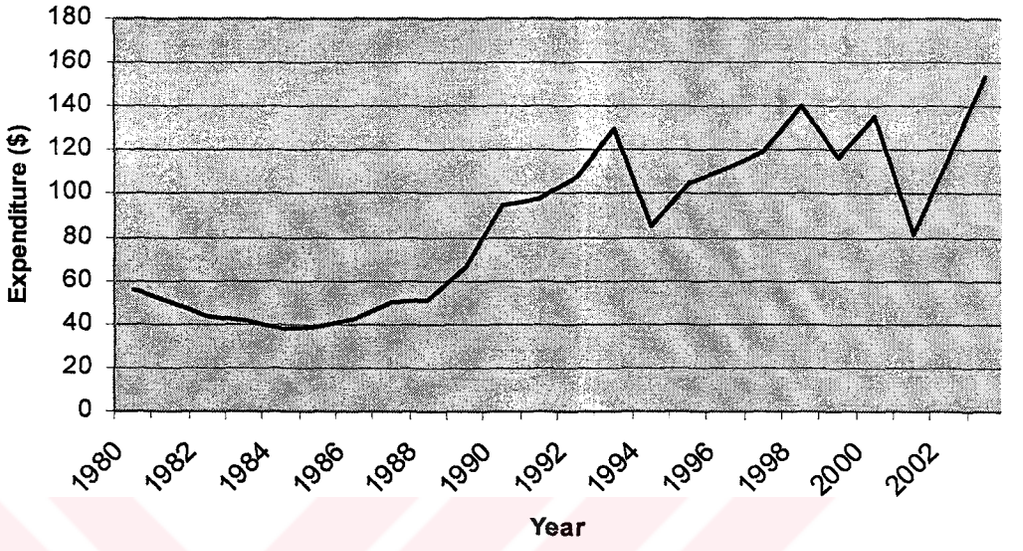
Real per capita healthcare expenditure has been increasing for the last twenty five years. The ratio of public health expenditure to total health expenditure has increased from 51,4% to 77,0% in the last two decades. The ratio of total health expenditure to GNP increased from 3,5% to 4,5% in the same period.

Table 5. Health Expenditures

Years	Health exp/GNP (%)	Public health exp/ total health exp. (%)	Per capita health exp.($)	Per capita health exp ($/PPP)
1980	3,5	51,4	55,5	86,5
1981	3,1	46,2	50,1	86,3
1982	3,1	45,6	43,3	91,8
1983	3,2	46,0	41,3	99,0
1984	3,1	43,9	38,2	101,4
1985	2,9	44,6	39,2	102,0
1986	2,9	46,5	42,5	108,4
1987	3,0	49,8	49,9	122,9
1988	3,0	52,2	51,0	129,6
1989	3,4	58,5	66,5	149,0
1990	3,5	61,9	95,0	173,8
1991	3,7	63,5	97,8	182,4
1992	3,9	66,2	107,7	207,0
1993	4,2	68,2	130,1	247,2
1994	4,1	64,7	85,2	161,7
1995	3,8	64,3	105,6	234,2
1996	3,7	64,0	111,4	251,1
1997	3,6	63,0	119,8	259,1
1998	4,0	63,0	139,9	279,1
1999	4,1	79,9	116,4	220,0
2000	4,3	80,0	135,3	250,0
2001	3,9	78,0	81,4	170,9
2002	4,3	77,0	117,7	245,7
2003	4,5	77,0	153,5	322,3

Source: Yıldırım, S., "Expenditure and Cost Analyses of Health Service", S.P.O., Vol:2350, Ankara,1994

Figure 7: Per Capita Health Expenditure (in dollars)



4

EMPIRICAL ANALYSIS OF EDUCATION AND ECONOMIC GROWTH IN TURKEY

4.1. Introduction:

In this section we try to find out the effects of human capital on real per capita income in Turkey. In the past, economic growth was usually explained by the Solow model. This was a common practice in economic literature as the Solow model presents well known method for explaining the influences of physical capital on growth.

N. Gregory Mankiw, *David Romer* and *David N. Wiel* published a paper in *Quarterly Journal of Economics* in 1992 by the name of "*A Contribution to the Empirics of Economic Growth*"[12]. The major aim of the paper was to test the augmented Solow model by cross-country data. The human capital accumulation was incorporated into the basic Solow model as a proxy. The result of the cross-country regression analysis was positive regarding the human capital accumulation which was included to the basic Solow model as an explanatory variable in regression analyses. The results produced by new model econometrically were more robust than those of the pure Solow model.

In this section, we will use a human capital-inclusive Solow model for the Republic of Turkey. Following Solow model, population growth and technological development ratios are assumed to be exogenous and depreciation rate is expected to be a fix ratio per year in the models. An education-based proxy for human capital is incorporated into the model.

4.2. Building the Model

Cobb Douglas production function provides the most popular method for explaining the growth models.

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[12] N. Gregory Mankiw, David Romer, David N. Weil, The Quarterly Journal of Economics, Vol.107, No.2 May, 1992, 407-437

The standard production function and the human capital inclusive production function are as follow:

$$Y = K^{\alpha}(AL)^{\beta}$$

and

$$Y = K^{\alpha}(AL)^{\beta} H^{1-\alpha-\beta}$$

Y stands for output, K is physical capital, L is labor, A is technology, and H is human capital. Labor and technology grow at a constant rate exogenously. Furthermore, the saving rate is determined exogenously. The time path of k is;

$$\dot{k}(t) = s_k y(t) - (n+g+\delta)k(t)$$

The sum of depreciation rate (δ) and the rate of technological progress (g) are assumed to have a constant value 0.05. The steady state value of physical capital per labor is;

$$k = \left[\frac{s}{n+g+\delta}\right]^{\frac{1}{1-\alpha}}$$

Logarithmic aggregate production function per labor is;

$$\ln\left[\frac{Y(t)}{L(t)}\right] = \ln A(0) + gt + \frac{\alpha}{1-\alpha}\ln(s) - \frac{\alpha}{1-\alpha}\ln(n+g+\delta)$$

Mankiw, Romer and Wiel simplify the model assuming $g.t$ converges to zero at a given time. If $\ln A(0)$ is accepted as a constant α in equation (8) than the model is modified as;

$$\ln\left[\frac{Y(t)}{L(t)}\right] = \alpha + \frac{\alpha}{1-\alpha}\ln(s) - \frac{\alpha}{1-\alpha}\ln(n+g+\delta)$$

When human capital is included in the model the time path of human capital can be shown as follows;

$$\dot{h}(t) = s_h y(t) - (n+g+\delta)h(t)$$

and the logarithmic production function per labor is expressed as;

$$\ln\left[\frac{Y(t)}{L(t)}\right] = \ln A(0) + gt + \frac{\alpha}{1-\alpha}\ln(s_k) - \frac{\alpha}{1-\alpha}\ln(n+g+\delta) + \frac{\beta}{1-\alpha}\ln(h)$$

We will econometrically estimate this equation in the following section.

4.3. Data and Samples

The data set which has been used in the model was collected from different sources. Per capita national income statistics were taken from the State Institute of Statistics (S.I.S.). Real value calculation are based on 1987 prices. The nominal values of investment values were taken from State Planning Organization. They converted to 1987's price level by deflator ratio which was also published by S.I.S.

The saving rate was assumed to be equal to (I/GNP).The conversion of nominal values to real values is based on deflator published by S.I.S.

The working age range was assumed to be between 15 to 65, as stipulated by OECD. The source of working age data is the OECD internet data base.[13]

Schooling is represented by proxy numerically estimated by the ratio of high school enrollment to working age population.

Finally, the sum of the rate of depreciation and rate of technological progress were taken exogenously to be 0.05, as the theory says. The population growth rate was calculated from S.I.S. tables.

[13] http://www1.oecd.org/scripts/cde/members/lfsdataauthenticate.asp

5

ANALYSIS and RESULTS

5.1. The Solow Model: Empirical Results

Making use of the "human-capital-inclusive" Solow model, we will formulate the following regression equation:

$$\ln\left(\frac{GNP}{N}\right) = \beta_0 + \beta_1 \ln\left(\frac{I}{GNP}\right) + \beta_2 \ln(n + g + \delta) + \beta_3 \ln(humancapital) + u$$

where schooling, which is represented by the percentage of working-age population that is in high school, is used as proxy for human capital. u is the disturbance term.

The regression results are as fallows:

$$\ln\left(\frac{GNP}{N}\right) = \underset{}{13.945} + \underset{(0.074)}{0.169}\ln\left(\frac{I}{GNP}\right) - \underset{(0.164)}{0.151}\ln(n + g + \delta) + \underset{(0.19)}{0.394}\ln(humancapital)$$
$$(0.470)$$

$R^2 = 0.93$. Standard errors are in parentheses.

All coefficients except for the one for $\ln(n + g + \delta)$ are statistically significant. All have the theoretically expected signs. In the log linear regression equations, coefficients represent elasticities. Thus, saving rate elasticity of GNP per capita is 0.169 and human capital elasticity of GNP per capita is 0.394. Hence the effect of human capital on GDP/N is positive and stronger than that of the saving rate.

Table 6: Summary: Estimation of Solow Growth Model including Human Capital: the case of Turkey

Sample	40
Constant	13,945 (0,470)
ln (I/GDP)	0,169 (0,076)
ln (n+g+δ)	-0,151 (0,164)
ln (school)	0,394 (0,19)
Adjusted R^2	0,926
F statistics	163,356
Dependent variable is *ln*(GDP/N), i.e., GNP per working age person Standard errors in parentheses	

5.2 A Structural Equation Model of Human Capital

Structural equation modeling (SEM) is a multivariate technique, which combines multiple regression and factor analysis methods to estimate a series of interrelated dependence relationships simultaneously. SEM techniques have two special characteristics different from the other multivariate techniques. First, SEM provides multiple and interrelated dependence relationship and second, it has ability of analyzing unobserved concepts and measurement error in the estimation process. This relationship will be constructed by the use of LISREL.

SEM estimate unknown coefficients in a set of linear structural equations. Variables in the equation system are usually directly observed variables, and/or unmeasured latent variables that are not observed but related to observed variables.

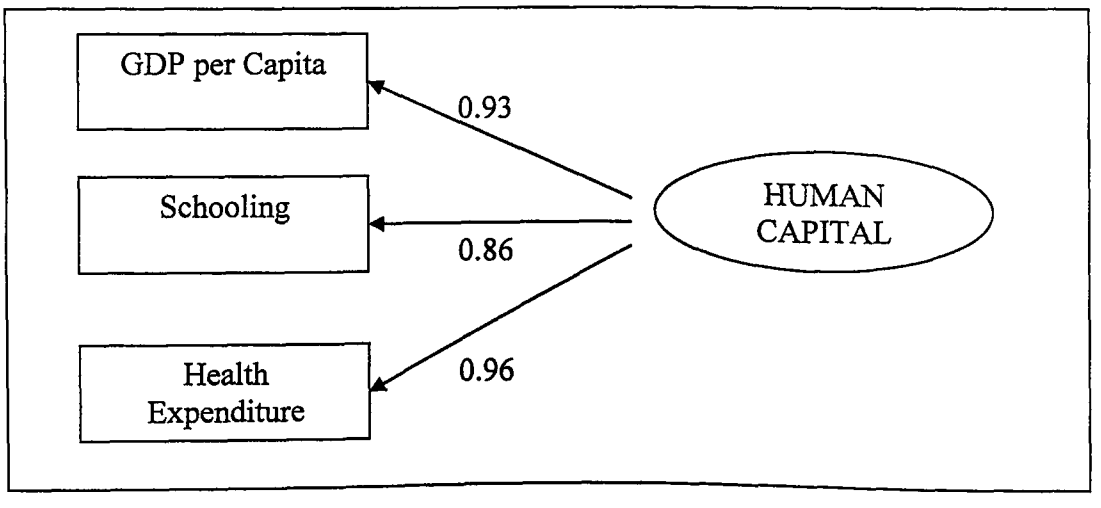
SEM shares three assumption with the other multivariate methods: independent observations, random sampling of respondents, and the linearity of all relationships. In addition, SEM is sensitive to the distributional characteristics of the

data, particularly the departure from multivariate normality (critical in the use of LISREL) or a strong kurtosis (skewness) in the data.[14]

In this part of the chapter, the multiple interrelated dependence relationship will be constructed in a single model. To better portray the interrelated relationships, a pictorial portrayal of the relationships, known as path diagram will be created in the next section for the Human Capital. Path analysis calculates the strength of each relationship depicted in the relationships using only a correlation or covariance matrix as input.[15]

In the path diagram of the model we prepare, human capital is the latent variable and schooling, health expenditure and GNP per capita are the assumed indicators. The numbers in the diagram represent the correlations between the selected variables included. The method of estimation is maximum likelihood.

Figure 8: A Path Diagram for Human Capital



[14] Hair J. F., Anderson R. E., Tatham R.L., Black W.C. (1995) *Multivariate Data Analysis*, New Jersey: Prentice Hall. pp.596-601
[15] Hair (1995), pp. 587

Table 7: Correlation Matrix

	GDP per Capita	Schooling	Health Expenditure
GDP per Capita	1.00		
Schooling	0.80	1.00	
Health Expenditure	0.89	0.82	1.00

LISREL ESTIMATES (Maximum Likelihood)

Table 8: Measurement Equation

GNP per capita = 0.93 * Human Capital	Errorvar. = 0.13 (0.070) 1.85	$R^2 = 0.87$
Schooling = 0.86 * Human Capital	Errorvar. = 0.26 (0.093) 2.81	$R^2 = 0.74$
Health Expenditure = 0.96 * Human Capital	Errorvar. = 0.83 (0.066) 1.25	$R^2 = 0.92$

Correlation Matrix of Independent Variables

Human Capital

1.00

Table 9: Goodness of Fit Statistics

Minimum Fit Function Chi-Square = 0.00 (P = 1.00)
Normal Theory Weighted Least Square Chi-Square = 0.00 (P = 1.00)
The Fit is Perfect !

6

CONCLUSION

This thesis makes use of a structural equation model to determine the "correlation-based determinants of human capital in Turkey. It turns out that these determinants are schooling, health expenditures and GNP per capita. We use an augmented Solow model to determine the effects of "schooling-based" human capital on GNP per capita. The results indicate that, compared to other variables in the regression equation, schooling-based human capital has a considerable positive effect on GNP per capita. A composite human capital index that takes into account schooling, health expenditures, and per capita GNP is expected to better reveal the effects of human capital on economic growth. Developing such an index is worthy of future work.

7

APPENDICES

Appendix A: Regression model's variables with *ln* model

YEARS	*ln*(GDP/N)	*ln*(I/GDP)	*ln*(n+g+δ)	*ln*(H)
1964	14,21	-1,53	-2,65	0,41
1965	14,22	-1,46	-2,65	0,43
1966	14,31	-1,43	-2,59	0,51
1967	14,33	-1,33	-2,60	0,60
1968	14,37	-1,64	-2,59	0,66
1969	14,38	-1,57	-2,59	0,75
1970	14,40	-1,52	-2,59	0,81
1971	14,44	-1,60	-2,49	0,92
1972	14,50	-1,50	-2,58	0,97
1973	14,53	-1,51	-2,65	0,99
1974	14,53	-1,57	-2,54	1,02
1975	14,56	-1,49	-2,54	1,09
1976	14,62	-1,36	-2,56	1,23
1977	14,62	-1,30	-2,58	1,32
1978	14,61	-1,40	-2,58	1,36
1979	14,58	-1,53	-2,58	1,38
1980	14,53	-1,52	-2,58	1,43
1981	14,54	-1,62	-2,50	1,41
1982	14,54	-1,65	-2,49	1,39
1983	14,55	-1,60	-2,49	1,35
1984	14,59	-1,64	-2,49	1,35
1985	14,60	-1,60	-2,49	1,38
1986	14,63	-1,48	-2,52	1,42
1987	14,70	-1,40	-2,53	1,46
1988	14,68	-1,34	-2,53	1,49
1989	14,67	-1,50	-2,53	1,51
1990	14,73	-1,49	-2,50	1,54
1991	14,70	-1,44	-2,56	1,58
1992	14,74	-1,45	-2,56	1,65
1993	14,79	-1,34	-2,56	1,72
1994	14,70	-1,41	-2,57	1,77
1995	14,75	-1,43	-2,59	1,82
1996	14,80	-1,38	-2,60	1,84
1997	14,85	-1,34	-2,62	1,81
1998	14,87	-1,41	-2,63	1,63
1999	14,79	-1,51	-2,64	1,68
2000	14,82	-1,48	-2,58	1,67
2001	14,70	-1,66	-2,65	1,67
2002	14,75	-1,75	-2,60	1,73

Appendix B: Regression model's real variables

YEARS	GDP / N	I / GDP	d(population)=n	(n+g+δ)
1964	1.483.097	0,22	0,02	0,07
1965	1.499.033	0,23	0,02	0,07
1966	1.638.297	0,24	0,02	0,07
1967	1.666.147	0,26	0,02	0,07
1968	1.734.481	0,19	0,02	0,07
1969	1.765.883	0,21	0,02	0,07
1970	1.799.740	0,22	0,02	0,07
1971	1.864.540	0,20	0,03	0,08
1972	1.984.102	0,22	0,03	0,08
1973	2.039.039	0,22	0,02	0,07
1974	2.045.720	0,21	0,03	0,08
1975	2.108.027	0,23	0,03	0,08
1976	2.237.015	0,26	0,03	0,08
1977	2.246.242	0,27	0,03	0,08
1978	2.216.880	0,25	0,03	0,08
1979	2.150.957	0,22	0,03	0,08
1980	2.038.956	0,22	0,03	0,08
1981	2.070.155	0,20	0,03	0,08
1982	2.066.597	0,19	0,03	0,08
1983	2.085.603	0,20	0,03	0,08
1984	2.163.405	0,19	0,03	0,08
1985	2.185.420	0,20	0,03	0,08
1986	2.263.956	0,23	0,03	0,08
1987	2.413.596	0,25	0,03	0,08
1988	2.377.265	0,26	0,03	0,08
1989	2.345.777	0,22	0,03	0,08
1990	2.486.383	0,23	0,03	0,08
1991	2.428.328	0,24	0,03	0,08
1992	2.514.337	0,23	0,03	0,08
1993	2.646.918	0,26	0,03	0,08
1994	2.421.930	0,24	0,03	0,08
1995	2.550.237	0,24	0,03	0,08
1996	2.666.527	0,25	0,02	0,07
1997	2.823.225	0,26	0,02	0,07
1998	2.868.967	0,24	0,02	0,07
1999	2.637.318	0,22	0,02	0,07
2000	2.733.486	0,23	0,03	0,08
2001	2.422.690	0,19	0,02	0,07
2002	2.549.908	0,17	0,02	0,07

Appendix C: Variables from statistical year books

Years	GDP with prices 1987	investment with 1987 prices	15-65 working age	enrolment	schooling
1964	16.979.238.095.238,10	3.670.261.781.818,16	16.614.000	251.532	1,51
1965	17.437.795.454.545,50	4.035.077.855.313,41	16.953.000	260.527	1,54
1966	19.450.851.063.829,80	4.645.557.579.275,80	17.372.000	288.964	1,66
1967	20.296.120.000.000,00	5.341.274.490.066,12	17.800.000	323.883	1,82
1968	31.517.826.923.076,90	6.139.498.136.665,85	18.239.000	351.901	1,93
1969	32.742.178.571.428,60	6.833.968.352.503,90	18.689.000	394.793	2,11
1970	34.635.800.000.000,00	7.539.695.461.336,67	19.152.000	432.282	2,26
1971	36.770.788.732.394,40	7.417.136.272.905,24	19.789.000	497.886	2,52
1972	40.274.307.692.307,70	9.006.337.360.417,43	20.301.000	535.084	2,64
1973	42.456.234.042.553,20	9.416.797.305.213,31	20.723.000	559.422	2,70
1974	43.713.626.016.260,20	9.100.627.617.394,15	21.329.000	589.810	2,77
1975	46.369.181.208.053,70	10.461.677.291.574,80	21.952.000	652.671	2,97
1976	50.468.941.860.465,10	12.970.427.266.660,10	22.547.000	773.436	3,43
1977	52.031.488.262.910,80	14.132.171.973.586,50	23.125.000	864.422	3,74
1978	52.586.853.035.143,80	12.937.274.643.409,30	23.719.000	926.091	3,90
1979	52.300.416.363.636,40	11.281.319.288.815,10	24.326.000	965.071	3,97
1980	50.892.612.284.069,10	11.093.396.923.711,60	24.949.000	1.046.683	4,20
1981	53.307.277.740.863,80	10.555.662.916.182,60	25.755.000	1.054.937	4,10
1982	54.955.252.200.932,20	10.533.529.817.665,60	26.596.000	1.071.199	4,03
1983	57.290.329.358.552,60	11.509.589.155.648,10	27.464.000	1.060.878	3,86
1984	61.355.493.772.488,20	11.857.072.956.472,00	28.358.000	1.090.180	3,84
1985	63.994.059.377.262,90	12.881.013.401.418,80	29.280.000	1.159.794	3,96
1986	68.319.219.567.538,70	15.578.269.427.988,50	30.175.000	1.244.661	4,12
1987	75.019.388.000.000,00	18.497.000.000.000,00	31.082.000	1.338.893	4,31
1988	76.106.229.717.787,10	19.899.251.752.783,80	32.015.000	1.417.794	4,43
1989	77.346.876.544.453,40	17.332.124.630.674,20	32.973.000	1.492.144	4,53
1990	84.592.253.237.348,80	19.145.510.308.400,10	34.022.000	1.582.445	4,65
1991	84.886.777.249.979,90	20.092.059.838.895,30	34.957.000	1.699.563	4,86
1992	90.322.454.384.744,50	21.148.749.846.544,20	35.923.000	1.871.057	5,21
1993	97.676.706.493.938,40	25.699.251.282.502,70	36.902.000	2.056.935	5,57
1994	91.733.035.960.342,40	22.469.539.530.186,80	37.876.000	2.220.674	5,86
1995	99.028.200.648.767,00	23.729.603.112.467,60	38.831.000	2.406.636	6,20
1996	106.079.743.463.533,00	26.614.096.828.316,30	39.782.000	2.511.919	6,31
1997	114.874.194.267.871,00	30.203.878.088.195,90	40.689.000	2.491.272	6,12
1998	119.303.124.047.017,00	29.029.129.416.716,20	41.584.000	2.129.969	5,12
1999	112.043.836.289.663,00	24.802.197.453.031,50	42.484.000	2.280.676	5,37
2000	119.144.467.741.258,00	27.106.100.375.288,20	43.587.000	2.316.350	5,31
2001	107.783.061.778.379,00	20.441.185.496.736,10	44.489.000	2.362.653	5,31
2002	116.165.493.851.405,00	20.165.178.146.255,40	45.556.736	2.579.819	5,66

Appendix D: Variables of Structural Analyzes

Year	GDP per Capita	Schooling	Health Expenditure
1980	2038956	4,20	40.475,64
1981	2070155	4,10	36.705,35
1982	2066597	4,03	36.119,10
1983	2085603	3,86	38.071,31
1984	2163405	3,84	38.579,75
1985	2185420	3,96	37.059,43
1986	2263956	4,12	37.959,34
1987	2413596	4,31	42.614,30
1988	2377265	4,43	42.722,17
1989	2345777	4,53	47.364,14
1990	2486383	4,65	52.748,79
1991	2428328	4,86	54.590,12
1992	2514337	5,21	60.539,87
1993	2646918	5,57	69.873,17
1994	2421930	5,86	62.320,33
1995	2550237	6,20	60.834,82
1996	2666527	6,31	61.613,51
1997	2823225	6,12	63.244,92
1998	2868967	5,12	74.852,78
1999	2637318	5,37	69.416,46
2000	2733486	5,31	79.969,65
2001	2422690	5,31	60.773,80
2002	2549908	5,66	71.423,92

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