The Relationship between Economic Growth and Human Capital: An Empirical Analysis for Turkey

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Abstract: The aim of this study is to explain the long and short run probable effects on the economic growth of human capital. According to main hypothesis of research, as human capital raises, the economic capital raises. In our analysis, human capital is defined with two variables. These are school enrollment rate (SR) and education spending for each student (ED). The growth rate is defined as real gross domestic product rate (GDP). The analysis includes 1970-2008 term of Turkey. The main hypothesis is tested by the help of Bounds test approach. According to the analysis results there are long run meaningful these are variables. On the other hand, long run coefficients which are estimated by the help of the model are meaningful but short run unmeaning. These are results is parallelisms between the literature and the long run and short run coefficients symbols from the analysis results.

Keywords: Human Capital, Economic Growth, Time Series.

1. Introduction

Growth models which started with Keynes effect in 1930's and frequently discussed till early 1950's, found base with Ricardo and that were brought alternative approach with Marx, has been pushed to background in economic literature for 30 years until 1980's. Although no general model has been reached about growth; several studies have been made in growth literature by the addition of new economic factors.

Globalization in world economy rendered the production and usage of learning technology, qualified labor power, and consequently the importance of human capital. Human capital is the only production factor that could unite and use all other production factors and handle the possible problems that could occur in all other production factors. For this reason, the formation targeted investments of developing countries gained importance in order to realize the expected level of the economic growth. Human capital concept which is one of the major sources of economic growth is being used to express all concepts such as {knowledge, ability, skills, health condition, place in social relations and education level} (Kar ve Ağır, 2003).

Although classic economists like Adam Smith, J. Stuart Mill and Alfred Marshall first studied the human capital concept, their opinions have been ignored by modern human capital theories. Later on, Denison, Schultz and Becker; developed the human capital concept referring to Smith's opinions and integrated it into their analysis as one of the production factors such as physical capital. Studies included in economy literature, has approved the hypothesis of "human capital needs investments just like economy needs physical capital investments" (Kar ve Ağır, 2003).

Human capital build up is accepted as the most important factor in the achievement of the expected growth and progress. Companies started giving more importance to personal training in order to exist, compete and get along with the innovation. In the recent years, it is accepted that training achieves not only personal development but also social and economical progress (Hoşgörür ve Gezgin, 2005). However, evoking of this power depends on human capital and the support given to training of human capital. It is a resource; in breeding of qualified labor power which is consistent with the needs of national economy, achievement of social order and realization of economical growth at desired level by supporting the development of higher techniques (Wykstra, 1971).

2. Literature

The impact of human capital on economic growth has been explained using Internal Growth Models and Neo-classical Growth Theory. In the studies concerning this issue the impact of human capital on growth has been measured using the impact of education, which is a measurable human capital indicator, on economic growth. Other capital factors were not included in the analyses made and the studies have been based on the relationship of education and growth (Atik, 2006).

The studies that formed the basis of neoclassical growth theory were carried out by Solow (1956) and Swan (1956). In the studies based on Neo-classical economics theory, the impact of human capital factors on economic growth was calculated using Cobb-Douglas production function. The function is given below.

$$Y^t = AKt^\alpha Ht^\beta Lt^\gamma \qquad (1)$$

In Equation (1), the following abbreviations were used; Y; Real income, A; External information, K; Physical capital, H; Education, L; Labor force, α; Physical Capital Elasticity of Production, β; Educational elasticity, γ; Labor force elasticity, t; Time.

In the studies based on Cobb-Douglas production function, different indicators were used for education variable. The most common indicators used are; school admission rates, graduation rates, average period of education, educational expenses and the rate of schooling (Atik, 2006).

The first study belongs to Schultz (1960). Schultz, making use of the educational indicators in USA between the years 1900–1956, reached the conclusion that all the GNP could not be accounted for by traditional production factors. Schultz asserted that the unaccountable part comprises the variables incorporated to the model under human capital indicators and the rise in the national product which was not accountable by the traditional production factors could be explained by the labor force who are primary school, secondary school and higher education graduates.

Nonneman and Vanhoudt (1996) made a generalization of Expanded Solow model in their study and obtained a production function related to the model and used effective labor force as a variable. In the study made by Nonneman and Vanhoudt using the economic growth rates of OECD member countries; only human capital, technological knowledge oriented investments and their starting points were considered to be significant and taken as explanatory variables. Through this study, Nonneman and Vanhoudt have reached the conclusion that the major factors which affect economic growth in almost every economy, especially those of OECD countries, are human capital and technological investments.

Denison (1962) investigated the relationship between average education period and economic growth using the annual data pertaining to 1910–1960 period. The results of the analysis suggest that 23% of the economic growth in the USA might be accounted for based on the increase in the level of education of the labor force.

Another study which investigates the impact of human capital on economic growth was conducted by Chuang (1999). In the study which investigated two major components of the impact of human capital on long-term economic growth, namely human capital accumulation and technological advancement processes, industrial data from Taiwan were taken as the basis. According to the findings of this study; 7% of the 29% increase in total production can be explained by the increase in levels of education.

Schultz (1999) who studied the relationship between economic growth and individual capital stressed that health and education investments not only bring individual benefits but also are important for economic growth. The investments in the fields of education and health in the African continent which is considered to be underdeveloped in education and health services have been assessed and the impact of the scarcity of investment in these fields on economy was evaluated. Schultz has, in view of the series used for obtaining data, reached the conclusion that education and health services in African countries positively effect economic growth.

Another study which investigates the impact of human capital on economic growth was conducted by Rangazas (2000). In his study, which uses the data pertaining to the USA for the period from 1870 to 1970, he has investigated the impact of human capital on economic growth. Rangazas divided the labor factor into human capital and unskilled labor force. According to the findings of the study, the growth rate realized as 9,3% from 1870 to 1970 might be accounted for as 20% by physical capital, 6,7% by human capital, and 69% by labor force. Moreover, it has also been concluded that educated labor factor increases the strength of physical capital in defining the increase in growth.

Romer (1986) and Lucas (1988) have laid the foundations of internal growth theories. In internal growth models human capital accumulation creates positive externalities and has a positive effect on economic growth. Internal growth models try to make up for the deficiencies of the Cobb-Douglas type production function. Internal growth models include the impact of human capital on production factors and total factor productivity in the analysis. The production function used in internal growth models is as follows (Atik, 2006):

Y=A(H) F(H,L,R,A) (2)

In the equation (2), the following abbreviations are used Y income, A(H): technology internalized during education, H education, L unskilled labor force, R: R&D, and A technological knowledge.

In Barro (1991)'s study which explains the relationship between human capital and economic growth, the increase in the real value of the per capita GNP of 98 countries in the time period covering 1960-1985 has a positive relationship with initial human capital (according to 1960 school records) yet displays a negative relationship with the initial value of the GNP. Countries that have larger human capitals also display a lower birth rate. Growth is in inverse proportion with the expenditures of government in GNP. Other important findings include the positive correlation between growth rates and political stability and the negative correlation of the growth rates with negative macroeconomic indicators of the market.

Wolff and Gittleman (1993) have defined the human capital variable as school admission rates and investigated the impact of human capital on economic growth. The impact of education on labor force has been analyzed in the study. As a result of the analyses it has been asserted that admission to higher education rates increase labor productivity.

Tallman and Wang (1994) investigated whether or not the human capital was the source of growth in Taiwanese economy using the data pertaining to the period 1965-1989. Tallman and Wang based their study on Lucas-Romer type internal growth model. The most important assumption of the model appears as human capital has a fixed yield. The findings of the study suggest that human capital factors effect the labor force in Taiwan and account for 40% of the economy and human capital is an important factor that enhances the productivity of technology and labor force.

Benhabib and Spiegel (1994), through the model they have built in their study, have studied the adaptation speed of human capital to technological developments in 121 developed and developing countries using the panel data pertaining to 1965-1985 period and they have tested the hypothesis "human capital effects the physical capital productivity and increases total factor productivity". They have obtained the result that human capital as a production factor has a negative effect on economic growth. However, as a result of the analysis they have made they concluded that human capital has an indirect impact on economic growth rather than a direct one.

Coe, Helpman and Hofmaister (1997) have taken average education period as the human capital variable. They have explained the impact of human capital on economic growth for 77 countries covering the time period from 1971 to 1990 in their study. According to the obtained findings, those developing countries which have high levels of education and research and development expenditures acquire positive externalities from the trade with developed countries and have an increase in the productivity of production factors as they produce new technologies.

Einarsson and Marquis (1998), on the other hand; adapted the Lucas model to the real business cycles and searched for the influence of human capital on economical growth of the USA. In this study performed using the annual data of the years from 1950 to 1989, they reached the conclusion that the rate of human capital growth was slower than that of physical capital growth and that its influence on economical growth was less strong compared to that of the physical capital.

Erk, Çubuk and Ateş (1998), studied on accumulation of physical capital and human capital and also their long run effects on economical growth. In this study they established three alternative models and applied them on 45 developing countries. Moreover, making use of the results of this study the reason for why the developed countries have lower long term growth coefficients compared to the under-developed countries was searched for. In the first model established they used the data pertaining to the 45 countries selected covering the period between the years 1960-1990 and these data revealed that the slope rates that give unit change rates of human capital and physical capital are high for the developed countries and low for the developing ones.

Another study focusing on theoretical approaches concerning human capital and production technologies belongs to Park (2004), who manipulates effects of economic growth on distribution of population as for human capital, considering educational success levels. Here, using the data pertaining to some developing and developed countries collected in five- year-periods between the years 1960 and 1995, it was concluded that human capital distribution has a positive interaction with growth.

Tunç (1993) in a study, searched for the contribution of schooling rate to the economic growth of Turkey using the annual data pertaining to 1968-1995 and simple regression method. According to the regression results the influence of secondary school schooling rates was determined to be 40%, while higher education schooling rate had a contribution of 0,09%. Furthermore, the study has shown that there is a close relationship between the development levels of the countries and the educational levels of the labor force in economy.

Ateş (1998), on the other hand, using the annual data pertaining to 1960-1994 period in Turkey, analyzed the capacity of extended Solow model with human capital to explain economic growth. Ateş reached the conclusion that the capacity to explain the changes in economic growth is higher in extended Solow model with human capital compared to the non-extended Solow model.

The common point of the all studies is that long term economic growth of the countries that care about human capital accumulation beside the other production factors is larger compared to that of the other countries (Gümüş, 2004: 159). Moreover, the main subject of these studies is economic development. Because the most important factor was deemed to be economic growth in realization phase of economic development, the studies were analyzed around the axis of growth.

3.Data and Methodology

This study examines the plausible impacts of human development on the economic growth in the light of hypotheses by using annual date for 1970-2008. For the model in which real gross national product (GNP) is dependent variable we use two independent variables, namely; school enrollment rate (SR) and educational expenditure per student (EDE). SR is defined as simple mean values of the rates of primary education, secondary education and higher education. GNP data are from State Planning Organization (DTP), EDE data are from Ministry of Education (MEB), and SR data are from database of World Development Indicators (WDI). In our analyses we use the logarithmic values of GNP, EDE, SR. The model is as follows:

$$\ln GNP_t = \alpha_0 + \alpha_1 \ln EDE_t + \alpha_2 \ln SR_t + u_t \qquad (3)$$

To implement the bounds test let us define a vector of two variables, z_t, where $z_t = (y_t, x_t')'$, y_t is the dependent variable and x_t is a vector of regressors. The data generating process of z_t is a p-order vector autoregression. For cointegration analysis it is essential that Δy_t be modelled as a conditional error correction model (CECM);

$$\Delta y_t = c_0 + \pi_{yy} y_{t-1} + \pi_{yx.x} x_{t-1} + \sum_{i=1}^{p} \vartheta_i \Delta y_{t-i} + \sum_{j=0}^{q} \phi_j' \Delta x_{t-j} + \theta \omega_t + \mu_t \qquad (4)$$

Here, π_{yy} and $\pi_{yx.x}$ are long-run multipliers. c_o is the constant and ω_t is a vector of exogenous components, e.g dummy variables. Lagged values of Δy_t and current and lagged values of Δx_t are used the model the short-run dymamic structure and μ_t is error term. The bounds testing procedure for the absence of any level relationship between y_t and x_t is through exclusion of the lagged levels variables y_{t-1} and x_{t-1} in Equation 4. It follows, then, that our test for the absence of a conditional level relationship between yt and xt entails the following null and alternative hypotheses:

$$H_0; \pi_{yy} = 0, \pi_{yx.x}=0',$$
$$H_1; \pi_{yy} \neq 0, \pi_{yx.x} \neq 0' \text{ veya } \pi_{yy} \neq 0,$$
$$\pi_{yx.x}= 0' \text{ ya da } \pi_{yy} = 0, \pi_{yx.x}\neq 0'$$

Peseran et.al.(2001) generated two sets of critical values assuming that both regressors are $I(1)$ and both are $I(0)$. While the critical values are reported in Pesaran and Pesaran (1997) and Pesaran et al. (2001), they are generated for sample sizes of 500 observations and 1000 observations and 20 000 and 40 000 replications, respectively. The F Statistic that has a non-standart distribution, depends upon; (i) whether the ARDL model contains an intercept and/or a trend, (ii) the number of regressors, (iii) whether variables included in the ARDL model are $I(0)$ or $I(1)$. If the calculated F statistic is higher than the upper critical value, $I(1)$, the null hypothesis of no long-run relationship can be rejected without knowing the order of integration of the regressors. Alternatively, if calculated F statistic is smaller than the lower critical value, $I(0)$, the null hypothesis is accepted without knowing the order of integration of the regressors. When the test statistic falls inside the upper and lower critical value, a conclusive inference cannot be made. Then, we must know the order of integration of variables, $I(d)$, for any conclusion can be drawn.

There are different advantages of the bounds testing approach that motivates us in our work. This procedure can be applied to models irrespective of whether the variables are $I(0)$ or $I(1)$. This is unlike other popular cointegration techniques such as the Engle and Granger (1987), Johansen and Juselius (1990) and, which require pre-testing the variables to determine their order of integration. (Pesaran and Pesaran, 1997)

Other advantage of bounds testing for this work that the method can be applied in case in which data set is of small sample sizes, such as a in the present study. Narayan(2005) show that the bounds testing approach to cointegration is popular in small sample sizes.

In addition to the tis advantages the bounds test, the Engle-Granger Method the Unrestricted Error Correction Model does not push the short run dynamics into the residual terms. Thus, the ARDL approach, because it draws upon the Unrestricted Error Correction Model has better statistical properties than the Engle-Granger cointegration test (Benarjee et.al., 1998)

The UECM for equation (1) can be written as below:

$$\Delta \ln GNP_t = a_0 + \sum_{i=1}^{n} a_{1i} \Delta \ln GNP_{t-i} + \sum_{i=0}^{n} a_{2i} \Delta \ln EDE_{t-i} + \sum_{i=0}^{n} a_{3i} \Delta \ln SR_{t-i}$$
$$+ a_4 \ln GNP_{t-1} + a_5 \ln EDE_{t-1} + a_6 \ln SR_{t-1} + a_7 DUM + e_t \qquad (5)$$

where, $\Delta \ln GNP$, $\Delta \ln EDE$ and $\Delta \ln SR$ are first difference of the logarithms of real domestic income ($\ln GNP$), real education expenditure ($\ln EDE$), and school rate ($\ln SR$) respectively. We include a dummy variable to account for structural break. DUM is dummy variable that indicates the beginning of eight-year basic education in Turkey in 1997. The dummy variable is defined by:

$$DUM = \quad 1 \quad \text{If} \quad t = 1997\text{-}2008$$
$$0 \quad \text{otherwise}$$

4. Empirical Results

The ADF and PP test the null of a unit root against the alternative of stationary. We allow both intercept and intercept with trends in the testing. As shown in Table 1, the testing results are mixed. Since none of the variables are integrated at an order higher than one, this allows the use of the ARDL bounds procedure.

Table 1. Test results for unit roots

	lnGNP	ΔlnGNP	lnEDE	ΔlnEDE	lnSR	ΔlnSR
ADF[a] intercept	0.37(0)	-6.48(1)*	0.32(2)	-3.34(1)*	0.17(1)	3.96(1)*
intercept and trend	-2.17(0)	-6.42(0)*	-1.09(2)	-3.37(1)*	-2.11(0)	-4.07(0)*
PP[b] intercept	0.08(2)	-6.48(0)*	0.52(0)	-4.87(3)	0.32(1)	4.05(1)*
intercept and trend	-2.67(0)	-6.42(0)*	-1.13(1)	-5.10(2)*	-1.79(1)	-4.08(1)*

Notes: [a]H_0: the series has a unit root. AIC is used to select the lag length. The maximum number of lags is set to be four. [b]H_0: the series has a unit root. Barlett–Kernel is used as the spectral estimation method. The bandwidth is selected using Newey–West method. *, indicate 1% level of significance. The optimal lag length or bandwidth is indicated in the parentheses.

The calculated *F*-statistic together with the critical values are reported in Table 2. The calculated *F*-statistic (Wald test), that necessary for testing the presence of cointegration relation among the variables of equation (2). When real GNP is the dependent variable, the calculated *F*- statistic is F_{RGNP}(RGNP|REDE,RSR)=7.6127 (Prob:0.002). This value higher than the upper bond critical value of 6.36 at the %1 level. The result suggest that the null hypothesis of no long-run relationship can be rejected. A maximum of 2 lags was used for the model. The estimated model presented here is based on the Schwarz Bayesian Criterion. The long-run and short-run results are presented in Tables 3.

Cusum and Cusum of Squares tests proposed by Brown et al. (1975) are used in testing for constancy of the long-run parameters. As seen from Figure 1, Cusum and Cusum of Squares tests statistics are inside the 95% confidence interval. This result shows that applied Cusum and Cusum of Squares tests clearly indicate stability of the estimated parameters of the CECM during the sample period. In addition to this Figure 1 was subjected to a number of diagnostic tests, including test of autocorrelation, normality and heteroskedasticity in the error stability term. We found no evidence of autocorrelation in the disturbance of the error term. The estimated model passes the Jarque-Berra normality tests, suggesting that the errors are normally distributed and the Ramsey-Reset test indicates that the model is correctly specified while according to the ARCH test, there is no problem of heteroskedasticity.

Table 2. Cointegration Test Results (Critical value Bounds of the *F* -statistic: Unrest'd intercepts and no trends)

	90% level		95% level		99% level	
	I(0)	*I*(1)	*I*(0)	*I*(1)	*I*(0)	*I*(1)
k						
2	3.17	4.14	3.79	4.85	5.15	6.36
Calculated *F*-statistic						
F_{RGNP}(RGNP|REDE,RSR)	7.6127 (Prob:0.002)					

Note: The critical value are extracted Peseran et. al. Table CI(iii) Case III and *k:* The number of explanatory variables.

Table 3. Estimated Short-Run and Long-Run Elasticity's UECM

	Short-run	Long-run
lnEDE	-0.02 (Prob: 0.1497)	0.022 (Prob: 0.0042)
lnSR	-0.13 (Prob: 0.2123)	0.40 (Prob: 0.0025)

*The long run coefficient of DUM variable is calculated to be 0.95 (Prob: 0.031).
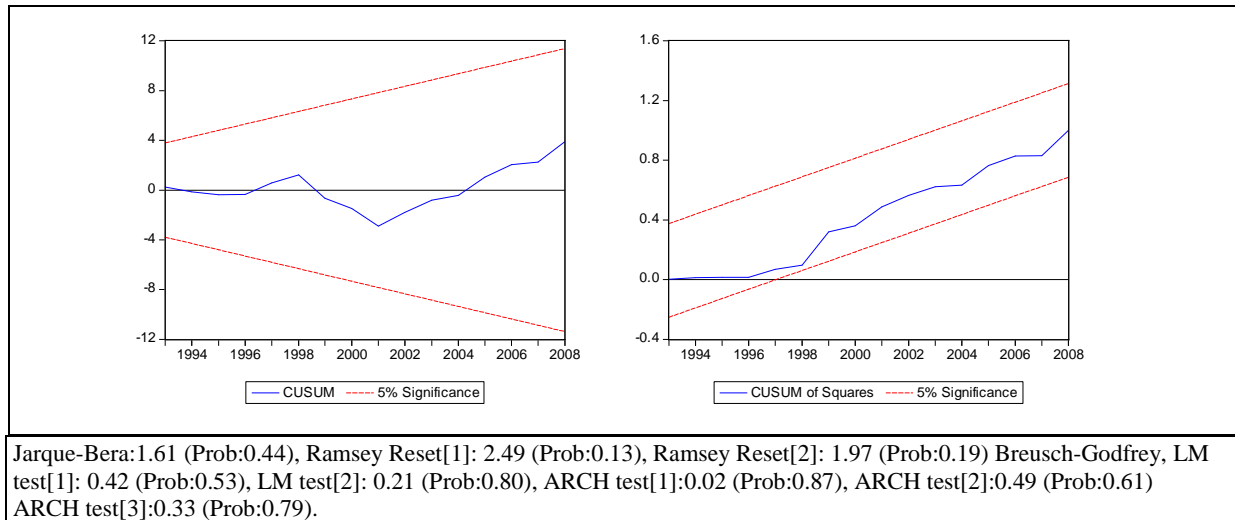

Jarque-Bera:1.61 (Prob:0.44), Ramsey Reset[1]: 2.49 (Prob:0.13), Ramsey Reset[2]: 1.97 (Prob:0.19) Breusch-Godfrey, LM test[1]: 0.42 (Prob:0.53), LM test[2]: 0.21 (Prob:0.80), ARCH test[1]:0.02 (Prob:0.87), ARCH test[2]:0.49 (Prob:0.61) ARCH test[3]:0.33 (Prob:0.79).

Figure 1. Plots of Cusum Cusum of Squares and Diagnostic tests for the estimated UECM

5. Conclusion and Policy Implication

Studies started in 1950's which human capital concept up to nowadays, are measuring the relationship between growth and progress of domestic economies and education level of the society and moreover effect of education on increase in average per capital income and accordingly rise in national income. Studies on determination of schooling rates and education expenses and their economical effects; stated that there is a positive relation between education and personal income. Additionally, continuing studies showed that as schooling rate and education period increase, the personal income increases faster, personal income raise could be explained with the raise in personal education, education expenses have positive effect on income distribution and domestic education expense levels have linear relation with development levels.

By the advantage of this fundamental knowledge and rich literature, a long term statistical meaningful relation has been found between schooling rates, educational expense per student and real gross national expenditure growth rate variables and variables derived from the results of Bounds test approach which were carried on between 1970 and 2008 in Turkey. While model based predicted long term coefficients are said to be meaningful, short term coefficients are found meaningless. At the end of the analysis, it was seen that long and short term coefficient signs derived from the analysis are parallel to the literature.

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