CAUSALITY TEST BETWEEN CHANGING IN NUMBER OF HEALTH CENTER FACILTIES AS AN INVESTMENT IN HUMAN CAPITAL AND ECONOMIC GROWTH

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Özet

1989-2001 dönemi Türkiyenin 67 ilinin fiziksel ve beşeri sermaye oranı (K/H) anlamında yatırım nitelemesi olarak değişen sağlık ocağı sayısı ve kişi başına düşen GSYİH arasındaki nedensellik ilişkisi birim kök ve Granger nedensellik yöntemi ile test edilmiştir. Ilk olarak değişkenlerin entegrasyon düzeyini test etmekle başladık. Örneklememizin çoğu I(0) olması nedeni ile, olağan nedensellik testini uyguladık. Ancak, farklı derecelerde bütünleşme olan örneklemelerin geri kalanı için nedensellik testini uygulamadık. 8 il için ln(K/H) daki değişmeler büyümeye neden olur iken, 7 il için büyüme ln(K/H) ya neden olmaktadır. Diğer 17 il için ise döngüsel bir ilişki söz konusudur. Kişi başına GSYİH ve fiziksel ve beşeri sermaye yatırımları bağımsız olması nedeni ile, başka faktörlerin etkisi ile birlikte değişim göstermiş olabilirler. Farklı iller için iki değişken arasındaki ilişki çeşitlilik arz etmektedir. Son olarak, gelir seviyelerine bakarak yorumladığımızda çelişkili bir nedensellik durumu göze çarpmaktadır. Bu bulgulardaki zıtlıkların varlığı, büyüme ve yatırım arasındaki ilişkinin yanında ekonomik büyümeyi açıklamada başka faktörler önemli olabilir.

Anahtar kelimeler: birim kök, ekonomik büyüme, fiziksel sermaye, sağlık göstergesi formunda beşeri sermaye, fiziksel ve beşeri sermaye arasındaki tamamlayıcılık ve Granger nedensellik.

BEŞERİ SERMAYEDE BİR YATIRIM OLARAK SAĞLIK OCAĞI SAYISINDAKİ DEĞİŞME VE EKONOMİK BÜYÜME ARASINDAKİ NEDENSELLİK TESTİ

Abstract

We have used unit root and granger causality test to verify the relationship between per capita GDP growth and changing in number of health center investment in terms of physical to human capital ratio for 67 provinces for the period 1989-2001. We first start testing the integration order of these variables. Since most of the samples are I(0), we have used regular causality test for them. However, for the rest of the sample, the variables are in different order so there is no causality test for those. We have found that the growth is caused by changing in ln(K/H) for 8 provinces while changing in ln(K/H) is caused by growth for 7 provinces. For seventeen provinces, there is a bi-directional causality occurred. There is also no causality at all for 17 provinces. Since per-capita GDP growth and physical to human capital investment are interdependent, they might move together under the influence of other factors. It has been observed that the relation varies for different provinces. Lastly, there is mixed result about the causality direction about the income level. Since the findings of causality for provinces are contradictory, there are factors which may be important to explain economic growth besides growth and investment's interactions.

Keywords: Unit root; Economic growth; Physical capital, Human capital in the forms of health indicator, complementarities between physical and human capital and Granger causality;

I. INTRODUCTION

Some economies are richer than others. To identify why it is a fundamental question for economists to answer, therefore, knowing what causes economic growth would make an enormous contribution to human wellbeing. The theoretical work of the mid-1950s proposes that an exogenous technological alteration is the main driving force of economic growth. While, after the mid-1980s, this simple exogenous technological alteration assumption is considered to be endogenous to understand the broad variety of international variations in terms of economic growth and income levels. However, in these extensive exogenous growth literature discussions, the emergence of human capital did not collect the awareness it deserved in the neoclassical growth theory of the sixties while human capital has now become the most important focus of awareness with endogenous growth discussion which deals with the technology issue.

Since human capital is considered one of the main determinants of economic growth besides raw labor, physical capital and technological progress, any increases in human capital have straight and meandering

influences on physical capital and technological progress. Consequently, economies with the higher initial stocks of human capital are anticipated to grow faster. In view of the fact that there is a very strong relationship between human capital and economic growth (Benhabib and Sipiegel, 1994; Barro, 1991; Mankiw et al., 1992; Nonneman and Vanhoudt, 1996; Goetz and Hu, 1996; De Georgia, 1996; Tallman and Wang, 1994; Young, 1995), health component is another main component of human capital formation and physical embodiment of knowledge in people. Therefore, we should integrate the economic growth and healthy people as if accumulating in human capital. Most economies face many diverse resource difficulties and infrastructural constraints that limit their economic growth potential. Therefore, there is also a very well-built positive relationship between health and economic prosperity levels. While lower income groups only allocate lesser resources for their health expenditure sources, their labor and human capital level which is derived from healthiness directly contribute to economic growth. The studies have shown that lower incomes cause poorer health and thus, poorer health status causes lower income (Howden-Chapmen and O'Dea, 2001; Strauss and Thomas, 1998; Bloom et al, 2001; Von Z. and Muysken, 2001; Fielding, 2001; Erdil and Yetkiner, 2004; Wagstaff, 2005; Thomas, 2001). Sachs and Brundtland (2002) consider health as a productive asset, and therefore, poverty is closely related with health. In most cases, with any health shocks, the immediate effects would be catastrophic to poor people. This point leads us to touch upon the issue of income inequality. Income inequality is related to socio-economic hierarchy and the ability to invest in the structural part of the economy. Therefore, income inequality is another important issue for planning but it is beyond the technical concern of this study.

Health is one of the main components of skilled-labor or human capital which is matter for economic outcome. As a result, health status of human capital and labor also matters for economic outcome. In this part, we present positive effects of health on the economy (Rivera and Currais, 1999). There are numerals of ways health status matters for economic outcomes. These are explicitly labor productivity, labor supply, education, savings and investment (Suhrcke et al., 2005). Reversely, income can also influence health situation through at least two channels: a direct channel on the material conditions that have a positive impact on biological survival and health and indirect channel which runs health conditions throughout social participation, the opportunity to control life circumstances and the feeling of security. At the family unit level, facts show that increases in economic resources are invested in improving diet, better sanitation techniques, enhanced health practices and more effective usage of health services (Wagstaff, 2001; Nixon, 1999).

After setting the health status and human capital link and their links with economic growth, we describe that economic growth is the term to describe the growth in output from an economy where there is a general agreement that the process of economic growth and investment in physical to human capital ratio is closely interlinked. Since the investment in physical to human capital ratio is the input to increase the income growth, the growth models should focus on investment in physical to human capital ratio as the models focuses on the capital. In the general literature, economists have emphasized the importance of investment but not the investment in physical to human capital ratio. In terms of investment, many of empirical work have investigated on the role of investment in economic growth and it is found that investments play crucial role in economic growth (Barro, 1991; Mankiw et al, 1992; Barro and Sala-i-Martin, 1995). While in Solow type of growth model, investment is the main contributor to economic growth; in endogenous growth their interaction is cyclical. Blomstrom et al. (1996) find that economic growth causes the investment rather than vice versa. The aim of our study is to test for causality between economic growth and investment in physical to human capital ratio in terms of changing in health facilities for 67 provinces data for the period 1989-2001.

In the next section, we discuss the methodology. In the third section, we describe the data. We also discuss the physical and human capital complementarities in the forth section. We discuss the estimation result in the fifth section. We sum up the general finding at the last section.

II. METHODOLOGY

According to the Granger causality test approach, a variable Y is caused by X if Y can be predicted better from past values of Y and X than from past values of Y alone or vice versa. Therefore, the following regressions are employed:

$$Y_t = b_0 + \sum_{i=0}^{m} b_i Y_{t-i} + \sum_{i=1}^{m} a_j X_{t-j} + u_t$$	
$$X_t = c_0 + \sum_{i=0}^{m} c_i X_{t-i} + \sum_{i=1}^{m} d_j Y_{t-j} + v_t$$	

Where u_t and v_t are mutually uncorrelated white noise series. Testing $a_j=d_j=0$ for all j (j=0,1,...m) against $a_j \neq d_j \neq 0$ for at least some js will determine the direction of the relationship between Y and X.

Prior to perform the causality test, we need to make sure that variables are stationary individually and cointegrated together. A series which is I(0) is held to be stationary. In order to test whether the series is stationary, the Augmented Dickey Fuller test (ADF) is employed. The estimation of the following regression are used:

$$\Delta X_t = \alpha_0 + \alpha_1 t + \alpha_2 X_{t-1} + \sum_{i=1}^{k} \alpha_3 \Delta X_{t-i} + e_t$$

Where Δ presents the first difference operator, t is the linear time trend and e_t is a normally distributed error term. In the third equation, H_0: $\alpha_2=0$ against the alternative H_0: $\alpha_2\neq 0$ is tested. If the absolute value of calculated t-ratio is greater than the critical value, then the null hypothesis of a unit root is rejected which means that the series is I(0).

III. THE DATA

In this study, 67 cross-provinces data is used for the period from 1989 to 2001. GDP per capita growth data and changing in number of health center data are employed. While growth rate is employed from Turkish Statistical Institution, changing in number of health center data (not include hospitals) is employed from Ministry of Health. Since some of the changing in number of health center data are negative, we have added one to minimum value of the changing in number of health center data to make sure it become positive when we take log of it. We have not employed any proxy for neither for physical nor human capital except the health indicator. Changing in number of health center data is employed to represent human capital.

IV. PHYSICAL AND HUMAN CAPITAL INTERACTION

Some studies designate that the fundamental relations between physical and human capital is not substitution but complementarities as if there is no physical capital then there will be no human capital in action or use of technology (Bulutay, 1995; Kalyoncu, 2008). If there is not an adequate amount of human capital then having more physical capital is futile. In the frequently accepted production function, the level of physical capital (K) and human capital in the production function entail that even the tiny unit of either physical or human capital is enough to continue for production:

$$Y_t = F_t\left[A_t, K_t, H_t, L_t\right] = F_t\left[A_t, c, H_t, L_t\right] = c_t^{\alpha} H_t^{\beta} \left(A_t L_t\right)^{1-\alpha-\beta} \text{ or}$$

$$Y_t = F_t\left[A_t, K_t, H_t, L_t\right] = F_t\left[A_t, K_t, c, L_t\right] = K_t^{\alpha} c_t^{\beta} \left(A_t L_t\right)^{1-\alpha-\beta}$$ where Y stands for GDP level, L for raw labor and A for technology parameters.

Nevertheless, it is not matter-of-fact to set such interaction since any type of machines requires skilled labor to operate. If it is not, it will not task as expected. The human capital and physical capital complementarities are established as the nature of the production process, for the reason that machines require trained workers to activate them and to repair them[1].

Therefore, our production function is as follows.

$$Y_t = F_t\left[A_t, \frac{K_t}{H_t}, L_t\right]$$

In the study, we assume there are no differences in physical capital and educational level of the provinces in order to see more clearly the effects of changing in number of health services facilities. Since $\left(\frac{K}{E}=1\right)$ for $(\frac{K}{Es})$, only differences is considered $\frac{1}{s}$ where "s" shows changing in number of health services facilities.

V. ESTIMATION

In terms of the economical inspiration, we briefly presents the causal relations of the GDP and physical to human capital ratio: any increase in income present incentive for more savings and in turn more physical to human capital investment, thus GDP causing physical to human capital investment- with any increase in per-capita GDP, governments would be able to expend more on infrastructure, which increases the marginal productivity of physical to human capital ratio and labor in private sector, encouraging more physical to human

[1] For more detail about the complementarities interaction and how they interact by describing the excludability degree for different types of capital, please look at Kalyoncu (2008).

capital investment and Alternatively, more physical to human capital investment presents more production competence, more opportunities for jobs and higher wages resulting in higher income so physical to human capital investment causing GDP.

In cooperation of per-capita GDP growth and physical to human capital investment is interdependent and could cause each other simultaneously or there could be no causality among them but they might move together under the influence of other factors.

We first check whether the series are stationary. Since most of the series are stationary at 10%, we move to second step for the stationary series to check the direction of the causality[2].

[2] For the provinces AĞRI, BİNGÖL, BOLU, ELAZIG, ERZİNCAN, ERZURUM, ESKİŞEHİR, GÜMÜŞHANE, KARS, KAYSERİ, KIRKLARELİ, MANİSA, NEVŞEHİR, ORDU, TOKAT, TRABZON, UŞAK, VAN, there is no further statistical test since GDP growth rate and changing in Ln(EL/E) are integrated of different orders.

TABLE I: Unit root test result

Provinces	Growth	changing in ln(1/S)
ADANA	Y	Y
ADIYAMAN	Y	Y
AFYON	Y	Y[C3]
AĞRI	Y	NO[C]
AMASYA	Y	Y[C]
ANKARA	Y	Y
ANTALYA	Y	Y
ARTVİN	Y	Y
AYDIN	Y	Y[C]
BALIKESİR	Y	Y[C]
BİLECİK	Y	Y
BİNGÖL	Y	NO[C]
BİTLİS	Y	Y[C]
BOLU	NO	Y[C]
BURDUR	Y	Y[C]
BURSA	Y	Y[C]
ÇANAKKALE	Y	Y
ÇANKIRI	Y	Y[C]
ÇORUM	Y	Y
DENİZLİ	Y	Y
DİYARBAKIR	Y	Y
EDİRNE	Y	Y
ELAZIG	Y	NO[C]
ERZİNCAN	Y	NO[C]
ERZURUM	Y	NO[C]
ESKİŞEHİR	Y	NO[C]
GAZİANTEP	Y	Y[C]
GİRESUN	Y	Y
GÜMÜŞHANE	Y	NO[C]
HAKKARİ	Y	Y[C]
HATAY	Y	Y[C]
ISPARTA	Y	Y
İÇEL	Y	Y[C]
İSTANBUL	Y	Y[T4]
İZMİR	Y	Y
K.MARAŞ	Y	Y
KARS	Y	NO[C]
KASTAMONU	Y	Y[C]
KAYSERİ	Y	NO[C]
KIRKLARELİ	Y	NO[C]
KIRŞEHİR	Y	Y[C]
KOCAELİ	Y	Y[C]
KONYA	Y	Y
KÜTAHYA	Y	Y[C]
MALATYA	Y	Y[C]
MANİSA	Y	NO[C]
MARDİN	Y	Y[T]
MUĞLA	Y	Y[C]
MUŞ	Y	Y
NEVŞEHİR	Y	NO[C]
NİĞDE	Y	Y
ORDU	Y	NO[C]
RİZE	Y	Y
SAKARYA	Y	Y[C]
SAMSUN	Y	Y[T]
SİİRT	Y	Y[C]
SİNOP	Y	Y[C]
SİVAS	Y	Y
ŞANLIURFA	Y	Y
TEKİRDAĞ	Y	Y[C]
TOKAT	Y	NO[C]
TRABZON	Y	NO[C]
TUNCELİ	Y	Y
UŞAK	Y	NO[C]
VAN	Y	NO[C]
YOZGAT	Y	Y[C]
ZONGULDAK	Y	Y[C]

[3] C stands for Constant term

[4] T stands for Constant and trend term.

Then we run the equation 1 and 2 to confirm the causality direction. The results are shown in table 2.

Table 2: The causality results

Provinves	growth is caused by changing in ln(1/S)	changing in ln(1/S) is caused by growth
ADANA	NO	NO
ADIYAMAN	YES	NO
AFYON	NO	NO
AMASYA	YES	YES
ANKARA	NO	NO
ANTALYA	NO	YES
ARTVİN	YES	YES
AYDIN	YES	NO
BALIKESİR	YES	YES
BİLECİK	NO	YES
BİTLİS	NO	NO
BURDUR	NO	YES
BURSA	YES	YES
ÇANAKKALE	YES	YES
ÇANKIRI	YES	NO
ÇORUM	YES	YES
DENİZLİ	NO	NO
DİYARBAKIR	NO	NO
EDİRNE	YES	YES
GAZİANTEP	YES	NO
GİRESUN	NO	NO
HAKKARİ	YES	NO
HATAY	NO	NO
ISPARTA	NO	NO
İÇEL	NO	NO
İSTANBUL	YES	YES
İZMİR	YES	YES
K.MARAŞ	NO	YES
KASTAMONU	NO	NO
KIRŞEHİR	NO	YES
KOCAELİ	YES	YES
KONYA	YES	YES
KÜTAHYA	YES	YES
MALATYA	YES	YES
MARDİN	NO	NO
MUĞLA	YES	NO
MUŞ	YES	YES
NİĞDE	YES	YES
RİZE	YES	YES
SAKARYA	NO	NO
SAMSUN	NO	NO
SİİRT	YES	NO
SİNOP	NO	YES
SİVAS	YES	NO
ŞANLIURFA	NO	NO
TEKİRDAĞ	NO	YES
TUNCELİ	YES	YES
YOZGAT	NO	NO
ZONGULDAK	NO	NO

We have employed the $\bar{R}^2$ in view of the fact that it is the result of penalty for the additional variables where these variables's t-test result is less than one. Growth is caused by changing in ln(1/s) for 8 provinces while changing in ln(1/s) is caused by growth for 7 provinces. For seventeen provinces, there is a bi-directional causality occurred. There is also no causality at all for 17 provinces.

Since most economies face many diverse resource difficulties and infrastructural constraints that limit their economic growth potential, there is also a very well-built positive relationship between health and economic prosperity levels. In the literature, the studies have shown that lower incomes cause poorer health and thus, poorer health status causes lower income (Howden-Chapmen and O'Dea, 2001; Strauss and Thomas, 1998; Bloom et al, 2001c; Von Z. and Muysken, 2001; Fielding, 2001; Erdil and Yetkiner, 2004; Wagstaff, 2005; Thomas, 2001). Therefore, in the table 3, we have reconsidered whether there is any influence of income level on causality results. Whether having higher income or lower income does not have any influences on the causality results. Therefore, we rearrange the table 2 according to income level.

Table 3: Considering the causality results by the income level

Provinces	Income Level	growth is caused by changing in ln(1/S)	changing in ln(1/s) is caused by growth
MUŞ	578	YES	YES
BİTLİS	646	NO	NO
HAKKARİ	836	YES	NO
YOZGAT	852	NO	NO
ADIYAMAN	918	YES	NO
MARDİN	983	NO	NO
ŞANLIURFA	1008	NO	NO
SİİRT	1111	YES	NO
ÇANKIRI	1136	YES	NO
AFYON	1263	NO	NO
DİYARBAKIR	1313	NO	NO
SİVAS	1399	YES	NO
MALATYA	1417	YES	YES
AMASYA	1439	YES	YES
GİRESUN	1443	NO	NO
SİNOP	1459	NO	YES
KIRŞEHİR	1488	NO	YES
ISPARTA	1510	NO	NO
KONYA	1554	YES	YES
K.MARAŞ	1584	NO	YES
TUNCELİ	1584	YES	YES
GAZİANTEP	1593	YES	NO
ÇORUM	1654	YES	YES
SAMSUN	1680	NO	NO
HATAY	1757	NO	NO
KASTAMONU	1781	NO	NO
NİĞDE	1781	YES	YES
KÜTAHYA	1805	YES	YES
RİZE	1897	YES	YES
BURDUR	1951	NO	YES
BALIKESİR	2005	YES	YES
AYDIN	2017	YES	NO
SAKARYA	2108	NO	NO
DENİZLİ	2133	NO	NO
ARTVİN	2137	YES	YES
ANTALYA	2193	NO	YES
ÇANAKKALE	2335	YES	YES
ADANA	2339	NO	NO
EDİRNE	2403	YES	YES
İÇEL	2452	NO	NO
TEKİRDAĞ	2498	NO	YES
BURSA	2507	YES	YES
BİLECİK	2584	NO	YES
ANKARA	2752	NO	NO
ZONGULDAK	2969	NO	NO
İSTANBUL	3063	YES	YES
İZMİR	3215	YES	YES
MUĞLA	3308	YES	NO
KOCAELİ	6165	YES	YES

In order to discuss the finding we get some helped from Gülcan and Aldemir (2008). They have specifically looked at two neighboring Turkish province which are Denizli and Aydın. They have conducted a survey in both states and they have concluded that not only economic factors but also cultural values, networks and organization seem to explain success or failure of regions. In general, it is expected that whichever the provinces have more resources, human capital, transportation facilities and proximity to center to trade to be better off. However, even though Aydın is well ahead of Denizli in terms of those factors, Denizli supersedes. According to them, the main reason behind these, it is the appropriate attitudes and behavior of individuals and

businessmen in Denizli. Denizli have the required values such as internal locus of control, individualism etc. Vural (2007) also investigate how institutional coordination influences the economic growth and she found that there is a strong relation between economic growth and institutional structure if there is integrated coordination among the institutions. Superiority of the firms does not depend on their physical and human capital sources or their ratio but the ambiance they create (Bulutay, 1995). He points out those agents (firms) of superiority in the production process are not formed by their human and physical sources but the superiority is formed by the ambiances with the sources. Therefore, firms and their assets can be more precious than what really they are because of created ambiance by firms. As Kalyoncu (2008) Bulutay (1995) points out that the essential interaction among inputs is not substitution but complementarities. Therefore, dynamic structural change involves strengthening economic linkages within the economy and productivity improvements in all major sectors. The degree of integration of the domestic firms in provinces also influences how much provinces are able to gain from economic activity and investment.

VI. CONCLUDING RESULT

In terms of changing in number of health center facilities, we have investigated on the role of changing in number of health center in economic growth as a proxy of investment in (K/H) and it is found that changing in number of health center plays crucial role in economic growth. We have used unit root test to determine the relationship between per-capita GDP growth and changing in number of health center facilities. Most series for 67 provinces are I(0). Therefore, we have run the Granger-causality test for those stationary series. Growth is caused by changing in ln(1/s) for 8 provinces while changing in ln(1/s) is caused by growth for 7 provinces. For seventeen provinces, there is a bi-directional causality occurred. There is also no causality at all for 17 provinces. Therefore, for those 17 provinces, changing in number of health center and growth might move together under the influence of other factors. As the last point, whether having higher income or lower income does not have any influences on the causality results.

We then may conclude that the transitions in economies are not problem free transition. These may go with the findings about the convergence in literature (Kalyoncu, 2008) since the findings are mostly conditional which accept the political influences on economies. Since the findings of causality for provinces are contradictory, there are factors which are much more important to explain economic growth and investment's interactions such as the ambiance in working area or in city culture.

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