# AN ASSESMENT OF THE EFFECT OF HEALTH AND NUTRITIONAL QUALITY ON WORKER EFFORT AND ECONOMIC GROWTH THROUGH PHYSICAL AND HUMAN CAPITAL: CROSS-COUNTRY AND TURKISH EVIDENCE

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KAHRAMAN KALYONCU

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_____

Prof. Dr. Sencer Ayata

Director

I certify that this thesis satisfies all the requirements as a thesis for the degree of Doctor of Philosophy.

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Prof. Dr. Haluk Erlat

Head of Department

This is to certify that we have read this thesis and that in our opinion it is fully adequate, in scope and quality, as a thesis for the degree of Doctor of Philosophy in Economics.

_____

Assoc.Prof. Dr. Erkan Erdil

Supervisor

**Examining Committee Members**

| | | |
|---|---|---|
| Assoc.Prof.Dr. Erkan Erdil | (METU,ECON) | _____ |
| Assist. Prof. Dr.Şirin Saraçoğlu | (METU,ECON) | _____ |
| Assist.Prof.Dr. Galip Yalman | (METU,ADM) | _____ |
| Assoc.Prof.Dr. Hakan Yetkiner | (İEU, ECON) | _____ |
| Assoc.Prof.Dr. İsmet Koç | (HÜ, Nüfus Et.Ens.) | _____ |

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Name, Last name: Kahraman Kalyoncu

Signature :

**ABSTRACT**

AN ASSESMENT OF THE EFFECT OF HEALTH AND NUTRITIONAL QUALITY ON WORKER EFFORT AND ECONOMIC GROWTH THROUGH PHYSICAL AND HUMAN CAPITAL: CROSS-COUNTRY AND TURKISH EVIDENCE

Kalyoncu, Kahraman

Ph.D., Department of Economics

Supervisor: Assoc. Prof. Dr. Erkan Erdil

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This dissertation aims to provide evidence on the inter-relationship between per-capita income variation and worker effort indices through nutritional intakes or income to food expenditure ratio. Based on these worker effort indices, there are two data sets; 69 countries data for the year 1980, 1990 and 2000 and 17 regionalized Turkish provinces data for 1994 and 2003. One major contribution is the definition of human and physical capital interactions since accumulation of human capital (H) and physical capital (K) depends on each other within a given technology. This is called "complementary interaction". Therefore, we emphasize K and H ratios are key factors in an economy rather than the absolute sizes. Another our main contribution to the literature is the data sources we employ. The 1980, 1990 and 2000 data are the first in the literature for 69 countries and more importantly, it is the first study for Turkish provincial level. While some studies are held for particular countries in terms of health proxy levels, there is no such study of any type pertaining to the Turkish economy. Our health proxies empirically play a very important role in our economic growth study. While health proxies make an important contribution in explaining income disparity approach, we do not see such effect on the convergence rate.

Keywords: productivity, worker effort, physical capital to human capital ratio, convergence and income disparity

# ÖZ

FİZİKSEL VE BEŞERİ SERMAYE YOLU İLE SAĞLIK VE NİTELİKLİ BESLENMENİN İŞGÜCÜ PERFORMANSI VE EKONOMİK BÜYÜME ÜZERİNDEKİ ETKİLERİNİN BİR DEĞERLENDİRMESİ: ÜLKELER VE TÜRKİYE DÜZEYİNDE KANITLAR

Kalyoncu, Kahraman

Ph.D., Ekonomi Bölümü

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Bu tez beslenme düzeyini veya gıdanın gelir içindeki payını iş gücü performansı hesaplamada baz alarak işgücü performans indeksi ve gelirdeki değişim arasındaki ilişkiyi ortaya koymaya çalışmıştır. İki ayrı örnekleme bu çalışma için şeçilmiştir:1980, 1990 ve 2000 yılları için 69 ülke ve 1994 ile 2003 yılları için 17 bölgesel hale dönüştürülmüş iller datası kullanılmıştır. En önemli katkılarından birisi ise veri teknolojide fiziksel sermaye (K) ile beşeri sermaye (H) arasındaki ilişkinin tamamlayıcı olarak tanımlanmasıdır. Böylece, asıl olanın K ve H nin seviye büyüklüğü değil fakat ikisinin birbirine oranı olduğu vurgulanmaya çalışılmıştır. Ayrıca çalışmada kullanılan veriler çalışmanın bir başka önemli katkısı olarak literatürde yerini alacaktır. 69 ülke için 1980, 1990 ve 2000 yıları olarak üç dönem veri kullanılırken Turkiye'nin bölgesel hale dönüştürülmüş iller veriside literatürde bir ilk olarak yerlerini alacaklardır. Kullandığımız sağlık göstergeleri, ekonomik büyüme çalışmamızda ampirik olarak önemli bir rol yüklenmiştir. Gelir dağılımında bu göstergelerimiz önemli bir katkı sağlarken, yakınsama çalışmasında aynı etkiyi göremedik.

Anahtar Kelimeler: verimlilik, işgücü performansı, fiziksel ve beşeri sermaye oranı, yakınsama ve gelir farklılığı.

.

To my mother, my father, my sisters and brothers, my wife and son, Kemal Tahir, Mehmet Akif Ersoy, Akira Kurosawa

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# CHAPTER I.

# INTRODUCTION

## I.1. Motivation

In the fall of the year 1994, I learned the true meaning of one profoundly famous Turkish proverb which is, "Her şeyin başı sağlık (Health is the onset of everything)". It was a period of my life during which I felt invincible mainly because of my youth, physical stamina and desire to succeed at all costs. Then I discovered that I had overestimated my ability to cope with unforeseen personal challenges which were brought about through injury, illness and disappointment. Although I had performed poorly on the "Test of English as a Foreign Language" (TOEFL) examination, I was still accepted into the Master's degree program for economics (at Indiana University Purdue University at Indianapolis (IUPUI) located in Indianapolis, Indiana). As soon as I had arrived and began the semester of classes toward completing my Master's degree I faced an academic world with unfamiliar lecturing settings and unorthodox Professors with very different teaching styles that made the fall semester seem like on unending marathon. Another obstacle I had to overcome was my lack of developing prior superior mathematic skills as well as having a limited understanding of English which created many complications in my daily life and educational progression which was not what I had been accustomed to nor was I prepared for. To complicate matters even more badly, I was involved in a serious bicycle accident. I sustained a head wound and severely injured my left arm so much so that I could barely use it while continuing my assignments. In the following spring semester, the pressure and stress of keeping pace with maintaining my personal academic standards of excellence was becoming unbearable which caused tremendous physical and mental obstacles, especially having Tuberculosis (TB) (Pablos-Mendez, 2001). My physical injuries and mental state took a total of six months to heal and stabilize but TB has still somehow affected my life. Although the total effects of these personal dilemmas were difficult to handle it has also taught me the value of perseverance and persistence in the face of adversity, the key being to maintain my own overall best health.

In my leisure time, I utilized television to enhance my familiarization of English. Whenever I have surfed on TV channels, much to my surprise I have discovered that there are numerous such health and wellness programs and the featured subject-matter experts offered very sound and relevant analysis reports. It becomes apparent after a short period of observation and comparison that the televisions programs' total times of health-related programs in TVs are nearly close the total times of finance-related programs. Since health is a concern that is shared throughout the universe with its relative vast topics and fields of study (such as orthopedics, Diet-related NCDs

(Non-Communicable Disease-includes cardiovascular disease, high blood cholesterol, obesity, diabetes, osteoporosis, high blood pressure and certain cancers) dental, diet related, obesity, sexuality, test-tube baby, pregnancy, hernia, child sickness, kidney, many different types of pain and so on) it was clear from an economist point of view that health has a direct correlation to personal income which directly impacts the overall state of the economy. The programs I observed highlighted the skill and professionalism of healthcare providers as well as the patients requiring medical attention, which ultimately signifies a relationship in a considerable amount of cost for both parties. Since there is a cost for education, training, facilities, supplies, transportation, staffing, medical services, etc., then there should also be an expectation of benefits too. Otherwise, why would anyone be interested in the medical profession in general?

Aside the personal experiences and daily life observations, during my professional life as an economist, I have been interested in why some countries are fundamentally richer than others. Therefore, I have concentrated on the factors that can generate or decelerate economic growth and development. If we understand what can generate economic growth and development then any society could greatly improve the quality of life for its citizens as well as increasing the capability to achieve economic independence through its economist power. Therefore, I have started to question how being healthy is related with income or vice versa and how I could compare these factors in relation to economic growth. Mankiw et al. (1992), one of the cornerstones of work in economic growth literature, also mention the health concept as being an integral part of human capital. In the literature there is also a very strong and positive relationship that coexists between health and economic prosperity levels. While lower incomes are parallel to lower resources of distribution and health expenditures, labor and human capital directly contribute to economic growth (Howden-Chapmen and O'Dea, 2001; Strauss and Thomas, 1998; Bloom et al, 2001c; Muysken, et al., 2003, Von Z., and Muysken, 2001; Fielding, 2001; Erdil and Yetkiner, 2004; Wagstaff, 2005; Thomas, 2001; Sachs and Brundtland, 2002).

If we understand that nutrition is one of the vital components of healthiness then it is apparent that economic status becomes significant in the role of determining how health is affected by the status of income and how income or the lack thereof affects health become important. There are several significant factors which must be mentioned at this point to provide a baseline for addressing the major issues of this subject. How do genetic, economic, social, cultural and environmental factors determine overall health status? How does overall health status affect the productivity, labor market and education level of the work force? What resources are available for investment in human capital? What are the direct consequences of the lack of access to material goods and what indirect conditions arise from systematic isolation in participation of social events, the opportunity to control life circumstances and the sense of controlling health conditions stemming from economic status? There have been some attempts to clarify these interactions

(Wagstaff, 2002; Bloom, et al, 2001a; Rivera and Currais 1999). Mainly they focus on health issues through human capital. Since health is a component of human capital and human capital matters for economic outcome, health also matters for economic outcome which also means economic outcomes matter for health.

Healthier workers maintain high physical and mental levels that are likely to increase their productivity levels, higher education and professional progression goals. This healthiness allows them with the opportunity to take advantage of advancements in technology and sciences by becoming more efficient just by being healthy (healthiness increases higher education awareness) (Broca and Stamoulis, 2006). Healthiness is directly related to labor work force productivity since reducing the number of sick days consequently results in sustaining the optimum number of normal operational work opportunities as well as maintaining income and salaries levels. The income and salary variables also help to determine a workers' ability to utilize accrued leisure time or excused absences and work preferences (Sachs and Brundtland, 2002). Additionally, Broca and Stamoulis (2006) mention that if an individual has better health and nutrition resources then the tendency to achieve better educational status becomes increased because they suffer less from school absenteeism and early drop-out of high school before graduation. It is also mentioned that improved health in early developmental ages directly contributes to future productivity. Broca and Stamoulis (2006) mention that poorer nutritional condition is associated with poorer school performance in children of school age. At its simplest, they briefly express as a hungry child cannot learn. The distribution of income between savings and consumption is closely related with the health status of individuals and the general population at large. Since the healthier individuals are more likely to have a more robust economic portfolio their accumulated savings ratio may consequently be higher than the savings ratio of individuals in poor health.

Income influences the health both directly and indirectly. In terms of direct impact of income, Wagstaff (2001) and Nixon (1999) mention that any increases in economic resources may be invested in improving diet, sanitation methods, health practices to increase the use of health services and benefits especially at the household level. There are some indirect health consequences to consider. There is a variety of issues such as socioeconomic factors that have underlying determinants of health or social-economic hierarchy, differential investment in structural, material and economic resources, human capital and the market structure for social cohesion. Briefly, higher income can result in better health outcomes through investing in health system, increasing the financial ability of individuals to access such services, increasing the skilled and understanding of individuals to access such services (especially, educating the mother to prevent her child to get sick) and changing the environment to have healthy life style.

Since health is a component of human capital and human capital matters for economic outcome, I would like to investigate whether the nutritional status as a health status can explain the large income differences in per capita incomes and whether relatively poorer economies can grow faster than richer economies in terms of per-capita income. These subjects get considerable attention in literature not only on the theoretical level but also on the empirical level of hypothesis generated from long-running economic growth models (Mankiw et al., 1992; Mankiw, 1995; Barro, 1991).

I prefer to focus on whether nutritional status as a health indicator provides an explanation into large income differences in per capita incomes and have any substantial markers about relatively poorer economies' growth and richer economies' growth in terms of levels of income convergence. This should expose whether health should belong in the Solow-Swan type growth regression category. Since the residuals are usually considered as an indicator of Total Factor Productivity (TFP from this point forward) in the Solow-Swan type growth regression, we should investigate whether health indicator is an omitted variable in this type of work. If there is any portion of health contribution in the TFP then we should have to include health in explaining such large income differences in per capita incomes and whether relatively poorer economies grow faster than richer economies in terms of income convergence levels.

After considering this residual issue, we will focus on income differences and convergence issues which empirically define human capital with education and worker effort level. The question is to what extent can differences in worker effort level account for the income disparity between the richest and poorest countries and if worker effort level causes any decrease or increase in the productivity gap and finally how the worker effort level affects the convergence rate? Therefore, if the worker effort level helps to explain the income variation, the income differences and rate of convergence, then we should be more careful about the nutritional status of society as a whole where worker effort is defined by the nutritional status.

**I.2. Data and Methodology**

Mankiw (1995) offers some critiques of the neoclassical model based on the fact that it has come under attack in recent years as providing an empirically inadequate theory of growth.He discusses these issues in detail; however, we will try to point his discussion. His argument can be indicated as:

- The magnitude of international differences: The model predicts less variation in income than is observed across countries.
- The rate of convergence: The model predicts a faster rate of convergence to the steady state than most studies do.

- Rates of return: The model predicts greater variation in rates of return across countries than is empirically plausible.

Therefore, we like to point that the worker effort or especially the (K/H) ratio may help us to come over first two of these critiques. Wang and Taniguchi (2003) mention that even though better nutrition enhances economic growth there should be a need for solid economic theories and models to formalize these relationships. Since nutrition status is far from being exogenous and economic growth has been widely documented to exact positive relationship between the impact of nutrition status and the income, these theoretical models should provide guidance on the search for possible transmission mechanisms between nutrition and growth. All these points indicate the direction of simultaneous determination with the question how the feedback effects are responsive. However, even though there is also a simultaneity problem between the control variables in growth studies, we like to fit our worker effort indices with nutritional level in Augmented Solow model, like Mankiw et al. (1992), because finding no-convergence is considered for endogeneity.

Thanks to the considerable empirical work on cross-country economic growth, a close two-way relationship has been observed in the theory of growth: the emergence of endogenous growth theories and the ensuing conflict between these on the one hand and the preexisting models of growth in the tradition of Solow or Cass-Koopmans model, on the other. A central focus of our work has been the issue of convergence besides (K/H) influences on growth and worker effort influences on growth. The finding of convergence has been generally thought of as evidence in support of the Solow-Cass-Koopmans model and the absence of convergence has been regarded as supportive of endogenous growth theories. The controversy has given rise to the concept of "conditional convergence", meaning convergence after differences in the steady states across countries have been controlled for. These controlled differences can be (K/H), worker effort indices, the sample and time specific dummies in the augmented regressions generally reflecting differences in national growth rates. At the margin, the high income sample dummy influences cross-country results in a different way from the low income sample dummy, suggesting the relative importance of product market deregulation for high and of the tax burden on labor for low.

Since finding a health indicator for health status for Turkish provincial level is not easy, especially for life expectancy data we have changed our objection to nutrition related proxy for cross-country besides Turkish regionalized provinces. We have used 69 countries data covering 1970, 1980, 1990 and 2000. Electricity consumption stands for physical capital proxy while GDP per capita in constant 2000 US$ and total population are as they are. These variables are taken from the World Bank's, World Development Indicators. Education data comes from Barro- Lee data set. Per-

capita Dietary Energy Supply (DES) and per capita Dietary Protein Supply (DPS) data are taken from FAO. DES and DPS are used in economic growth study besides worker effort index.

We have used per-capita income for 1985, 1994 and 2003 data in terms of Turkish Regionalized Provinces Data. Others variables values are taken for 1994 and 2003. Per capita income, aggregate income, education and ratio of per capita income to food expenditure are taken from TUİK data set. Industrial electric consumption is taken from TEDAŞ on the provincial level. The per-capita incomes to food expenditure rate are calculated from household budget survey on the individual level for the some provinces of Turkey. We aim to have nutrition data for provincial level. However, no nutritional survey in nationwide has recently conducted. Therefore, we like to employ households' budget survey to use per-capita income to food ratio for provincial level. However, TUIK dos not conduct this survey for all Turkish provinces and we have data for 17 regionalized provincial level data.

We attempt to identify the complementary interaction of physical to human capital. We also discuss our setting of worker effort indices. Variance decomposition analysis will be applied to distinguish the contribution of accumulated factor and the contribution of total factor productivity (TFP). This will allow us to investigate the impact of the health proxy in per capita GDP and likewise in TFP. After clarifying this impact, we will focus on explaining the income differences and determine whether the health proxy makes any differences to explain this income or productivity differences. In the literature, there are mainly two approaches to check the productivity difference dynamics, one is the actual income level approach and the other is the convergence regression approach (McGrattan and Schmitz, 1998; Barro and Sala-i-Martin, 1995). With the former approach we can estimate whether our health proxy may explain the income level differences and with the latter approach we can project whether our health proxy may decrease the income gap between high level income and low level income and if it is shrinking how fast this gap will shrink or be closed with our health proxy, besides our setting of (K/H) approach.

We expect to see positive contribution of electricity consumption and education ratio (EL/E) besides worker effort level indices "e". We expect that contribution of (EL/E) for high-income level is higher and worker effort contribution for high-income level is lower than relatively lower income-level in income disparities. We also expect more accurate convergence rate with worker effort level, besides adding worker effort in regression may lower the coefficient of (EL/E) and its significant level in regression comparing to regression with (EL/E) with no worker effort level.

### I.3. Contribution

I would like to point out our major contributions as the complementary interaction between human and physical capital since accumulation of human capital (H) and physical capital (K) depends on each other with a given technology (Graca et al., 1995; Erk et al., 1998a). Also human capital is considered to be an obstacle for physical capital mobility from rich to poor economies, since human capital does not serve well as collateral (Mankiw, 1995). Therefore, it should not be surprising that the physical capital does not flow into poor economies because there is a shortage of human capital. Also since the hidden technological level in K requires same technological level in K and any technological improvements requires a similar improvement in K and H. Therefore, the component in its broadest sense stirs up long term economic growth in all countries. Once again, not the absolute sizes of K and H are the key in an economy but their ratio is. We have not given any specific priority for the ratio either to be (K/H) or (H/K) in production set up. However, it may be important depending on the overall condition of the country. The data for 69 countries and the first ever such data set for 17 regionalized Turkish provinces are other main contributions of this study.

### I.4. Organization of the Study

This thesis is organized as follows. In Chapter 2, I start with examining the health and income relationship. I also discuss the relationship between human capital and economic growth. A discussion on the convergence issue in terms of concept and empirical findings is also provided. In chapter 3, we identify the physical to human capital interaction and the model and methodologies are provided. After the data set is described, we analyze the findings. In chapter IV, we also discuss the Turkish regionalized provincial data and discuss the findings. The last chapter in this dissertation is the summary of the main findings, conclusions and policy implications derived from the previous chapters.

## CHAPTER II.

## LITERATURE SURVEY ON HEALTH AND ECONOMIC GROWTH

### II. 1. INTRODUCTION

Why some countries are richer than others is a fundamental question for economists to answer. To recognize what generates economic growth would make an enormous contribution to human welfare. The theoretical work of the mid-1950s suggests that an exogenous technological change is the main driving force of economic growth. However, after the mid-1980s, this simple assumption is considered to be endogenous to understand the wide range of international variations in terms of economic growth and income levels. Unfortunately, in these widespread exogenous growth literature discussions, the emergence of human capital did not receive the attention it deserved in the neoclassical growth theory of the sixties. However, since then human capital has now become the primary focus of attention with endogenous growth discussion which deals with the technology issue.

Human capital is one of the main determinants of economic growth besides raw labor, physical capital and technological progress. The increase in technological and productivity levels also ultimately leads toward building physical capital which becomes de facto standard in quantifying definition of human capital afterwards. Any increases in human capital have direct and indirect influences on physical capital and technological progress. Therefore, countries with the higher initial stocks of human capital are expected to grow faster. Since 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; Glaser et al, 1995; Goetz and Hu, 1996; Georgia, 1996; Tallman and Wang, 1994; Young, 1995) and health is another main component of human capital formation and physical embodiment of knowledge in people, we should integrate the economic growth and healthy people as if accumulating in human capital. Most countries face many different resource difficulties and infrastructural constraints that limit their economic growth potential. Nutritional deficiencies or malnutrition, poor environmental conditions and inadequate educational infrastructure hinder children's learning ability which is critical for the future supply of skilled labor (human capital which consists of education, health and nutrition) and hence for economic growth and development. Therefore, nutritional and health care policies are necessity in education to promote growth.

There is also a very strong positive relationship between health and economic prosperity levels. While lower income groups only allocate fewer resources for the health expenditure, labor and

human capital directly contribute to economic growth which is derived from healthiness. The studies have shown that lower incomes cause poorer health and 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). 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.

Whether interregional differences in income levels either within or across countries tend to disappear or tend to increase over time is another subject of the thesis. If income disparities tend to decline automatically, we may be less worried about creating aid programs or policies. While Barro and Sala-i-Martin (1995) conclude that policy variables have a significant effect on growth, Levine and Renelt (1992) show that a large number of policy variables are not robustly correlated with growth. Therefore, if income disparity persists over time or shrinks very slowly, we have to develop policies that could overcome the income gap.

We organize this chapter as follows. A discussion is held to convey the relationship between health and income with its theoretical approaches and its empirical findings. In that context, the relationship between human capital and economic growth is briefly considered. Finally, the last section of the chapter provides definitions of the convergence concept and a discussion of the convergence findings.

## II.2. THE RELATIONSHIP BETWEEN HEALTH AND INCOME

The questions posed by Asafu-Adjaye (2005) ask why some communities (or societies) are healthier than others. Is it simply because they are wealthier and can therefore afford better nutrition and health care, or are there other significant factors at play? These questions have preoccupied researchers and policy analysts for the last three decades. The 20$^{th}$ century has seen remarkable gains in health where the gains in health outcomes have been made possible by improvements in sanitation, nutrition, education, infrastructure and culture. While Von Z. and Muysken (2001) report that primary health care which has greatly improved the average life expectancy in developing countries, and despite this substantial progress in the average life expectancy, there still remain some glaring disparities between and within countries, Booysen and Bacmann (2002) report that in Sub-Saharan Africa, human development has actually worsened within the last two decades as trends in health have remained constant or declined

Economic development is related with the relative contribution of these factors since the synergism between the underlying factors work in complex ways. Recognizing various determinants of life expectancy is emphasized as one of the most important factors of economic development. However, since life expectancy is strongly influenced by child mortality, low-cost interventions such as the provision of antenatal care and vaccination programs in poor countries can be effective instruments for raising life expectancy. More generally, economic development depends on the level of skilled workers and on capital formation. The former is influenced by child nutrition, educational infrastructure, and actual household resources, together with parents' physical health and cognitive attainment. The latter accumulation depends on the savings rate that is also influenced by adult health since unhealthiness causes health care expenditure (Von Z. and Muysken, 2001). Therefore, poverty is a multi-dimensional concept.

It has been established that while health and nutrition matter for economic outcomes, it is equally true that economic outcomes matter for health and nutrition since both situations require human capital as an integral component of economic outcomes. While health is determined by genetic, economic, social, cultural, medical services and environmental factors, the economy is also influenced by the individual and overall health of a population. Health affects the outcomes mainly through four channels: higher productivity, higher labor supply, increased technical skills as a result of higher education and specialized training, and better access to liquid assets for investment in physical and intellectual capital. Health of the individual depends on multiple factors: genetic endowments (genotype and phenotype), economic and social lifestyle, living environment, working conditions (access to and use of health care, education, wealth, occupation, and infrastructural status) and the more general socioeconomic, cultural and environmental factors. Thomas (2001) mentions that both the influences of genotype and phenotype further complicate measurement because of health being a stock. Many genotype influences are difficult to observe and may only be revealed later in life. Moreover, health at a point in time combines the cumulative effects of phenotype factors including an individual's behavior through the life course as well as the health and socio-economic environments to which the individual has been exposed. Capturing all of these influences is extremely difficult

After outlining the way of interaction through health to income, there is at least two ways in which income can influence health condition. Firstly, it is the direct effect on the material conditions that have a positive impact on biological survival and health. Secondly, it indirectly affects health conditions of individuals in social participations particularly where the opportunity to control life circumstances are at risk and confidence in personal security is fleeting.

There is causal influence between health and the economy (Erdil and Yetkiner, 2004). Poverty and ill-health are entangled. Poorer countries tend to have worse health outcomes than better-off

countries (Wagstaff, 2002). Within countries, poor individuals have worse health outcomes than wealthy people. The connection between poverty and ill-health reflects causality running in both directions. Poorer health or excessively high fertility may encompass a substantial impact on household earnings or wealth and may even make the difference between being above and being below the poverty line. Furthermore, poorer-health is often associated with substantial health care costs. But poverty and low income also cause poorer-health. Simply poverty breeds poorer-health and poorer-health maintains poverty (Bloom, et al, 2001a).

### II.2.1. Channels of Influence from Health to Economy

Health is a component of skilled-labor or human capital which is matter for economic outcome. Therefore, health also matters for economic outcome. In this part, we present positive effects of good health on the economy (Rivera and Currais, 1999). There are number of ways health matters for economic outcomes. These are namely labor productivity, labor supply, education, savings and investment (Suhrcke et al., 2005)

#### II.2.1.1. Labor Productivity

Healthier workers could reasonably be expected to produce more since the worker' physical and mental condition are better and thus enables them to increase their physical and mental activities and facilitates the use of technology, machinery or equipment more efficiently all by maintaining a healthy lifestyle. A healthier worker could also be expected to be more flexible and adaptable to changes. Several mechanisms have been proposed in support of this claim (Mills and Gilson, 1988). Schultz (2003) also mentions that improvements in providing nutrition to children greatly enhance the population's working capital pool since poverty and the lack of nutrition is closely related with the total output of productivity levels.

Healthier workers are physically and mentally more energetic, stronger and robust. Therefore, they are plausibly more productive and earn higher wages. They are also less likely to be absent from work due to illness or illness in the family. For individuals and families, healthiness brings the capacity for personal development and economic security in the future. Healthiness is not only basis for job productivity but clearly facilitates the capacity to learn in academic environments through increased development of intellectual, physical and emotional capabilities. There is a causal effect of iron deficiency on reduced work capacity, energy efficiency and productivity. Iron deficiency can cause greater susceptibility to disease, fatigue and reduces child development besides elevating infant and maternal mortality (Thomas, 2001; Nixon, 1999). There are basically two ways in which iron deficiency affects physical activity (Thomas, 2001). Firstly, as hemoglobin levels deteriorate, the maximum amount of oxygen that the body can use deteriorates. Secondly, the decline in iron stored causes less oxygen to be available for muscle consumption

thus reducing endurance and most importantly the heart has to work harder to produce the same amount of activity. Therefore, in this case worker productivity suffers due to income loss for medical care, time loss at work and low return of investment in skilled position.

Since ill workers are more likely to be absent from work due to illness or illness in the family, chronically ill worker may not be hired at all. Consequently, these types of people fall into a health-based poverty trap. The provision of public resources for better health can also be reallocated so that poor individuals can release resources for other investments into education to escape from poverty. Improved health in early ages directly contributes to future productivity through education. Therefore, healthier and better educated workforce also attracts foreign investment which is empirically supported by Alsan et al. (2004).

The following statements outline the health effects on labor productivity based on Howitt (2004):

1. Healthier workers are more productive in any given technological environment;

2. Increased life expectation will encourage people to acquire more education so do their productivity will increase;

3. Improvements in early childhood and prenatal health enhances a person's learning capacity and promotes a permanent desire for continued advancement in their human capital stock throughout their lifetime;

4. Improvements in early childhood and pre-natal health also makes a person more creative and innovative;

5. Improvements strengthen skills that people need to remain healthy while dealing with the stresses created by rapid technological changes;

**II.2.1.2. Labor Supply**

The health effects on labor supply are theoretically ambiguous. Being healthier reduces the number of sick days. Consequently, the number of healthy days available for either work or leisure is increasing. However, the relationship of income and healthiness dictates alteration in the labor supply and worker selection preferences (Sachs and Brundtland, 2002). As a result, the total effects on labor supply are not clear. If health affects income positively through wage-related productivity, any increase in the worker's labor supply because of wages is called substitution effect. As health improves working becomes less cumbersome and the individual might be more inclined to take on new challenges and work assignments in lieu of leisure time. However, being healthier should allow workers to accumulate higher overall earnings but it could also play a negative role by providing more income for the worker to enjoy leisure activities which would prevent the worker from acquiring additional work or opportunities if they are not motivated

(income effect). Health improvement reduces the demand for health treatment and therefore reduces the relative preferences for work, leading to a reduction of working time and an increase in leisure time. Finally, good health prospects raises life expectancy as well as quality of life. As each individual's life time experience of consumption increases so do the labor supply should increase in order to compensate this consumption increase. This could occur even both worker preferences and wage changes (substitution and income effects) are mute.

**II.2.1.3. Education**

Human capital approach theorizes that individuals who obtain higher academic achievements are more productive which warrants higher wages earned. If individuals have better health and nutrition, these individuals also tend to achieve better education status and suffer less from school absenteeism, early drop-out before high school or college graduation. Longer life expectancy stimulates the investment incentives in higher education opportunities since the depreciation rate of skills acquired would be lower.

Good nutrition, health and education also allow individuals to maximize many aspects of the human experience and to expand the scope of their potential. When physical capital starts to accumulate and new technologies are introduced, households with fewer income but healthier and better educated children have an advantage over households with more but less healthy and less educated children. The spillover of investments in human capital occurs in nutrition, health and education. For instance, spillovers occur when the likelihood of suffering from acute and chronic disease is decreasing, which leads to increased quality and length of life of the population (Bleakly and Lange, 2005). Better-nourished children are less likely to suffer from infectious diseases in their early developmental stages and later in life from chronic disease. Longer life expectancies increase the return on investments in education. Healthier and more educated individuals are better prepared to adapt to new technologies and apply productive processes. Presumably, human capital in the form of health combines the ability to work hard, cognitive function and possibly other aspects of health (Weil, 2005).

Since life expectancy is strongly influenced by child mortality, longer life spans mean more incentive to invest in human capital. If parents have poor health, children may have to take care of their parents' household tasks. In that case these households' tasks normally preformed by the parents could reduce the amount of time the children are attending school or other social development activities. Since education is a cumulative process these children who take care of household responsibilities would be less likely to complete their education.

Education is a vital human capital component as it is a proven source to improve output excellence. Education also leads to better health outcomes as noted by Giuffrida et al. (2005)

where households' incomes closely related with higher levels of education. Therefore, not only education but also biological variables have an impact on economic growth and human well being in general. When demographic changes and better nutrition choices are available to larger groups of the population, those lead to exceptional levels in health and life-span expectancies particularly among the population of richer countries. These changes also radically transform the environment within those households who made decisions regarding human capital investments and ultimately increased aggregate levels of nutrition, health and education. It is also emphasized that expenditures on education, training and health could all be considered as investments in human capital. Human capital refers to the endowments of nutritional status, health and education of individuals (Torres, 2004).

**II.2.1.4. Savings and Investment**

The health status of individual or the population at large is likely to influence the distribution of income between savings and consumption. Therefore, health status of individuals or the population would influence the willingness to pursue investment. Healthier individuals are more likely to live longer and consequently their savings ratio may be higher. The saving ratio of poor, unhealthy individuals may be lower since they have lower life expectation and high health expenditure. Therefore, increases in life expectancy of the population may cause increases in savings. As a result, it is reasonable to expect a higher propensity to invest in physical or intellectual capital (skilled-labor) for their retirements (Thomas, 2001). Besides this, any reduction in both visits to doctor and the use of medicines inevitably have an impact on budget of individual and government. Therefore, resulting from improved health, higher income can also lead to higher capital formation.

Improving human qualities can be pursued as a high-value factor or capital in augmenting the production potential of the economy that, in turn, also enhances the income earning abilities of people. Specifically, investing in people's health is seen to be worthy if the rate of return surpasses the cost of the investment in human capital. Low life expectancy discourages human capital investment in education (because populations are uncertain whether they will be able to benefit from those investments), reduces skill accumulation and, thus, returns to physical capital, which in turn further prevents growth (Mills and Gilson, 1988; Subramanian, et al, 2002). Any rise in life expectancy increases the optimal fraction of life spent for working but not enough to balance the increased need for retirement income. For that reason, savings rates get higher at every age as longevity rises in order to meet the increased need for assets to finance consumption during retirement (Fuentes et al., 2001).

Population growth has a direct interactive component to the behavioral characteristics of saving which has a relationship with economic growth (Barro and Sala-i-Martin, 1995). As people become more educated, they prefer to invest in themselves rather than having children and they mainly maintain their social and economic status. This causes birth rates to decline as children become less desirable for a specific time period. Therefore, the modeling on population and economic growth depends on the age structure of population (Bloom et al., 2001d).

### II.2.2. Channels of Influence from Economy to Health

Income can influence health conditions through at least two channels. The first channel has a direct effect on the material conditions that have a positive impact on biological survival and health. Secondly, it indirectly affects health conditions throughout social participation, the opportunity to control life circumstances and the feeling of security. At the household level, evidence shows 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). Nutrients such as protein and iron which are very effective at maintaining work stamina are typically found in high concentrations of animal products, which are relatively expensive and often beyond the financial limits of poorer households to afford. Poverty is a condition that creates micronutrient. The shortages of income create direct losses in an individual's ability to control their financial robustness which promotes a weak contribution to the production process (Wagstaff, 2001; Nixon, 1999). The lack of proper nutrition causes deficiencies in vitally needed vitamins, minerals and essential elements required by a human being. The direct result of this deficiency includes a progressive deterioration of health and a less protective life style, especially where dietary and child-feeding practices are concerned. Superior sanitary practices—e.g. hand-washing, anti-microbial products and thorough household cleaning regiments—are also usually positively linked with income. Income is often linked with the number of children a woman has and the age at which she has her first child. Higher income households also typically provide greater encouragement to children (Wagstaff, 2001), while an injury, although unintentional, reduces the number of effective working days a person can work and therefore poses a risk to the population. Thus, we can safely conclude that the provision of health requires resources. Turrel (2001) and Wagstaff (2001) consider some of the indirect effects of income on health because of adverse psychosocial responses. For example, an unemployed person who lives on a low income budget may experience high rates of stress and anxiety about current personal disadvantages and expectations for the future. More generalized responses may occur to the extent that a perception of societal inequality and all of the associated injustice that comes with it may affect the whole population. Some members of the population may suffer from poorer psychosocial well-being as a result of their self-positioning within the socio-economic

hierarchy, causing negative assessments of their ability to share in the opportunities, rewards and resources that are available to others.

There are two main paths that link physiological health independence to any type of psychosocial morbidity. One of these paths is direct, while the other is indirect. The direct approach conceptualizes poorer psychosocial states such as stress and anxiety as negatively impacting on the endocrine and immune systems, which in turn produces adverse biologic reactions such as hypertension, fibrin production, suppressed immune function and adrenalin release. If these conditions are sustained over long periods of time, then the outcomes of such conditions contribute to the onset and progression of chronic degenerative situations such as cardiovascular disease. The indirect link, on the other hand, grasps the conditions such as stress and feelings of hopelessness as impacting on morbidity and mortality via health-related behaviors such as smoking, alcohol consumption and drug use. Psychosocial well-being and socio-economic position have a strong association which is confirmed by a large number of studies in the literature. Those at the lower level of the socio-economic hierarchy are less likely to behave in ways that are conducive to better health.

Economic growth is not always attainable since industrialization usually is associated with increased urbanization, overcrowded infrastructures, high cost of living expenses and aggressive competition for basic living necessities. A link also exists between production structure changes and health of the population. If there are balanced shifts between manufacturing and agriculture industries and agricultural products are exclusively produced for exports rather than local subsistence, most workers' status will be affected by these shifts. Therefore, new technical skills emerge because of these shifts from agriculture to manufacturing sector and from domestic market to exports. Workers neither possess these skills nor are they prepared to handle new technologies safely in new assignments. Consequently, the health of the population will be harmed (Mills and Gilson, 1988). Heltberg (2006) points out that economic growth is not enough to reduce malnutrition. Therefore, direct nutrition and health interventions are required.

At the individual level it has been established that richer people have better health because they can afford goods and services (e.g. medical care, better nutrition, sanitation and housing) that promote health. Distribution of income is also important since it affects one's own consumption of medical care, food, shelter, clothing, water, sanitation, immunizations, and other modern conveniences. Therefore, it is an established fact that income inequality is correlated with lower health status (Booysen and Bacmann, 2002; Wagstaff, 2001; Turrel, 2001). Affordability of certain key inputs, such as immunization in the case of child health by poor and rich households shows large variations. Feng and Yu (2006) explain that any change in income inequality strengthens the income effect. This means the health of lower-income groups is worsening

because they are more easily exposed to adverse income shocks. Three sets of factors are described (Booysen and Bacmann, 2002; Wagstaff, 2001; Turrel, 2001).

- Socioeconomic factors or underlying determinants of health or social-economic hierarchy are determined by the household's resources, their financial income and assets, other physical assets (such as land, animals, etc.), as well as human "assets" in the form of knowledge, literacy, and education. It is not just the levels of these variables but also their distribution within the household—especially the distribution between men and women. Brenner (2005) mentions that social status is related to health status.

- Differential investment in structural, material and economic resources are essential for human capital and market structures such as households that are influenced by cost, quality, accessibility and availability of health services provided, as well as by the prices, availability and quality of other factors that influence health outcomes, such as food, transportation, and so on. Using biomass fuels (such as wood and charcoal) for cooking and heating purposes represent serious health hazards to the population. Technological improvements in central forced-air heating/cooling units as well as gas/electric stoves eliminate indoor air pollution and harmful effects on health. Access to clean energy for cooking and better transportation systems (particularly in rural areas) may also contribute to better health (Agénor and Neanidis, 2006).

- Social cohesion: Finally, households will be influenced by a variety of community-level factors such as the culture and values shared by the local community as reflected in its social capital. One example is the environment—good sanitary practices are harder if the water and sanitation conditions in the community are poor. Another example is the ecology and geography of the neighborhood—getting to a health center is harder if the roads are impassible during the rainy season (previously discussed with more detailed).

**II.2.3. Causality between Economy and Health**

There have been several studies on the dynamic links between health and economic affluence (Bhargava, 2001; Ruchlin and Rogers, 1973; Nixon, 1999; Erdil and Yetkiner, 2004). Grossman (1999) considers health as a utility component which effects income because of two main reasons. As a consumption commodity, it is directly related to disutility generated by sick days. As an investment in health, it also reduces the time loss to invest in wealth and income-related activities. Health, one of the main components of human capital, is also one of the production factors. Therefore, the complication comes from the health being a factor of both utility and production function. There is an important disagreement in the scientific literature for several reasons.

Primarily, health is a stock that progresses over time, and prior health behaviors and health shocks are likely to influence current economic category. Thomas (2001) indicates that health is a stock

that evolves over the course of life and many health problems that are associated with early life experiences -- including intra-uterine growth -- only emerge much later in life. If the nutritional statuses of children are improved, then they overcome the delay in growth and catch up (Romney et al., 2004). Torres (2004) shows how nutrition, especially at young ages, has had an important influence on health, longevity and economic growth in the past two centuries in North American and European countries that underwent industrial revolutions. Virtually we know nothing about the speed with which the effects of health transitions at the individual level are transmitted to the labor market in low-income settings. Is there any period of poor health (or a negative health shock) which puts a worker on a permanently lower wage trajectory or do the negative consequences of poorer health dissipate as health subsequently improves? The scope of the catch up attempt probably depends on the nature of the health dilemma (being genotype or phenotype), the structure of the labor market and the characteristics of the workers' education as well as their ability to rely on saved wealth to use as a buffer during the period of hard conditions.

Since inadequate intakes of nutrition would cause ill health and adequate intakes of nutrients are essential for maintaining adult health and productivity over the life span, developmental progress of individuals or children is critically dependent on the quality of diet that the household can afford and on the level of parents' knowledge (Broca and Stamoulis, 2006). If the household can not afford because of any reasons, then children may have to move into the work force prematurely, causing a reduction in the time needed for school-related work because of poor parental health and income (Bhargava, 2001). Some studies such as Bhargava (2001) and Ruchlin and Rogers (1973) exhibit that the level of education of individuals is a significant determinant of health status and particularly the improvement of mother's literacy is closely related with the improvements in children's health. Where women have the environment with poorer iodine, consumption of iodized salt by pregnant women is important for the normal development of the fetal brain (Bhargava, 2001; Ruchlin and Rogers, 1973). However, Fall et al., (2003) indicate that the link between maternal nutrition and fetal nutrition is indirect. Furthermore, having low intakes of fresh fruits and vegetables during certain seasons causes vitamin A, vitamin C and other nutrient deficiencies, making individuals more susceptible to disease. There are also cultural effects on health and income links. Cultural norms are also important determinants of consumption patterns and health outcomes. It is also closely related with status of women in the society. If women have access to the households' income then the children are generally healthier. The overall health status of women and children are directly impacted by increased parental care, decreased household workload activity and robust agricultural productivity at the local level (Fall and et al., 2003). Currie and Moretti (2002) show higher maternal education achievements also leads to improvements in infant health.

The idea of deterioration in health caused due to lack of nutrition and less protective life styles. Higher income earning households' also typically provide greater stimulation to children (Wagstaff, 2001). Thus, we can safely conclude that provision of health requires resources. On the other hand, health is an invaluable human asset—we require it when we are learning at school and when we are working. In the case of the poor, health becomes an especially crucial asset (Wagstaff, 2001). Health affects income in various ways, since health is a multi-dimensional issue. These multi-dimensions reflect the combination of an array of factors that include physical, mental and social well-being, genotype and phenotype influences as well as expectations and information (Bhargava, 2001; Thomas, 2001; Sachs, 2001). The porer health has influenced on the time allocations, labor productivity and the production process. Therefore, declining income occurs after one becomes ill.

As health status sharply increases, the incentive to attend school is stimulated. Students' cognitive and critical thinking skills are enhanced; there will be reduced absenteeism and improvements in mortality which transcends into savings for retirement and elevated investment in physical and human capital (Weil, 2005). For example, manual labor wages may be determined mostly by physical strength, while sedentary occupations wages do not depend on physical strength. Therefore, any kind of physical wound might have a destructive impact on the earning capacity of the former but; present a more optimistic impact on the earning capacity of the later. A poorer health or death in a household, or excessively high fertility, can have a substantial impact on household income. Therefore, it would, in extreme cases, make the difference to a household being above the poverty line or falling below it. Of course, it is not just the loss of income linked with poor health—it is also often substantial financial costs of medical treatment needed necessary to restore health.

Another way of causal interaction between health and economic development is as follows. While economic growth provides the extra resources for better education, better nutrition, better housing, sanitation, health services and technology which reduce mortality, the decline in mortality triggers economic development (Mills and Gilson, 1988). However, in the transition period, the gain by economic development could be absorbed by high population growth, since the mortality rates of infants, young children and the elderly decline. Serious medical conditions such as heart disease and cancer may also be caused by the nutritional differences. Low birth weight and poor childhood nutritional status are also associated with an increased risk of adult diseases including heart disease, obesity and high blood pressure. Disease impedes economic well-being and development. This relationship can be summarized by three main points. Firstly, avoidable disease reduces the number of years of healthy life expectancy. Secondly, the children's diseases affect parental investment in children. If infant and child mortality rate is high in the society, this may cause a high fertility rate; then the families have a hard time investing in

children's health and education. Lastly, beyond the individual worker productivity, worker sickness affects the investment on business and infrastructure as well as political and macro economic stability (Sachs, 2001). Romney et al. (2004) show that if the nutritional status of children is improved then they overcome growth delay complications and maintain steady growth.

Since healthiness affects the age structure of the population and economic growth is closely related to demographic structure of the economy, we should discuss the relationship between economic development and demographic transition.

**II.2.4. Demographic Transition**

Economic development is also sometimes called "demographic transition" as it is referred to as the "demographic gift" in the literature (Bloom, et al., 2001d). Historically, high birth rates have mostly been offset by high death rates. Therefore, population growth rate stays stable. There are conceivable corridors through which health improvements can influence the pace of income growth via their effects on labor market participation, worker productivity, investments in human capital, savings, fertility, and population age structure (Mills and Gilson, 1988; Subramanian et al., 2002; Zamao, 2000). As Barro and Sala-i-Martin (1995) mention population growth directly interacts with savings behavior and economic growth.

Some growth theories consider the population change as a barrier while others consider it as beneficial and some models even consider no interaction at all with economic growth. Despite the considerations, all these models focus on size of population and its growth. Nevertheless, age structure becomes important in the discussion. As population sizes change, the age structures of economies change too and changes in certain age groups of a country would have significant effects on its economic performance. Depending on the country's high portion of children or elderly in the population or both together, the country has to devote a high proportion of resources to children's needs such as education likewise for elderly care or both. This results in the country's economic growth being depressed by high portion of children or elderly requirements. On the other hand a country possessing a high portion of working people in the population would experience higher economic growth, as these age groups have the greatest productivity potential. For that reason the modeling on population and economic growth depends on the age structure of population (Bloom et al., 2001d).

Let's examine the unenthusiastic approach linked with the great law of nature. If the population grows faster than the food supply, then quick and immediate action must be taken to protect the country. Advancements in technology, human capital accumulation and innovative agricultural techniques would have to be introduced as an approach to preserve its validity (Bloom, et al., 2001d). According to enthusiastic approach, while the population growth doubles, per capita

income increases by almost two thirds (Bloom et al., 2001d). However, considering other factors such as country size, trade relations, educational attainment of the population and the stability of political establishment, population growth strongly affects economic growth (Bloom et al., 2001d; Weil, 2005). This approach relies on technological progress which creates economic scale. On the other hand, the neutralist approach found little significant connection considering the statistical correlation.

Nabar (2004) defines the growth rate of GDP per capita as the combination of the growth rate of GDP per worker and growth rate of working age fraction of population. He analyses the effects of the shifting age structure in three stages. In the first stage, infant and child mortality declines but fertility continues to be high leading to a "youth glut" (increasing the youth-dependency ratio) which has a negative impact on per capita GDP growth besides increasing longevity which also increases the dependency burden. Secondly, youth glut cohorts begin working, mortality transition is largely completed and fertility starts to decline with a lag, so youth-dependency ratio declines. Therefore, this stage has a positive impact on per capita GDP growth since the large working age group of a country raises its productivity capacity. This is called demographic bonus. In the third stage, demographic bonus is over; fertility declines and old-age dependency rate increases. Empirically, Guaitoli (2000) robustly finds that age structure of population matters for economic growth. For subsequent growth in per capita income level across the US states between 1920 and 1990, the number of people at the age between 25 and 65 is important for speed of convergence in income growth regression.

Economic growth provides the extra resources for better education, better nutrition, better housing, sanitation, health services and technology which lead to lower mortality and the lower mortality triggers the economic development (Mills and Gilson, 1988). Therefore, in the transition period the gain made by economic development could be absorbed by high population growth, since infant mortality rate, young and children mortality rate, and older age mortality rate declines. Better health or lower health differences such as heart disease and cancer may also be caused by the nutritional differences. Bhargava, et al. (2001) reports that the parameter estimates implies large positive effects of Adult Survival Rate (ASR) on growth rates for poor countries in the sample. However, for highly developed countries the estimated effects of ASR on growth rates were negative.

Briefly, as Sachs and Brundtland (2002) mention that a successful transition depends on improvement in health. The basic reasoning is that a decline in child mortality means lower fertility and parents can invest more effectively in each child with their scarce resources. This investment in terms of health and education raises the life expectancy and the return of this

investment will be longer and higher. Therefore, it drives economic growth and human development upward.

### II.3. EMPIRICAL LITERATURE

In this section, findings will be classified according to the channels as we discuss in the relationship between health and income: Channels of influence from health to the economy, channels of influence from economy to health and channels of feedback influence between economy and health: Causality

#### II.3.1. Channels of Influence from Health to the Economy

Fuentes et al. (2001) demonstrate that there are significant positive increases in income with nutritional supplementation. While Weil (2005) finds that better nutrition is associated with faster economic growth in the long run, Fogel (2002) finds that increases in the amount of calories available for every worker made significant contributions to the growth rate of per capita income of countries. Wang and Taniguchi (2003) conclude that the average long run real GDP per capita growth rate can be increased by 0.5% point if Dietary Energy Supply (DES) is raised by 500 kcal/day. Qureshi (1997) shows that Dietary Energy availability has a substantial impact on worker productivity while promoting economic growth. Subramanian et al. (2002) show that perhaps 40% of economic growth in developing countries can be ascribed to improved health and nutritional status.

While Thomas (2001) finds a strong positive connection between health and economic prosperity which is confirmed by micro and macro data, Mills and Gilson (1988) indicate that health in the form of ASR makes a positive and statistically significant contribution to aggregate output and they cannot reject the hypothesis that a one percentage point increase in ASR raises worker productivity. Bloom, et al. (2001c) shows that health has a positive and statistically significant effect on economic growth. Their data suggests that a one year improvement in a population's life expectancy contributes to a 4% increase in output. Bloom and Canning (2005) display that health as an ASR has positive and statistically significant effect on aggregate output. Subramanian, et al. (2002) finds there is a step-wise graduation in poor health associated with progressively lower incomes, such that a person making $20,000 per year (who is not officially poor) nonetheless experiences worse health than someone making $35,000 annually. The ratio of ill health, comparing the poorest to the most affluent, is twice, three times, or even higher in some cases depending on the health outcome studied. While Acemoglu et al. (2002) emphasizes that health matters for economic growth but not as much as institutional differences, Arora (2001) mentions that changes in health increased the pace of growth by 30 to 40 percent permanently. Sendi and

Brouwer (2005) find that using quality of life measure influences on income as a health indicator has no effects.

Chakraborty et al. (2005) investigate whether diseases are important in measuring growth of income from theoretically and empirically perspective. They conclude that diseases are important for growth of income. Delfino and Simmons (1999) conclude that the interaction between the disease and the economy can also decrease the amplitude of epidemic cycles. Gallup and Sachs (1998) mentions that diseases reduce the annual incomes of society. While Weil (2005) finds that malaria has a large effect on the level of GDP per capita, Sachs (2001) demonstrates that malaria reduces the per capita GDP for cross country study. Malaria stricken countries have grown only 0.4% annually in the period between 1965 and 1990, compared with 2.3% annual growth for countries not affected by malaria (Subramanian et al., 2002). Booysen and Bachmann (2002) find that households affected by HIV/AIDS have to deal with substantial burdens of chronic illness and death therefore, this illness causes severe poverty. McDonald and Roberts (2004) report the econometric results that the macroeconomic effects of the HIV/AIDS epidemic have been substantial especially in Africa where the average marginal negative impact on income per capita of a one percent increase in HIV prevalence rate is 0.59%.

Latin American and Caribbean (LAC) countries show positive income-health correlation (Casas, 2000). Mayer (2001) shows that causal interaction runs from health to income in 18 Latin American economies. Torres (2004) finds that in Nicaragua income shocks due to ill health reduce the income of the individuals. Even in countries where a considerable part of the population enjoys sufficient levels of nutrition, health and education, inequality in the distribution of human capital may lead economies to a situation where each group attains different economic equilibrium points on their rates of sustained economic growth. This acquired human capital is due to low income groups of parents which can invest so little in health and education of their children. Fielding (2001) finds that most of Africa's poor growth performance is due to poor health matters.

While Shastry and Weil (2004) find that 1.3% of the log variance of income per capita is explained by differences in anemia and 19% of it is explained by ASR. Sohn (2000) show that worker effort contribution is ranging 11~18% of the income variation across countries by using variance decomposition and levels accounting method where worker effort depends on nutritional level. Health related components can explain 7~9% of the variation in economic growth rates across 100 countries and 11~14% across 74 developing countries. This means health is a major determinant of economic growth. He also shows that in Korea, 11.8% and 20% of GDP growth is explained by health related improvement for the years 1962 and 1995. Weil (2005) finds that variation in health does have a large effect on variation in output per worker. Health accounts for

10.8% in terms of menarche method and 22.6% in terms of ASR. In a different perspective, Sur (2000) shows that in rural Bangladesh a 1% increase in adult height (1.56cm) and an average adult body mass index (BMI) is likely to increase total household incomes by 1.4% and 0.73% respectively.

Thomas (2001) analyses the dynamics between health and economic prosperity. He attempted to isolate unanticipated changes in health between rounds of the survey and measured the impact of those "shocks" on wealth under the assumption that the timing of the onset of chronic conditions and their severity is largely unanticipated (controlling such factors as smokings, weight, exercise and health of siblings and parents). He shows the mild health shocks affect income in the shape of a $3,600 reduction in wealth. Severe shocks, however, bring about a $17,000 or 7% reduction in household wealth. While Gangadharan and Valenzuela (2001) point out that health and income has positive correlations if environmental conditions are worsened then health status of population will become worse as well. Costa and Steckel (1995) show that in the early industrial revolution period economic growth was not sufficient enough to offset the declines in health but increases in health matters outpaced economic growth later.

While Gani and Clemes (2003) show in a cross-country regressions that aid for education and water are positively correlated with human well being in low-income countries while aid for education and health are positively correlated with human well being in lower-middle income countries. Catherine (2006) finds that there is positive impact of aid on children which does not come from health aid and therefore she reports no growth effect. Currie and Stabile (2004) find that the treatment for children with symptoms of Attention Deficit Hyperactivity Disorder (ADHD) increases with income in USA as opposed to Canada. However, they also show that ADHD and income interactions in USA are insignificant while Canadian's have higher incomes in protective shelters.

Kalemli-Özcan et al. (1998) find that reduced mortality and increased investment in education are two of the most significant characteristic of the economic growth process, while Sastry (2002) shows growth and inequality in mortality of children under the age of five for Sao Paulo declined between 1970 and 1980 and between 1980 and 1991 even if there are a few years negative growth over the second period. Howitt (2005) indicates that improvement in health will raise the growth rate steadily because the economy is more productive and therefore can finance technological investment and increase productivity which tends to raise physical capital. Howitt (2004) shows that increasing health can raise long run TFP and per capita growth. As Gani and Clemes (2003) find, cross-country regressions revealed that human well being leads to higher outcomes.

#### II.3.1.1. Labor Productivity

Since health is an important form of human capital (Sen, 2005; Bueno et al., 2004), it can enhance workers' efficiency by increasing their physical scopes such as strength and endurance as well as their mental capacities such as cognitive functioning, reasoning ability and skilled level of population. These attributes are influenced by child nutrition, educational infrastructure and households' resources, including physical health and cognitive attainment. Therefore, it is expected that there should be a positive relationship between health and productivity for both skilled and unskilled workers (Mills and Gilson, 1988).

Thomas (2001) and Hunt (2002) conclude in their summaries that iron deficiency reduces the work capacity as well as productivity. Thomas (2001) indicates that Iron Deficient Anemia (IDA) is associated with reduced endurance at below maximal work rates. Thomas (2001) summarizes some findings where we briefly express his findings in here:. Iron supplementation was provided to Sri Lankan female tea plantation workers and resulted in increased work activity. Four hundred male rubber tree tappers and weeders working in Indonesia received an incentive payment to take the pills as scheduled. At the end of the period, blood hemoglobin, aerobic capacity and output of those who were initially anemic increased to nearly the levels of the non-anemic workers (whose biological indicators did not change) after the treatment concluded. Among those in the anemic control group, productivity and blood hemoglobin levels also rose, although the increase was substantially smaller than among those in the treatment group. The results suggest that the output of IDA workers can be raised by around 20% through supplementation. This has a very large effect. In Guatemala, Sugar cane cutters who received calorie supplements were no more productive than the control subjects. Randomization was at the village level and it may be that changes in productivity between villages during the study confounded the estimates. Contrastly, calorie supplementation had a small but significant positive impact on the amount of roads made by road construction workers in Kenya where the 47 subjects studied were randomized at the individual level. Haas and Browlie IV (2001) and Horton and Levine (2001) also summarize the literature findings which indicate IDA and its variety affect the physical working capacity of workers and their endurance.

Mills and Gilson (1988) compare the size of the microeconomic estimates about the effects between health and wages with the macroeconomic estimates of the effects of workers' health and productivity. Healthiness, in the form of ASR, makes a positive and statistically significant contribution to the aggregate output. The hypothesis that increases in ASR raise worker productivity cannot be rejected. This estimate is done as a measure of the straight productivity benefits of health and excluding any effect that operates through a longer expected life span on investments in capital accumulation or education. An increase in longevity is likely to go hand-in-

hand with top-to-bottom health improvements that may increase the productivity and wages. Body size and food supply are also health indicators that have an effect on long-term labor productivity. African continent shows chronically poor economic performance, poorer productivity and academic progression since Africa is a dencely populated area and is heavily burdened by disease (Artadi and Sala-i-Martin, 2003; Sachs, 2001). Aguirre and Hadley (2005) mention that economic cost of malaria alone is 1- 5% of GDP in African countries and that reduces the productivity of workers by 60%.

Gupta and Mitra (2004) indicate that economic growth and health status are positively linked and have a two-way relationship, suggesting that better health enhances growth by improving productivity (Wang and Taniguchip, 2003) and higher growth allows better human capital formation. While Howden-Chapman and O'Dea, 2001) expose that health status of men in the labor force will make them more vulnerable for unemployment: the data shows that unemployment rates of workers with a limited health are 140% times higher than the unemployment rate of the workers with no health limitations. Therefore, health related productivity is a matter of great concern. Fuentes et al. (2001) put forward that protein supplementations have positive effects on academic achievement. It also has effects on physical height differences and mortality where it declines with protein supplementations. Sohn (2000) also calculated that 18~27% of the contribution of productivity differences calculated by recent levels of accounting studies can be eliminated by adding worker effort. Therefore, the contribution of the productivity differences which is measured by residuals is knocked down to 44~65% from 60~76%. In the studies of Wang and Taniguchip (2003) and Qureshi (1997), dietary energy availability has a substantial impact on worker productivity and promotes economic growth. Zon and Muysken (2001) have presented calculations to quantify the relationship between health indicators and subsequently found that economic productivity is more subtle in the developed countries. The relationship was stronger in physically-demanding occupations where earnings are typically low. Bloom et al. (2001b) and Thomas (2001) show evidence at the macro level for cross-country panel data for the period of 1960-1990; health has positive effect on productivity which is also consistent with micro evidence.

**II.3.1.2. Labor Supply**

Health effects on labor supply are theoretically ambiguous; there is empirical evidence to support different approaches to this conclusion. In the study conducted by Thomas (2001), we see that after iron supplementation was administered to Sri Lankan female tea plantation workers, workers' productivity and activity increase. Thomas et al. (2005) expose that males treated for iron deficiency are better off in terms of physical health, psycho-social health and economic success. These men tend to work longer, sleep less and lose less work time due to illness. They

are also more energetic and more adaptable in handling physically arduous activities. Their psycho-social health is also better which increases their productivity. However, the result for women is about the same but the direct results are more muted. Although being healthy is good thing it does not necessarily mean that healthy individuals directly work in favor of the output process. Healthy persons may use their free time in some other manner outside of voluntary work activities. Fuentes et al. (2001) also presented that in addition to an increase in life expectancy, there has been a remarkable decline in the disability of the aged in the U.S. over the last 100 years and concluded that health improvements increased longevity and reduce morbidity by allowing a sufficient increase in the length of working life. Brenner (2005) inversely finds that being unemployed increases the mortality rate. This could let us consider decreasing the labor supply.

Sohn (2000) observations for the Republic of Korea and Fogel (1994, 1997) observation for Great Britain also show that improved nutrition improves health by increasing available labor inputs. While Sohn (2000) calculated that improved nutrition increased available labor inputs in the Republic of Korea by 1 percent a year or more during 1962–95, Fogel (1994, 1997) found that a large part of the British economic growth during 1780—1980 was due to increases in effective labor inputs that resulted from workers' better nutrition and improved health. There is another issue called chronic pain which is related to variety of chronic diseases such as non-chronic cancer. Any type of this disease affects labor supply as well. Pizzi et al. (2005) show chronic pain suffered by workers in the work place significantly affects the employer. The total number of days lost because of sickness due to absence and short term disability claims was 331,242 days which is worth an estimated $US39.4 million in wages. Combined medical and pharmacy costs were $US 4,607 per employee per year for pain related healthcare which also impacted the physical capital level for all human capital or row labor activities.

#### II.3.1.3. Education

Nutrition is a major determinant of general health and helps the human capital formation by facilitating concentration on education, using cognitive ability and physical development. Both physical and mental capability suffers from poor nutrition which could cause the loss of some human potential. Torres (2004) summarizes the findings of the literature review and reports the findings for Ecuador in 1998 for the relationship between nutrition, health and human capital investment: Investment in the nutrition and health of the individuals increase the likelihood of longer, healthier and more productive life spans. Demment et al. (2003) and Broca and Stamoulis (2006) show that low nutrition status of a person is closely associated with his work and concentration level. Weak health and poorer nutrition among school age children weaken their cognitive development either through physiological variations or by reducing their ability to participate in new learning experiences. Therefore, it affects the worker productivity.

There are also some studies which show health has an influence on education and learning abilities. Fuentes et al. (2001) show that protein supplementations have positive effects on school grade achievement. Hunt (2002) displays IDA as a depressant of human capital productivity and the policy toward dietary quality may be the key to enhance the learning and earning capacity. Romney et al. (2004) show that if the nutritional statuses of children are improved then the children overcome growth delay and maintain growth pattern expectations.

Sachs (2001) shows that some ingenious indirect evidence. The economic effects of childhood diseases, such as hookworm disease which is an intestinal parasite absorbing nutritious from the bloodstream, and dietary insufficiencies are enormous, much larger than typically believed. He points out that the deficits in key nutrients which change brain development in children (iron, vitamin A) are associated with deficits of cognitive learning ability and academic examination test results. He also displays the relationship between early health and success in education. Healthy children are able to learn better and become better-educated (and higher earning) adults. It is also concluded that the elimination of intestinal parasites such as hookworm and schistosomiasis is important for children development. In a randomized study of cure of school children in opposition to hookworm, roundworm, and schistosomiasis, children in the treated schools confirmed significantly higher attendance rates than children in schools without treatment programs (Sachs, 2001).

The heavy burdens of infection and its multiple effects on efficiency, demography, and education, have certainly played a role in Africa's chronic poor performance (Zamao, 2000). Economic growth requires not only healthy individuals but also educated individuals (Sachs, 2001). A serious illness may plunge a household into unanticipated impoverishment. This serious sickness may extend even to the next generation as children are forced from school and into the workforce. Therefore, some macroeconomic evidence confirms that countries with the weakest conditions of health and education standards have a much harder time achieving sustained growth than do countries with better conditions of health and education (Sachs, 2001).

In developing countries, investment in nutrition, health and education can be even more relevant for the lower income strata and in rural areas populations. Investing in the nutrition and health increases the likelihood of longer, healthier and more productive life spans. Torres (2004) also mentions that additional investments in nutrition and health enhance the efficiency and effectiveness of investments in education. He shows that nutrition, especially at young ages, has had an important influence on health, longevity and economic growth in the past two centuries in North American and European countries that underwent industrial revolutions. He also showed that physiological factors (such as malnutrition) suffered by individuals early in life were related to their work levels, health and mortality rates at middle and later ages. He also points out that

research conducted on the impact of health on economic growth from various countries suggests that nutrition has a substantial effect on the productivity of individuals, both directly and indirectly through life expectancy and schooling.

There are studies which stipulate that education affects the health or well being. Gani and Clemes (2003) show that cross-country regressions exposed aid for education and water to be positively interconnected with human well being in low-income countries while aid for education and health are positively correlated with human-well being in lower-middle income countries. Chernichovsky and Coate (1979) display that the correlation of family income and education of the household head have been statistically significant but provided very small positive effects on the nutrition intake levels of young children. Giuffrida et al. (2005) point out that the estimates suggest that health of adult women and men is improved by water, sanitation and particularly by filtering the drinking water used in the house. Education and wealth improve health status. Kalemli-Özcan et al. (1998) show that reducing mortality rates through increased investment in education is economically significant.

Since the children health status are very closely tied up with mother health and her status in family, women's education is very important. The education of women is strongly associated with the level of health service utilization, type of provider, private versus public medical facility patronage, dietary and child-feeding practices and sanitary regiments in the household. In addition to general education, health-specific knowledge also matters (Giuffrida et al., 2005; Zamao, 2000; Guldan et al, 2000). Investing in the mothers' health and education not only improves the nutritional status of children from birth but also in their subsequent educational attainments. Therefore, mother's education may influence their children future occupational choices and productivity. Women who are empowered in the family are also more likely to have premium fertility conditions, better antenatal and neonatal care and lower infant mortality, as well as reducing the prevalence of low birth weight and their own maternal health status. Lack of control by women over household resources often damages health outcomes for them and for their families (Wagstaff, 2001). The introduction of iodized salt to pregnant women is vitally important for the normal development of the fetal brain (Bhargava, 2001; Ruchlin and Rogers, 1973). Therefore, it is also closely related with a women's status in the society. If women have the right to use of income then the children may be healthier. The health status of women directly impacts their children as their children's education may depend on the policy of more access of parental care, less household chores and agricultural work.

Women's empowerment also affects the fertility rate by lowering the fertility, better antenatal and neonatal care and lower infant mortality, as well as reducing the prevalence of low birth weight and their own maternal health status. Better maternal health status of women means not only

higher nutritional status of children but also better performance of children in school. This means that higher the human capital formation stronger the productivity effects. Healthy and educated mothers are also able to pay attention to their children's school works. Therefore, children's productivity is closely related to mother's health and education.

### II.3.1. 4.Savings and Investment

As Fuentes (2001) mentions, a rise in life expectancy increases the optimal fraction of life spent in working. However, it is not enough to balance the increased need for retirement income. Consequently, savings rates rise at every age as longevity rises in order to finance consumption during retirement. Sachs (2001) mentions that diseases reduce the individual's potential lifetime income. Bhargava et al. (2001) report that for highly developed countries the estimated effects of ASR on growth rates were negative. Aguirre and Hadley (2005) state the economic cost of malaria alone is 1-5% of GDP in African countries. They also mention that direct and indirect costs of malaria in Sub-Saharan Africa amount to as much as 40% of total public health expenditure. Ruchlin and Rogers (1973) report that in order to attain economic growth it is necessary to improve accumulated capital and labor. Accumulation of capital depends on savings. The larger the family size for a given income, the more difficult it is to save. With respect to less developed countries where average annual income per capita is as little as 75 dollars compared to families in the United States with family incomes of less than 3000 dollars it is obvious that a large family makes it extremely difficult if not impossible to save (Ruchlin and Rogers, 1973).

### II.3.2. Channels of Influence from Economy to Health

A great deal of evidence has been presented to indicate that income has a causal impact on health (Howden-Chapman and O'Dea, 2001; Wagstaff, 2001; Ruchlin and Rogers, 1973; Nixon, 1999; Costa and Steckel, 1995; Nabar, 2004; Giuffrida et al., 2005). As Howitt (2005) mention that income gap between rich and poor nations causes a gap in living standards between rich and poor nations. Just as developing countries suffer from persistent poverty, developed countries enjoy growing prosperity. The ratio of per capita income in the richest group of countries to per capita income in the poorest group of countries grew from 11 times in 1950 to 19 times in 1998. This convergence rate for the richest and poorest is undesirable (in fact divergence). In order to close this gap, health plays a crucial role since mortality rate is still high and there is still a considerable part of population having no access to safe drinking water. They are under threat of many debilitating types of sicknesses: AIDS, malaria and tuberculosis in Africa even if life expectancy in poor countries is increased. Tuberculosis is one of the leading killers in the world and it is the most common human infectious disease which causes 80% of all communicable diseases. It accounts for about 2 million deaths per year. Malaria causes 300 to 500 millions people deaths in

a year. Therefore, these sicknesses have direct and indirect costs which may serve to drive families into poverty trap from which it is difficult to emerge. (Sachs and Brundtland, 2002; Howitt, 2005). At the personal level, it has been established both theoretically and empirically that richer people have better health because they can afford goods and services (e.g. medical care, better nutrition, sanitation and housing) that improve health (Howden-Chapman and O'Dea, 2001). Howden-Chapman and O'Dea (2001) show that low income is more conducive with disability, chronic illness, greater morbidity and more time loss due to reduced activity and illness. Wagstaff (2002) also mentions that poorer countries tend to have worse health outcomes than the richer countries and the same outcome exists for poorer persons versus richer people. Pritchett and Summers (1996) find, by using time series data on health indicators such as infant and child mortality and life expectancy, that long-run income elasticity of infant and child mortality in developing countries lies between -0.2 and -0.4. Therefore, there were over a half-million youngster deaths in the developing world in 1990 alone, which can be attributed to the poor economic performance in 1980s.

There are some empirical findings about the impact of income on death rates. Brenner (2005) finds that in short term mortality increases with income but in the long run declines for the United States between 1901 and 2000. Wagstaff (2002) also displays that the poor die earlier and have higher morbidity rates. Sorkina (1976) demonstrates that there is a substantial impact of income on death rates. Low income persons have more periods of illness than the rich individuals. On the basis per 1000 in a population, those with less than $2000 in family income report more than four times as many heart-related problems as opposed to those in the highest income group; six times as much mental and stress ailments; six times as much arthritis and rheumatism; six times as many cases of high blood pressure; over three times as many orthopedic impairments (excluding paralysis and absence of limbs); and almost eight times as many visual impairments (Sorkina, 1976). Similarly, Leon et al. (2005) report that in the cluster of low-spending countries there is huge variation in life expectancy. On the other hand, in medium and high expenditure countries, there is huge gap in per capita expenditure, which shows almost no relation to life expectancy. Much of the international disparity in death has to be accounted for by factors determining differences in occurrence of disease. Jamison et al. (2001) demonstrate that if the effect of income on infant mortality rate declines sharply it may be because of complementary education, innovative technology and policy. Sastry (2002) reports that the development and inequality in children under-five living mortality rates in Sao Paulo have declined between 1970 and 1991.

Increases in economic resources may be invested in improved diet, better sanitation and health practices, and health service access and promotes more effective use of these services. Nixon (1999) mentions an important body of evidence. This evidence demonstrates that in an extended period, the positive association between economic prosperity and health of a population as

measured by morbidity, mortality or nutritional status exist. Chernichovsky and Coate (1979) state that even though correlation between family income and education of the household head is statistically significant it shows very little positive effects on the nutrition intake levels of young children. Sur (2000) reports numerical findings. She noted that households' incomes have strong positive effects on adult Body Mass Index (BMI) in rural Bangladesh. A 1% increase in income is associated with readings of 0.12 and 0.14 BMI for adult men and women respectively. Also a 1% increase in adult height (1.56cm) coupled with an average adult BMI is likely to increase total household incomes by 1.4% and 0.73% respectively. However, Costa and Steckel (1995) indicate that, in the early industrial period, economic growth was not sufficient enough to offset the declines in health but increases in health status outpaced economic growth later. One study sets up the direction from health expenditure to economic growth and shows that the data in Spanish Regions on health spending has positive effects on economic growth (Rivera and Currais, 2004). Giuffrida et al. (2005) report that unemployment eventually impacts health negatively.

Bloom et al. (2001e) develop the idea that technology only has little impact on the health. Since the 20$^{th}$ century struggles against tuberculosis (TB), development of what causes of TB has helped people to mobilize against the disease with impressive results. Therefore, innovation of a vaccine reinforced society's efforts and is instrumental in driving the disease down to vanishingly small levels but it also led to community satisfaction and the latter part of the century saw TB on the rise again. However, technological development is not enough by itself to have better health in the society. The governments must provide leadership and direction at all degree from local to global to combat such pandemics such as HIV/AIDS. This high-profile effort taken by the governments highlights the importance of planned coordinated action directed at making the best use of tools and skills or knowledge. Therefore, governments have a fundamental role to play both in steering the development of new technologies and facilitating their use. Once more, tools or skills or knowledge by itself will not solve health problems – its interaction with all levels of society is the key to its success. Governments have to take a strategic view on technology. Technology has had some astonishing successes in the last 100 years; these achievements have been facilitated by society's use of them. The perception of "social technology" places technology at the center of the myriad of social forces that mediate its use.

### II.3.3. Causality between Economy and Health

While some studies conclude that the link is direct or indirect from income to health, others consider that poor health causes the low income. Turrel (2001) suggests that there is substantial evidence that many people live at poverty level incomes and have poor health. Cross-country evidence also demonstrates that nations with large disparities in their distribution of income have poorer health profiles than nations with a narrower income gap between the rich and poor.

Bhattacharyya (2004) also mentions that health in agriculture sector account for the substantial income gap. This is applicable even, if applied, within the same country. Dewan and Hussein (2001) report that strong relationship exists between initial levels of health and economic growth and any improvement in health is associated with faster economic growth. Wagstaff (2002) shows that poor countries tend to have worse health outcomes than the richer countries. He also concludes that the relationship between poverty and ill-health reflects causality running in both directions as Erdil and Yetkiner (2004) indicate. However, Rivera and Currais (1999) found that there is a positive, sizable and statistically significant effect between aggregate output and good health. Sur (2000) surmises that households' incomes have strong positive effect on adult Body Mass Index (BMI) in rural Bangladesh: 1% increase in income associates with a 0.12 and 0.14 BMI for adult men and women respectively. Also a 1% increase in adult height (1.56cm) and in average adult BMI is likely to increase total household incomes by 1.4% and 0.73% respectively.

Howden-Chapman and Des O'Dea (2001), Wagstaff (2001), Ruchlin and Rogers (1973), Nixon (1999) and Thomas (2001) demonstrate evidence that income has a causal impact on health. All seem to agree that increases in economic resources should be invested in improving diet, better sanitation and health practices, increased use of health services and possibly more effective use of these services. Nutrients such as protein and iron, which are very effective on working pace, are typically found in high concentration in animal products, which are relatively expensive and often beyond the budgets of the poorer households. Therefore, poverty creates micronutrient so the shortages of income cause less robust individuals, which therefore weakly contributes to the production process (Wagstaff, 2001; Nixon, 1999). Thus, the provision of health requires resources. Conversely, economic growth is not always good for health of the population. Industrialization may be sources for devastating accidents such as Chernobyl in 1986 and Bhopal in 1984. In other indirect cases, mass sickness can be caused by such as methods as irrigation. The need to sustain crop production necessitates adequate irrigation for higher agricultural output but irrigation can also facilitate the spreading of waterborne diseases (schistosomiasis), yellow fever and malaria. Consequently, economic growth might cause the deterioration in health.

Bhargava (2001) and Ruchlin and Rogers (1973) evaluated the vast majority of studies which show that the level of education of individuals is a major determinant of healthiness and mainly the progress of mothers' literacy is closely related with the improvements in children's health. If parental conditions are not good then the children may have to move to the work force. Therefore, this will reduce the time for school-related work because of poor parental health and income (Bhargava, 2001).

## II.4. THE HUMAN CAPITAL AND ECONOMIC GROWTH RELATIONSHIP

In early growth accounting studies, it has been recognized that economic growth is not explained by conventional labor and capital measures. Therefore, quality of labor, which is also an crucial component to explain the residuals, gains importance in the literature (Mankiw et al., 1992). Torres (2004) mentions that human capital investment nowadays is considered to be the essential element in economic growth. The main factor of wage and income difference relies on the labor quality, which is human capital difference. The most direct way of increasing labor quality is through health awareness and as an additional support contributions, strength of family relationships may increases the labor quality. Developing personal talents depends on changing educational differences. Therefore, human capital becomes the important component of economic growth in the growth literature.

Zamao (2000) and Barro and Sala-i-Martin (1995) agree on the role of human capital in growth theories. Human capital is considered to be the driving force for innovation, learning and entrepreneurship which are important preconditions for economic growth since it increases workers' ability to learn new technologies that increases their productivity. Increases in worker productivity will also indirectly increase the productivity of physical capital and encourage greater investment. This means countries with higher initial stocks of human capital are expected to grow faster. Therefore, in both endogenous and exogenous growth models, human capital becomes a major factor behind the economic growth (Mankiw et al., 1992; Barro, 1997; Barro and Lee, 1993, 1996; Lucas, 1988; Romer, 1986, 1990). The growth rate depends on the income gap of the leader and follower through human capital. Knowledge produced anywhere can benefit producers everywhere by allowing diffusion through policies, social capital, institutions and diminishing returns. By extending the Solow model with human capital, countries do converge and countries with higher initial human capital converge faster than countries with lower initial human capital. However, human capital plays a crucial role in the endogenous growth model before it appears in exogenous growth because of improvements in the quality of labor.

The accumulation in human capital raises the labor productivity and output without any increase in physical capital. In endogenous growth model, human capital is the main source of technological progress and total factor productivity, as well as creating physical capital. Endogenous growth models suggest that policy variations allow physical and human capital accumulation as well as research and development investment. These types of models mostly consist of increasing returns to scale because of specialization and knowledge-based capital investment. Therefore, they show mostly sustained and long term growth in per capita income (Jones, 1998). If there is not enough investment in human capital or if it is not sustained, then growth rate slows down in contemporary economies. In order to absorb the new technology to be

more productive, there should be appropriate human capital investments to increase or sustain the growth. Technology in most developed countries are produced and diffused throughout the labor market which requires human capital or skilled labor (Özatağan, 2005).

The change in income gap relies on either the diminishing rate of return or technology transfer or both. Diminishing rate of return is an automatic process. The technology transfer helps disadvantaged countries since they do not have to invest in research and development; they just imitate the processes (Barro and Sala-i-Martin, 1995; Barro, 1997). However, some technology may not be imitated. Firstly, some technology is "tacit" and can not be copied; imitators have to spend costly time to adopt it. Adopting technology depends on skilled and experienced labor. Technology embodied in physical capital may also have to be modified according to local conditions. These two factors may force countries to stand back further in order to keep transferring the technology at the same rate to all sectors which causes income to fall relative to the size of investment. The advantages of Schumpeterian theory compared to the neoclassical theory is that it allows different growth rates between poor and rich to differentiate in the productivity rate rather than the differences in rates of factor accumulation (Howitt, 2005).

Since human capital seems to be the driving factor on explaining the differential growth patterns in the models, we should look into how it is defined in the analyses. There is a three-fold definition of how human capital is determined in terms of education, learning and innovation and entrepreneurship (Özatağan, 2005; Fratianni and Huang, 1995).

- The concept of human capital embodies education: There are four different proxies in the studies; (1) school enrollment rate between age 6 to 19 (Barro and Lee, 1993), (2) teacher-student ratio (Barro, 1991; Barro and Lee, 1996; Çeçen et al., 2003), (3) adult literacy rate (Coulombe et al., 2004) and (4) total number of university graduate students in master and doctorate degrees programs

- Learning and innovation: The most widely used technology indicators are R&D and patenting (Verspagen, 2000) which proxies by either the share of R&D personnel are in total employment or the number of academic personnel per 10000 populations.

- Entrepreneurship: If a person has more education, this increases his capacity to facilitate acquired knowledge in an enterprise. New firm formations, self employment, employment in newly opened firms and firms' birth rates are proxies for entrepreneurship (Malecki, 1997).

Fuente and Doménech (2000) complete the exercise that was originally motivated by the view of weak data and likely to be one of the main reasons for the discouraging results obtained in the recent empirical literature on human capital and growth. Their results clearly support the weak

data hypothesis. Some of the empirical findings in literature are as follows which all confirm that human capital is important for growth.

**TABLE II.1: Some studies on economic growth and human capital findings**

| Author | Findings |
|---|---|
| Benhabib and Spigel (1994) | Human capital plays a crucial role on economic growth |
| Barro (1991) | Human capital proxy and economic growth has positive relationship |
| Mankiw et al., 1992) | Human capital proxy and economic growth has positive relationship |
| Nonneman and Vanhoudt (1996) | Human capital proxy and economic growth has positive relationship |
| Goetz and Hu (1996) | Human capital proxy and economic growth has positive relationship. |
| De Georgia (1996) | Human capital proxy and economic growth has positive relationship |
| Tallman and Wang (1994) | Human capital proxy and economic growth has positive relationship |
| Young (1995) | Human capital proxy and economic growth has positive relationship |
| Weisbrot et al., (2005) | Education and per capita income growth declines together. |
| Rannis et al.,(2000) | Human capital proxy is necessary for economic growth |
| Griliches (1996) | Human capital proxy is necessary for economic growth |

Ranis et al. (2005) informs us about human development (HD from this point forward) which has been defined as expanding people's choices in a way that enables them to lead longer, healthier and fuller lives. The definition of HD as ``enlarging people's choices" is very broad. For the purpose of exploring the links between HD and Economic growth (EG from this point forward) theoretically, and especially empirically, we need to narrow it down. We shall consider the HD of a country as consisting of the health and education of its people, recognizing that this is very much a reductionist interpretation. Clearly, a strong connection between EG and HD exists. EG provides the resources to permit sustained improvements in HD. Other improvements in the quality of the labor force are important contributors to EG.

Torres (2004) mentions that human capital, understood as the nutrition, health and education of populations, are considered as the central motor of economic growth that contributes to technological innovation and assimilation of more productive activities that sustain higher levels of living standards. Torres (2004) also shows evidence from the current literature that insufficient human capital investment is related to sluggish economic growth. Education is good to improve agricultural output. He notes from the literature that yield on human capital investment in the US economy was larger than the yield on investment in physical plant formations such as new plants and machinery.

## II.5. THE LITERATURE SURVEY ON CONVERGENCE

Economists are very interested in knowing whether the distribution of income changes over time. For example, we are interested in whether within a country, interregional differences in income levels tend to disappear or tend to increase over time. If they diminish, then we may be less worried about creating aid programs (such as the regional and Cohesion Fund Policies carried out by the governments of the European community) rather than if these differences tend to perpetuate themselves. We are also interested in knowing whether the regions that are relatively

poor now are the same as the ones that were relatively poor one hundred years ago. If the answer is yes (that is, if poverty tends to persist over time) then we may want to enact public aid programs to allow the poor regions to escape this predicament. If the answer is no (that is, the economies that are relatively poor today are not likely to remain relatively poor in the future), then we may not need to worry about the countrywide distribution of income.

After giving this brief information about why convergence is important to us, I wish to discuss some empirical evidence on convergence on country, state, province, region, city levels and the Turkish provinces. I will give some empirical convergence definitions and speed of convergence will be the main concern. I also discuss empirical comparisons of endogenous and exogenous growth theories in some perspective.

Before the findings are evaluated let us talk about the type of convergence in terms of empirical findings. Empirically, there is no solid definition of convergence concept. Since the convergence concept has been widely investigated in economics, the convergence hypothesis has become the subject of intense controversy. This controversy is largely empirical, focusing on the validity of competing hypotheses which are indicated below (Angel de L F., 2000).

i. The absolute convergence hypothesis: there is absolute β-convergence if poor economies tend to grow faster than rich ones. Per capita incomes of countries converge with each other in the long run and they are independent of their initial conditions. Where name of β-convergence comes from the coefficient of convergence regressions.

ii. Sigma (σ) convergence hypothesis: economies are converging, if their dispersion of per capita income levels tends to decrease over time. We should point out that it is impossible for economies to converge or get closer to each other if β-convergence does not occur. Therefore, β-convergence is necessary conditions for σ-convergence.

iii. The conditional convergence hypothesis: per capita incomes of countries that are identical in their structural characteristics (e.g. preferences, technologies, rates of population growth, government policies, etc.) converge to one another in the long run independently of their initial conditions. (This could also mean that absolute divergence since we have different steady states).

iv. The club convergence hypothesis-(polarization, persistent poverty, and clustering)-per capita incomes of countries that are identical in their structural characteristics converge to one another in the long run provided that their initial conditions are similar as well. (This could also mean that absolute divergence since we have different steady states club).

v. Another important point to indicate is that economies could still get closer to each other not because of the application of diminishing return to per capita or R&D but because of the diffusion

of the technology. Now clarification of the two distinct concepts can be made. Convergence because of diminishing returns and convergence because of implementations and innovation (catch up hypothesis which does depends on the assumption of diminishing rate of returns to implement the technology and it is far from automatic since it depends on social capability of economies to implement these technologies) (Barro and Sala-i-Martin, 1995); Kalyuncu and Kalyoncu, 2002).

vi. One more mechanism for convergence which is not mentioned very often in the literature works with structural change in the economies or reallocation of productive factors in economies such as moving from the agricultural sector to manufacturing, migration or mobility of factors: Workers tend to migrate from low-wage countries to high wage countries. This increases the capital-labor ratio in their home country at the same time it lowers the capital-labor ratio in the economy to which they migrate, thus reducing factors intensity causes differences in two economies. Since developing countries have relatively backward technologies with low but appropriate human capital endowments they have been able to capture very high long term growth rates. However, it is not the case for developed countries whose devastated technological improvements had not been able to capture high growth rates because of the relative inadequacy of human endowment. Therefore, it is not the absolute sizes of K and H but their relative concentration values which should be the key determinant of long term economic growth.

In the literature the most widely discussed convergence concept is β-convergence, the main question is "why β-convergence is interesting but not Sigma (σ) convergence?". Two different economies which are structurally different show no sigma convergence. However, when one of these economies might show β-convergence, then the income distribution of this economy changes such as the poor is becoming richer and rich is staying at the same level. The question now becomes which economy is similar to ours and can anything be done to transform the economy, which does not show β-convergence. How fast the poor become rich and rich become poor is important. All of these questions deal exclusively with β-convergence but not in sigma convergence.

The key issue about convergence and the convergence expectation seem to be hold for mostly structurally homogenous countries. For the broad sample, each country heads to the different steady state level of income Therefore, this convergence expectation does not match for the broad sample. These different targets come from different government policies, protection of property rights, provision of infrastructure services, education and cultural habits such as attitudes for saving, work effort, fertility and the availability of natural resources. For a given steady state level of income, determined by government policies and other factors, convergence tendencies depend on speed to reach their steady states. Speed is mostly similar for these samples In general; the

convergence rate is about two percent per year which is low but empirically important (Kalyuncu, 1998).

### II.5.1. Studies on World

I tabulate the summary of different studies in Appendix A where mostly tables are either modified from Kalyuncu (1998) or from original studies. The first columns in the tables show the author(s), second columns show the sample and period which is used in the study. Type of convergence is shown at the last columns. The tables are reported in the Appendix A.

The body of empirical evidence of these tabulated studies concerns the existence of the significant correlation between the long-run average growth rate of real per capita GDP and initial real per capita GDP. In these studies, besides this relationship, a number of structural and policy variables are taken into consideration. Some of these are educational attainment, life expectancy, investment to GDP and terms of trade policy. Aghion and Howitt (1998) mention that the body of empirical evidence concerning the existence of the significant correlation between the long-run average growth rate of real per capita GDP and a number of structural and policy variable estimations may seem to be supporting the AK model but these type of estimations show reserve causation of growth using other variables. Another empirical body of the literature shows convergence. In these cases, most samples have a tendency to converge but convergence type remains to be very important. Since the concepts of convergence are defined very clearly, we can safely say that convergence is mostly conditional (concludes club type too).

### II.5.2. Studies on Turkey

I also tabulate some of the studies on Turkey in Appendix B where the tables are represented in the same manner as for world studies and some study are summarized verbally. Turkish province data does not show solid conclusion. While Tansel and Güngör (1997) conclude convergence is mostly the conditional type. Erk et al. (1999) finds divergence for 67 provinces. However, Erk et al. (1999) reach controversial results for the regions. While some regions converge after adjustment, others diverge. They also estimate non-linear regression to see whether the same data does show convergence tendency. They conclude that these samples show convergence tendency. However, we should point out that findings for the provinces do not let us to conclude that somewhat solid convergence rates or convergence conclusions as much as cross country, city, state, and regions in the world.

Tansel and Güngör (1997) study on 67 provinces of Turkey. They find convergence for the provinces of Turkey. However, Filiztekin (1997) discovers divergence in his research of the same set, in the period between 1975 and 1990. Temel et al. (1999) investigated the convergence issue about labor productivity levels for the 67 provinces of Turkey for the period between 1975 and

1990. The findings show polarization. This happens in terms of club convergence. This study uses rather different methods than the rest by using the Markow Chain model. Derviş et al. (2004) discuss the convergence issue for Turkey and then conclude that over the long-term, per capita income in Turkey will converge or diverge depending on relative rates of investment, relative increases in labor inputs, relative increases in total productivity and terms of trade when it is compared to EU averages.

Kılıçaslan and Özatagan (2005) use a somewhat unorthodox approach for convergence testing. They used 64 provinces of Turkey in the period between 1987 and 2000 and attempted to find out the extent to which regional differences tended to narrow over this period. They find growth differences between provinces tended to diminish in terms of both income and per capita income, with the pace of per capita income being 50 % larger than that of income. Moreover, they concluded that 17% of the 100 % point growth of per capita income during this period resulted from the change in population share in favor of the provinces with high per capita incomes. They imply that convergence occurs since per capita income of wealthy provinces declines because of increasing population shares in the rich rather than the relatively poor. Their conclusion is reconciled in the World Bank Report (2000).

Kırdar and Saraçoğlu (2006, 2007) find divergence in 67 provinces of Turkey from 1975 to 2000. They also investigated whether the conditional convergence exist in this sample. They reached the conclusion of conditional convergence. Kalyoncu (2001) conducts a study for 67 provinces of Turkey in the period between 1979 and 1997. He finds divergence among the provinces. Therefore, there is some good deal of evidence that economies initially far from its own initiatives eventually produce faster growth. Augmented Solow model is almost certainly better at comparing than the AK model. However, it has some shortages, such as technological change. It holds exogenous and therefore, is unexplained. It also does not explain how human and physical capital interact which requires some policy decision.

**II.5.3. Speed of Convergence**

Since the vast majority of empirical studies support the prediction of neoclassical convergence theory, the next important point to be determined is how fast the convergence occurs in these studies. After seeing that the neoclassical model was consistent with the studies but not exactly for the Turkish provinces or regions data, the coefficient found implies a speed of convergence of about two percent per year. This result can be reported in terms of how many years it takes to eliminate the half-life of the gap between initial per capita income and steady state income. The time series studies display a similar speed of convergence for the countries with cross-sectional studies. Table A.1, shows the study of cross section of countries results and in Table A.2, time series of countries is shown Convergence rates for the regions in the world in Table A.3 indicate

that similar tendencies are observed with cross sectional country data sets With a break in 1946, regions in the US exhibit approximately 2% convergence rate, which is shown in Table A.4. However, after the break, these rates are lower than pre-break rates for regions in the US. Cross-sectional convergence rate studies for the states in the US are displayed in the convergence rates in Table A.5, approximately 2% per year as well. In Table A.6, time series regressions for states in the US are reported. In these conventional studies, similar convergence rates match with cross section studies; an alternative approach shows higher a convergence rate because it includes much of the time series variations and does not control the cross-economy differences. Coefficients for cities in Table A.7, has the quickest convergence rate and the coefficients for countries in Table A.8, are the second quickest. This may be due to two reasons. Firstly, cities and countries have completely open economies; therefore, there are no legal restrictions on capital movement, migration, and mobility of ideas among cities and counties. Cities and countries are less arbitrary economic units but rather more specialized units. Secondly, these samples in the US show similar political and social structures.

As Kalyuncu (1998) compares the exogenous and endogenous growth models regression result, he concludes that according to endogenous growth theory, permanent changes in potential determinants of long run economic growth such as physical investment rates, human capital and trade policy should lead to permanent changes in economic growth rate. OECD countries data do not support this model because a permanent increase in the investment rate affects growth rate only over a relatively short horizon of eight to ten years which is far from the infinite horizon predicted by the AK model.

Jones (1998) evaluates endogenous growth models and he concludes that R&D-based models in the endogenous growth literature focus on endogenizing technological change. This kind of model makes the counter-factual prediction that a permanent increase in the level of resources devoted to R&D should lead to a permanent increase in growth rates. He also mentions that these scale movements have been emphasized such as integration of two technologically distinct economies can result in an increase in the steady-state growth rate on the condition that these economies avoid the duplication of efforts in R&D and focus on different innovation. However, from empirical standpoint, the numbers of scientist and engineers engaged in R&D have exhibited rapid growth rates in sharp contrast to apparent stationary output growth rates. Increasing the level of resources devoted to R&D does not show any persistent movement in growth rate. Thus, we can safely conclude that the overall evidence favors transitional growth theories.

## CHAPTER III

## NUTRITION, PHYSICAL TO HUMAN CAPITAL RATIO, INCOME DIFFERENCES AND CONVERGENCE FOR CROSS-COUNTRY CASE

### III.1. INTRODUCTION

In this study, one of our aims is growth accounting, while income differences by level accounting and convergence issue are the other aims in our study. Growth accounting helps us to break down the growth rate of aggregate output into contributions from the growth of inputs. It is usually pointed out that these inputs are labor, physical capital and technology. We also investigate whether the differences in physical capital to human capital ratio account for the productivity gap between the richest and poorest countries or the differences in worker effort level account for the productivity gap between the richest and poorest countries. We also study income dynamic for cross country by using convergence approach. In neoclassical theory, physical capital accumulation is the transitional driving force of output growth. Technological progress is assumed to be exogenous to the economy as population growth. Diminishing return to physical capital is a key assumption of a neoclassical model which eventually leads to catching up to the growth rate of the developed countries.

Growth accounting lets us to distinguish accumulated factors and productivity where Nabar (2004) mentions that the productivity for the richest five countries is more important than the factor accumulation as a determinant of income relative to the US. However, factor accumulation for the poorest five countries is relatively more important than productivity as a determinant of income relative to the USA. It is also reported for the whole sample that 59% of the variation in output is due to variation in factor accumulation and 41% is due to variation in productivity. Nabar (2004) also points out that in a cross country study, 69% of variation in cross-country growth rates of income per worker attributed to variation in growth rates of TFP.

Mankiw et al. (1992) somehow object to these residuals to be interpreted as productivity by employing human capital in a growth model. The main source for TFP is human capital because ideas are created and spread by human capital. Inventing and adopting new technology depend on human capital. Benhabib and Spiegel (1994) indicate that the growth rate of TFP depends on the national human capital stock level through domestic technological improvements and technological adaptation from abroad. Nonneman and Vanhoudt (1996) modify Mankiw et al. (1992) model by adding a technological proxy. Besides human and physical capital proxy and initial income, they show that with technological proxy variable the impact of human capital

proxy has declined. Therefore, we can see that there is a very close relationship between human capital and technological proxy variable so do residuals.

Since human capital becomes one of the key factors in growth model, Mankiw et al. (1992) introduce human capital in conditional convergence concept which shares some portions of saving beside physical capital. This concept means that the convergence of income and growth rates across economies is conditional (among other things such as geography, government policies, revolutions and coups, inflation, financial systems) on human capital. Why is this important in our study? In growth accounting, technological progress is measured as a residual of these models. Including new variables changes the size of the residuals in the estimations. Therefore, one of the main aims of this chapter is to analyze this residual to clarify whether the worker effort is missing variables in the production fucntion. Then, we also consider the income differences by the level accounting and by the convergence issue empirically. We employed the physical capital to human capital ratio and the worker effort level where human capital is defined firstly as just the education and both the education and the worker effort level.

Von Z. and Muysken (2001) consider human capital contains not only education and experience but also health since health is also included in human capital and healthy human beings can exert more effort and produce more output. Specifically, Ranis et al. (2005) mention that good health; primary and secondary education and nutrition raise the productivity of workers in rural and urban areas. A well-developed labor force, in terms of better education, nutritional status and health is likely to produce more from a given resource base than less-skilled workers (Dewan and Hussein, 2001). Part of being healthy is based upon nutrition. Ganegodage et al. (2006) show that GDP growth rate and DES coincidentally suggest the similar movements of the GDP growth rate for the period between 1961 and 2000. If a person has low nutrition, this will affect a person's work and their concentration level at work. Thus, we will examine the importance of nutrition status in income variation across countries.

In the next section, we will examine why we should define the human capital in terms of education, health and nutrition. The third section deals with physical and human capital interactions in production capital. In section IV, we discuss the model and variance decomposition approach. We describe the data and present results in section V. The sixth section discusses cross-country income differences with accounting approach and the convergence issue is analyzed in section VII. The last section discusses the overall findings of this chapter.

### III.2. HUMAN CAPITAL OR EDUCATION, HEALTH AND NUTRITION

The importance of human capital in long-term economic growth is well known. Human development has three distinct components: education, health and nutrition (Sen, 2005). At the

most basic level a person requires adequate nutrition in order to perform labor. If this essential condition is not met or if the person lives in an unhealthy environment, the result is poor nutritional status and the person's ability to do sustained work is reduced. Nixon (1999) and Foster (2005) note a substantial body of literature indicating that nutritional status affects labor outcomes. There is no doubt that better nutrition improves physical health. Wang and Taniguchi (2003) indicate that researchers have found evidence that healthier labor force could increase productivity with nutritional intake which is important to economic growth.

There is evidence that poor nutritional status leaves people more susceptible to illness. This vicious cycle may exist whereby inadequate food intakes combined with frequent sickness spells result in poor nutritional status which in turn creates an increased susceptibility to illness. If a healthier worker is less susceptible to disease then that worker is more alert and energetic, this will ultimately result in them being more productive workers commanding higher earnings. Establishing this link is not straightforward. It is, however, very important. If health does affect economic prosperity then evaluations of health interventions that do not take this into account will tend to understate the economic benefits (Nixon, 1999).

There is a risk of intergenerational transmission of poor nutritional status. For example, women who suffer from poor nutrition are more likely to give birth to underweight babies. These babies, thus, start out with a nutritional handicap. As Bhargava (2001) and Ruchlin and Rogers (1973) mention, these babies can not complete the full developmental stages in the brain since the normal development of the fetal brain depends on consumption of iodized salt by pregnant women. Furthermore, low intakes of fresh fruits and vegetables during certain seasons cause vitamin A, vitamin C and other nutrient deficiencies, making individuals more susceptible to disease. Adequate intakes of such nutrients are essential for maintaining adult health and productivity over the life span; children’s development critically depends on the quality of diet that the household can afford.

There is also evidence that poor nutrition is associated with poor school performance in children of school age. This would not necessarily imply any impairment in the child’s cognitive ability but merely that because of hunger the child is listless, tired, distracted and cannot participate in learning activities. Unfortunately, it may also be the case that cognitive ability itself is impaired as a result of prolonged and severe malnutrition. Another downturn is that children who do poorly in school severely damage their future economic prospects. A vast knowledge of the inter-relationships between nutrition, infection and child development would be useful for the allocation of resources (Bhargava 2001; Wagstaff 2001; Thomas 2001; Sachs 2001). Thus, for example, malnourished children are unlikely to fully benefit from the resources spent on the educational infrastructure.

People who live on the edge of starvation can be expected to follow a policy of safety first with respect to investments. They will avoid taking risks since the consequences ofa short-term downward fluctuation in income will be catastrophic for survival. However, less risky investments also tend to have lower rewards. Moreover, health at a point in time combines the cumulative effects of phenotype factors including an individual's behavior through the life course as well as the health and socio-economic environments to which the individual has been exposed (Thomas, 2001; Nixon, 1999). Capturing all of these influences is extremely difficult. Indeed, recent evidence suggests that exposure to nutritional distress during key periods of intra-uterine growth results in health problems that emerge only in middle or later life such as coronary heart disease, strokes, diabetes and hypertension (Nixon, 1999). Those people who were exposed to the famine during the last trimester of fetal growth are more.

There is some evidence that the macroeconomic performance of the whole economy may suffer as a result of the cumulative impact of these effects. It has been shown recently that the overall effect may be to reduce a country's rate of economic growth. Based on historical studies, Broca and Stamoulis (2006) report that an improvement in nutrition and health explains half of the economic growth estimates and are also presented for losses. Childhood cognitive impairments associated with iron deficiency, adult productivity losses arising from the combined effect of stunting, iodine deficiency and iron deficiency are equivalent to 2 to 4 percent of GDP. Reductions in the incidence of infectious diseases, together with changes in diet, clothing and shelter, increased efficiency with which the food energy was converted into work output and translated into higher economic growth.

### III.3. PHYSICAL AND HUMAN CAPITAL INTERACTION

Bulutay (1995) criticizes the "substitution between the inputs" approach of the traditional economic theory. He points out that the important interaction among inputs is not substitution but complementarities since if there is no physical capital, and then there will be no human capital in production action or use of technology in production process. As it is in less developed countries, if there is not enough human capital, then having more physical capital is meaningless (Bulutay, 1995).

Doepke (2007) points out that neoclassical growth model contains remarkable success and failure in its anticipation. Therefore, we have to mention some stylized facts of growth. Brzoza-Brzezina (2007) briefly summarizes some facts as such:

- Most economies grow over time both in aggregate and per capita terms.
- Growth rates differ substantially between countries.

- Even small differences in annual growth rates accumulate to big differences in income in the long run.
- In the long run cyclical fluctuations matter much less than the average growth rate.

Where each and every one of the stylized facts of growth in developed countries accounted by the model is considered to be the model's success. Therefore, since the model captures some key characteristics of the actual economic system of advanced industrial countries, the neoclassical growth model is the underlying structure which is used for the most macroeconomic research concerning developed countries. Doepke (2007) also believes that most of the world is evidently not growing and what ever causes that is not captured in the neoclassical growth model. He also indicates that the neoclassical growth model does not provide any explanation for the lack of convergence between rich and poor countries during the last 50 years. Therefore, this lack of convergence is considered to be a failure of the neoclassical growth model.

In the early growth literature, physical capital was assigned to be a driving force behind growth The Solow model does not provide a framework for incorporating human capital as one of the driving forces of growth. Before Mankiw et al. (1992) introduced human capital into the exogenous growth model, human capital entered into the growth model through the endogenous growth models. The endogenous growth models introduce human capital in one-sector model and two-sector model (Barro and Sala-i-Martin, 1995). In these models, these two types of capital (human and physical capitals) are considered to be substitutes, not complements. Barro and Sala-i-Martin (1995) assume that components of the production function in a one-sector model are physical and human capital; and the production function exhibits the standard neoclassical properties, including constant returns to scale in inputs. Output is used either in investing in physical capital or human capital (education). Both types of capital are depreciating. After solving and manipulating the model, they conclude a condition which determines a unique, constant value of human to physical capital ratio (H/K). Therefore, if they define A=f(H/K), the model implies just the AK model. They mainly consider the AK model's K as a composition of capital goods which includes physical and human capital component.

Barro and Sala-i-Martin (1995) also consider the imbalances between the levels of physical and human capital. They conclude that the growth rate of output is higher, the larger the magnitude of the gap between the ratio of physical to human capital and the steady state value of this ratio. When they consider two-sector model where different technologies are needed to produce these inputs, the production function creates an asymmetry in the effect from imbalances between physical and human capital on the growth rate. They consider the source of asymmetry. It can be obtained from the positive effect of the ratio of physical to human capital on the real wage rate (per unit of human capital) and thus, on the alternative cost of human capital devoted to education. Therefore, in this setting a broad concept of output growth rate still increases with the

magnitude of imbalances between physical and human capital if human capital is relatively abundant but tends to fall with the magnitude of the imbalance if the human capital is relatively scarce.

When Barro and Sala-i-Martin (1995) relax the constraint of diminishing returns to a broad concept of capital by the presence of human capital, the presence of human capital can lead thereby to long-term per capita growth in the absence of exogenous technological progress. Therefore, to generate long-term growth, human capital production may be seen an alternative to improvement in technology. They also emphasize some respect in which the accumulation of human capital differs from the creation of knowledge in the form of technological progress. When they consider the human capital as skills embodied in a worker, then the use of these skills in an activity precludes their use in another activity. Therefore, we can safely conclude that human capital is a rival good and it is a subject to tragedy of common. Human capital is also an excludable good since its uses in one activity excludes its uses in another activity at the same time span with the appropriate capital in those activities.

Doepke (2007) asks the question that whether we need to abandon the standard growth model entirely in order to understand dullness in developing countries. He sets a model that it is possible to expand the standard model in a way that provides all its implications for rich countries whole, while also suggesting an explanation for dullness in the poorer countries of the world. The human capital is the key ingredient for his explanation by using Lucas model. The law of motion for human capital is set in a different form comparing to physical capital. While the physical capital is a part of output converted in to productive capital, the human capital is not. The law of human capital motion requires the use of existing human capital. Therefore, the existing human capital is educated and the key ingredient in the production of education is knowledge. Therefore, his assumption is that future human capital is produced by only the human capital, no contribution of the physical capital and the amount of future human capital depends on the fraction of time spent on education. This is crucially different from the Solow model. While in the Solow model long-run growth rate was determined by productivity growth (exogenously determined parameter), in this particular model, growth rate depends on the time spent on education (endogenously determined parameter). Therefore, the question is arising that what the human capital in the model implies for growth.

Doepke (2007) considers the case of two countries called “A” and “B” in this model. These countries have the same amount of human capital, $H_A=H_B$. These two countries are different only in their initial levels of capital stock. Since the dynamics of the economies are the same, human capital stocks in both economies will always be the same. Since in the long-run ratio of capital, $k_t$, is constant, these two economies will have the same level of physical and human capital and

output. If one of the countries has the lower level of physical capital, then this country will grow faster than the other and they will converge to one another. Therefore, the model becomes just like the Solow model when both countries have identical amount of human capital. However, when these two countries have different initial level of human capital stock, the conclusion will be different. When a country has only half as much human capital as of other country and if the human capital will grows at the same constant rate in both countries, the ratio of human capitals between countries will be always the same. Since the physical to human capital ratios are constant, the long-run ratio of physical capital will be the same as well. What this means is that when a country starts out with less human capital, it never catches up with the rich. Therefore, convergence should not be expected between these countries. Therefore, according to this model, the human capital is the key for most of the evidence on the world income distribution and economic growth. Briefly, this model predicts the convergence or divergence depending on the initial level of human stock. It keeps the door open for country to converge through investing a higher share of resources into education even if the initial human capital is low.

Ramcharan (2004) has slightly emphasized the complementary relationship between the human and the physical capital with imbalances in these two stocks of capital, as well as human capital externalities. He also concludes from the more formal econometric evidence that the important complementarities do exist between various types of human capital. Therefore, highly educated people, such as scientists and technicians appear to have a comparative advantage in understanding and adapting new or existing ideas into production processes where most of the technology forms in physical capitals. He also asks that whether all types of human capital affect growth identically, the impact of a particular type of human capital on growth depends on the presence of other types of human capital and what should be the characteristics of an optimal education policy. When he answers these questions, he emphasizes the role of the composition of the human capital stock where each skill type performs a specific but complementary function within the production process in the skilled sector and moreover, the ideas developed by the highly skilled are assumed to be non-rival but excludable, creating demand linkages between the education types that are external to the firm. He also emphasizes that the rate of return for either skill input depends on the educational composition of the entire workforce, not only the individual's workforce.

Lee (2007) concludes that in Korea human capital has made an extra contribution to income growth by heartening the physical capital investment and the rates of return to investment are high due to a well-educated labor force. He also considers that the complementarities between the human capital and the physical capital are the nature of the production procedure since the machines require skilled workers to manage them and to repair them. He also gives an example that while modern productive agriculture needs a literate agricultural workforce. In his

description, workers should be able to read instructions on a fertilizer bag, comprehend information contained in literature distributed by extension agents and understand the contents of a repair manual for agricultural equipment. In the modern services (travel, finance, tourism), worker should be able to make simple calculations quickly and accurately. Therefore, if a country that gives priority to its physical capital while neglecting its human capital, it will soon discover that the returns to its physical capital are lower than they need to be then it will have lower output. Finally, the technical changes require complemantery investment (similar improvements) in people. Lee (2007) also points out that it is not easy to initiate improved methods of production, new ways of doing things and more complex and sophisticated products if buyers, workers and consumers have insufficient training and education to enable them to understand the technology. Therefore, he also concludes that physical capital formation, the accumulation of human capital and technical change are closely interlinked.

Leeuwen (2007) plots the human-physical capital ratio and this ratio is almost constant in Indonesia and India. However, for Japan it increases slightly up until 1950 then decrease afterwards for the period of 1890 to 2000. Duczynski (2003) considers the imbalance effects for 73 countries between 1960 and 1990 and he reaches a robust result about the (H/K) where if the human capital, the physical capital and the output are included as additional explanatory variables in the regression. Leeuwen' (2007) study underscores the role of the relative human-capital abundance in the fast-growing Asian economies (Indonesia, Japan, Korea, Singapore, Taiwan and Thailand). This study's facts are reliable with two-sector models of endogenous growth models with the large adjustment costs for changing human capital and the models of technological diffusion. Duczynski (2003) checks the direct connection between the human-physical ratio and the output growth and he concludes that his study seems to be better than the existing studies, which provide only indirect evidence for the imbalance effect.

Erk et al. (1998) study on factors like technological inclusion, diffusion, learning by doing and other endogenous factors, not exposed in traditional AK-type models. Available technological level (concealed in K) and improvement in it needs similar improvements in H. Therefore, its broadest sense stirs up long-term economic growth in all countries. Since under-developed countries have the relatively backward technologies with low but the appropriate human capital endowments, they have been able to capture the high long-term growth rates. However, it is not the case for developed countries whose overwhelming technological improvements had not been able to capture the high growth rates because of the relative inadequacy of human endowment. Therefore, as they emphasize that it is not the absolute sizes of physical capital (K) and the skilled-labor (H) but their relative concentration values should be the key determinant of long-term economic growth.

Graca et al. (1995) present a model which has two developmental stages. In the take off stage, human capital accumulation is very low since there is not a sufficient amount of physical capital. When a sufficient level of physical capital is available, the incentive for human capital investment increases. Grier (2000) shows that increases in the stock of one type of capital significantly raises the stock of the other. Lucas (1990) also indicates that one of the main reasons for physical capital not to flow from rich to poor countries is differences in human capital and its external benefits to physical capital. In Table III.1, from high to low, each category uses different intensity and type of physical capital in their work. Goods and services suffer from the "tragedy of the commons" so do their degrees of excludability. For that reason, physical capital and human capital should be matched with these degrees of excludability; otherwise it will be a waste. Therefore, we can say human capital and physical capital are complementary rather than substitute. The complementary and excludability depend on the production process. The arrow on the left shows the degree of excludability from high to low in the Table III.1, below.

**Table III.1: Excludability degree for different types of capital**

| | |
|---|---|
| High ↓ Low | Special professional services (high priority highly skilled workforce) such as expert professor, Lawyer, Doctor, computer professional services and etc.<br>Less ordinary professional services (highly skilled workforce) such as Lawyer, Doctor services and etc.<br>More ordinary professional services such as Lawyer, Doctor services and etc.<br>Ordinary teaching services<br>Ordinary staff services<br>Raw labor services |

Briefly, people have property rights in their own skills, as well as in their raw labor. these property rights in their own skills are closely related with capability of serving well as collateral on loans. Since human capital is a rival good and it is a subject to tragedy of commons, human capital is an excludable good. Another point is that the highly skilled-labor are assumed to be non-rival but still excludable, creating demand linkages between the education types that are external to the firm.

### III.4. EMPIRICAL ANALYSIS

In the section III.4.2, we will break down the growth rate of aggregate output into contributions from the growth of inputs in terms of (K/H), worker effort index and technology. Since growth accounting lets us distinguish the accumulated factors (EL/E and the worker effort level) and the productivity, we consider whether the worker effort index should be in the production function. After testing for these accumulated factors' contribution into production function, in the section III.4.3, we also investigate whether the differences in physical capital to human capital ratio account for the productivity gap between the richest and poorest countries or the differences in

worker effort level account for the productivity gap between the richest and poorest countries. Whether the worker effort is missing variables is the first issue we consider and we also consider whether the worker effort level affects for the income differences, besides studying the income dynamic for cross country by using convergence approach in the section III.4.4. The convergence issue empirically will be tested in terms of absolute convergence and conditional convergence where the conditions are physical capital to human capital ratio and worker effort level.

**III.4.1. DATA**

We have used data for the years 1980, 1990 and 2000 and for the convergence regression, 1970's per-capita income data observation is also included as an initial value for 69 countries. We list the countries included in the study and variables definitions at the Appendix C. Electric power consumption (kWh) shown as (EL) stands for physical capital proxy. GDP per capita and total populations and electric power consumption (kWh) are taken from World Bank's World Development Indicators. Education (E) data comes from the Barro- Lee data set where education data is the average Years of School from Educational Attainment of the Aged 15. DES and DPS data are taken from FAO where "e" stands for worker effort level.

FAO describes that DES measures the daily energy (calorie) intake from food consumption, its unit is the per-capita kcal/day and it is recorded in terms of the national average (Wang and Taniguchi, 2003). There is no doubt that a country's nutritional status is closely associated with its level of income. There is also no doubt that a country's nutritional status is closely associated with its level of economic development. For developed (high-income) economies, the average DES is around 3264 per-capita kcal/day. While the average DES for mid-income countries is around 2690 per-capita kcal/day, it is around 2202 per-capita kcal/day for low-income countries. For DPS it is 101 per-capita kcal/day for High-income, 70 per-capita kcal/day for mid income and 55 per-capita kcal/day for low-income.

We observe high correlation between per-capita GDP level and "e" with per-capita DES level and "e" with DPS level for total sample. We also check correlations between per-capita GDP level and "e" with per-capita DES level and "e" with DPS level according to income level classification in Table III.2. The highest correlation occurs for mid-income sample and lowest for the high income as we expected. We also have checked the correlation between growth rate and worker effort level indices as given in Appendix D.2. The correlation between growth rate and worker effort level indices for high-income is (%10.52 by DES and %9.77 by DPS). It is (%0.27 by DES and %1.68 by DPS) for mid-income. It is (%48.55 by DES and %24.09 by DPS) for low-income. These findings about the correlation between growth rate and worker effort level indices for the income groups should not be surprising since poor spares the most of its income to food

expenditure. Since in the developed countries, most of the work requires less physical strength while for the less developed ones it requires more if the indirect impact of nutrition through cognitive achievement is ignored. Sohn (2000) assumes that physically demanding jobs are relatively rare or these jobs are largely substituted by machinery in developed countries. Thus, income growth and "e" interaction work as expected.

**Table III.2: The Correlation between Per-Capita Income and DES or DPS**

| By year | Whole Sample | | High-Income | | Mid-Income | | Low-Income | |
|---|---|---|---|---|---|---|---|---|
| | DES | DPS | DES | DPS | DES | DPS | DES | DPS |
| 1980 | 0.66 | 0.73 | 0.1 | 0.18 | 0.46 | 0.54 | 0.38 | 0.33 |
| 1990 | 0.6 | 0.71 | -0.29 | -0.05 | 0.34 | 0.43 | -0.005 | -0.02 |
| 2000 | 0.65 | 0.73 | -0.15 | -0.09 | 0.3 | 0.44 | 0.29 | 0.26 |

In order to test for convergence, Islam (1995) assumes that the countries included in the sample are at their steady states. Therefore, according to him, studying the correlation between initial levels of income and subsequent growth rates helps us to check whether countries are at their steady states since the Solow type of models rely on diminishing marginal returns to capital where countries with low levels of capital stock will have higher marginal product of capital and hence, for similar saving rates, grow faster than those with already higher levels of per capita capital stock. Consequently, he points out that finding of a negative correlation or no negative correlation between initial levels of income and subsequent growth rates has become a popular criterion for judging whether or not convergence holds. Finding negative correlation has the scope of being interpreted as evidence of convergence in terms of both income and growth rate. However, finding no negative correlation has the scope of being interpreted as evidence of divergence in terms of both income and growth rate. Following Islam (1995), when we assume all countries are the same in terms of all conditions except the initial level of capital ratio, we do have positive correlation (0.0538) between the initial level of income and the subsequent growth. However, when we allow income groups to be different then we observe negative correlation between the initial income and the subsequent income growth as such (-0.561 for High income, -0.4516 for mid-income, -0.4911 for low income). Other variables' correlations are also reported in Appendix D.2.

We also look at the descriptive statistics of the variable used in this study where we report them in the Appendix D.1. We have compared the mean of these variables according to income classification. As we can see from Table III.3, mean of (EL/E) for the high income countries is around 3 times greater than the mid income countries average and it is around 5 times greater than the low income countries average. This difference is around 2 between mid-incomes and low-income countries. Since it is not easy to conclude which set of income groups of (EL/E) is greater than other, we would like to weight (EL/E) by GDP levels to have some idea about its size for each income groups. It will give statistical information about (EL/E) ratio for our samples but not

the theoretical level. When we weigted (EL/E) by each country's GDP level and weighted by USA GDP level, these differences are less than 1 and they are very similar. It is the highest for mid to low income rate. It is the lowest for high to low income rate.

We also compare the mean growth rate of the subsamples since richer should grow slower than poorer in terms of sigma convergence in Table III.3. However, the findings may be supoorted by the absolute and conditional beta convergence approaches. The mean of growth rate is the highest for high to low income rate (4.68) and secondly it is 3.82 for mid to low income mean growth rate. However, the growth rate is greater in rich than the poor as oppose to our expectation in terms of sigma convergence but not in terms of beta convergence. We expect the growth rate differences should be less than one between rich to poor since sigma convergence means that poor should grow faster than rich. Since we found negative correlation between initial income and subsequent growth for sub sample, this could lead us to witness for beta convergence.

**Table III.3: Comparison of the Means According to Income Classification.**

| Variable | High/Mid | High/Low | Mid/Low |
|---|---|---|---|
| (EL/E) | 3.13 | 5.38 | 1.72 |
| log lag of per-capita GDP | 1.29 | 1.59 | 1.23 |
| e by DES | 1.13 | 1.29 | 1.14 |
| e by DPS | 1.43 | 1.84 | 1.29 |
| Growth rate | 1.23 | 4.68 | 3.82 |
| (EL/E*Y) | 0.49 | 0.27 | 0.57 |
| (EL/E*$Y_{USA}$) | 0.48 | 0.28 | 0.59 |

We have also calibrated whether the differences in mean of log-lag of per capita GDP are greater for richer than poorer in order to study convergence issue in Table III.3. The differences in mean of log lag of per-capita GDP are between high and low income rate is the greatest (1.59) while it is 1.29 for high to mid and 1.23 for mid to low level rate since we expect that it should be greater than one so it is validated. We also calibrate whether the richer has greater worker effort indices than poorer because of their nutritional intakes. In Table III.3., we experience that richer has greater nutritional intakes.

## III.4.2. MODELLING AND MEASURING THE WORKER EFFORT AND VARIANCE DECOMPOSITION

### III.4.2.1 The Model

Relying on the reasoning for physical to human capital ratio, the model is as follows

$$Y = \left(\frac{K}{H}\right)^{\alpha} \left(AL^{*}\right)^{1-\alpha} \qquad (1)$$

Effective labor input, $L^{*}$, is related to raw labor input $(L)$ by

$L^*=e(.)L$ (2)

where Y, e, L, K, H and A stands for output, the average level of worker effort (the effectiveness of labor) in a country, the number of workers, physical capital, human capital (which is a function of education and worker effort indices) and the level of productivity, respectively. $\alpha$ shows the share of physical-human capital in the production function. At the individual level, a worker's effort can be a function of the nutrient intake level if we consider the direct and indirect impact of nutrition. Let's assume that at the country level, average worker effort (e) is an increasing function of the country's average nutrient intake level ($x_c$) then it follows that

$e = e(x_c)$, $e' > 0$ and $e'' < 0$ (3)

We like to show production function has two components: accumulated factors and productivity where H is composed of education and worker effort level (H=Education*worker effort).

$$Y = \left[\frac{EL}{E^*e}\right]^{\alpha}(AeL)^{1-\alpha} \text{ and } \frac{Y}{L} = A\left[\frac{EL}{EY}\right]^{\frac{\alpha}{1-\alpha}}(e)^{\frac{1-2\alpha}{1-\alpha}} = A\chi \quad (4)$$

where E stands for education and $\chi$ is the accumulated factors. Therefore, the Cobb-Douglas production function in per worker terms tells us that output consists of productivity times accumulated factors ( $\chi$ ).

We follow Sohn's (2000) study to measure the worker effort. He reports the following quadratic function for the labor efficiency:

$$e^i = (4.34*10^{(-4)})*(x_c^i) - (4.16*10^{(-8)})(x_c^i)^2 \quad (5)$$

where $e_i$ is efficiency units of labor for worker i and $x_c^i$ is the daily calorie intake at the individual level. It is assumed that all workers are identical in a country, so "e" shows countries' efficiency units of labor from an average worker and $x_c$ denotes DES or DPS. Therefore, we have two different worker effort measurements.

For the methodology of levels accounting, we utilize Sohn' decomposition of the variance (Sohn, 2000) in output per worker (Y/L) across countries into the contribution from A and the contribution from $\chi$ or simply having the variance of $\frac{Y}{L} = A\chi$:

$$Var\left[\ln\left(\frac{Y}{L}\right)\right] = Var\left[\ln(A)\right] + Var\left[\ln(\chi)\right] + 2Cov\left[\ln(A)\ln(\chi)\right] \quad (6)$$

and after dividing by Var(ln(Y/L)) we will have

$$\frac{Var\left[\ln\left(\frac{Y}{L}\right)\right]}{Var\left[\ln\left(\frac{Y}{L}\right)\right]} = \frac{Var\left[\ln(A)\right] + Var\left[\ln(\chi)\right] + 2Cov\left[\ln(A)\ln(\chi)\right]}{Var\left[\ln\left(\frac{Y}{L}\right)\right]} \quad (7)$$

$$= \frac{Var\left[\ln(A)\right] + Cov\left[\ln(A),\ln(\chi)\right]}{Var\left[\ln\left(\frac{Y}{L}\right)\right]} + \frac{Var\left[\ln(\chi)\right] + Cov\left[\ln(A),\ln(\chi)\right]}{Var\left[\ln\left(\frac{Y}{L}\right)\right]} \quad (8)$$

$$1 = \frac{Cov\left[\ln\left(\frac{Y}{L}\right),\ln(\chi)\right]}{Var\left[\ln\left(\frac{Y}{L}\right)\right]} + \frac{Cov\left[\ln\left(\frac{Y}{L}\right),\ln(A)\right]}{Var\left[\ln\left(\frac{Y}{L}\right)\right]} \quad (9)$$

1=the contribution of ln( $\chi$ )+ the contribution of ln (A) (10)

When there are more than two components of per capita GDP correlated with one another, it is better to present the variance decomposition in this way. The reasoning behind such decomposition is that "if per capita GDP is higher by one percent, what could be our best guess as to how much higher productivity (A) and factor inputs ( $\chi$ ) are?". Using this variance decomposition, we can conveniently compare the relative importance of $\chi$ vs. A. Especially, how much worker effort, e, included in the "$\chi$" term explains some of the portion of the unexplained residual term "A" (Sohn, 2000) .

**III.4.2.2. The Results**

We run different regressions for the whole sample and for three sub samples classified by income as high, mid and low-income. Following Sohn (2000), we divide data into sub-samples because the positive relationship between nutrition and effort may be insignificant in the developed countries if the indirect impact of nutrition through cognitive achievement is ignored. In the developed countries, most of the work requires less physical strength while for in less developed ones it requires more. Therefore, we can compare the worker effort effects in each sub sample. We use education to define human capital at this point and we do not consider the worker effort in labor where L*=L at this stage. Therefore, we have run equation (11) to have alpha values to calculate variance decomposition calculation where EL stands for K proxy and E for Education.

$$\frac{Y}{L} = A\left(\frac{EL}{E*Y}\right)^{\frac{\alpha}{1-\alpha}} \quad (11)$$

Since only mid-income level sample shows heteroskedastic charecter where it is tested by White test approach, OLS estimation is not appropriate. Therefore, using feasible generalized least

square (FGLS) and iterated feasible generalized least square (IFGLS) estimation may have solved the heteroskedasticity problem of the data besides considering the cross sectional heteroskedacticticty for the whole subsample. After calibrating the alpha parameters from equation (11), we use the model in equation (4) to calculate the role of the each component by using

$\frac{Cov(Ln(\frac{Y}{L}),Ln(Z))}{Var(Ln(\frac{Y}{L}))}$), $\frac{Cov(Ln(\frac{Y}{L}),Ln(Des))}{Var(Ln(\frac{Y}{L}))}$ and $\frac{Cov(Ln(\frac{Y}{L}),Ln(Dps))}{Var(Ln(\frac{Y}{L}))}$ with Z where

$Z=\left(\frac{EL}{E^{*}Y}\right)^{\frac{\alpha}{1-\alpha}}$ and $DES=e^{\frac{1-2\alpha}{1-\alpha}}$ or $DPS=e^{\frac{1-2\alpha}{1-\alpha}}$ stand for each $\chi$ components of Y separately.

**Table.III. 4: The role of worker effort to explain the residuals***

| | Z | DES | DPS | Residual | DES/Residual | DPS/Residual | Changing in size of residuals (DES) | Changing in size of residuals (DPS) |
|---|---|---|---|---|---|---|---|---|
| Whole (OLS) | 0.39 | 0.36 | 0.14 | 0.63 | 0.57 | 0.23 | 0.75 | 0.53 |
| High(OLS) | 0.057 | 0.054 | 0.006 | 0.943 | 0.057 | 0.0065 | 0.111 | 0.063 |
| Mid(OLS) | 0.063 | 0.163 | 0.058 | 0.937 | 0.174 | 0.062 | 0.226 | 0.121 |
| Low(OLS) | 0.038 | 0.102 | 0.046 | 0.96 | 0.106 | 0.048 | 0.14 | 0.084 |
| Whole (FGLS) | 0.3538 | 0.3538 | 0.1399 | 0.646 | 0.548 | 0.217 | 0.7076 | 0.4937 |
| High(FGLS) | 0.073 | 0.057 | 0.066 | 0.927 | 0.0616 | 0.007 | 0.13 | 0.139 |
| Mid(FGLS) | 0.156 | 0.221 | 0.076 | 0.844 | 0.26 | 0.09 | 0.377 | 0.232 |
| Low(FGLS) | 0.015 | 0.096 | 0.043 | 0.986 | 0.0976 | 0.044 | 0.111 | 0.058 |
| Whole(IFGLS) | 0.31 | 0.327 | 0.129 | 0.694 | 0.47 | 0.186 | 0.637 | 0.439 |
| High(IFGLS) | 0.23 | 0.0899 | 0.1 | 0.769 | 0.1169 | 0.0134 | 0.3199 | 0.33 |
| Mid(IFGLS) | 0.062 | 0.18 | 0.062 | 0.938 | 0.19 | 0.066 | 0.242 | 0.124 |
| Low(IFGLS) | -0.029 | 0.085 | 0.038 | 1.0299 | 0.083 | 0.037 | 0.0551 | 0.0081 |

*DES and DPS stand for worker effort with DES and DPS respectively.*
*OLS (Ordinary Least Square, FGLS (Feasible Generalized Least Square, IFGLS (Iterated Feasible Generalized Least Square), the regressions results are reported at the AppendixE.*

As seen from table III.4 for the whole (OLS) data, attributing the percentage of the unexplained residuals to the differences in worker effort is calculated as around 0.57 for worker effort level by DES, while 0.23 at DPS for 207 observations. Since DES indicates the energy supply, it is more effective than DPS in terms of per-capita income changes. The expectation for the contribution of Z is the highest for the high income and the lowest for the low income at the OLS calibration of alpha parameters. Therefore, somehow (partially) our expectation is verified since the contribution of Z is almost the highest around (0.057) for the high income and the lowest for the low income around (0.04). However, worker effort contribution is expected to be the highest for the low income countries and lowest for the high income countries. Worker effort contribution by DES is lowest for the high-income (0.054) and the highest for the middle income (0.163) and it is 0.102 for low-income while worker effort contribution by DPS is lowest for the high income (0.006) and the highest for the middle income (0.046 and 0.058, respectively). Therefore, the expectation is partially verified.

Since the data is in panel form and there is the cross sectional heteroskedacticticty in this form and the mid-income level sample displays the heteroskedacticticty, we have picked up the results of (IFGLS) among the there estimation despite of contribution of "z" is negative. Only the IFGLS results the significant coefficients for the log (EL/E). Therefore, the question is whether this negativity is possible or not. It could occur when human capital and raw labor live on the substandard levels of nutrition and most of the work requires more physical strength for the less developed countries. Mainly, the population should reflect a recovering status. Although it may be just enough to survive on their DES and DPS level it may not enough to turn into output. People who live on the edge of starvation can be expected to follow a policy of safety first with respect to making investments. They will avoid taking risks since the consequences of a downward fluctuation in income will be catastrophic. But less risky investments also tend to have lower rewards. In low-income countries, as in the model presented by Graca et al. (1995) which has two developmental stages, possibly in the take off stage, human capital accumulation is at very low levels since there may not be a sufficient amount of physical capital or vice versa in our cases. If sufficient physical capital is available then human capital investments increase. This may be supported since the contribution of Z in low income is around (0.04). This transition process from the take of stage to second stage works well in mid-income but not in low-income. Therefore, nutrition can be turned into output in mid-income but not in low-income. We should also point out that when we add Z and the worker effort level, the size of the residuals declines as we display in the last two columns of the table III.4. This shrink in residuals also lead us that the worker effort level (depends on the nutritional level) is important.

### III.4.3.CROSS-COUNTRY INCOME DIFFERENCES WITH LEVEL ACCOUNTING APPROACH

McGrattan and Schmitz (1998) report that gross domestic product (GDP) per worker of rich countries like the United States is about 30 times more than that of poor countries like Ethiopia. The fastest-growing countries now grow at 9 percent per year, whereas 100 years ago the highest rates of growth were around two percent. They also report that over the postwar period, there was virtually no correlation between income and subsequent growth rates as growth rates show very little persistence. In order to analyze the income dynamics and its differences, there is little consensus concerning approaches. One approach is actual income by level accounting and the other is convergence regression. When we review the levels and growth accounting literature, we observe that the objective of this literature is to estimate the contributions of physical capital, labor, educational attainment, nutrition and technological progress to differences in levels or growth rates of per-capita income. Even though it is not directly addressed why factor inputs differ across countries, the level accounting exercises are still important steps in explaining cross-country income differences. For example, to estimate the effects of policy in quantitative theories,

reliable estimates for certain parameters, like capital shares, are needed. The accounting exercises provide careful measurements of labor and capital inputs, estimates of the shares of these inputs. In our case, we estimate (EL/E) effects and worker effort effects to explain the income differences.

It is shown that the estimates of TFP are sensitive to the measurement of human capital (McGrattan and Schmitz, 1998) and also the estimates of TFP are sensitive to the shares of income to physical and human capital ratio as we showed in the variance decomposition section. McGrattan and Schmitz (1998) point out that there is little consensus on the size of the stock of human capital or on the magnitude of the factor shares. Thus, we calculate the fraction of income differences explained by differences in observed factor inputs. We ask the following question that what extent can differences in physical capital to human capital ratio account for the productivity gap between the richest and poorest countries or what extent can differences in worker effort level account for the productivity gap between the richest and poorest countries? To be precise the ratio is calculated as

$$\frac{\frac{1}{N_{rich}}\sum\left(\frac{Y}{L}\right)rich}{\frac{1}{N_{poor}}\sum\left(\frac{Y}{L}\right)poor}=\frac{\frac{1}{N_{rich}}\sum_{i\in rich}\left(\frac{EL_{irich}}{E_{irich}*Y_{irich}}\right)^{\frac{\alpha}{1-\alpha}}*e_{irich}^{\frac{1-2\alpha}{1-\alpha}}}{\frac{1}{N_{poor}}\sum_{i\in poor}\left(\frac{EL_{ipoor}}{E_{ipoor}*Y_{ipoor}}\right)^{\frac{\alpha}{1-\alpha}}*e_{ipoor}^{\frac{1-2\alpha}{1-\alpha}}} \qquad (12)$$

the "rich" stands for both high or middle income countries and the "poor" stands for either middle or low income countries. As McGrattan and Schmitz (1998) assume no differences in technology, we also assume no differences in technology "A" across countries so it is cancelled out. Thus, if we use observations of EL/E, the ratio is a prediction of the productivity gap due only to variations in EL/E ratio. Briefly, the objective in the levels accounting is to apportion differences in income levels to differences in levels of TFR and factor inputs.

**III.4.3.1. The Results**

We start with the actual ratio Rrate as shown in Table III.5 and Table III.6 where Rrate stands for the ratio of average per-capita GDP for rich to per-capita GDP for poor. Rrate for high-income to middle-income, high-income to low-income, mid-income to low-income are 7.95, 42.7 and 5.4, respectively, and these are reported in the second column in Table III.5. For high-income to middle-income, high-income to low-income, mid-income to low-income ratios show that high-income countries' per capita income is at least 8 times greater than mid-income countries, around 43 times greater than low-income countries and mid-income countries' per capita income is almost 5.4 greater than low-income countries' per capita income.

The predicted productivity gap for high-income to middle-income, high-income to low-income, mid-income to low-income, assuming only differences in $Z=\left(\frac{EL}{E^{*}Y}\right)^{\frac{\alpha}{1-\alpha}}$, are calculated in the third column of Table III.5 as 1.92, 1.67 and 0.87 respectively. We can safely say that productivity gap in terms of Z are less than the actual ratio. The predicted productivity gap for high-income to middle-income, high-income to low-income, mid-income to low-income, assuming only differences in worker effort level by DES, are calculated in the fourth column of Table III.5 as 1.22, 1.53 and 1.25 respectively. Also assuming only differences in worker effort level by DPS, the predicted productivity gap for high-income to middle-income, high-income to low-income, mid-income to low-income are calculated in the fifth column of Table III.5 as 1.79, 2.78 and 1.55 respectively. Therefore, productivity gap in terms of DES and DPS are less than the actual ratio. Yet, worker effort level by DPS disparity is greater than worker effort level by DES

**Table.III.5: Productivity gap due to factor intensities with same alpha level for all countries**

| Same Alpha | Rrate | Z | DES | DPS | Z /Rrate | DES/Rrate | DPS/Rrate |
|---|---|---|---|---|---|---|---|
| High/Mid | 7.95 | 1.92 | 1.22 | 1.79 | 0.32 | 0.096 | 0. 28 |
| High/Low | 42.7 | 1.67 | 1.53 | 2.78 | 0.14 | 0.114 | 0.27 |
| Mid/Low | 5.4 | 0.87 | 1.25 | 1.55 | -0.085 | 0.14 | 0.26 |

*IFGLS (iterated feasible generalized least square) regression methodology is used and it fits cross-sectional time-series linear models using feasible generalized least squares except for low-income. The regressions results are reported at the AppendixE.*

The numbers in the sixth, seventh and eight columns of Table III.5 are the ratios of predicted to actual productivity gap, both in logarithms. These are measurements of the gap in productivities attributable to variation in Z, worker effort by DES and DPS, at the same α level for countries. In the case of high to middle income, productivity gap with only assuming differences in Z is 1.92 and the actual ratio is 7.95. Therefore, log(1.92)/log(7.95) is 0.32 which means 32 percent of the gap in productivity can be explained by differences in Z intensities. Therefore, it is a measure of the gap in productivities attributable to variation in Z. These values are 0.14 and -0.085 for high to low income and for mid to low income, respectively. Thus, 14 percent of the gap in productivity can be explained by differences in "e" by DES intensities for high to low income and -8.5 percent of the gap in productivity can be explained by differences in "e" by DPS intensities middle to low income. this -8.5 percent does mean that there is no productivity gap and both samples DPS level are very close or low-income level DPS consumption is higher than the mid-income level countries. These percentages are 0.096, 0.114 and 0.14 for effort level by DES and they are 0.28, 0.27 and 0.26 for effort level by DPS. Therefore, worker effort levels could explain some of the productivity gap where DPS does better explanation than DES.

We set the different production function for each income classification. Therefore, we have three different physical-human capital ratio shares where we assume no differences in "A" term for income classification. The predicted productivity gap for high-income to middle-income, high-

income to low-income, mid-income to low-income, assuming only differences in Z, are calculated in the third column of Table III.6 as 7.2, 40.34 and 5.6 respectively. We can safely say that productivity disparities, assuming only differences in Z, are less than the actual ratio. The predicted productivity gap for high-income to middle-income, high-income to low-income, mid-income to low-income, assuming only differences in worker effort level by DES, are calculated in the fourth column of Table III.6 as 1.5, 2.4 and 1.54 respectively. Also assuming only differences in worker effort level by DPS, the predicted productivity gap for high-income to middle-income, high-income to low-income, mid-income to low-income are calculated in the fifth column of Table III.6 1.74, 1.31 and 0.75 respectively. Therefore, productivity gap in terms of DES and DPS are less than the actual ratio. Worker effort level with DES in the same production function and different production function almost gives the same result. However, worker effort by DPS varies greatly when we allow different production function for each income groups. The effect of worker effort by DPS declines greatly. Therefore, DPS does not cause much productivity differences when each of the income groups has different production function.

**Table.III.6: Productivity gap due to factor intensities with different alpha level**

| Different Alpha | Rrate | Z | DES | DPS | Z /Rrate | DES/Rrate | DPS/Rrate |
|---|---|---|---|---|---|---|---|
| High/Mid | 7.95 | 7.2 | 1.5 | 1.74 | 0.95 | 0.2 | 0.27 |
| High/Low | 42.7 | 40.34 | 2.4 | 1.31 | 0.99 | 0.23 | 0.07 |
| Mid/Low | 5.4 | 5.6 | 1.54 | 0.75 | 1.03 | 0.27 | -0.17 |

*IFGLS (iterated feasible generalized least square) regression methodology is used and it fits cross-sectional time-series linear models using feasible generalized least squares except for low-income. The regressions results are reported at the AppendixE.*

The numbers in the sixth, seventh and eight columns of Table III.6 are the ratios of predicted to actual productivity gap, both in logarithms. These are measurements of the gap in productivities attributable to variation in Z, worker effort by DES and DPS, at different production values of α for each income groups. In the case of high to middle income, productivity gap with only assuming differences in Z is 7.2 and the actual ratio is 7.95. Therefore, log(7.2)/log(7.95) is 0.95 which means 95 percent of the gap in productivity can be explained by differences in Z intensities. Therefore, it is a measure of the gap in productivities attributable to variation in Z. These values are 0.99 and 1.03 for high to low income and for mid to low income, respectively. Therefore, the Z is higher in mid-income than the low-income and it causes the productivity gap. Thus, 99 percent of the gap in actual incomes can be explained by differences in "e" by DES intensities for high to low income and -103 percent of the gap in actual incomes can be explained by differences in "e" by DPS intensities middle to low income. These percentages are 0.2, 0.23 and 0.27 for effort level by DES and they are 0.27, 0.07 and -0.17 for effort level by DPS. Therefore, worker effort levels could explain some of the productivity gap. This negative value of "e" by DPS for high to mid income means that mid-income of "e" by DPS influences on per-capita income is higher than high-income of "e" by DPS. Briefly, we tried to apportion

differences in income levels to differences in the factor inputs ((EL/E) and worker efforts) by the levels accounting and they do well.

### III.4.4. CONVERGENCE APPROACH FOR CROSS COUNTRY INCOME DIFFERENCES

Whether poor grows faster than rich and how fast the average poor becomes rich and how fast the average rich becomes poor is the subject of convergence approach which is widely used in the regressions (Barro and Sala-i-Martin, 1995; Levine and Renelt, 1992). Hitiris and Nixon (2001) find β-conditional convergence where the further away health care expenditure is from its steady state the faster it approaches. Rivera and Currais (1999) employ health expenditure in β-conditional convergence regression and they find that it has positive and significant effects on the growth. We set our model ratio of K/H with labor augmenting technology and the model is defined according to equation (2) and (3) where $0 < \alpha < 1$. In terms of model dynamics, $A_t$ is growing at a constant rate of g and $L_t$ at a rate of n where we define

$$\frac{\dot{A}}{A} = g \quad \text{and} \quad \frac{\dot{L}}{L} = n \tag{13}$$

Suppose a fixed fraction of output "s" is invested and the depreciation rate of capital ratio is δ then the dynamics of physical to human capital ratio accumulation is given in equation 14 and where "*", such as $\left(\frac{\mathrm{K}}{H}\right)_t^*$, denotes differentiations with respect to time.

$$\left(\frac{\mathrm{K}}{H}\right)_t^* = sY_t - \delta\left(\frac{\mathrm{K}}{H}\right)_t \tag{14}$$

We give the detailed solution of the model in Appendix E and we report just the equations we need for interpreting the results. In equation (15), we give per-effective capital ratio dynamics of the economy and in equation (16) convergence rate are given. We show $f(k)=\frac{Y}{L}$ and $k=\frac{K/H}{AL}$

$$k^* = sf(k) - (n+g+\delta)k \tag{15}$$

$$\beta = (1-\alpha)(n+g+\delta) \tag{16}$$

In terms of panel specification; we should set absolute case in equation (17) and conditional case in equation (18).

$$\frac{1}{T}\ln\left(\frac{y_{it}}{yi_{t-T}}\right) = a - \left(\frac{1-e^{-\beta t}}{T}\right)\ln(y_{it-T}) \tag{17}$$

$$\frac{1}{T}\ln\left(\frac{y_{it}}{y_{it-T}}\right)=\left(\frac{1-e^{-\beta t}}{T}\right)\ln(y^*)-\left(\frac{1-e^{-\beta t}}{T}\right)\ln(y_{it-T}) \quad (18)$$

where y* stands for steady state value of per capita income. Firstly, we set the per capita income without worker effort level. Therefore, the stock of (K/H) is proxied with (EL/E) and we can write steady state per capita income as

$$\ln(y^*)=Ln\left(\frac{Y}{L}\right)^*=Ln(A)+\alpha Ln\left(\frac{EL}{E}\right)$$

To measure total worker effort effects on income convergence, worker effort effects "e" in human capital and in effective labor (e*L) are combined. Therefore, we can measure worker effort effects on per-capita income convergence and plugging ln(y*) in equation (18) we will have (18.1) which does not include any effort level indexes.

$$\frac{1}{T}\ln\left(\frac{y_t}{y_{t-T}}\right)=\left[\frac{1-e^{-\beta t}}{T}\right]Ln(A_0) \quad (18.1)$$
$$+\alpha\left[\frac{1-e^{-\beta t}}{T}\right]Ln\left(\frac{EL}{E}\right)-\left[\frac{1-e^{-\beta t}}{T}\right]\ln(y_0)$$

When we consider the worker effort in the model then we will have $\ln(y^*)=Ln\left(\frac{Y}{L}\right)^*=Ln(A)+\alpha Ln\left(\frac{EL}{E}\right)+(1-2\alpha)Ln(e)$ and plugging ln(y*) in equation (18) we will have (18.2).

$$\frac{1}{T}\ln\left(\frac{y_t}{y_{t-T}}\right)=\left[\frac{1-e^{-\beta t}}{T}\right]Ln(A_0)+\alpha\left[\frac{1-e^{-\beta t}}{T}\right]Ln\left(\frac{EL}{E}\right) \quad (18.2)$$
$$+(1-2\alpha)\left[\frac{1-e^{-\beta t}}{T}\right]Ln(e)-\left[\frac{1-e^{-\beta t}}{T}\right]\ln(y_0)$$

The $A_t$ term can be divided into two parts as such $\ln A_t=\left(1-e^{-\beta t}\right)Ln(A_0)+g\left(t-e^{-\beta t}t_0\right)$. The first term is called the constant term of an economy-specific term: $\left(1-e^{-\beta t}\right)Ln(A_0)$ in equations (18.1 and 18.2) and the second term is called the constant term of an economy-invariant time specific factors: $g\left(t-e^{-\beta t}t_0\right)$. Both capture the steady-state factors. However, only the constant term of an economy-specific term will be included specifically in the regression equation.

**III.4.4.1. The Results**

Sala-i-Martin (1994) considers the concept of β-convergence (either absolute or conditional convergence) as the most interesting convergence concept. He illustrates his points within an example. He considers the ordinal rankings of the NBA teams over time and he assumes that ranking's dispersion is constant by definition. Therefore, the most interesting question for sports analysts and team owner is how fast the leader team reverts to mediocrity and how long teams' dynasties last. More clearly he points that how long did it take for the great Boston Celtics and Los Angeles Lakers of the 1980s to become average teams or how quickly mediocre teams

become great teams such as how long did it take to create the Chicago Bulls of the 1990s. Therefore, he is also interested in question that what kind of strategies the NBA could introduce to transform bad teams into great teams in as little time as possible. In terms of economic application of his discussion, he poses the same questions such as whether poor grows faster than rich and how fast the average poor becomes rich and how fast the average rich becomes poor, independently of whether the aggregate cross-sectional variance is falling or rising. According to him, whether the aggregate cross-sectional variance is falling or rising is secondary importance. All of these questions refer to β-convergence but not σ-convergence. Therefore, we are interested in β-convergence either in terms of absolute or conditional convergence. The β-convergence occurs if we have significantly negative coefficient for log-lag of per-capita income. Log(EL/E) stands for log(Industry Electric Power consumption (kWh)/Education). In the Table III.7 we also report the Log-likelihood ratio. The models with the conditional variables fit better except the regression with income dummies, (EL/E) and worker effort level by DES in the seventh column since log-likelihood ratio would increase with additional control variables.

In Table III.7, we have run absolute convergence and conditional convergence regressions where we show the empirical models in Table III.8. We have estimated the growth rate of per-capita income on the log-lag of per-capita income. From third to eight column of Table III.7 we have reported conditional convergence results where we have run the regressions with additional control variables such as Industry Electric Power Consumption (kWh) to Education ratio (EL/E) and worker efforts besides income dummies. In Table III.8., we have tabulated the regressions we run. In the first column of Table III.8, the models are presented while the numbers in the second column of Table III.8 show the regressions whose results are reported in Table III.7.

Since we have panel data, we have run all the regressions with iterated feasible generalize least square (IFGLS, heteroskedastic, no autocorrelation) methology. For the absolute convergence case in the second column, we experience significant divergence while conditional convergence regression with (EL/E) does show convergence tendency with insignificant coefficients in the fourth column. However, for all the other conditional convergence regressions (with EL/E) and income dummies, with (EL/E) and worker effort level and finally with (EL/E), worker effort level and income dummies) we have found significant convergence coefficient. Since beta coefficients (β) show how fast the gap vanishes between steady state per-capita GDP and current per-capita GDP where beta depends on alpha value (α), the implied-β (Beta value) and implied-α (alpha value) values are reported in the tables. As the model predict, the implied-α-values are in the range of between zero and one. However, we experience very high implied-α –values with worker effort but without income dummies in the conditional regression. One of the implied-α–value (0.67) is worth to consider. It is very close to total value of physical capital share and human capital share in Mankiw et al. (1992) where (0.48+0.23=0.71). However, when we included other

control variables such as (EL/E), income dummies besides worker effort indices in the regression, the implied-α–values decline substantially. For the regression with lag of GDP and (EL/E) the implied-α–value for this specific case is greater than one where implied-β for this case is insignificant. Therefore, we ignore it.

**Table III.7: Convergence**

| Dependent variable: Average per-capita GDP growth rate | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| $\log(y_{t-T})$ | 0.001 | -0.013 | -0.001 | -0.013 | -0.003 | -0.113 | -0.003 | -0.012 |
| | (1.98)* | (12.80)** | -1.09 | (12.47)** | (4.43)** | (10.17)** | (3.65)** | (10.22)** |
| Income Dummies for High | | 0.141 | | 0.1 | | 0.912 | | 0.112 |
| | | (14.99)** | | (9.86)** | | (8.17)** | | (5.70)** |
| Income Dummies for Mid | | 0.113 | | 0.073 | | 0.694 | | 0.091 |
| | | (15.53)** | | (8.90)** | | (7.58)** | | (4.83)** |
| Income Dummies for Low | | 0.079 | | 0.041 | | 0.43 | | 0.062 |
| | | (12.54)** | | (5.58)** | | (4.71)** | | (3.28)** |
| log(EL/E) | | | 0.002 | 0.002 | 0.002 | 0.016 | 0.002 | 0.002 |
| | | | (5.82)** | (6.01)** | (4.59)** | (6.32)** | (3.93)** | (6.72)** |
| log(e) by DPS | | | | | | | 0.02 | 0.007 |
| | | | | | | | (4.14)** | 1.82 |
| Constant | 0.011 | | -0.033 | | 0.012 | | 0.074 | |
| | (2.28)* | | (3.61)** | | -1.02 | | (2.96)** | |
| log(e) by DES | | | | | 0.059 | 0.202 | | |
| | | | | | (5.54)** | (2.45)* | | |
| Observations | 207 | 207 | 207 | 207 | 207 | 207 | 207 | 207 |
| Log likelihood | 574.37 | 608.29 | 581 | 613.3 | 586.5 | 136.8 | 584 | 612 |
| Convergence Rate | -0.001 | 0.012 | 0.0001 | 0.012 | 0.003 | 0.077 | 0.003 | 0.011 |
| Alpha-Value | | | | 0.15385 | 0.67 | 0.14 | 0.67 | 0.17 |

*Absolute value of z statistics and its significance level are in parentheses and significant level shown with * at 5%; ** significant at 1%. IFGLS (iterated feasible generalized least square) regression methodology is used and it fits cross-sectional time-series linear models using feasible generalized least squares.*

The regression with lag of per capita income and income dummies results the highest convergence rate. The convergence rates are higher with (EL/E), income dummies and worker effort with DES than just any other regression. (EL/E) coefficients do show minor change when we add worker efforts in the regression. The income dummies are all significant. Only exception is for mid-income dummies in the regression with worker effort with DPS. The regressions in Table III.8 are the ones we reported their results in Table III.7, the alpha level ranges between the 0.155 and 0.67. While the regression with the income dummies besides (EL/E) and worker effort level gives the result of a lower value of implied-α, the regression without income dummies gives the result of a higher value of implied-α. This higher transition occurs for regression with income dummies, (EL/E) and worker effort with DES. Since the data becomes more homogeneous with adding all explanatory variables in the regression, it is more reasonable to pick up their implied-α values. These are 0.155 and 0.17. We should also point out that income dummies seem to be more

effective than the other control variables. Therefore, considering these dummies to close the gap may be more important than (EL/E) and "e".

**Table III.8: Convergence Regression**

| | |
|---|---|
| $\frac{1}{T}\ln\left(\frac{y_{it}}{yi_{t-T}}\right)=\text{Constant}-\left(\frac{1-e^{-\beta t}}{T}\right)\ln(y_{it-T})$ | 1 |
| $\frac{1}{T}\ln\left(\frac{y_{it}}{yi_{t-T}}\right)=\varphi_1\text{Income Dummies for High}+\varphi_2\text{Income Dummies for Mid}$ $+\varphi_3\text{Income Dummies for Low}-\left(\frac{1-e^{-\beta t}}{T}\right)\ln(y_{it-T})$ | 2 |
| $\ln\left(\frac{y_t}{y_{t-T}}\right)=\text{Constant}+\alpha\left(\frac{1-e^{-\beta t}}{T}\right)Ln\left(\frac{EL}{E}\right)-\left(\frac{1-e^{-\beta t}}{T}\right)\ln(y_0)$ | 3 |
| $\ln\left(\frac{y_t}{y_{t-T}}\right)=\varphi_1\text{Income Dummies for High}+\varphi_2\text{Income Dummies for Mid}$ $+\varphi_3\text{Income Dummies for Low}+\alpha\left(\frac{1-e^{-\beta t}}{T}\right)Ln\left(\frac{EL}{E}\right)-\left(\frac{1-e^{-\beta t}}{T}\right)\ln(y_0)$ | 4 |
| $\ln\left(\frac{y_t}{y_{t-T}}\right)=\text{Constant}+\alpha\left(\frac{1-e^{-\beta t}}{T}\right)Ln\left(\frac{EL}{E}\right)$ $+(1-2\alpha)\left(\frac{1-e^{-\beta t}}{T}\right)Ln(e)-\left(\frac{1-e^{-\beta t}}{T}\right)\ln(y_0)$ | 5 |
| $\ln\left(\frac{y_t}{y_{t-T}}\right)=\varphi_1\text{Income Dummies for High}+\varphi_2\text{Income Dummies for Mid}$ $+\varphi_3\text{Income Dummies for Low}+\alpha\left(\frac{1-e^{-\beta t}}{T}\right)Ln\left(\frac{EL}{E}\right)$ $+(1-2\alpha)\left(\frac{1-e^{-\beta t}}{T}\right)Ln(e)-\left(\frac{1-e^{-\beta t}}{T}\right)\ln(y_0)$ | 6 |
| $\ln\left(\frac{y_t}{y_{t-T}}\right)=\text{Constant}+\alpha\left(\frac{1-e^{-\beta t}}{T}\right)Ln\left(\frac{EL}{E}\right)$ $+(1-2\alpha)\left(\frac{1-e^{-\beta t}}{T}\right)Ln(e)-\left(\frac{1-e^{-\beta t}}{T}\right)\ln(y_0)$ | 7 |
| $\ln\left(\frac{y_t}{y_{t-T}}\right)=\varphi_1\text{Income Dummies for High}+\varphi_2\text{Income Dummies for Mid}$ $+\varphi_3\text{Income Dummies for Low}+\alpha\left(\frac{1-e^{-\beta t}}{T}\right)Ln\left(\frac{EL}{E}\right)$ $+(1-2\alpha)\left(\frac{1-e^{-\beta t}}{T}\right)Ln(e)-\left(\frac{1-e^{-\beta t}}{T}\right)\ln(y_0)$ | 8 |

Both of the worker effort affects the convergence rate without the income dummies. That is also valid for regression with only (EL/E). We have experienced higher convergence rate with only income dummies besides $\log(y_{t-T})$ (1.2%) than either (EL/E) (0.01%) or (EL/E) and "e" (0.3%) in the regressions without income dummies. When ever we included income dummies we have higher convergence rate for (EL/E) (1.2%) or (EL/E) and "e" (7.7% by DES and 1.1 by DPS) in the regressions. Therefore, income dummies raise the convergence rate. These significant income

specific dummies also lead us to think that differences at different income levels are also very important. Removing such differences causes a faster convergence rate; what that means is that there will be room for policy. This policy opportunity enters in our content because using income dummies and other variables already allow production function to be different. These variables may have direct positive effects on the country's long-run income so do on the transitional growth rate. However, since both worker effort indices contributes for economic growth in the long run, any policies to improve nutritional status will be effective because of worker effort indices have to have a long run provision. Policy maker should focus on more on the DES level since it contributes more on income growth and DES covers the DPS. Speculatively, improvement of nutritional status in developing countries has several important consequences since health and nutrition are interlinked. Since healthier labor force or human capital are more productive and healthier student will provide better human capital and healthier worker will save more because of spending less on medicine and visiting doctor and for his retirement, all these influences will let the country to have stable economy. Besides this, model gives us a clue that "e" by DES causes the fastest convergence. Therefore, we may have to focus on DES structure of the society while DPS is a portion of the DES. However, we may have to take care of "e" and (EL/E) interaction when policy makers set a policy.

The finding of lower rate of convergence may also emerge to emphasize the policy-relevance philosophy attributed to the Solow model. In reality, our finding also sheds light on the issue of policy activism since conventionally, only the saving and population growth rates were thought to be the variables for policies to be directed to. However, as Islam (1995) points out, our study also emphasizes the role of the A(0) term as a determinant of the steady-state level of income. Therefore, we can safely say that even with exactly the same rates of saving and population growth, a country can also directly improve its long-run economic circumstances by conveying about improvements in the components of A(0). Besides any improvements in A(0) can also have productive effects on saving and population growth which can lead to a further (indirect) increase in the steady state level of income. Therefore, as Islam (1995) indicates, our study could point to a richer capacity for policies in raising the long-run incomes of countries and in speeding up the pace of reaching them. As a result, the current study helps to connect that discussion with the recent work on growth empirics since beta values with income dummies ranges around 0.003 to 0.077. With income dummies beta convergence is higher.

Sala-i-Martin (1994) considers the β-convergence concept as the most interesting convergence concept since whether the aggregate cross-sectional variance is falling or rising is secondary importance. We conclude that the poorer grows faster than the richer, however some estimation results the slower rate than usual findigs, independently of whether the aggregate cross-sectional variance is falling or rising. Therefore, this lower transition leads us to consider policy issue in

our approach. As an economist what kind of strategies we should introduce to close this gap between the poor and the rich preserve its importance. Controlling for (EL/E) and the worker effort level results with lower beta convergence and the significant income dummies with (EL/E) without worker effort indices result with beta convergence rate

### III.5. CONCLUSION

In this chapter, we rationalize the human capital and nutritional interaction besides rationalizing the physical to human capital ratio which is another main contribution to the literature. After this set up, we estimate how much effort level (e) contributes to explain the residuals and we show thet it does explain the great portion of the residuals. In the short-run, better nutritioned workers are stronger and more energetic and in the long-run, they could have stronger bodies. The interaction between nutrition and productivity has established in previous chapters and this study exploits the interaction between nutrition and labor quality which has been investigated recently by some empirical growth researchers to explain the income variation and convergence. Firstly, we show that the effort level decreases the size of the residuals and causes the productivity differences. We also look at convergence issue with the worker effort level influences on per-capita income growth and the worker effort level (e) does engage in recreation significant higher transition effects in convergence too.

We have presented a variance decomposition methodology to analyze the direct effect of nutrition on income per capita with physical capital to human capital ratio in production technology. We have used DES and DPS to calculate the worker effort. As it is expected, these two variables have good explanatory power to analyze unexplained residuals. This is applicable for the whole sample and sub samples. Expectation for low income countries' contribution of DES and of DPS in worker effort does partially occur since in the less developed countries, most of the work requires more physical strength than developed ones. This can happen when human capital and raw labor may rely on substandard levels of nutrition since most work activity requires more physical strength for the less developed countries. Mainly, the population should appear to look like getting well or recovering in status. It may be just enough to survive on but not enough to turn into output. They will keep away from potential jeopardy since the consequences for short-term endurance of a descending variation in income will be tragic. Therefore, less hazardous investments also have a tendency to have lower rewards. Furthermore, health at a point in time merges the collective effects of phenotype aspects including an individual's behavior through the life course as well as the health and socio-economic environments to which the individual has been exposed (Thomas, 2001; Nixon, 1999).Therefore, this transition process may work well in the mid-income countries but not in the low-income maybe because of the socio economic environment conditions.

After defining the (K/H) ratio as the key parameter, regardless of the sample, we find that nutritional level is important to define human capital. Since it has great explanatory power on residual and productivity gap, we should also note that the results are very sensitive to the choice of physical-human capital ratio shares. When we have different shares of physical-human capital ratio for the sub samples, we experience that this differences are greater than the same shares of physical-human capitals ratio. When we allow different production function for each income groups, we also admit the α-values to be different in production function for each income groups. With the different α-values, we observe higher productivity gap. Therefore, not only worker effort indices depending on the nutritional level but also the different alpha levels for each income groups play very crucial role to calculate differences in the ratio of productivity gaps.

We can also conclude that, without nutritional differences, we reach convergence according to the sample and we experience slower transitions with "e" by DPS but not with DES. The richer grows slower than the poorer, which is the main conclusion of Solow model. We also account for differences in terms of income level dummies because the productivity gap is greater with the worker effort level at the different alpha value and income dummies are significant. Therefore, it may be better to let production function be different for each sub samples. The estimated-α-values for country sample with worker effort level is ranging less than previous studies, since both shares of physical and human capital are around 0.71 in Mankiw et al. (1992) study. However, even though we have reached solid conclusions about nutrition and economic growth, in order to have more valid evidence regarding the impact of nutrition on cognitive achievement, we should have data on the impact of nutrition on cognitive achievements. Then we may have more precise conclusions. The reason is that even after we calculate the worker effort effects in income and income differences, we have still a large fraction of the income differences remains unexplained. For the further study the production function should be allowed to be different for income of country convergence regression to see whether the implied alpha value varies besides beta convergence rate.

## CHAPTER IV

## INCOME TO FOOD EXPENDITURE RATIO, PHYSICAL TO HUMAN CAPITAL RATIO AND TURKISH PROVINCAL INCOME DIFFERENCES AND CONVERGENCE

### IV.1. INTRODUCTION

As we have studied growth accounting, income differences by level accounting and the convergence issue for the cross-country data in the previous chapter, we will apply these techniques to Turkish regionalized province data in this chapter. While we break down the per-capita income into its contributions by employing variance decomposition methodology, we also investigate whether the differences in physical capital to human capital ratio account for the productivity gap between the richest and the poorest countries or if the differences in the worker effort level account for the productivity gap between the richest and the poorest countries besides studying the per capita income dynamic by using the convergence approach.

In the previous chapter, we rationalized the physical to human capital ratio and we estimated the contribution of worker effort level (e) to explain the great portion of the residuals. It also exploits the interaction between nutrition and labor quality, which has been investigated recently by some empirical growth researchers to explain the income variation and the convergence. The worker effort level decreases the size of residuals and causes productivity gap for cross-country data. Also, the worker effort level (e) does play an important role in the convergence regression as much as in the variance decomposition and the productivity gap approaches for the cross-country. In this chapter, since we do not have nutritional intake data, we have used the per capita income to food expenditure ratio.

In the next section, we will discuss Turkish health status after giving some brief information about why nutrition is important and how it is related with income level. The third section deals with the data. In section IV, we discuss our worker effort indices and we apply the variance decomposition approach then we present results. In section V, Turkish regionalized-provincial income differences are discussed by the level accounting approach and the convergence issue is discussed in section VI. The last section discusses the overall findings of this chapter.

### IV.2. SOME DISCUSSION ON HEALTH STATUS OF TURKEY

The The World Bank (2006) report shows some aspects of theTurkish health status compared to the rest of the world. It appears that the severity of malnutrition for underweight children and stunted children at the age less than five, vitamin A deficiency and supplementation coverage and

iodine deficiency disorders and iodized salt consumption rates status for Turkey are not the worst in the world, but Turkey still has some problems. Before we discuss the health status in Turkey with some more detail, we would like to show with the help of a figure how income poverty and malnutrition interact. The Figure IV.1 shows how straight losses in physical productivity from weak physical status, indirect losses from poorer cognitive development, loss in schooling and losses in resources from increased health care costs affect the income and how income affects malnutrition which causes the straight losses in physical productivity, indirect losses from poorer cognitive losses and loss in schooling and losses in resources from increased health care costs. Therefore, malnutrition hinders both the physical capacity to perform work as well as the earning ability.

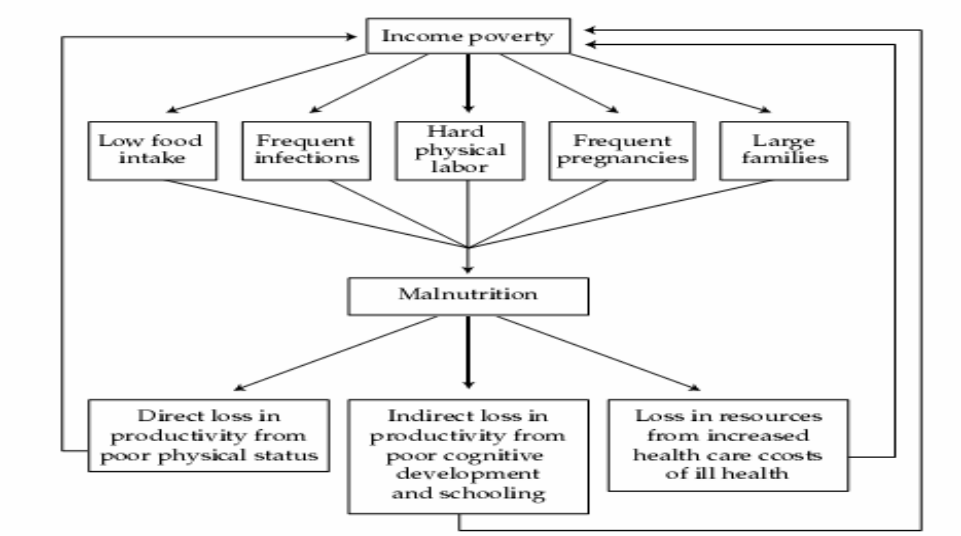


Figure IV 1: The vicious cycle of poverty and malnutrition
(Source: The World Bank, 2006a)

Factual evidence shows that the macroeconomic presentation of the whole economy may undergo as a result of the collective impact of these effects. The World Bank (2006a) has shown that the overall effect may be to reduce a country's rate of economic growth (Broca and Stamoulis, 2006). Broca and Stamoulis (2006) summarize some of the literature about the nutrition and macroeconomic performance and they report that based on historical studies, developments in nutrition and health explain one-half of economic growth, estimates are also presented for wounded including youth cognitive impairment associated with iron deficiency, mature productivity losses arising from the combined effect of stunting, iodine deficiency and that iron deficiency is equivalent to 2 to 4 percent of GDP loss. At the macro level, we have considered and discussed how health and income forms human capital. Since health and income affects one another, healthy people invest more of their income and time into their education. Therefore, they can enjoy higher human capital benefits later (Subramanian et al., 2002; Nixon, 1999). Thus,

individuals with higher income and better health can experience faster income growth rates but, faster income growth also leads to higher rates of investment in human capital and health and better health leads to earn higher income and get better education.

The World Bank (2006a) also points out some other benefits beyond standard economic benefits. These are namely leadership, equality and human well-being.

Leadership (the loss to society of potentially outstanding individuals): Because the existence of so many top quality persons in the middle and upper class is a result of opportunity rather than genetic potential. Therefore, it seems appropriate to ask how many top quality minds have been and are being lost or subdued because of malnutrition. If nutritional jeopardy is as lofty as studies now suggest, a considerable number of top quality people will never step forward. This means not just to the invaluable involvements of Tagore's and the Gandhi's, but also to the one-in-a-thousand or one-in-ten-thousand that could amass large funds, who could innovate and who could provoke people into action. Success or failure is important when taking into account the quality of leadership in most states; any defeat would seem to slow down the probability for economic development.

Equality: For societies whose prevailing philosophy places a premium on egalitarianism, the intellectual failure caused by malnutrition is the strongest barrier to achieving the social goal. However, a malnourished child's probability for social mobility are greatly constrained no matter what else is presented in education or other paths planned by policymakers to make upward movement possible within a society. Sufficient intellectual development and sufficient nutrition would appear to be an essential requirement to confirm other programs for mobility that are being developed as a matter of community strategy. Briefly, if a child has limited interest and intellectual power, to say nothing of the possibility of intellectual potential, the other chances are not major.

Human well-being: In spite economic misery people have the capability for taking pleasure in an extensive range of non-economic intake. These are people's positive reception of nature, love, friends, conversation, sporting activities and enjoying parenthood. Since they are part of consumption, they are the some of the major sources of satisfaction in life which are not marketable services, neither quantifiable nor measurable in the national accounts. However, a person who is ill because of nutritional anemia or harmed by the seemingly constant attacks with nutritionally connected diarrheas cannot in fact enjoy with these pleasures. Whether he or she has the capacity to enjoy these most fundamental sources of human satisfaction are the main concern and not the income. Therefore, human well-being is the main requisite.

However, The World Bank (2006) indicates some serious misapprehensions about the following myths concerning nutrition since planners, politicians, and economists often fall short to recognize these associations. Undernourishment is not the first and foremost matter of insufficient food intake. Since most serious undernourishment is caused by awful cleanliness and sickness, leading to diarrhea particularly amongst young children, women's position and women's education play a serious role in improving nourishment. Therefore, improving care of young kids' and women's status are vital. Improved nutrition demands focus on action by parents and societies, especially in water and sanitation. Therefore, it is not just related to poverty reduction. Given limited resources, broad-based accomplishment on nourishment is viable on a mass scale, particularly in poorer countries. Despite severe economic setbacks, many developing countries have made remarkable progress. Therefore, accumulation vaccination and endorsement of oral dehydration to lessen deaths from diarrhea have also done greatly to advance nourishment.

According to the UN System Network on Rural Development and Food Security, Turkey is considered to be self-sufficient in food production. Nevertheless, around 12-13 million people are estimated to constitute vulnerable groups in terms of food insecurity and they also point out that the number of people living below the poverty line has increased during the last ten years from 15% to 22%. According to the UN System Network on Rural Development and Food Security, the life expectancy during the period of 1935-2002 demonstrated 21.3 years increase for female and 15.5 years for men while both unsophisticated birth and mortality rates gradually shrink by 22.4% and 24.7% respectively. They also mention that there are also regional variations within Turkey for the life expectancy at birth. While Prenatal is the one of main causes of death in children under 5 years old, heart disease is one the of most important causes for all deaths. Frequent pregnancies with the short birth periods, particularly periods of less than 24 months, are known to be damaging to the health of offspring.

Oomman et al. (2003) consider the income level differences and health related behaviours and benefits for Turkey. They show that poorer women are more than twice as likely to marry early compared with their peers who are wealthier. Approximately 20% of adolescent women have had an infant by age 18 and this incidence is more than 3 times more possible to occur in adolescent women who are poorest compared with young women who are the richest. Edirne et al. (2004) mention also that according to the census in 2000 there are 16.3 million married women belonging to the reproductive period of 15-49 years in Turkey and this is about 25% of the population. In 1990, 14.1 million women in this group were recorded. Total fertility rate (TFR) has deteriorated progressively in the last three decades. TFR have decreased from 4.9 in 1970, to 2.53 in 1999 and further decreased to 2.46 in 2002 (Edirne et al., 2004). Oomman et al. (2003) consider TFR in terms of income differences. Turkish women from the poorest families have 2.5 times more births per woman. This is also indicative of socio-cultural differences. The differences

come from awareness of family planning and access to modern contraceptive methods. The use of contemporary contraception among Turkish women is not high. The average is approximately 34.5%. The inter-quintile discrepancy ratio between rich and poor is 2.1. Therefore, richer women are more likely to use modern contraception (Oomman et al., 2003).

According to Edirne et al. (2004), in 1993 the percentage of pregnant women acquiring antenatal care shows an increase of 63%. The average time of first antenatal care has declined from 7 months to 3 months. However, 68% of future pregnancies are related at least with one risk. Nutrition is inadequate and unbalanced anemia is common in these cases. Oomman et al. (2003) consider income differences and health services benefits. Usage of health services between the poor and the rich in Turkey are large for all services. However, the biggest of all differences occurs for the use of safe motherhood services. The inter-quintile discrepancy ratios between the poorest (reference) and the richest quintiles suggests that the rich utilize safe motherhood services at least twice as much as the poor since these ratios are 2.0 or more. The major variation is in antenatal care where inter-quintile disparity ratio is 2.8, which is followed by deliveries attended by skilled medical personnel (2.3), contraceptive prevalence rate (CPR) (2.2), and immunization (2.0). As a consequence, the high averages of the use of child and secure motherhood health services (> 60%, excluding CPR) cover the low levels of consumption by the poor (Edirne et al., 2004).

Although Turkey has achieved significant declines in the recent past, there are several causes of high maternal mortality in Turkey. Edirne et al. (2004) also mention that fifty percent of maternal deaths happen at birth and the rate of births at home is as high as 24%. As they mention, it is similar to the results of 1988-93 surveys. While infection is considered as the most common cause of death, toxemia is also a potentially deadly condition. In 1997 the most common cause of 31 percent of the deaths has been tagged as "other complications of pregnancy, birth and puerperium." In this definition anything from obstructed labor, uterine rupture, infection or hemorrhage could be included. "Delivery without mention of complication" counted for another 21 percent of the deaths in this situation. Besides these two causes, the most common cause of maternal mortality is related to abortions, although the number of induced abortions is decreasing at 1993 (Edirne et al., 2004). Another important statistic is that 70% of families do not desire additional children, the rate of families using family planning is only 62.6% and only 34.5% use a modern method (Edirne et al., 2004). Oomman et al. (2003) mention that while only 11.6% of the poorest women have had deliveries that were attended by a doctor; it is 72.3% for the richest women. This indicates almost six fold differences. Overall, the poorest women are more likely to have a nurse or midwife attend their deliveries whereas the richest women are more likely to have trained doctors attend their deliveries.

While neonatal mortality is mainly influenced by maternal health standing, maternal uniqueness (e.g., age), and the extent to which there was prenatal care. Prenatal maternal nutrition, prenatal infectivity (regularly linked to maternal infectivity prior to delivery) and post neonatal mortality is more linked to obstacles resulting from premature birth, low birth weight, infectivity (e.g., diarrhea, childhood diarrhea influence on an average 25% of offspring), of poorer offspring are only slightly worse off than the rich (Oomman et al., 2003) and feeding exercises (i.e., lack of breastfeeding). Turkish Demographic and Health (TDHS, 2003) reports that infant mortality rate is 2.9%, Low Birth Weight (LBW) is 8% where it is closely related with nutrition in take. Breast feeding is 97% according to TDHS (2003) and average feeding time is 14 months. This period is 2 months longer than 1998 measurement.

Oomman et al. (2003) consider also antenatal care according to income level of individuals. They point out that the richest women are 4 times more likely to visit a doctor and 2.6 times less likely to visit a nurse for antenatal care compared with poorest women. The richest women are almost 3 times more likely to have at least one antenatal visit and about 3.6 times more likely to have two or more antenatal visits relative to women who are poorest. On average, 62.5% of women account for at least one antenatal appointment whereas 54.4% account for at least two visits. Child mortality (i.e., age 12-59 months) is greatly influenced by infectivity (e.g., respiratory tract infectivity, diarrhea, and vaccine-preventable illness). Therefore, the underlying health system procedure and public health topic that have an effect on neonatal mortality and post-neonatal mortality are reasonably different.

Infant mortality rates (IMR) vary considerably across urban and rural areas within and across the Turkish provinces. Therefore, IMR and under age five mortality rate (U5MR) are less than the nationwide average in urban areas and in Western and Southern provinces. Also, IMR and U5MR are almost 40 percent higher than the countrywide average in rural areas and in the Eastern region. Diarrhea is an important cause of morbidity among children under age 5 in Turkey even though significant progress has been made in recent years. Acute respiratory diseases are also sources of morbidity and mortality in offspring under five-years of age. Poorer children were more than twice more likely to have been ill compared to richer children (Oomman et al., 2003).

Oomman et al. (2003) also examine the issue of “Prevalence and Treatment of Diarrhea in Children”. On average 25% of children are affected by childhood diarrhea. The richer children are only slightly better off than the poorer children. Oral dehydration therapy (ORT) is commonly used and it appears to be the same in both the rich and the poor alike. However, inequity in medical treatment of childhood diarrhea is slightly higher between rich and poor. Inter-quintile disparity ratio is 1.8. An acute respiratory infection (ARI) on average affects less than 40% of children. Poorer children were twice as likely to have been sick compared to the richer children.

Treatment rates vary considerably between the poorer and the richer. While about 25% of poorer children are brought to a health facility, only 22% are seen in a public facility. In comparison, 56% of richer children are brought to a health facility for an ARI episode, and of these, 36.7% are taken to a public facility.

Even though Turkey displays very good performance in terms of economic growth, it could not perform well in terms of human development. Since Turkey has long-standing income distribution problem (Baysal, 2003), there are also health, education, housing problems. Baysal (2003) studies the instability of nutritional consumption. She displays that there are great differences between high and low income families where higher income groups consume the foods with higher protein supplies than poor income groups for a day in Turkey. She also reports that 15% of our family population have problem to find enough food. She also mentions that low-income group in Ankara would not even consume foods which contains vitamins B. Nutritional inequality among school children also do shows variation (Baysal, 2003). She mentions that most of the students do not have appropriate nutritional opportunity. She reports that 40% of poor children do not have breakfast and most students who have breakfast do not have enough food in their breakfast. She displays statistics that show student in private school are 12-15 cm taller than states school. According to her, while private school students have milk on regular base, 13% of state school student has opportunity have milk. Since there are skinny student in states school comparing to private school, these children experience more tiredness, weakness, hunger and carelessness. This is somehow applicable for higher education students in Turkey (Baysal, 2003)

She also mentions that child-labor is in much worse conditions. Mostly, they do not have lunch or dining facility. Even though mostly they work in chemicals work, they can not get food to develop immune system and protect from chemicals. Because of the insufficient feedings, 46% of child-labor is weak, 16% of them get sick often and 29% of them have work accident (Baysal, 2003). There are also nutrition related sicknesses such as obesity, cardiac, cancer and osteoporosis and they tend to increase. While cardiac related sickness causes highest death, cancer is the second highest. Baysal (2003) also mentions that saturated fat causes coronary heart disease which is one of the main mortality reasons. DPT (2003b) also points out that chronic malnutrition and insufficient energy in takes are closely related with body mass index (BMI). The chronic malnutrition and insufficient energy in takes level increase between 1998 and 2003 and BMI declines from 2.6% to 2%.

Since The World Bank (2006a) indicates that malnutrition is not the primarily a matter of inadequate food in take and most serious malnutrition is caused by bad sanitations, diseases and so on. Therefore, we should have some idea about whether there are enough water supplies, its quality and whether there are contagious illnesses present. For 2000, we have calculated some

statistics about these issues from the website of Turkish Institute of Statistics (TUIK). While 80 percent of villages have a water supply, only 78 % of the total population of the village benefits from this water supply in 1996. In 2000, 77 % of water is microbiologically useable, 75.5 % is chemically sufficient. Drinkable water has low fluorine level (DPT); 2003a) all over Turkey. As we can see from Table IV.1, the number of people faces these illnesses are not small. These situations cause inefficient use of sources, schooling attendance regression and growing retardation.

**Table IV.1. Number of contagious diseases from water and some foods**

| Typhiod Fever | Paratifo | Amoeba | Bacillus | Hepatit A |
|---|---|---|---|---|
| 25840 | 782 | 23725 | 1071 | 10654 |

(Source: TUIK, 2007)

Oomman et al. (2003) also make a common conclusion in his analysis saying that a strong association exists between socioeconomic statuses on the one hand and health status and utilization of services on the other. They also consider "Why Maternal and Reproductive Health Services Are Not Reaching Poor People" and "Why Nutrition Services and Food Are Not Reaching Poor People". The factors are shown in a brief outline in terms of Socioeconomic and Cultural Factors.

Poor women hesitate to obtain easy access to health services, health care, nutritional services and intervention even when quality health services are geographically within their reach, partly because of a combination of social, economic, and cultural barriers. Access to health care is expensive, there are certain terms of social and cultural norms and perceptions about illness, and the ability to seek health care depends on the income level; such factors have great influence on their behavior. While a richer woman may consider illness as an issue, a poorer woman may not be inclined to make a case of it. Therefore, poor women are indeed worse off, since the socioeconomic and cultural factors affect women's demand and utilization of health services in general. Wealthier individuals habitually benefit from government health financing more than the poor do. It is considered that health systems are dysfunctional (nutrition interventions are dysfunctional because of health and other services) for poorer individuals because there are limited skilled human resources. There is no incentives for skilled workers and live in rural villages, small urban areas or remote regions. Poor quality of medical services emerge, since the poor areas are less likely to have skilled health providers, drugs, supplies, electricity, running water and skilled medical facility administration. Critically needed emergency care may have diminished capabilities as well and this inability to handle expected medical crisis situations directly contribute to maternal mortality.

Health care accessibility for poor people is paramount in nature. The mainstream of poor women survives in countryside and districts where sufficient coverage of health services is not available.

Distance and travel time are vital factors in the consumption of health-care services in particular maternal and reproductive health services. Therefore, poor women are more likely to develop pregnancy complications and need timely emergency obstetric care, since mostly poor regions and rural areas often have low-quality transportation resources and lack public transportation systems. Poor women in rural areas often have to walk some distance to the nearest health facility. They are able to seek health care from less-trained providers. Since shortages of food are frequently overlooked, it is the main reason of malnutrition in developing countries. Therefore, malnutrition consists of poor food intake, high rate of infection, disease, and undesirable behavior. Accessibility to successful nutrition interventions remains a dilemma in most developing countries because successful counseling on newborn feeding is hardly ever available at health services or in the community.

Secondly, we will consider how affordable are interventions, food, and health and nutrition services for poor women in rural areas. Whether user fees are formal or informal, those fees prevent people to use of reproductive and maternal-newborn health services. The volatility of total costs for pregnancy and possible complications also prevent poor people from seeking skilled attendance. Other hidden costs could come from additional maternity care supplies such as gloves, syringes, and drugs. In view of the fact that the majority of poor women face very high out-of-pocket expenditures on health care, families are forced to fall deeper in poverty. Ill people must give up time that they would usually spend on domestic household tasks such as collecting water and fuel, cooking, and cleaning as well as on agricultural work. Therefore, costs of illness in terms of time lost and its cure costs are tedious and huge on poor people. Although utilization of health care improves with higher household incomes, poorer women experience a lack of power caused by household expenditures restrictions and use of reproductive and maternal health services such as family planning, antenatal care, and child-delivery at a health facility. The food may be a restrictive factor in determining malnutrition in some families and in crisis situations, maybe certain types of food may be limited because of seasonal variation or cost but, many families have sufficient food supplies to adequately feed their young children. However, having adequate amounts of food for young children is not enough since good practices are often limited by women's need to work to offset financial imbalances.

Thirdly, the issue about the current low status of girls and women in the society is even harder for poor women because of gender inequality. This gender group has very limited access to possessions such as land, credit, education, work productivity as well as the right to make decisions that affect their lives. Also they face obstacles to seek health care and nutrition services, interventions which hinder development in improving maternal health outcomes among poor people. This undesirable situation causes socioeconomic dependency. Therefore, poorer women may be more vulnerable to illicit and sexual misuse such as intellectual castration or unwanted

pregnancies because some poorer women do not have any control to govern their personal affairs. In terms of nutrition, women and girls may receive less of the family's food, because they have to care for younger siblings.

Fourthly, another issue related with low status of girls and women is their education level. Investing in mother's education directly affects her capacity to care for their children and this is passed down to her daughter's who will eventually become mothers. Improvements in the mother's nutritional status directly affect her children's health status. Negative nutritional intake is related with stunted growth and stunted children are less likely to enroll in or complete school as micronutrient deficiencies are associated with poor performance in school. Poorer females are less likely to have access to education when compared to boys. This gender disparity becomes more obvious after primary school. Poorer girls are more likely to drop out of school after primary education. There is a strong relationship between women's education level and reproductive-maternal health. There is also a strong relationship between women's education level use of reproductive-maternal health services since women's status increases with education level by affecting the marriage age lessen unwanted fertility and progress in utilization of health services because education enables women to build self-confidence, develop maternal skills and to increase their awareness of information. Therefore, education would help to alter the way others interact with and empower them to make decisions concerning the outcome of their lives.

Therefore, cultural norms and practices may affect the social status of girls and women; education level, cultural modesty and lack of privacy are limiting factors that inhibit poor women from using health facilities. If a woman thinks that eating too much during pregnancy will result in a larger baby as learned from cultural teachings, then she is placing her health as well her child's health at higher risks for complications.

**IV.3. EMPIRICAL ANALYSIS**

In the section IV.3.1, we will describe the data and in the section IV.3.2, we will break down the growth rate of aggregate output into contributions from the growth of inputs in terms of (K/H), worker effort index and technology. However, being short of finding the nutritional data for Turkish provincial level, we have used ratio of per capita income to food expenditure ratio to proxy nutritional level. Since growth accounting lets us distinguishing accumulated factors (K/H and worker effort level) and productivity, we will consider whether the worker effort index should be in the production function. After testing contribution of these accumulated factors into the production function, in the section IV.3.3, we will also investigate whether the differences in physical capital to human capital ratio account for the productivity gap between the richest and poorest provinces or the differences in worker effort level account for the productivity gap

between the richest and poorest provinces. Whether the worker effort is a missing variable in the production fucntion and we will consider the worker effort level effects to analyse the income differences. We will also study income dynamics for provinces by using convergence approach in the section IV.3.4. The convergence issue empirically will be tested in terms of absolute convergence and conditional convergence where the conditions are physical capital to human capital ratio and worker effort level.

### IV.3.1 THE DATA

We have used data for 1994 and 2003 where the year for 1985 Per-capita income data is used as an initial value for convergence regression. Per-capita income, aggregate income, education and ratio of food expenditure to the per capita income are taken from TUİK data set. Industrial electricity consumption is taken from TEDAŞ on the provincial level. The ratios of per capita income to food expenditure are reported from household budget studies on individual level for the regions of Turkey. The other data are reported on the provincial level so we have calculated for the 17 regionalized provincial regions described at Appendix C. Educational data is calculated by summing up the teacher to student ratio from preschool level to the high school level where teacher-student ratio is one of the proxies in the studies for the concept of human capital embodies in education (Özatağan, 2005).

Since nutritional data (Wang and Taniguchi, 2003; Sohn, 2000) is used in cross-country study, we do not have problem to calculate the worker effort level (Sohn, 2000). However, we do face problem to have provincial data for Turkey. Pekcan (2001) mentions that a few nutritional surveys have been conducted in 1974, 1984 and 1997. In 1974, a nation-wide nutrition survey was held to develop a national nutrition policy. This covers various socio-economic, age and gender group. The survey in 1984 was held for three regions in summer and winter time to observe the change in socio-economic and nutritional status. Ministry of Health in 1997 conducts a survey for 7 provinces. According to Pekcan (2001), these surveys indicate that the average diet was adequate to meet recommended daily intake of energy and most of the nutritients. However, these surveys also show animal protein, calcium, vitamin A and riboflavin are lower than the recommended daily allowance (RDA). She concludes that there are no significant changes observed in average per-capita consumption within 25 years. She also mentions that there are differences among families, other sub-groups and seasons in terms of energy and nutrient intakes.

The most important parameters which influence the food consumption pattern are the income and lack of knowledge (Pekcan, 2001). She points out that while poor families rely mostly on bread consumption, rich families consume more meat and meat-related products, fresh fruits and vegetables. Therefore, she indicates that the problem is not unavailability of food but its

distribution. According to DPT (2003b), while per-capita meat consumption in Turkey increases from 16kg to 18kg for the period 1990-1999, per-capita milk consumption for the same period declines from 171kg to 157kg. DPT (2003b) also summarizes that 50% of daily energy intakes are consumed from bread and grain and there is a change in consumption patterns: while bread, milk, meat, fresh vegetables and fruits consumptions decline, dry leguminous, eggs and grain consumption increase. Grain consumption is the highest consumption group among the all and vegetables consumption is the second. However, meat and meat-related products consumption level is low (3%). Number of families with insufficient level of energy intakes is low. Therefore, protein needs are supplied by mostly vegetables but not meat-related products

She also mentions that there is no national-level survey conducted after 1974 and 1984. Therefore, we have to change our attention to fill the data gap in order to carry out our analysis for Turkey since there is no data. There is a theory in economics which is called "Giffen goods". Pekcan (2001) draws our attention on consumption pattern of Turkish families according to their income: according to her, consumption of poor families rely mostly on bread, but rich families' consumption rely mostly on meat and meat related products, fresh fruits and vegetables. Therefore, the idea to use "Giffen goods" approach simply can be expressed as income increases the portions of income to food ratio decreases. We will describe later in next section with more detail.

There is no doubt that regionalized provincial per-capita income to food ratio is closely associated with its level of income. The positive correlation between these variables is not obvious. For high-income provinces, the average income to food ratio is around 31.6; while it is around 26 for low-income provinces. The means of per capita income to food expenditure ratio in 2003 is around 13 times greater than mean of per capita income to food expenditure ratio in 1994. Therefore food share in income is substantial as it is in worker effort level. The correlation between per capita income to food ratio and growth rate is very high for whole and sub sample. It is -0.73 for low-income while it is -0.91 for high-income where for the whole sample it is -0.81. However, we expect just the opposite. It seems that there is clear correlation between per-capita GDP growth rate and per capita income to food ratio as it is seen between per-capita GDP and income to food ratio. This may be evidence for conditional convergence if per capita income to food ratio proves to be a good proxy for the initial level of real per capita GDP. We detect significant negative correlation between the growth rate of real per capita GDP and per capita income to food ratio. In terms of means values of variables, we also check the changing in per-capita GDP, per-capita GDP growth, education, electric consumption in industry, per capita income to food ratio by year. We see that for high and low-income regionalized provincial data, income to food ratio and GDP level decrease, others increase.

In order to test for convergence we have to assume that the provinces included in the sample are in their steady states. Therefore, as we previously mention that studying the correlation between initial levels of income and subsequent growth rates are employed to check whether provinces are in their steady states since our model relies on diminishing marginal returns to capital where provinces with low levels of capital stock will have higher marginal product of capital and hence, for similar saving rates, grow faster than those with already higher levels of per capita capital stock. Consequently, a finding of negative correlation or no negative correlation between initial levels of income and subsequent growth rates has become a popular criterion for judging whether or not convergence holds. Finding the negative correlations has the scope of being interpreted as evidence of convergence in terms of both income and growth rate. However, finding the no negative correlations has the scope of being interpreted as evidence of divergence in terms of both income and growth rate. When we assume all provinces are same in terms of all conditions except the initial level of capital ratio, we do have negative correlation (-0.6025) between initial level of income and subsequent growth. When we also allow provinces-specific factors to be different we observe negative correlation between initial income and subsequent income growth as such (-0.67 for high income, -0.66 for low income). Therefore, we could conclude that we would have convergence. Coefficients of other variables correlations are also reported in Appendix D.4.

We also look at simple statistics of the variable we have used in this study where we report them in the Appendix D3. We have compared mean of these variable according to income classification. As we can see from the Table IV.7, mean of (EL/E) for high income provinces is around 3.3 times greater than the low income provinces. When we adjusted (EL/E) by GDP level, this difference decreases but it is still greater than two. The mean rate of growth rate for high to low-income is less than one. Therefore, the growth rate is greater in poorer than the richer as expected. We expect the growth rate differences should be less than one between rich to poor since convergence means that poor should grow faster than rich.

**Table IV.2: Comparison of the Means According to Income Classification.**

| Variable | High/Low |
|---|---|
| growth rate | 0.844604 |
| (EL/E) | 3.332911 |
| e | 1.213359 |
| (EL/E*Y) | 2.094059 |
| food expenditure ratio | 1.214323 |
| per-capita income | 1.585833 |

## IV. 3.2 MODELLING AND MEASURING WORKER EFFORT AND VARIANCE DECOMPOSITION

Since we have not had nutritional data, we have used ratio of per-capita income to food expenditure. Therefore, worker effort is calculated with this ratio:

$$e^i = (4.34*10^{(-4)})*(x_c^i) - (4.16*10^{(-8)})(x_c^i)^2 \quad (1)$$

where $e^i$ is efficiency units of labor for worker i and $x_c^i$ is per capita income to the food expenditure at the individual level. This relationship is set because of inferior goods idea: As income increases, the income to food ratio decrease. World Bank Institute (2005) reminds us that over a century ago Ernst Engel showed that as household income per capita rises, expenditure on food rises however; it rises at a decreasing rate. Ranis et al. (2005) also indicate that when poorer households receive extra income, they increase their food payments and calorie consumption considerably. When we look into Turkish household budget survey data for 2002 and 2003, we can see that the richest income food expenditure lies below 10% while the poorest lies around 38.2% and 39.8%, respectively. For the same sample food and non-alcohols consumption is around 13% for the richest income and 28% for the lowest 20% income.

Rahman (2002) also points out that in line with Engel's law; it is obvious that the share of food spending declines, as income rises. The lower income cluster spends as regards three-quarters of their total resources on food which declines to as regards seventy percent for the middle income cluster. Yet, the higher income cluster spends a considerable amount of their total resources (sixty two percent) on foodstuff which indicates the importance of food in individual health in a poorer country like Bangladesh. Leibtag and Kaufman (2003) conclude once that even though the poor spends more on food, the quality of food is less than the rich. Regmi et al. (2007) also point that the poorer-income countries expend a greater segment of their resources on food and they are more responsive to earnings and food price varies in middle-income and high-income countries. Higher value food and manufactured goods is produced through greater resources modifications to price and income shocks while resources for staple food products like cereal alter the least.

As we have done in the previous chapter, we also apply variance decomposition methods in order to distinguish the contribution of each component. We report the result of each component's contributions besides the contribution of worker effort to explain the residuals in Table IV.8. The percentage of the unexplained residuals to the differences in worker effort is calculated as 0.52. Considering the impact of food expenditure ratio to explaining the productivity differences is almost 52%. The contribution of Z is around 0.19 for the sample and the contribution of worker effort level is around 0.42. What this means is that worker effort has an important role in per-capita income variation. Since food expenditure ratio in per capita income plays such a great role, government should be careful its population nutritional level. Since 1=the contribution of ln (X) + the contribution of ln (A), without effort level, the contribution of Z is very low and with effort level total effect is around 61%. Therefore, with worker effort level, size of residual declines from 81% to 39% since "effort"+Z=0.42+0.19=0.61. While the ratio of residual without worker effort level to residual with worker effort level is greater than 2, worker effort "e" being as one of the

accumulated factors of per capita income contribution to per capita income is 2.25 times greater than the contribution of Z to per capita income for regionalized provincial Turkish data. Where we show $Z=\left(\frac{EL}{E*Y}\right)^{\frac{\alpha}{1-\alpha}}$ and $effort=e^{\left(\frac{1-2\alpha}{1-\alpha}\right)}$. Since the data is in panel form and there is the cross sectional heteroskedacticticty in this form, IFGLS is employed.

**Table IV.3. The role of worker effort to explain the residuals**

| | Z | effort | Residual | Ratio of explanation |
|---|---|---|---|---|
| All | 0.1865 | 0.42 | 0.81 | 0. 52 |

It is IFGLS regression result

### IV.3.3 CROSS-REGIONALIZED PROVINCES INCOME DIFFERENCES WITH INCOME LEVEL APPROACH

We have to divide our regionalized-provincial data into two parts with the same reasoning in our cross-country study. If income is less than $2000 in 1994, we assign them as low income group. While the most of the works require more physical strength in low-income regionalized provinces, the most of the works require less physical strengths for high-income regionalized-provinces. Therefore, we expect a productivity gap between the richer and poorer regionalized provinces which should be explained with per capita income to expenditure ratio. Whether or not the distribution of income changes over time for Turkish regionalized provinces is analyzed. We start with the actual ratio for high-income to low-income which is around 1.92 and these are reported in second column in Table IV.4. High-income to low-income ratio shows that high-income regions' per capita income is around twice as much as low-income regions' per capita income.

**Table IV.4. Productivity gap due to factor intensities with same alpha-level**

| same alfa | Rrate | Z | effort | Z /Rrate | e /Rrate |
|---|---|---|---|---|---|
| High/Low | 1.92 | 0.88 | 1.31 | -0.197 | 0.418 |

The predicted productivity gap for high-income to low-income assuming only differences in Z are calculated in the third column of Table IV.4 as around 0.88. We can safely say that productivity gap in terms of Z are less than the actual ratio. The predicted productivity disparities for high-income to low-income assuming only differences in worker effort level are calculated in the fourth column of Table IV.4 as 1.31. The number in the fifth is the ratios of predicted to actual productivity disparity, both in logarithms. It is the measurement of the gap in productivities attributable to the variation in Z with and without effort level at the same α-level for provinces. We find that log (0.88)/log (1.92) is around -20 percent. The -20% of the gap in actual productivity gap can be explained by differences in capital intensities. Since the difference in Z is less than one, the Z ratios are very close in both regionalized provinces. Therefore, there is almost no difference between these groups in terms of Z level. Roughly we could say that productivity

gap or productivity differences are not mainly caused by Z. However, the difference in terms of the worker effort level is higher. Therefore the percentage is around 42%. We can say effort level (e) causes more productivity differences in Turkish regionalized case. As a result, differences in the worker effort are substantial in terms of regionalized provinces data. Since we are in short of data, we have not reported different alpha level results.

### IV.3.4 CONVERGENCE APPROACH FOR CROSS-REGIONALIZED-PROVINCIAL INCOME DIFFERENCES

The economic growth is considered to be a limited parameter to explain the demand side. Therefore, how income and social and cultural facilities are distributed is important. Thus, the development levels of provinces vary and show unbalanced stages since every one of the provinces have different resources and characteristics. While we have hugely growing cities on one side, we have undeveloped provinces on the other. These two sides of the social and economic structure create some problems such as migration or vice versa. If the provinces receive immigrants, since it will cause some shifting at the ratio of (K/H) and some shifting at income level, most probably they will face the demand problem of housing, water, energy, infrastructure, crowded street and traffic jams, noises, education, health services and so on. However, migrant giver provinces have insufficient demand so they will get worse in time. Therefore, data are taken from DPT (2003a) and we calculate the mean of the indices where we divide the provinces according to whether their per-capita income is either greater or less than $2000 in year 1994 value. The Table IV.5 shows that while the richer 22 provinces seem to be better structured in terms of social-economic, manufacturing, health and education sector indices for the year 2000. However, poorer 59 provinces do not seem to be better structured in terms of social-economic, manufacturing, health and education sector indices for the year 2000. Therefore, According to DPT (2003a) report, we speculate that the regional differences in terms of social-economic structure, manufacturing, health and education structure cause migration and this migration also negatively influences welfare of the society; these factors may be some of the reasons for people to migrate since the mean rate of migration for the richer is positive, the mean rate of migration for the poorer is negative.

**Table IV.5: Some indicator of the provinces (2000)**

| High Income | Observation | Mean | Low Income | Observation | Mean |
|---|---|---|---|---|---|
| rate of migration | 22 | 11.25 | rate of migration | 59 | -29.5 |
| social-economic | 22 | 0.715 | social-economic | 59 | -0.26 |
| Manufacturing sector | 22 | 0.49 | Manufacturing sector | 59 | -0.18 |
| health sector | 22 | 0.66 | health sector | 59 | -0.25 |
| education sector | 22 | 0.65 | education sector | 59 | -0.24 |

(Source:DPT (2003a))

Since we set (K/H) in the production function, from our data set, we tabulate the $\log\left(EL/E\right)$ and $\mathbf{Log}\left(EL/Ee\right)$ in the Table IV.6. The growth rates of $\left(EL/E\right)$ from 1994 to 2003 are mostly negative for our regionalized provinces except Bursa-Eskisehir-Bilecik, Gaziantep-Adiyaman-Kilis and Samsun-Tokat-corum-Amasya. However, the growth rates of $\left(EL/Ee\right)$ from 1994 to 2003 are all negative for our regionalized provinces in the Table IV.6. The growth rate of worker effort level is positively very high.

**Table IV.6: Dynamics of the (EL/E) and e**

| Regionalized_provinces | year | $\mathbf{Log}\left(EL/E\right)$ | $\left(\overset{*}{EL/E}\right)$ | $\mathbf{Log}\left(EL/Ee\right)$ | $\left(\overset{*}{EL/E*e}\right)$ | e | $\overset{*}{(e)}$ |
|---|---|---|---|---|---|---|---|
| Adana-Mersin | 1994 | 5.37 | | 11.76 | -0.31 | 0.002 | 2.49 |
| Adana-Mersin | 2003 | 4.74 | | 8.64 | | 0.020 | |
| Ankara | 1994 | 4.48 | -0.083 | 10.73 | -0.34 | 0.002 | 2.73 |
| Ankara | 2003 | 4.12 | | 7.64 | | 0.030 | |
| Antalya-isparta-Burdur | 1994 | 3.68 | -0.062 | 9.98 | -0.35 | 0.002 | 2.70 |
| Antalya-isparta-Burdur | 2003 | 3.46 | | 7.07 | | 0.027 | |
| Bursa-Eskisehir-Bilecik | 1994 | 5.46 | 0.069 | 11.82 | -0.21 | 0.002 | 2.64 |
| Bursa-Eskisehir-Bilecik | 2003 | 5.85 | | 9.56 | | 0.024 | |
| Denizli-Mugla-Aydin | 1994 | 2.85 | -0.085 | 9.15 | -0.35 | 0.002 | 2.48 |
| Denizli-Mugla-Aydin | 2003 | 2.62 | | 6.44 | | 0.022 | |
| Diyarbakir-sanliurfa | 1994 | 2.15 | -0.575 | 9.01 | -0.57 | 0.001 | 2.99 |
| Diyarbakir-sanliurfa | 2003 | 1.21 | | 5.08 | | 0.021 | |
| Erzurum-Erzincan-Bayburt | 1994 | 2.11 | -0.219 | 8.48 | -0.39 | 0.002 | 2.33 |
| Erzurum-Erzincan-Bayburt | 2003 | 1.69 | | 5.74 | | 0.017 | |
| Gaziantep-Adiyaman-Kilis | 1994 | 4.72 | 0.070 | 11.43 | -0.21 | 0.001 | 2.46 |
| Gaziantep-Adiyaman-Kilis | 2003 | 5.06 | | 9.31 | | 0.014 | |
| Kayseri-Sivas-Yozgat | 1994 | 4.33 | -0.043 | 10.75 | -0.27 | 0.002 | 2.40 |
| Kayseri-Sivas-Yozgat | 2003 | 4.15 | | 8.17 | | 0.018 | |
| Kocaeli-Sakarya-Duzce-Bolu-Yalova | 1994 | 6.02 | -0.024 | 12.52 | -0.26 | 0.002 | 2.68 |
| Kocaeli-Sakarya-Duzce-Bolu-Yalova | 2003 | 5.88 | | 9.70 | | 0.022 | |
| Konya-Karaman | 1994 | 5.54 | -0.180 | 12.03 | -0.34 | 0.002 | 2.54 |
| Konya-Karaman | 2003 | 4.63 | | 8.57 | | 0.019 | |
| Malatya-Elazig-Bingol-Tunceli | 1994 | 3.39 | -0.107 | 9.90 | -0.34 | 0.002 | 2.51 |
| Malatya-Elazig-Bingol-Tunceli | 2003 | 3.05 | | 7.04 | | 0.019 | |
| Samsun-Tokat-corum-Amasya | 1994 | 4.40 | 0.117 | 10.78 | -0.25 | 0.002 | 2.91 |
| Samsun-Tokat-corum-Amasya | 2003 | 4.95 | | 8.42 | | 0.031 | |
| Trabzon-Ordu-Giresun-Rize-Artvin-G.hane | 1994 | 3.29 | -0.030 | 9.47 | -0.35 | 0.002 | 2.72 |
| Trabzon-Ordu-Giresun-Rize-Artvin-G.hane | 2003 | 3.20 | | 6.66 | | 0.031 | |
| Zonguldak-Karabuk-Bartin | 1994 | 5.48 | -0.199 | 11.97 | -0.34 | 0.002 | 2.48 |
| Zonguldak-Karabuk-Bartin | 2003 | 4.49 | | 8.50 | | 0.018 | |
| istanbul | 1994 | 6.84 | -0.110 | 13.03 | -0.31 | 0.002 | 2.74 |
| istanbul | 2003 | 6.13 | | 9.59 | | 0.032 | |
| izmir | 1994 | 6.34 | -0.063 | 12.66 | -0.28 | 0.002 | 2.71 |
| izmir | 2003 | 5.95 | | 9.56 | | 0.027 | |

According to DPT (2003a), Turkey aims to be efficient world wide state, be a full member of European Union, be a center of Eurasian, develope the knowledge based economy, efficiently reallocate the resource of its regions and increase its people' education and health status. Therefore, in these development plans of Turkey, having balanced development among the regions is as important as the aimed development pace. Therefore, recognition of the local characteristics and social fabric of the regions is very important to design the policy for reallocating the human and the physical capital and setting the policy for public investment. Furthermore, European Union emphasizes the balanced development of the regions and supports the getting rid of the regional differences. Therefore in order to have somehow concrete knowledge to do so we have conducted this convergence study.

Even though it is not directly addressed why factor inputs differ across provinces we look into infant mortality rates (IMR), U5MR and TFR. These indicators are closely related with nutritional level, sanitary practices and etc, so do worker effort level and efficiency of labor and human capital. There have been 130000 finger size babies born in Turkey (Sabah, 2008) where it is closely related with nutritional and nutritinal level of mother. IMR, U5MR and TFR are also interacted with these finger size babies. For the Turkey, TFR is closely related with education levels so do size of the baby. When educational levels rise, TFR falls. According to TDHS (2003), TFR is higher among women with no education (3.65) or minimal education (2.39) compared to those who have at least secondary school education (1.77). The provincial differences in TFR are suggestive of the lack of correspondence in access to health and family planning services, differences in income, education levels and differences in cultural values across Turkey. This TFR is important for our study since TFR and nutritional level are closely related so do education level since hungry child can not learn. Pekcan (2005) also reports about the interaction between education and TFR and between education and total expected fertility rate (TWFR) in the Table IV.7. When educational levels decline, TFR and TWFR arise.

**Table IV.7: Fertility rate according to education level**

| Education level | Total expected fertility rate (TEFR) | Total fertility rate (TFR) |
|---|---|---|
| No diploma | 2.4 | 3.9 |
| Primary school | 2 | 2.6 |
| Secondary school and + | 1.5 | 1.6 |
| Turkey | 1.9 | 2.6 |

Source: from Pekcan, (2005)

In Table IV.8, IMR and TFR vary considerably across regions. Therefore, IMR and TFR are less than the nationwide in Western, central and Southern provinces. IMR is almost 40 percent higher than the countrywide average in the Eastern region. Oomman et al. (2003) point out that diarrhea is an important cause of morbidity among children under age 5 in Turkey even though significant progress has been made in recent years. Acute respiratory diseases are also a source of morbidity

and mortality in offsprings under five-years of age. Poorer children were more than twice more likely to have been ill compared with richer children (Oomman et al., 2003).

**Table IV.8: Total Fertility Rate and Infant mortality Rate by Regions**

| | Infant mortality Rate (%) | Total Fertility Rate (%) |
|---|---|---|
| East | 41 | 3.65 |
| West | 22 | 1.88 |
| South | 29 | 2.30 |
| North | 34 | 1.94 |
| Central | 21 | 1.86 |
| Turkey | 29 | 2.23 |

(Source: from Pekcan, (2005))

Edirne et al. (2004) mention that according to the census in 2000, there are 16.3 million married women belonging to the reproductive period of 15-49 years in Turkey and this makes about 25% of the population. In 1990, 14.1 million women in this group were recorded. Total fertility rate (TFR) has deteriorated progressively in the last three decades. TFR have decreased from 4.9 in 1970, to 2.53 in 1999 and further decreased to 2.46 in 2002. On the other hand, Turkey's country-wide TFR covers substantial deviation in fertility across regions. In TNSA (2003) as it is shown in the Table IV.8, the Eastern provinces have the highest TFR (3.65), almost 1.5 times as high as that in the Western provinces (1.88). The Northern, Central and Southern provinces are clustered around a TFR of 2.03. Looking at the TFR for Istanbul and Southeastern region while it is 1.83 in Istanbul, it is 4.19 in southeastern region. Therefore the gap is greater than two. The gap between TFR, IMR and antenatal care and delivery assistance issue may be related with health expenditures. Health care expenditures and outcomes are not evenly distributed among the regions in Turkey. In 2003, Turkey spends around 6.7 percent of its Gross National Income on health and about 70 percent of this expenditure is accounted by the public expenditures (The World Bank, 2006a). The Central and Mediterranean regions over the other parts of the country receive the highest than the proportionate share of GDP spending given their population and East and Southeast of Turkey receive the least than the proportionate share of spending given their population (The World Bank, 2006a).

Oomman et al. (2003) consider TFR in terms of income level differences. Turkish women from the poorest families have 2.5 times more births per woman. This is also indicative of socio-cultural differences. The differences come from awareness of family planning and access to modern contraceptive methods. There is also regional difference about antenatal care and delivery assistance in table IV.9. While the east has the lowest rate of receiving antenatal care and delivery assistance, the west has the highest rate as shown in Table IV.9. This may be also considered as an indicative of socio-cultural and-economic differences. The use of contemporary contraception among Turkish women is not high. The average is approximately 34.5%. The inter-quintile discrepancy ratio between rich and poor is 2.1. Therefore, richer women are more likely to use

modern contraception. These income level differences are important for our study since the TFR and the nutritional level are closely related with the income level too.

**Table IV.9: Percentage of women who did not receive antenatal care and delivery assistance from health personal**

| | Antenatal care (%) | Delivery Assistance (%) |
|---|---|---|
| East | 38.8 | 40.3 |
| West | 8.5 | 4.7 |
| South | 14.6 | 11.2 |
| North | 14.8 | 13.5 |
| Central | 16.6 | 9.0 |
| Turkey | 18.6 | 17.0 |

(Source: from Pekcan, (2005))

Since insufficient intakes of nutrition would cause ill-health and sufficient intakes of nutrients are essential for maintaining adult health and productivity over the life span, individuals or children's developmental progress is critically dependent on the quality of diet that the household can afford and parents' knowledge (Broca and Stamoulis, 2006). If the family can not afford, then kids may have to move to work force prematurely which causes a reduction in the time needed for school-related work because of the poor parental health and income (Bhargava, 2001). Some studies such as Bhargava (2001) and Ruchlin and Rogers (1973) display that the level of education of individuals is a significant determinant of health status and particularly the improvement of mothers' literacy is closely related with the improvements in children's health. A poorer health or death in a household, or excessively high fertility, can have a substantial impact on household income. Therefore, it would, in extreme cases, make the difference to a household being above the poverty line or falling below it. Of course, it is not just the loss of income linked with poor health—it is also often substantial financial costs of medical treatment needed necessary to restore health. Low birth weight and poor childhood nutritional status are also associated with an increased risk of adult diseases including heart disease, obesity and high blood pressure. Disease impedes economic well-being and development which can be summarized by three main ways. Firstly, avoidable disease reduces the number of years of healthy life expectancy. Secondly, the children disease affects on parental investment in children. If infant and child mortality rate is high in society which may end up high fertility rate, then the families have hard time to invest in children's health and education. Lastly, beyond the individual worker productivity, disease of worker affects the investment on business and infrastructure investment as well as political and macro economic stability (Sachs, 2001). Romney et al. (2004) show that if the nutritional status of children is improved then they overcome growth delay complications and maintain steady growth

If a person has low nutrition, this will affect persons work and its concentration on his work (Broca and Stamoulis, 2006). Thus, we will examine the importance of nutrition status in income variation across provinces but we should first summarize why nutrition is so important.

- Nutritional status affects labor outcomes. There is no doubt that better nutrition improves physical health since poor nutritional status leaves people more susceptible to illness

- There is a risk of intergenerational transmission of poor nutritional status. Women who suffer from poor nutrition are more likely to give birth to underweight babies. Women who have more children may also more likely pay less attention to these children and family will have fewer resources to these children.

- There is also evidence that poor nutrition is associated with poor school performance in children of school age. At its simplest, this is expressed as a hungry child cannot learn.

- People who live on the edge of starvation can be expected to follow a policy of safety first with respect to investments.

- There is some evidence that the macroeconomic performance of the whole economy may suffer as a result of the cumulative impact of these effects.

Therefore, TFR, IMR and U5MR have influences on the nutrition level of the people and society so do their wealth status. They seem to have strong simultaneous interaction. We also consider the mean growth rate of per capita GDP and variance for per capita GDP for the period from 1987 to 2000 at the seven regions level of Turkey in Table IV.10. DPT (2003b) reports that per-capita GDP of the seven regions in Turkey do not display that the gap among them does decline over time. The variance for per-capita GDP of the regions in the Table IV.10 shows that there is a huge regional differences in terms of per-capita GDP since the variance of the per capita GDP for Turkey is 0.43. This DPT report also shows that the mean variance of the per capita GDP for Turkey does show leapfrogging tendency.

**Table IV.10: Regional mean growth rate of per capita GDP and variance for per capita GDP for the period from 1987 to 2000**

| Regions | Mean-Growth Rate | Variance for per-capita GDP |
|---|---|---|
| Marmara | 4.2 | 0.35 |
| Egean | 3.7 | 0.33 |
| Mediterranean | 3.5 | 0.28 |
| Center Anatolia | 3.2 | 0.41 |
| South Anatolia | 3.4 | 0.35 |
| Black sea | 2.9 | 0.49 |
| Eastern Anatolia | 1.9 | 0.50 |
| Turkey | 3.6 | 0.43 |

(Source: DPT (2003a))

Under these region-specific differences and regional per-capita GDP dynamics, we are very interested in knowing whether the distribution of income changes over time: whether within Turkey; interregional differences in income levels tend to disappear or tend to increase over time. If they diminish, then we may be less worried about creating any policy programs (rather than if these differences tend to perpetuate themselves). We should also point out that not only interregional differences in income levels tend to disappear is important but also how fast it

occurs is important. If the gap declines very slowly, we should also focus on policies to increase this pace. Therefore, we are also interested in knowing whether the regions that are relatively poor now are the same as the ones that were relatively poor years ago. If the answer is yes (that is, if poverty tends to persist over time) then we may want to enact public aid programs such as aiming to reduce infant mortality rates (IMR), U5MR and TFR or (K/H) differences to allow the poor regions to escape this predicament. If the answer is no (that is, the economies that are relatively poor today are not likely to remain relatively poor in the future), then we may not need to worry about the countrywide distribution of income.

We like to pick up (K/H) and the health related variables in terms of its role in per-capita income and income growth specifically in the issue of convergence. Since the relationship between economy and health is one of the cornerstones in this discussion, even though setting up this relationship is complex, we simply try to include this in the production function to see its effects on the per capita income growth and the convergence issue. Therefore, if the income dispersion among regionalized provinces declines automatically we may have a more competitive Turkish economy in the world, which means a sustainable economic growth with more and better jobs, more and healthier environments to live in and greater social cohesions because of having better income differences. If the expected coefficient for log-lag of per-capita GDP is negative then we can conclude that the convergence occurs. However, finding the absolute or conditional convergence is sufficient only to conclude that there is a dynamic change in income disparity but there is no solid conclusion about the ranking's dispersion of regionalized provinces.

We start with the absolute convergence and it significantly occurs. However, it is a bit surprising since mostly the conditional convergence occurs for Turkish provincial studies. There could be two reasons: the data for 1994 for 2003 are the crises year and the year after crises, respectively and the data set is in short of observations. We also check how the constant term of an economy-specific term ( $\left(1-e^{-\beta t}\right)Ln(A_0)$ ) and the constant term of an economy-invariant time specific factors ( $g\left(t-e^{-\beta t}t_0\right)$ ) will affect on the conditional convergence rate. It means that how the convergence rate will be influenced if there are no income level differences or crises year's effects or both. We have shown the regressions in Table IV.11a where their results are reported in Table IV.11b. Both dummy sets have significantly positive influences. We have also experienced significant convergence. In the third column of Table IV.11b, when we only add income dummies in the regression, the convergence coefficient becomes higher because they look alike, whereas, with time dummies we experience lower convergence rate because as if no crisis occurs. Since both sets of dummies are significant, we have included them in the same regression and we have a significantly convergence but it is lower than just the income dummies.

**Table IV.11a: Regressions for Absolute and Conditional Convergence for TableIV.11b**

| | |
|---|---|
| $\frac{1}{T}\ln\left(\frac{y_{it}}{yi_{t-T}}\right)=\text{Constant}-\left(\frac{1-e^{-\beta t}}{T}\right)\ln(y_{it-T})$ | 1 |
| $\frac{1}{T}\ln\left(\frac{y_{it}}{yi_{t-T}}\right)=\varphi_1\text{Income Dummies for High}+\varphi_3\text{Income Dummies for Low}-\left(\frac{1-e^{-\beta t}}{T}\right)\ln(y_{it-T})$ | 2 |
| $\frac{1}{T}\ln\left(\frac{y_{it}}{yi_{t-T}}\right)=\phi_1\text{Time Dummies (1994)}+\phi_2\text{Time Dummies (2003)}-\left(\frac{1-e^{-\beta t}}{T}\right)\ln(y_{it-T})$ | 3 |
| $\frac{1}{T}\ln\left(\frac{y_{it}}{yi_{t-T}}\right)=\varphi_1\text{Income Dummies for High}+\varphi_3\text{Income Dummies for Low}$ $+\phi_1\text{Time Dummies (1994)}+\phi_2\text{Time Dummies (2003)}-\left(\frac{1-e^{-\beta t}}{T}\right)\ln(y_{it-T})$ | 4 |

**Table IV.11b: Absolute and Conditional Convergence with Dummies**

| Dependent variable: GDP per-capita growth rate | | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| $\log(y_{t-T})$ | -0.024 | -0.033 | -0.012 | -0.014 |
| | (4.37)** | (5.05)** | (3.27)** | (3.03)** |
| Income Dummies for High | | 0.279 | | 0.123 |
| | | (5.57)** | | (3.29)** |
| Income Dummies for Low | | 0.265 | | 0.12 |
| | | (5.71)** | | (3.45)** |
| Dummy for 1994 | | | 0.131 | 0.027 |
| | | | (4.99)** | (7.56)** |
| Dummy for 2003 | | | 0.103 | |
| | | | (3.70)** | |
| Constant | 0.21 | | | |
| | (5.06)** | | | |
| Observations | 34 | 34 | 34 | 34 |
| Number of index | 2 | 2 | 2 | 2 |
| Log likelihood | 92.7 | 94.92 | 111.4 | 111.66 |
| Convergence Rate | 0.022 | 0.029 | 0.011 | 0.013 |

Absolute value of z statistics and its significance level are in parentheses and significant level shown with * at 5%; ** significance level at 1% in all tables.

After confirming the convergence for 17 regionalized provinces we like to investigate how other regional-specific conditions will affect the convergence coefficient. Therefore, we have shown the regressions in Table IV.12a where their results are reported in Table IV.12b. We start with the effects of (EL/E) on growth and convergence. With or without dummies, adding (EL/E) causes significant convergence. However, when we add year dummies we have insignificant coefficients

for (EL/E). Adding (EL/E) in the regressions increases the convergence rate. Fits of the models also increase with (EL/E). Actually we also have the highest convergence rate with just adding (EL/E) and income dummies.

**Table IV.12a: Regressions for Conditional Convergence with (EL/E) for TableIV.12b**

| | |
|---|---|
| $\frac{1}{T}\ln\left(\frac{y_{it}}{yi_{t-T}}\right) = \text{Constant} + \alpha\left(\frac{1-e^{-\beta t}}{T}\right)Ln\left(\frac{EL}{E}\right) - \left(\frac{1-e^{-\beta t}}{T}\right)\ln\left(y_{it-T}\right)$ | 1 |
| $\frac{1}{T}\ln\left(\frac{y_{it}}{yi_{t-T}}\right) = \varphi_1 \text{Income Dummies for High} + \varphi_3 \text{Income Dummies for Low} + \alpha\left(\frac{1-e^{-\beta t}}{T}\right)Ln\left(\frac{EL}{E}\right) - \left(\frac{1-e^{-\beta t}}{T}\right)\ln\left(y_{it-T}\right)$ | 2 |
| $\frac{1}{T}\ln\left(\frac{y_{it}}{yi_{t-T}}\right) = \text{Time Dummies (1994)} + \phi_2 \text{Time Dummies (2003)} + \alpha\left(\frac{1-e^{-\beta t}}{T}\right)Ln\left(\frac{EL}{E}\right) - \left(\frac{1-e^{-\beta t}}{T}\right)\ln\left(y_{it-T}\right)$ | 3 |
| $\frac{1}{T}\ln\left(\frac{y_{it}}{yi_{t-T}}\right) = \varphi_1 \text{Income Dummies for High} + \varphi_3 \text{Income Dummies for Low} + \phi_1 \text{Time Dummies (1994)} + \phi_2 \text{Time Dummies (2003)} + \alpha\left(\frac{1-e^{-\beta t}}{T}\right)Ln\left(\frac{EL}{E}\right) - \left(\frac{1-e^{-\beta t}}{T}\right)\ln\left(y_{it-T}\right)$ | 4 |

**Table IV.12: Convergence with Dummies and (EL/E)**

| Dependent variable: GDP per-capita growth rate | | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| log(yt-T) | -0.034 | -0.04 | -0.014 | -0.017 |
| | (5.72)** | (6.21)** | (2.96)** | (2.98)** |
| Income Dummies for High | | 0.308 | | 0.14 |
| | | (6.63)** | | 3.35 |
| Income Dummies for Low | | 0.296 | | 0.14 |
| | | (6.83)** | | 3.47 |
| Dummy for 1994 | | | 0.144 | 0.03 |
| | | | (4.67)** | 6.48 |
| Dummy for 2003 | | | 0.117 | |
| | | | (3.54)** | |
| Constant | 0.255 | | | |
| | (6.41)** | | | |
| Ln(EL/E) | 0.006 | 0.005 | 0.001 | 0.001 |
| | (2.94)** | (2.73)** | 0.73 | 0.76 |
| Observations | 34 | 34 | 34 | 34 |
| Log likelihood | 96.52 | 98.3 | 111.61 | 111.949 |
| Convergence Rate | 0.029 | 0.034 | 0.013 | 0.016 |
| Alpha-Value | 0.18 | 0.1250 | 0.07 | 0.059 |

We also investigate worker effort effects on economic growth. The models with the worker effort level we run are shown in Appendix F at Table F1a where their results are reported in Appendix F at Table F1b. The worker effort has negative influences on economic growth and adding the time

dummies make the coefficients of worker effort level insignificant. These results do not seem to be helpful to explain the relationship between worker effort and growth becasue of short-time span of the available data. Thus, we have presented these results in Appendix F.

Our finding also sheds light on the issue of policy activism. The faster rate of convergence may emerge to emphasize the policy-irrelevance philosophy attributed to the Solow model. In reality, conversely, the vice versa is the case. Conventionally, only the saving and population growth rates were thought to be the variables for policies to be implemented. However, as mentioned in the previous chapter, our study also emphasizes the role of the A(0) term as a determinant of the steady state level of income. Therefore, we can say without a doubt that even with exactly the same rates of saving and population growth, a country can also directly improve its long-run economic situation by improving in the components of A(0). Besides, any improvements in A(0) can also have productive effects on saving and population growth which can lead to a further (indirect) increase in the steady state level of income. Therefore, our study could point to a richer capacity for policies in raising the long-run incomes and in speeding up the pace of reaching them. As a result, the current study helps us to form a connection with the discussion with the recent work on growth empirics since we have lower alpha values with dummies. In order to have more accurate convergence rate, we add the time and provincial specific effects. Thus, both of these specific effects are very important and eliminating them is important since they decrease the convergence rate. Therefore, these findings point out that not only differences in more heterogeneous economies but also differences in more homogenous economies are very important.

## IV.4. CONCLUSION

In this chapter, in addition to using the human capital and nutritional interaction and the physical to human capital ratio, we have also pointed out that in line with Engel's law, the share of food spending declines, as income rises (Rahman, 2002). After these acknowledgments, we estimate how much effort level (e) contributes to the explanation of the residuals. It is found that this figure is 52%. Since we displayed the importance of effort level in the income variation, we experience that effort level causes the productivity gap with level accounting approaches but (EL/E) differences are not high between rich and poor. Since food expenditure ratio in per capita income variation and productivity gap investigation account for such a large impact, government should focus on its population's nutritional level to have better worker effort level beside educational policy and industrial policy. However, since regionalized provincial-specific dummies play a significant role on per-capita income growth, policy makers should focus on these provincial-specific effects more than other control variables. We also checked whether the worker effort index for regionalized provincial level influence the per-capita income growth. It has significantly

negative influences on per-capita income growth. While provincial-specific and most time-specific dummies have significantly positive effects on growth rate, there are also some insignificant negative effects of time dummies. The time-specific dummy for 1994 represents a crisis year and the time specific dummy for 2003 represents year after crisis. These positive coefficients of time dummies suggest that the growth rates do not decrease over time. Provincial-specific dummies may represent the regionalized provincial industry level, socio-economic level, educational opportunity, manufacturing status and being located in the terror area. These dummies may also represent the regionalized differences in IMR, U5MR and TFR which have influences on the nutrtional status of the people and educatioanl opportunity. These significant provincial dummies also lead us to think that differences in similar economies are also important since provincial economies are more homogenous than cross-country economies. In order to carry a more robust study, Turkey has to solve its data collection problem about nutritional status of the nation at the provincial level. Even though we have reached somehow solid results about the (K/H) and economic growth, in order to have more valid evidence regarding the impact of (K/H) for the further study, we should have longer time horizon for the data on the impact of (K/H) and on worker effort. Because of the lack of data and a sudden independent policy changes in the educational system, the period analyzed may not give solid results about (K/H). There should be adjustment period for the physical capital and the new education sytem.

## CHAPTER V

### V.I CONCLUSION AND POLICY IMPLICATIONS

Mankiw (1995) discusses some critiques of the neoclassical model which has been under attack in recent years. It is said to be an empirically inadequate theory of growth and therefore, we tried to come over first two of these critiques by employing the worker effort indices or especially the (K/H) ratio idea rather than employing the level of K and H. These two critiques are:

- The magnitude of international differences: The model predicts less variation in income than is observed across countries: The difference between the richest and the poorest for our cross-country study is 2527.3 times for the data we employed.

- The rate of convergence: The model predicts a faster rate of convergence to the steady state than most studies do. It ranges between 0.0001 and 0.077 for our cross-country data.

We have another issue to deal with before we discuss how well our approach overcomes these critiques. Therefore, in order to set better nutrition for enhancing economic growth, we try to set a solid economic theory and model to formalize these relationships even though there is also a simultaneity problem between the control variables in the growth studies, especially for nutrition. Since nutrition status is far from being exogenous and economic growth has been widely documented to exact its positive impact on nutrition status, these theoretical models should provide guidance on the search for possible transmission mechanisms between nutrition and growth. All these points indicate the direction of simultaneous determination with the question of what way or size the feedback effects are responsive. Similar to Mankiw et al. (1992) model, we set our nutritional level in defining for worker effort indices within the Augmented-Solow model. Finding no-convergence is considered as a support for a simultaneous relationship and finding convergence could be used against the simultaneity problem. Therefore, firstly we try to expose whether health as a worker effort indices could belong in the Solow-Swan type growth regression category, since the residuals which usually are considered Total Factor Productivity (TFP) in the Solow-Swan type growth regression. Thus, we firstly confirm that health indicator is an omitted variable in the Solow-Swan type growth model. Since health contribution as worker effort indices explains the TFP, we have included health as a worker effort index to explain the large income differences. After all we have verified whether relatively poorer economies grow faster than richer economies in terms of levels of income convergence. Our model predicts more variation in income as it is observed across countries and in general empirically, our model predicts a slower rate of convergence to the steady state than most studies do for the cross-country study except the regression with income dummies. Therefore, we may say that Mankiw (1995)' critiques are

partially solved. In order to have more solid result, we should adjust or consider the per–capita GDP with effort indices since we have confirmed that worker effort belongs in the Solow type of model in this thesis. Then, we could have a more reasonable convergence rate to overcome these critiques. The complementary interaction of physical to human capital has an effect on the convergence coefficients. Without the dummies in the regressions for the cross-country study, including Electiric power consumption to education data (EL/E) have changed the sign of the convergence paramater from positive to negative. For the Turkish regionalized provinces regression, including the (EL/E), we have the second highest convergence rate among the regressions.

After rationalizing the physical to human capital ratio as complementary, we also discuss our setting of worker effort indices and we consider the worker effort is an omitted variable. Since worker effort indices explain the some big portion of unexplained residual issue, we should also point out that with the worker effort level ("e"), the size of the residuals declines. For the cross-country case while the size of the residual without the worker effort level ranges between 69% and 96%, with the worker effort level it ranges from 34% and 91.6%. For the Turkish regionalized provinces, with the worker effort level, the size of residual declines from 81% to 39% since adding the contibution of worker effort to (EL/E) ("e+Z"=0.42+0.19=0.61) as an accumulated factors explains the income variation. Therefore, because of these declines in residuals, the nutritional level in terms of the worker effort level is important in our model. Besides setting the physical to human capital ratio as complementary where we also set the worker effort indices as a portion of human capital we could confirm that the worker effort is an omitted variable.

Once setting the physical to human capital ratio as complementary and confirming the importance of the worker effort for explaining the unexplained residual, we tried to answer the questions "to what extent can differences in (EL/E) account for the income disparity between the richest and poorest countries and if (EL/E) causes any decrease or increase in the productivity gap" and "to what extent can differences in the worker effort level account for the income disparity between the richest and poorest countries and if the worker effort level causes any decrease or increase in the productivity gap". Before I discuss the level accounting results for these questions, I would like to point out that (EL/E*Y) contribution explaining the unexplained residual is the highest for the high-income countries and lowest for the low-income countries where Y displays the GDP level of the country. Therefore, with the level accounting approach, we find that the worker effort level causes the productivity gap as well as (EL/E*Y) ratio. In terms of (EL/E*Y) differences, we have experienced greater productivity gap when we allow α-values to be different, we have the highest productivity gap in terms of (EL/E*Y). Since the worker effort level has some great explanatory power on the productivity gap, we also note that the results are very sensitive to the choice of

capitals ratio shares too. When we have different capitals ratio shares for the sub samples, we experience that these differences are greater than the same capitals ratio shares. With the different α-values, we observe higher productivity gap except for DPS. Therefore, not only the worker effort indices depending on the nutritional dataset but also the α-values play very crucial role to calculate differences in ratio of productivities gap. Since the log of (EL/E) parameter for Turkish data explains negative differences in productivities, we should be careful about concluding the negative sign of the log of (EL/E). It should mean that there are not many differences in productivities in terms of the (EL/E) for the regionalized province data as well as for the cross-country sample; we experience the similar results for the worker effort level with DPS

After setting the physical to human capital ratio as complementary and confirming the importance of the worker effort for explaining the unexplained residual and answering the questions the role of differences in (EL/E) and the differences in the worker effort level accounting for the income disparity between the richest and poorest countries, we also look into convergence issue. Controlling the (EL/E) and the worker effort level (e) does not play greater effects than the country or the provincial-specific effects on convergence rate. We can conclude that just adding the country-group-specific effect with and without (EL/E) and the nutritional differences for the worker effort indices, we observe the convergence for cross-country data. Turkish regionalized provinces data already results the absolute convergence. Adding the other control variables also affect the convergence rate too.

Our findings also shed light on the issue of policy activism and our study could point to a richer capacity for policies in raising the long-run income levels and in speeding up the pace of reaching the steady state income. The faster rate of convergence may emerge to emphasize the policy-irrelevance philosophy attributed to the Solow model. In reality, conversely, the vice versa is the case. Conventionally, only the savings and population growth rates were thought to be the variables for policies to be directed to. However, as we mention in the previous chapter, our study also emphasizes the role of the contants economic specific ($A_t$) term as a determinant of the steady state level of income. Therefore, we can safely say that even with exactly the same rates of saving and the population growth, a country can also directly improve its long-run economic situation by conveying about improvements in the components of $A_t$. Besides, any improvements in $A_t$ can also have productivity effects on the savings and the population growth which can lead to a further (indirect) increase in the steady-state level of income. As a result, the current study helps us to connect the discussion with the recent work on growth empirics since we have lower alpha values with dummies. We have lower alpha value when we do not have the worker effort indices in the regression for the Turkish case. It may have changed if EL/E were significant. However, when we have the worker effort in the regression it is around little higher than ½. Thus, both of these specific effects are very important and eliminating them is essential since they

influence the convergence rate. Therefore, these findings point out that not only differences in different economies but also differences in similar economies are very important.

The convergence process may be prevented by the cumulative processes in economic growth such as facing the economic crises. In Turkey, economic actions and population are concentrated in a few metropolitan core regions as a consequence of swelling processes. It seems that, the absorption of economic activities and population in a few metropolitan regions (Table IV.5) while leaving the lagging ones at the other side gestures serious problems for both regionalized clubs of provinces. As DPT (2003a) points out, as a matter of fact, this course of action, on one hand leaves the end with a risk of creation of local competences or worsening of existing ones, and, on the other hand forms over amassing of activities in the latter and deters the restructure or modernizing processes. Moreover, additional analysis pointed to increasing disparities not only between the two quite distinct regionalized clubs of provinces but also within them. While the group of regionalized provinces defined as dynamic growth regions designated increasing income growth and appeared to catch-up the others, the dissimilarity between them and the metropolitan core regions in terms of initial income levels and income growth rates seem to keep on.

Clearly, there are many ways for achieving this convergence but the findings indicate that even focusing on basic (EL/E) would contribute to reducing income growth differences and eliminating the differential income growth pattern among provinces in Turkey since conditional convergence regression with (EL/E) results the higher convergence rate (Table IV.12). Regional strategies focusing on upgrading the existing human capital capacities through the enhancement of educational capacities and physical capital capacities through the strategy for industrial structure would provide a growth and development scheme for the different groups of provinces and help eliminating the differential growth pattern. On the other hand, if the long time lag between human capital investment and returns to human capital, particularly with regard to education is considered, a decline in income growth differences would come out in the long run. Moreover, with strategy on increasing the human capital potentials of regions, the lagging areas could be supported with some help to be integrated to the national economy and regional income growth differences could be reduced.

However, since the regionalized provincial specific dummies play significant role on per-capita income growth, policy maker should focus on these provincial specific effects such as in the Table IV.5. Therefore, in terms of policy perspective, we may have to focus on the provincial-specific effects. The data of migration at 2000 (TUİK, 2007) and structural indices from DPT (2003a) represented by the provincial dummies show that according to our classification, socio-

economic, health, manufacturing and education sector in low income level provinces should be improved besides the migration issues. While the richer provinces are migrants-receiver, lower-income provinces are giver. Socio-economic, health, manufacturing and education sector indices in low income provinces are negative. Therefore, the province-specific dummies are most probably related to these indices. Thus, equalizing these differences would affect the convergence rate. We also checked whether or not the worker effort indices for regionalized provincial level influence on per-capita income growth. It has significantly negative influences on per-capita income growth. Therefore, we have located such convergence regression in the Appendix F. (EL/E) contribution in the economy may be increased in order to have positive effects of the worker effort.

(EL/E) contribution in the economy may be increased with developing the provincial structural indices in order to have higher positive effects on economic growth. Any changes on the cross-regionalized-provincial structural differences will directly influence the dynamics of economics such as preventing the economic crises. The capital stock is difficult to measure such as building, machinery, equipment and inventory. The industrial electricity consumption has the advantage of being a "flow" and thus it is an appropriate approximation of the utilization physical capital. The industrial electricity consumption increases less than the education proxy in Turkish case. While the industrial electricity consumption growth is 0.48, the education proxy growth is 0.8. The education proxy grows almost double of the industrial electricity consumption. Therefore, the (EL/E) declines while the industrial electricity consumption should increase more than education data in order for E to use more effectively. The growth of (EL/E) from 1994 to 2003 is around -0.31. E increases because of increasing in compulsory education from 5 to 8 years. However, there are no sudden policy changes in industry structure. Therefore, EL has to adopt this increase. Thus, the worker effort level may be wasted because of being short in EL compared to E. The provincial-specific and the time-specific dummies have significantly positive effects on growth rate even though there are some insignificant negative effects of time dummies. The 1994 time-specific dummy represents the crisis year and the 2003 time-specific dummy represent the year after crisis. These positive coefficients of time dummies suggest that growth rate does not decrease over time.

These provincial specific dummies may be related with their industry level, socio-economic level, educational opportunity, manufacturing status as in the Table IV.5 and being located in the terror area beside the differences in TFR and IMR. As we mention previously, human well-being is the main requisite to emphasize these provincial-specific dummies. In spite of economic misery, people have the capability for taking pleasure in an extensive range of non-economic intake. These are people's positive reception of nature, love, friends, conversation, sporting activities and enjoying parenthood. Since they are part of the consumptions, they are the some of the major

sources of satisfaction in life which are not marketable services, neither quantifiable nor measurable in the national accounts. However, a person who is ill because of nutritional anemia or harmed by the seemingly constant attacks with nutritionally connected diarrheas or a person located in the teror area can not in fact enjoy these pleasures. Whether he or she has the capacity to enjoy these most fundamental sources of human satisfaction is the main concern and not the income level. Therefore, human well-being is the main requisite which may be closely related with the provincial-specific effects.

In conclusion, the lessons to be taken forth from our study may be summarized as follows:

- Human capital can be defined with health proxy besides educational data which is the worker effort indices in our cases. It is confirmed firstly by the variance decomposition results since worker effort explains the some good portion of the unexplained residuals
- The worker effort indices have great influences on per capita income variation and income differences.
- Besides the worker effort indices, (K/H) ratio in the production function has been nicely fitted just as it was in the previous studies except some estimation for Turkish regionalized provinces with some other control variables and dummies.
- Besides worker effort indices and (EL/E) ratio, country and province-specific effects are also important.

However, even though we have reached solid conclusions about the nutrition and economic growth, in order to have more valid evidence regarding the impact of nutrition on cognitive achievement, we should have data on the impact of nutrition on cognitive achievements then we may have to have more precise conclusions. Since, even after, we calculate the worker effort effect in income and income differences, we have still a large fraction of the income differences which remain unexplained. For a further study, the production function should be allowed to be different for income level of country convergence regression to see whether the implied alpha value varies besides beta convergence rate or not.

Since the cross-country income level dummies and the province-specific effects are important I would like to discuss how some national and international structure may have an effect on the convergence pace and economic growth in Ffigure V.1 Government, domestic markets, globalization and international markets and historical, political, cultural influences affect the welfare, tax, unemployment, education policy, investment incentives, wages rate, industrial restructuring and demographic changes. Despite of being complex and being not completely understood, they still try to answer the question what can be done to reduce income differences

within a society or worldwide and what role governments or World Bank or such institution can and should play in facilitating this process. Even though what gives rise to income inequality and how it is sustained and/or changed over time is complex and not completely understood by economists, health has bidirectional relationship with economic and material factors so do with income inequality.

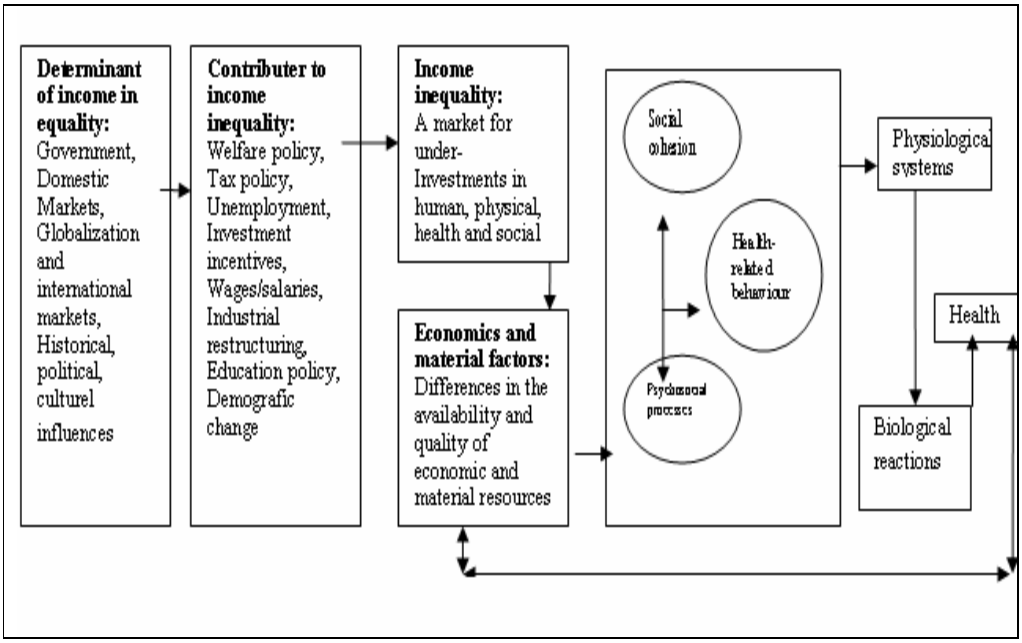


Figure V.1: A diagrammatic representation of the presumed relationship between income inequality and health
(Source: Turrell, 2001)

In discussions focusing on the significance of income inequality for population health, Turrell (2001) have summarized some of more specific mechanisms and processes that are consequences of these broader forces contributing to income disparities in Table V.1. There are many ways in which governments can lessen the extent of income inequality in society (eg, progressive taxation, income maintenance for low-income individuals and families, improved access to education and training, job creation, and structural adjustment programs) and given the strong evidence linking income distribution and health, there is ample justification for them to do so.

Plummeting income inequality calls for superior and more even handed investments across regions in terms of physical, educational, social and economic infrastructure, underpinned by an explicit acknowledgement that influence ultimately investments in population health. Therefore, investing in human, physical and social infrastructure are crucial to both individual and population health. These investments would influence health through the economic and material environment they create and through the direct effect of this environment has and via other

mechanisms. Namely, these other mechanisms include social cohesion (or the lack of it) and psychosocial processes and the effect of these factors on the health-related behaviors. The lesser income inequality is likely to be characterized as the stronger social-cohesiveness as a consequence of being well endowed with stocks of physical capital and skilled level. Therefore, this densely interconnected social fabric should act to promote and protect psychosocial well-being and minimize the likelihood of health-damaging behaviors. These policies in Table V.1 are closely related with the idea of complementarity between physical and human capital.

**Table V.1: Some factors contributing to income inequality**

| |
|---|
| • Emergence of a service economy and subsequent rising demand for skilled and educated labor (highly paid), associated with a stagnant pool of low-skilled, poorly educated workers on low incomes. |
| • Changes in investment patterns and industrial restructuring |
| • Move from a manufacturing/industry-based economy to one based on service provision and technology, resulting in an increased demand for high skills and education and consequent shifts in rewards |
| • A steady increase in the demand for skilled workers relative to unskilled workers |
| • The internationalization of financial markets and the relative decline in manufacturing jobs |
| • Changing industrial structure |
| • Education policy |

(Source: Turrell, 2001)

Since the complementarities between human capital and physical capital are the nature of the production procedure because machines require skilled workers to operate them and to repair them, there should be proper policies to invest in physical and human capital. While modern and productive agriculture needs a literate agricultural workforce: workers who can read instructions on a fertilizer bag, comprehend information contained in the literature distributed by extension agents and understand the contents of a repair manual for agricultural equipment, modern services (travel, finance, tourism) require numeracy people who can make simple calculations quickly and accurately. Therefore, if a country that gives priority to physical capital, it has to give priority to human capital too. Otherwise the returns to physical capital will be lower than they need to be if human capital is not in line with physical capital. In order to have greater output, we should also point out that technical change requires investment in people. It is not easy to initiate improved methods of production, new ways of doing things and more complex and sophisticated products if buyers, workers and consumers have insufficient training and education to enable them to understand the technology which is somehow related with social cohesion, social fabric and so on. Therefore, physical capital formation, the accumulation of human capital and technical change are closely interlinked. Available technological level (hidden in K) and improvement in it need similar improvements in H. Since under-developed countries have relatively obsolete technologies with low but appropriate human capital endowments, they may be able to capture high short-term growth rates. However, it may be short-term growth loss for developed countries whose overwhelming technological improvements might not be able to capture high growth rates

because of the relative inadequacy of human endowment. In terms of model parameters, a country can also directly improve its long-run economic situation by conveying improvements in the components of $A_t$ as long as improvements in the components of $A_t$ are transformed into physical capital and so do the same improvements for skilled embodied in human capital.

If we like to have a more competitive and dynamic Turkish economy in the world, we should get rid of the regionalized provincial-specific characteristic. These regionalized provincial-specific characteristics such as the biggest of all differences for the use of safe motherhood services occur besides IMR, TFR and so on. The inter-quintile discrepancy ratios between the poorest (reference) and the richest quintiles are at least twice as much as the poor since these ratios are 2.0 or more where we may speculate same results for our low and high-income regionalized provinces. The major variation is in antenatal care where inter-quintile disparity ratio is 2.8, which is followed by deliveries attended by skilled medical personnel (2.3), contraceptive prevalence rate (CPR) (2.2), and immunization (2.0). As a result, the high averages of the use of teen and secure motherhood health services (> 60%, excluding CPR) cover the low levels of consumption by the poor.

Considering the β-convergence concept as the most interesting convergence concept, we have introduced the physical capital to human capital complementarity ratios (K/H). It is not easy to conclude that $\left[\frac{K}{H}\right]_{rich} \overset{>}{\equiv} \left[\frac{K}{H}\right]_{poor}$. The only point we may focus on how appropriately (K/H) matches within a country. If $\left[\frac{K}{H}\right]_{poor}$ is more efficiently and effectively organized or matched in some period in time horizons with a given technology, then the poor will grow faster than the rich. Consequently, how long this more effectively and efficiently structured physical-human capital ratio will last is another issue to consider. The $\left[\frac{K}{H}\right]_{rich}$ could also be better organized surely than the poor and however, if the rich develop a new technology and make use of this newly discoveries by the community, this is another important issue. When this new discovery takes place, it will cause a structural change in the economy such as reallocation of productive factors in economies like moving from the manufacturing sector to high technology intensive, migration or mobility of factors. Therefore, the poor grow faster than the rich in the short run because the rich are in the process of adjusting and implementing this new technology. However, after this adjustment and implementation period is over, the rich grows faster than the poor in the short run. What will happen when the poor implement this new technology is also another important issue to consider. Since implementing this newly developed technology by the poor is less costly and even

takes less time to adjust, the poor will get over this leapfrogging faster than the rich. We should also indicate the "learning by doing" concept as one of the reasons to evaluate this issue. In literature, it is stated that a country with the current technological lead has learned to be highly productive through experience with the newly-created techniques. Until substantial learning-by-doing has occurred, there will be no full use of higher productivity offered by the newly-created techniques. However, it may be learned much more easily by the follower since the leader has to establish the problem and figure out the solution for them. Since developing countries have relatively backward technologies with low but appropriate human capital endowments, they may have been able to capture very high short and long -erm growth rates. However, it is not the case for developed countries whose devastated technological improvements had not been able to capture the high growth rates because of the relative inadequacy of human endowment. Therefore, observing a leapfrogging should not be surprising for the economist and in the long run, the poor should grow faster than the rich.

The model we set and other convergence-related model discusses that initially lagging economies tend to grow faster. There are two issues which are related to policy paramaters: as one issue, from the stand point of the diffusion of technology, the force that underlies convergence is that, at least over some range, the cost of imitation is smaller than the cost of innovation and as another issue, decision on investment path of economy will change countries' profile and the club they belong to. In our model as similar to models in similar line, any changes in any of the model parameters because of policy changes, output per worker begins to grow more rapidly. However, this rapid growth continues temporarily until the output-technology ratio reaches its new steady state. Therefore, at that point, growth rate will return to its long-run level. What this means to us is that, firstly, policy changes in the Solow type of the model increase growth rates but only temporarily along the transition to the new steady state, and secondly, policy changes can have level effects. Therefore, a permanent policy change can permanently raise or lower the level of per-capita output. What happen the transition period of the economy when there are some policy changes? Briefly, policy reforms that shift the steady state path of an economy upward can generate increases in growth rates along a transition path. Thus, increases in investment rate, skill accumulation or the level technology will have this effect. Such rapid growth continues temporarily until the output-technology ratio reaches its new steady state. Therefore, at that point, growth rate will return to its long-run level.

How these two effects works out. As Barro and Sala-i-Martin (1995) discuss in a model that a country that was initially technologically backward would eventually become the innovator. Their results depend on the assumption that the initially backward place happened to have a better productivity parameter, A, perhaps because its government policies or infrastructural

establishment or how they are governed and etc. were more conducive to economic activity. As we mentioned in previous paragraph that developing countries have relatively backward technologies with low but appropriate human capital endowments and they may have been able to capture very high short and long term growth rates but developed countries. Developed countries devastated technological improvements had not been able to capture the high growth rates because of the relative inadequacy of human endowment.

As another issue, decision on investment path of economy will change countries' profile and the club they belong to. Decision on investing the high-tech investment sector instead of consumption goods means building the skilled and unskilled labor demand according to that choice of decision makers. As an example, moving from a textile industry-based economy to one based on automobile industry technology will result in almost totally different demand for high skills and education policy. Therefore, sub-investment will be occurred according to this decision because of the externalities in sector maybe even in nation. We should be clear about whether all types of human capital affect growth identically; the impact of a particular type of human capital on growth depends on the presence of other types of human capital and what should be the characteristics of an optimal education policy. When we answer these questions, we should emphasize the role of the composition of the human capital stock where each skill type performs a specific but complementary function within the production process with the other skilled sector and moreover, the ideas developed by the highly skilled are assumed to be non-rival but excludable, creating demand linkages between the education types that are external to the firm. Therefore, we should be aware of that the rate of return for either skill input depends on the educational composition of the entire workforce not on the individuals' workforce. In short, with any of these changes, the growth rate will return to its long-run level.

The principle of development, of foregoing consumption today in favor of more investment, is to generate a higher level of human well-being tomorrow for more people. To most people in developing countries that higher level of well-being literally means a better diet. Food is of major importance in all of our lives and is unfortunately a major problem for many people. Every single-living person is dependent on food and if food is made available to everyone regardless of location or status then all of humanity can celebrate the greatest success that mankind has ever accomplished. Nutritional deficiencies or malnutrition, poor environmental conditions and inadequate educational infrastructure hinder children's learning ability which is critical for the future supply of skilled labor (human capital which consists of education, health and nutrition) and hence for economic growth and development. Therefore, nutritional and health care policies are necessity in education to promote growth.

Briefly as the last but not the least, we mentioned leadership, equality and human well-being as some other benefits of health beyond standard economic benefits (The World Bank, 2006). Where leadership let the loss to society of potentially outstanding individuals and equality allows a child who has limited interest and intellectual power, to say nothing of the possibility of intellectual potential, the other chances are not major. In terms of human well-being, in spite economic misery people have the capability for taking pleasure in an extensive range of non-economic intake where these are people's positive reception of nature, love, friends, conversation, sporting activities and enjoying parenthood. Since they are part of the consumptions, they are the some of the major sources of satisfaction in life which are not marketable services, neither quantifiable nor measurable in the national accounts. However, a person who is ill because of nutritional anemia or harmed by the seemingly constant attacks with nutritionally connected diarrheas cannot in fact enjoy these pleasures. Whether he or she has the capacity to enjoy these most fundamental sources of human satisfaction are the main concerns and not the income. Thus, human well-being is the main requisite. However, the World Bank (2006a) indicates that some serious misapprehensions about the following main requisite, myths concerning nutrition since planners, politicians and economists often fall short to recognize these associations. Undernourishment is not first and foremost matter of insufficient food intake. Since most serious undernourishment is caused by awful cleanliness and sickness, leading to diarrhea, particularly amongst young children and women's position and women's education play a serious role in improving nourishment. As a result, improving care of young kids and women's status are vital. Improved nutrition demands focused on action by parents and societies, especially in water and sanitation. For that reason, it is not just related to poverty reduction. Given limited resources, broad-based accomplishment on nourishment is viable on a mass scale, particularly in poorer countries. Despite severe economic setbacks many developing countries have made remarkable progress. Consequently, accumulation vaccination and endorsement of oral dehydration to lessen deaths from diarrhea have also done greatly to advance nourishment. Briefly, as an economist, we should be careful how income and social and cultural facilities are distributed since the economic growth is considered to be limited parameter to explain the demand side.

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## APPENDIX

## APPENDIX A: Empirical Evidence with Cross-Country, Regional and Provincial Data

**TABLE A.1: Country data: Cross sectional regressions**

| Author(s) | Sample | Convergence Type |
|---|---|---|
| Barro (1991) | 1960-1985 (98 countries) | Absolute |
| Mankiw et al. (1992) | 1960-1985 (98 Non-Oil countries) | Conditional |
| Mankiw et al. (1992) | 1960-1985 (75 Intermediate countries) | Conditional |
| Mankiw et al. (1992) | 1960-1985 (22 OECD countries) | Conditional |
| Mankiw et al. (1992) | 1960-1985 (22 OECD countries) | Absolute |
| Ben-David (1993) | 1951-1985 (EEC6) | Conditional |
| Ben-David (1993) | 1951-1985 (EFTA6) | Conditional |
| Ben-David (1993) | 1951-1985 (EFTA6 and EEC6) | Conditional |
| Ben-David (1993) | 1951-1985 (United States and Canada) | Conditional |
| Dowrick (1992) | 1960-1988 (poor 42 countries) | Conditional |
| Dowrick (1992) | 1960-1988 (42 middle countries) | No convergence |
| Dowrick (1992) | 1960-1988 (42 rich countries) | Conditional |
| Dowrick (1992) | 1960-1988 (all samples countries) | Conditional |
| Cho (1996) | 1960-1985 (109 countries) | No convergence |
| Cho (1996) | 1960-1985 (109 countries) | Conditional |
| Cho (1996) | 1960-1985 (109 countries) 2SLS method | No convergence |
| Heitger (1993) | 1950-1990 (OECD countries) | Conditional |
| Heitger. (1993) | 1950-1990 (OECD countries) | Conditional |
| Heitger.(1993) | 1950-1990 (13 OECD countries) | Conditional |
| Heitger.(1993) | 1950-1990 (13 OECD countries) | Conditional |
| Heitger.(1993) | 1960-1990 (OECD countries) | Conditional |
| Heitger.(1993) | 1960-1990 (OECD countries) | Conditional |
| Heitger.(1993) | 1960-1990 (13 OECD countries) | Conditional |
| Heitger.(1993) | 1960-1990 (13 OECD countries) | Conditional |
| Felipe&McCombie (2003) | 1960-1985 (OECD countries) (critical to Mankiw et al., 1992) | Conditional |
| Felipe&McCombie (2003) | 1960-1985 (OECD countries) (critical to Mankiw et al., 1992) | Conditional |
| Felipe&McCombie (2003) | 1960-1985 (OECD countries) (critical to Mankiw et al., 1992) | Conditional |
| Felipe&McCombie (2003) | 1960-1985 (OECD countries) (critical to Mankiw et al., 1992) | Conditional |
| Felipe&McCombie (2003) | 1960-1985 (OECD countries) (critical to Mankiw et al., 1992) | Conditional |

**(Modified from Kalyoncu, 1998)**

**TABLE A. 2: Country Data: Time Series Regressions**

| Author(s) | Sample | Convergence Type |
|---|---|---|
| Ben David&H.Papel (1995) | 16 OECD countries Prebreak<br>After Break | Absolute<br>Absolute |
| Evans&Karras(1996) | 54 countries 1950-1990 | Absolute |
| Evans&Karras(1996) | 54 countries 1950-1990 | Absolute |

**(Modified from Kalyoncu, 1998)**

**TABLE A. 3: Regions Data in the World: Cross Sectional Regression**

| Author(s) | Sample | Convergence Type |
|---|---|---|
| Sala-I-Martin (1994) | Japan 47 Prefectures 1955-1990 | Absolute |
| Sala-I-Martin(1994) | Japan 47 Prefectures 1955-1990 | Conditional |
| Sala-I-Martin(1994) | Japan 47 Prefectures 1955-1990 with panel data | Conditional |
| Sala-I-Martin(1994) | Europe Total 90 regions 1950-1990 | Absolute |
| Sala-I-Martin(1994) | Europe Total 90 regions 1950-1990 | Conditional |
| Sala-I-Martin(1994) | Europe Total 90 regions 1950-1990 | Conditional |
| Sala-I-Martin(1994) | Germany 11 regions | Absolute |
| Sala-I-Martin(1994) | Germany 11 regions | Conditional |
| Sala-I-Martin(1994) | Germany 11 regions | Conditional |
| Sala-I-Martin(1994) | U.K.11 regions | Absolute |
| Sala-I-Martin(1994) | U.K.11 regions | Conditional |
| Sala-I-Martin(1994) | U.K.11 regions | Conditional |
| Sala-I-Martin(1994) | France 21 regions | Absolute |
| Sala-I-Martin(1994) | France 21 regions | Conditional |
| Sala-I-Martin(1994) | France 21 regions | Conditional |
| Sala-I-Martin(1994) | Italy 20 regions | Absolute |
| Sala-I-Martin(1994) | Italy 20 regions | Conditional |
| Sala-I-Martin(1994) | Italy 20 regions | Conditional |
| Sala-I-Martin(1994) | Spain 17 regions | Absolute |
| Sala-I-Martin(1994) | Spain 17 regions | Conditional |
| Sala-I-Martin(1994) | Spain 17 regions | Conditional |
| Cappelen et al (2001) | 1980-1997 (105 regions in Europe) | Sigma convergence |
| Cappelen et al (2001) | 1980-1997 (95 regions in Europe) | Sigma convergence |
| Cappelen et al (2001) | 1980-1997 (regions in Europe excluding Greece, Portugal &Spain) | Sigma divergence |
| Cappelen et al (2001) | 1980-1997 (105 regions in Europe) | Conditional |
| Cappelen et al (2001) | 1980-1997 (105 regions in Europe) | Conditional |
| Cappelen et al (2001) | 1980-1997 (95 regions in Europe) | Conditional |

**(Modified from Kalyuncu, 1998)**

**TABLE A.4: Regions Data in US: Time Series Regressions (Modified from Kalyoncu, 1998)**

| Author(s) | Sample | Convergence Type |
|---|---|---|
| Carlino&Mills (8 US regions 1929-90 with break at 1946) (1993) | NE | |
| β1 is for 1929-45 | | Conditional |
| β2 is for 1946-90 | | Conditional |
| Carlino&Mills (8 US regions 1929-90 with break at 1946) (1993) | ME | |
| β1 is for 1929-45 | | Conditional |
| β2 is for 1946-90 | | Conditional |
| Carlino&Mills (8 US regions 1929-90 with break at 1946) (1993) | GL | |
| β1 is for 1929-45 | | Conditional |
| β2 is for 1946-90 | | Conditional |
| Carlino&Mills (8 US regions 1929-90 with break at 1946) (1993) | PL | |
| β1 is for 1929-45 | | Conditional |
| β2 is for 1946-90 | | Conditional |
| Carlino&Mills (8 US regions 1929-90 with break at 1946) (1993) | SE | |
| β1 is for 1929-45 | | Conditional |
| β2 is for 1946-90 | | Conditional |
| Carlino&Mills (8 US regions 1929-90 with break at 1946) (1993) | SW | |
| β1 is for 1929-45 | | Conditional |
| β2 is for 1946-90 | | Conditional |
| Carlino&Mills (8 US regions 1929-90 with break at 1946) (1993) | RM | |
| β1 is for 1929-45 | | Conditional |
| β2 is for 1946-90 | | Conditional |
| Carlino&Mills (8 US regions 1929-90 with break at 1946) (1993) | NE | |
| β1 is for 1929-45 | | Conditional |
| β2 is for 1946-90 | | Conditional |

**TABLE A.5: States Data in US: Cross Section Regressions**

| Author(s) | Sample | Convergence Type |
|---|---|---|
| Barro&Sala-I-Martin(1991) | 48 contiguous states 1880-1988 | Absolute |
| Barro&Sala-I-Martin(1991) | 48 contiguous states 1840-1980 | Conditional |
| Barro&Sala-I-Martin(1991) | 48 contiguous states 1963-1986 | Absolute |
| Barro&Sala-I-Martin(1991) | 48 contiguous states 1963-1986 | Conditional |
| Sala-I-Martin(1994) | 48 US States 1980-1990 | Absolute |
| Sala-I-Martin(1994) | 48 US States 1980-1990 | Conditional |
| Sala-I-Martin(1994) | 48 US States 1980-1990 with panel data | Conditional |
| Crihfield et al.(1995) | 50 US States 1955-1987 (2SLS) | Conditional |
| Crihfield et al.(1995) | 50 US States 1955-1987 | Conditional |
| Crihfield et al.(1995) | 50 US States 1955-1987 (2SLS with time dummy) | Conditional |
| Crihfield et al.(1995) | 50 US States 1955-1980 (2SLS benchmark) | Conditional |
| Crihfield et al.(1995) | 50 US States 1955-1980 (OLS) | Conditional |
| Crihfield et al.(1995) | 50 US States 1955-1980 (2SLS) | Conditional |
| Crihfield et al.(1995) | 50 US States 1955-1980 (2SLS) | Conditional |
| Crihfield et al.(1995) | 50 US States 1955-1980 (2SLS W/LAR) | Conditional |
| Crihfield et al.(1995) | 50 US States 1955-1980 (2SLS restricted) | Conditional |
| Crihfield et al.(1995) | 50 US States 1980-1987 (2SLS benchmark) | Conditional |

**(Modified from Kalyuncu, 1998)**

**TABLE A.6: States Data in US: Time series regressions**

| Author(s) | Sample | Convergence Type |
|---|---|---|
| Evans&Karras(1996) | 48 states 1929-91 | |
| | Conventional | Conditional |
| | Alternative | Conditional |

**(Modified from Kalyoncu, 1998))**

**TABLE A.7: Cites in USA: Cross sectional Regressions**

| Author(s) | Sample | Convergence Type |
|---|---|---|
| Glaser (1995) | 203 cities 1960-1990 | Conditional |

**(Modified from Kalyoncu, 1998)**

**TABLE A.8: Counties in US: Cross sectional regression**

| Author(s) | Sample | Convergence Type |
|---|---|---|
| Goetz and Hu (1996) | 1980-90 1365 counties in south of US | |
| | 2SLS | Conditional |
| | OLS | Conditional |

**(Modified from Kalyoncu, 1998))**

**TABLE A.9: Countries in World: Panel data**

| Author(s) | Sample | Convergence Type |
|---|---|---|
| Roger&Dowrick (1997) | 57 countries 1965-90 MRW specification | Conditional |
| Roger&Dowrick (1997) | 57 countries 1965-90 Technological catch up approach | Conditional |
| Roger&Dowrick (1997) | 57 countries 1965-90 Technological catch up approach | Conditional |

**APPENDIX B: Empirical Evidence onTurkish Provinces**

**TABLE B.1: 67 Province of Turkey: Panel Regressions**

| Author(s) | Sample | Convergence Type |
|---|---|---|
| Tansel&Güngör (1997) | 67 province of Turkey | |
| | 1975-1980 | Divergence |
| | 1980-1985 | Absolute |
| | 1985-1990 | Absolute |
| | 1990-1995 | Absolute |
| | 1975-1995 | Absolute |
| | 1980-1995 | Absolute |
| | | |
| | 1975-1980 | Conditional |
| | 1980-1985 | Conditional |
| | 1985-1990 | Conditional |
| | 1990-1995 | Conditional |
| | 1975-1995 | Conditional |
| | 1980-1995 | Conditional |

**TABLE B.2: 67 Province of Turkey: Panel Regressions**

| Author(s) | Sample | Convergence Type |
|---|---|---|
| Tansel& Güngör (1997) | 67 province of Turkey | Unrestricted One |
| | 1975-1980 | MRW methods so Conditional |
| | 1980-1985 | MRW methods so Conditional |
| | 1985-1990 | MRW methods so Conditional |
| | 1990-1995 | MRW methods so Conditional |
| | 1975-1995 | MRW methods so Conditional |
| | 1980-1995 | MRW methods so Conditional |
| | | MRW methods so Conditional |
| | 1975-1980 | Conditional with mean year of schooling |
| | 1980-1985 | Conditional with mean year of schooling |
| | 1985-1990 | Conditional with mean year of schooling |
| | 1990-1995 | Conditional with mean year of schooling |
| | 1975-1995 | Conditional with mean year of schooling |
| | 1980-1995 | Conditional with mean year of schooling |

**TABLE B.3: 67 Province of Turkey**

| Author(s) | Sample | Convergence Type |
|---|---|---|
| Erk et al. (1999) | 67 province of Turkey 1979-1997 | Divergence |
| Erk et al. (1999) | Eagen-Marmara-Mediterenean Regions: 1979-1997 | After adjustment |
| Erk et al. (1999) | East-central-GAP-Black Sea Regions: 1979-1997 | Divergence |
| Erk et al. (1999) | GAP and Marmara Regions 1979-1997 | After adjustment |
| Erk et al. (1999) | East Anatolian and Marmara Regions | Divergence |
| Erk et al. (1999) | Eagen-Marmara Regions: 1979-1997 | After adjustment |
| Erk et al. (1999) | Marmara Regions: 1979-1997 | After adjustment |
| Erk et al. (1999) | Eagen-Marmara-Black Sea and GAP Regions: 1979-1997 | After adjustment |
| Erk et al. (1999) | Central Anatolia and Black Sea Regions: 1979-1997 | Divergence |
| Erk et al. (1999) | Eagen-Marmara Regions: 1979-1997 | After adjustment |
| Erk&Ates&DirekciEast (1999) | East Anatolian-Mediterranean& Central Anatolian Regions 1979-97 | Divergence |

**TABLE B.4: 67 Province of Turkey: Non-Linear Estimation**

| Author(s) | Sample | Convergence Type |
|---|---|---|
| Erk et al. (1999) | 67 province of Turkey 1979-1997 | Tendency for convergence |
| Erk et al. (1999) | Eagen-Marmara-Meditereranean Regions: 1979-1997 | Tendency for convergence |
| Erk et al. (1999) | East-central-GAP-Black Sea Regions: 1979-1997 | Tendency for convergence |
| Erk et al. (1999) | GAP and Marmara Regions 1979-1997 | Tendency for convergence |
| Erk et al. (1999) | East Anatolian and Marmara Regions | Tendency for convergence |
| Erk et al. (1999) | Eagen-Marmara Regions: 1979-1997 | Tendency for convergence |
| Erk et al. (1999) | Marmara Regions: 1979-1997 | Tendency for convergence |
| Erk et al. (1999) | Eagen-Marmara-Black Sea and GAP Regions: 1979-1997 | Tendency for convergence |
| Erk et al. (1999) | Central Anatolia and Black Sea Regions: 1979-1997 | Tendency for convergence |
| Erk et al. (1999) | Eagen-Marmara Regions: 1979-1997 | None |
| Erk et al. (1999) | East Anatolian-Mediterranean& Central Anatolian Regions 1979-97 | Tendency for convergence |

**TABLE B.5: 67 Province of Turkey: Beta Convergence for two different homogenous samples**

| Author(s) | Sample | Convergence Type |
|---|---|---|
| Erk et al. (1999) | Second group | Divergence |
| Erk et al. (1999) | First group | absolute |
| Erk et al. (1999) | Second group | Divergence |
| Erk et al. (1999) | GAP and Marmara Regions 1979-1997 | Divergence |

**APPENDIX C: List of countries and regionalized provinces and Information on Sources and Models Variable Definitions:**

**APPENDIX C.1: Country List**

| High-income | Mid-income | Low-income |
|---|---|---|
| Australia | Algeria | Bangladesh |
| Austria | Argentina | Benin |
| Canada | Bolivia | Cameroon |
| Denmark | Botswana | Ghana |
| Finland | Brazil | Haiti |
| France | Bulgaria | India |
| Germany | Chile | Indonesia |
| Greece | China | Kenya |
| Iceland | Colombia | Nicaragua |
| Ireland | Costa Rica | Pakistan |
| Italy | Dominican Republic | Senegal |
| Japan | Ecuador | Sudan |
| Korea, Rep | Egypt Arap Rep. | Togo |
| Netherlands | Guatemala | Zambia |
| New Zealand | Honduras | Zimbabwe |
| Norway | Hungary | |
| Portugal | Iran Islamic Rep | |
| Spain | Jordan | |
| Sweden | Malaysia | |
| Switzerland | Mexico | |
| United Kingdom | Panama | |
| United States | Paraguay | |
| | Peru | |
| | Philippines | |
| | South Africa | |
| | Sri Lanka | |
| | Syrian Arab Republic | |
| | Thailand | |
| | Trinidad and Tobago | |
| | Tunisia | |
| | Turkey | |
| | Uruguay | |

**APPENDIX C.2:** ***Cross-Country Data:***

**GDP per capita:** Data are from World Development Indicators web page (2005). GDP per-capita is measured at constant 2000 US$). http://devdata.worldbank.org

**K/H: we have used (Electric power consumption (kWh)/Education) where: Electric power consumption (kWh)*:*** it is taken from the WDI (2005). Since Güngör (1997) indicates that it is difficult to measure capitals stocks such as building, machinery, equipment and inventory, this proxy has the advantage of being a "flow" and thus it is an appropriate approximation of the utilization physical capital and ***Education:*** The dataset is from Barro and Lee dataset. It is taken from World Development Indicators web page (2005). It is Average Years of School from Educational Attainment of the Aged 15 http://devdata.worldbank.org/edstats/ThematicDataOnEducation/countryData/total_age15.xls. It is probably the best indicator of human capital, even though they do not constitute a perfect human-capital measure.

***GDP per-capita growth rate***: GDP per-capita growth (average). http://devdata.worldbank.org

***Population:*** Total population for the year in question, from the WDI (2005). http://devdata.worldbank.org

***Income level Dummy Variables:*** This assignment was made according to income of World development classification of 2002. http://devdata.worldbank.org

***DES:*** per-capita dietary energy supply measures the daily energy (calorie) intake from food consumption, its unit is the per-capita kcal/day and it is recorded in terms of the national average. DES is the food that countries produce or import for human consumption. DES is not an indicator of what people actually eat (**http://www.fao.org/News/1998/981204-e.htm).**

***DPS:*** per-capita dietary energy supply measures the daily protein intake from food consumption, its unit is the per-capita kcal/day and it is recorded in terms of the national average. **Sources: FAOSTAT;**

We also fill the data point for the following countries at the parentheses point for the mentioned variable: Congo (Dem) _ education (2000) and Germany_ education (2000) Germany's 1970 per capita GDP is calculated as (1-growth rate of per capita GDP between 1980 and 1990).

**APPENDIX C.3:** ***Regionalized provinces list:***

| High-Income | Low-Income |
|---|---|
| Ankara | Zonguldak-Karabuk-Bartin |
| Bursa-Eskisehir-Bilecik | Samsun-Tokat-corum-Amasya |
| Istanbul | Diyarbakir-sanliurfa |
| Kocaeli-Sakarya-Duzce-Bolu-Yalova | Erzurum-Erzincan-Bayburt |
| Izmir | Trabzon-Ordu-Giresun-Rize-Artvin-G.hane |
| Denizli-Mugla-Aydin | Kayseri-Sivas-Yozgat |
| Antalya-isparta-Burdur | Malatya-Elazig-Bingol-Tunceli |
| Adana-Mersin | Konya-Karaman |
| Gaziantep-Adiyaman-Kilis | |

**APPENDIX C.4: Regionalized provincial data:**

***Per-capita income:*** Per capita gross domestic product by provinces; 1985 and 1994 and 2003 (At Dollar). For the year of 2003, TUİK does not publish per-capita income data point at the provincial level. Therefore, we have to project them by using 2002 and 2003 overall growth rate of Turkey data. It is taken from TUİK.

***Gross domestic product:*** At dollar, for the year of 2003, TUİK does not publish aggregate income data point at the provincial level. Therefore, we have to project them by using 2002 and 2003 overall growth rate of Turkey data. It is taken from TUİK.

***Teachers to student ratio:*** it is taken From National Education Statistics of Ministry of National Education. Educational data is calculated by summing up the teacher to student ratio from preschool level to the high school level.

***Per capita income to Food expenditure:*** It is taken from TUİK Household Budget Survey data set. It is aggregated from individual income to food ratio for provincial level. The ratios of food expenditure to per capita income are reported from household budget studies on individual level for the regions of Turkey

***Industrial electricity consumption:*** It is taken from TEDAŞ on the provincial level. Since Güngör (1997) indicates that it is difficult to measure capitals stocks such as building, machinery, equipment and inventory, this proxy has the advantage of being a "flow" and thus it is an appropriate approximation of the utilization physical capital.

**APPENDIX D: Simple statistics**

**TABLE D.1: Mean statistics for Cross-Country**

| Variable | Obs | Mean | Std. |
|---|---|---|---|
| (EL/E) | 207 | 1.53E+10 | 3.73E+10 |
| ln(EL/E) | 207 | 21.89114 | 1.831411 |
| log lag of per-capita GDP | 207 | 7.76557 | 1.474308 |
| "e" by DES | 207 | 0.872947 | 0.103325 |
| "e" by DPS | 207 | 0.033105 | 0.009474 |
| log of "e" by DES | 207 | -0.14304 | 0.120826 |
| log of "e" by DPS | 207 | -3.4494 | 0.289598 |
| Growth rate | 207 | 0.017707 | 0.022248 |
| (EL/E*Y) | 207 | 0.096426 | 0.100631 |
| **High-Income** | | | |
| (EL/E) | 66 | 3.02E+10 | 5.49E+10 |
| ln(EL/E) | 66 | 23.15754 | 1.425183 |
| log lag of per-capita GDP | 66 | 9.536521 | 0.538305 |
| "e" by DES | 66 | 0.971683 | 0.045704 |
| "e" by DPS | 66 | 0.043473 | 0.005415 |
| log of "e" by DES | 66 | -0.02983 | 0.047561 |
| log of "e" by DPS | 66 | -3.14397 | 0.13353 |
| Growth rate | 66 | 0.023817 | 0.012616 |
| (EL/E*Y) | 66 | 0.046634 | 0.01919 |
| **Mid-Income** | | | |
| (EL/E) | 96 | 9.64E+09 | 2.47E+10 |
| ln(EL/E) | 96 | 21.55091 | 1.642004 |
| log lag of per-capita GDP | 96 | 7.381376 | 0.769531 |
| "e" by DES | 96 | 0.861274 | 0.08156 |
| "e" by DPS | 96 | 0.030406 | 0.006739 |
| log of "e" by DES | 96 | -0.15379 | 0.094926 |
| log of "e" by DPS | 96 | -3.51689 | 0.218521 |
| Growth rate | 96 | 0.019421 | 0.025071 |
| (EL/E*Y) | 96 | 0.096219 | 0.071781 |
| **Low-Income** | | | |
| (EL/E) | 45 | 5.61E+09 | 1.50E+10 |
| ln(EL/E) | 45 | 20.75956 | 1.7069 |
| log lag of per-capita GDP | 45 | 5.987788 | 0.459233 |
| "e" by DES | 45 | 0.753035 | 0.053933 |
| "e" by DPS | 45 | 0.023655 | 0.003225 |
| log of "e" by DES | 45 | -0.28615 | 0.071626 |
| log of "e" by DPS | 45 | -3.75336 | 0.137285 |
| Growth rate | 45 | 0.005088 | 0.022358 |
| (EL/E*Y) | 45 | 0.169895 | 0.162796 |

**TABLE D.2: Correlation Coefficients for Cross-Country**

| | (EL/E) | log lag of per-capita GDP | "e" by DES | "e" by DPS | Growth rate |
|---|---|---|---|---|---|
| log lag of per-capita GDP | 0.2464 | 1 | | | |
| "e" by DES | 0.269 | 0.7559 | 1 | | |
| "e" by DPS | 0.2556 | 0.8036 | 0.9179 | 1 | |
| Growth rate | 0.1766 | 0.0538 | 0.2688 | 0.2235 | 1 |
| (EL/E*Y) | -0.0366 | -0.445 | -0.289 | -0.2811 | -0.1784 |
| **High-Income** | | | | | |
| log lag of per-capita GDP | 0.3028 | 1 | | | |
| "e" by DES | 0.0803 | 0.0698 | 1 | | |
| "e" by DPS | 0.0391 | 0.1597 | 0.7508 | 1 | |
| Growth rate | -0.0762 | -0.561 | -0.1052 | -0.0977 | 1 |
| (EL/E*Y) | -0.2341 | -0.1269 | -0.0579 | 0.242 | 0.0569 |
| **Mid-Income** | | | | | |
| log lag of per-capita GDP | -0.2512 | 1 | | | |
| "e" by DES | 0.1804 | 0.3484 | 1 | | |
| "e" by DPS | 0.1192 | 0.4214 | 0.8885 | 1 | |
| Growth rate | 0.3015 | -0.4516 | -0.0027 | 0.0168 | 1 |
| (EL/E*Y) | 0.3782 | -0.3512 | 0.3098 | 0.2442 | 0.0981 |
| **Low-Income** | | | | | |
| log lag of per-capita GDP | -0.2261 | 1 | | | |
| "e" by DES | 0.2754 | -0.0308 | 1 | | |
| "e" by DPS | 0.0708 | 0.1062 | 0.6596 | 1 | |
| Growth rate | 0.3568 | -0.4911 | 0.4855 | 0.2409 | 1 |
| (EL/E*Y) | 0.0473 | 0.0059 | -0.1742 | -0.1217 | -0.2381 |

**TABLE D.3: Mean statistics for Turkish Regionalized Provinces:**

| Variable | Obs | Mean | Std. |
|---|---|---|---|
| growth rate | 34 | 0.029304 | 0.0201808 |
| (EL/E) | 34 | 168.5692 | 203.0064 |
| "e" | 34 | 0.012388 | 0.0115494 |
| (EL/E*Y) | 34 | 3.06E-07 | 6.06E-07 |
| food expenditure ratio | 34 | 28.65632 | 26.75033 |
| per-capita income | 34 | 2417.208 | 1032.217 |
| **High-Income** | | | |
| growth rate | 16 | 0.026703 | 0.0187524 |
| (EL/E) | 16 | 267.8116 | 253.0968 |
| "e" | 16 | 0.01366 | 0.0125538 |
| (EL/E*Y) | 16 | 4.23E-07 | 8.60E-07 |
| food expenditure ratio | 16 | 31.60992 | 29.07988 |
| per-capita income | 16 | 3004.883 | 691.7974 |
| **Low-Income** | | | |
| growth rate | 18 | 0.031616 | 0.0216394 |
| (EL/E) | 18 | 80.35365 | 77.25142 |
| "e" | 18 | 0.011258 | 0.0108167 |
| (EL/E*Y) | 18 | 2.02E-07 | 1.91E-07 |
| food expenditure ratio | 18 | 26.0309 | 25.04808 |
| per-capita income | 18 | 1894.83 | 1015.881 |

**TABLE D.4: Correlation Coefficients for Turkish Regionalized Provinces:**

| | (EL/E) | growth rate | "e" | food expenditure ratio | (EL/E*Y) |
|---|---|---|---|---|---|
| growth rate | -0.09 | 1 | | | |
| "e" | -0.075 | -0.81 | 1 | | |
| food expenditure ratio | -0.07 | -0.81 | 1 | 1 | |
| (EL/E*Y) | 0.77 | -0.022 | -0.21 | -0.21 | 1 |
| per-capita income | 0.51 | -0.28 | 0.13 | 0.13 | 0.31 |
| **High-Income** | | | | | |
| growth rate | -0.038 | 1 | | | |
| "e" | -0.15 | -0.91 | 1 | | |
| food expenditure ratio | -0.15 | -0.91 | 1 | 1 | |
| (EL/E*Y) | 0.78 | 0.03 | -0.29 | -0.29 | 1 |
| per-capita income | 0.48 | -0.12 | 0.22 | 0.22 | 0.19 |
| **Low-Income** | | | | | |
| growth rate | -0.06 | 1 | | | |
| "e" | -0.16 | -0.73 | 1 | | |
| food expenditure ratio | -0.16 | -0.73 | 1 | 1 | |
| (EL/E*Y) | 0.68 | -0.11 | -0.17 | -0.17 | 1 |
| per-capita income | 0.37 | -0.33 | -0.01 | -0.012 | 0.83 |

**APPENDIX E: The Regression Results for Variance Decomposition and Income Level Approaches**

**Table E.1: The regression results for variance decomposition for Cross-Country Case**

| | | | | | |
|---|---|---|---|---|---|
| **OLS and robust specifies that the Huber/White/sandwich estimator of variance** | | | | | |
| Dependent:log(Y/L) | Coef (OLS) | t (OLS) | t (OLS, robust) | Number of obs | 207 |
| log(EL/E) | -1.286372 | -10.93 | -12.16 | R-squared | 0.3683 |
| cons | 4.54977 | 14.16 | 16.21 | | |
| White's test for Ho: homoskedasticity against Ha: unrestricted heteroskedasticity | | | | | |
| chi2(2) | | | | | 2.4 |
| Prob > chi2 | | | | | 0.3015 |
| | | | | | |
| **HIGH: OLS and robust specifies that the Huber/White/sandwich estimator of variance** | | | | Number of obs | 66 |
| Dependent:log(Y/L) | Coef (OLS) | t (OLS) | t (OLS, robust) | R-squared | 0.0571 |
| log(EL/E) | -0.2829785 | -1.97 | -2.03 | | |
| cons | 8.884501 | 19.49 | 19.76 | | |
| White's test for Ho: homoskedasticity against Ha: unrestricted heteroskedasticity | | | | | |
| chi2(2) | | | | | 0.31 |
| Prob > chi2 | | | | | 0.8561 |
| | | | | | |
| **MID: OLS and robust specifies that the Huber/White/sandwich estimator of variance** | | | | Number of obs | 96 |
| Dependent:log(Y/L) | Coef (OLS) | t (OLS) | t (OLS, robust) | R-squared | 0.1652 |
| log(EL/E) | -0.4643115 | -4.31 | -3.4 | | |
| cons | 6.395163 | 22.74 | 17.96 | | |
| White's test for Ho: homoskedasticity against Ha: unrestricted heteroskedasticity | | | | | |
| chi2(2) | | | | | 10.29 |
| Prob > chi2 | | | | | 0.0058 |
| | | | | | |
| **LOW: OLS and robust specifies that the Huber/White/sandwich estimator of variance** | | | | Number of obs | 45 |
| Dependent:log(Y/L) | Coef (OLS) | t (OLS) | t (OLS, robust) | R-squared | 0.0382 |
| log(EL/E) | -0.1001919 | -1.31 | -1.3 | | |
| cons | 5.828732 | 34.03 | 34.60 | | |
| White's test for Ho: homoskedasticity against Ha: unrestricted heteroskedasticity | | | | | |
| chi2(2) | | | | | 0.24 |
| Prob > chi2 | | | | | 0.8887 |

| | | | | |
|---|---|---|---|---|
| **Cross-sectional time-series FGLS regression: (heteroskedastic, no autocorrelation)** | | | | |
| Dependent:log(Y/L) | Coef | z | Number of obs | 207 |
| log(EL/E) | -1.23549 | -25.51 | Wald chi2(1) | 650.53 |
| cons | 4.659825 | 38.87 | | |
| | | | | |
| **HIGH:** | | | Number of obs | 66 |
| Dependent:log(Y/L) | Coef | z | Wald chi2(1) | 13.3 |
| log(EL/E) | -0.36161 | -3.65 | | |

| | | | | |
|---|---|---|---|---|
| cons | 8.666508 | 26.72 | | |
| | | | | |
| **MID:** | | | Number of obs | 99 |
| Dependent:log(Y/L) | Coef | z | Wald chi2(1) | 60.99 |
| log(EL/E) | -0.43787 | -7.81 | | |
| cons | 6.418023 | 46.28 | | |
| | | | | |
| **LOW::** | | | Number of obs | 45 |
| Dependent:log(Y/L) | Coef | z | Wald chi2(1) | 0.44 |
| log(EL/E) | -0.03846 | -0.66 | | |
| cons | 5.963899 | 48.4 | | |
| | | | | |

| **Iterated Cross-sectional time-series FGLS regression: (heteroskedastic, no autocorrelation)** | | | | |
|---|---|---|---|---|
| Dependent:log(Y/L) | Coef | z | Number of obs | 207 |
| log(EL/E) | -1.06653 | -30.73 | Wald chi2(1) | 944.09 |
| cons | 5.038575 | 62.45 | | |
| | | | | |
| **HIGH:** | | | Number of obs | 66 |
| Dependent:log(Y/L) | Coef | z | Wald chi2(1) | 4875.7 |
| log(EL/E) | -1.14387 | -69.83 | | |
| cons | 6.040051 | 110.4 | | |
| | | | | |
| **MID:** | | | Number of obs | 99 |
| Dependent:log(Y/L) | Coef | z | Wald chi2(1) | 39.84 |
| log(EL/E) | -0.17475 | -6.31 | | |
| cons | 7.035114 | 97.3 | | |
| | | | | |
| **LOW:** | | | Number of obs | 45 |
| Dependent:log(Y/L) | Coef | z | Wald chi2(1) | 3.65 |
| log(EL/E) | 0.078689 | 1.91 | | |
| cons | 6.081503 | 60.44 | | |

**Table E.2: The regression results for Income level approaches for Cross-Country Case**

| **Iterated Cross-sectional time-series FGLS regression: (heteroskedastic, no autocorrelation)** | | | | |
|---|---|---|---|---|
| Dependent:log(Y/L) | Coef | z | Number of obs | 207 |
| log(EL/E) | -.68357 | -595.97 | Wald chi2(1) | 355176.31 |
| | | | | |
| **HIGH:** | | | Number of obs | 66 |
| Dependent:log(Y/L) | Coef | z | Wald chi2(1) | 254265.28 |
| log(EL/E) | 3.048942 | -504.25 | | |
| | | | | |
| **MID:** | | | Number of obs | 96 |
| Dependent:log(Y/L) | Coef | z | Wald chi2(1) | 51685.93 |
| log(EL/E) | -2.839708 | -227.35 | | |
| | | | | |
| **LOW:** | | | Number of obs | 45 |
| Dependent:log(Y/L) | Coef | z | Wald chi2(1) | 3954.69 |
| log(EL/E) | -2.460048 | -62.89 | | |

**Table E.3: The regression results for variance decomposition for Provinces Case**

| Cross-sectional time-series FGLS regression | | | | | | |
|---|---|---|---|---|---|---|
| Coefficients: generalized least squares, Panels: heteroskedastic, no autocorrelation | | | | | | |
| Estimated covariances = 2 | | | Number of obs = 34 | | | |
| Log likelihood = -10.7652 | | | Prob > chi2 = 0.0010 | | | |
| Dependent Variable:log (Y/L) \| | Coef. | Std. Err. | z | P>\|z\| | [95% Conf. Interval] | |
| log (EL/E) \| | .1083941 | .0328554 | 3.30 | 0.001 | .0439987 | .1727896 |
| cons \| | 9.625213 | .5203892 | 18.50 | 0.000 | 8.605269 | 10.64516 |

**Table E.4: The regression results for Income level approaches for Provinces Case**

| Cross-sectional time-series FGLS regression | | | | | | |
|---|---|---|---|---|---|---|
| Coefficients: generalized least squares, Panels: heteroskedastic, no autocorrelation | | | | | | |
| Estimated covariances = 2 | | | Number of obs = 34 | | | |
| Log likelihood = -45.4924 | | | Prob > chi2 = 0.0000 | | | |
| Dependent Variable:log (Y/L) \| | Coef. | Std. Err. | z | P>\|z\| | [95% Conf. Interval] | |
| log (EL/E) \| | -.4701495 | .0095733 | -49.11 | 0.000 | -.4889128 | -.4513863 |

**APPENDIX F: Solution of the Model**

When we transform the dynamics of physical to human capital ratio accumulation in per effective capita terms, we have motion of (K/H) in general form. For convenience we set $k=\left(\frac{K/H}{AL}\right)$ and $\overset{*}{\left(\frac{K}{H}\right)}=I-\delta\left(\frac{K}{H}\right)=sY-\delta\left(\frac{K}{H}\right)$ where $0\le s\le 1$, then $\frac{\overset{*}{(K/H)}}{AL}=sy-\delta k$ and the logarithms of the k is $\ln k=\ln\left(\frac{K}{H}\right)-\ln A-\ln L$. If we derivate with respect to time, we will have $\frac{\overset{*}{k}}{k}=\frac{\overset{*}{(K/H)}}{(K/H)}-\frac{\overset{*}{A}}{A}-\frac{\overset{*}{L}}{L}$, rearranging it results $\overset{*}{k}=\frac{\overset{*}{(K/H)}}{AL}-(n+g)k$. Plugging the $\frac{\overset{*}{(K/H)}}{AL}$ into this will leads us to following equation of motion of 15th.

$$\overset{*}{k}=sf(k)-(n+g+\delta)k \qquad 15$$

After setting per effective output level as $y=Y/AL=\left(\frac{(K/H)}{AL}\right)^{\alpha}=k^{\alpha}$ we should find steady state value of k as $k^{*}=\left[\frac{s}{(n+g+\delta)}\right]^{\frac{1}{1-\alpha}}$ and $y^{*}=\left[\frac{s}{(n+g+\delta)}\right]^{\frac{\alpha}{1-\alpha}}$. To find convergence rate and convergence equation we take the derivates with respect to time, $\frac{\overset{*}{y}}{y}=\alpha\frac{\dot{k}}{k}$.then substitute the equation of motion into this will yield $\frac{\overset{*}{y}}{y}=\alpha\left[\frac{sy-(n+g+\delta)k}{k}\right]$ where k and s are as follows $k=y^{1/\alpha}$ and $s=(n+g+\delta)y^{*\frac{(1-\alpha)}{\alpha}}$. Substituting back into growth rate of per capita GDP will result convergence equation $\frac{\dot{y}}{y}=\alpha(n+g+\delta)\left(\left(\frac{y^{*}}{y}\right)^{\frac{(1-\alpha)}{\alpha}}-1\right)$. Log-linearizing it, $\frac{\overset{*}{y}}{y}=\frac{d(\log y_t)}{dt}$,.gives the speed of convergence. Applying a Taylor's expansion around the steady-state value of log y, gives $\frac{d(\log y_t)}{dt}=\frac{d(\log y_t)}{dt}\Big|_{y^{*}}+\frac{d\left(\frac{d(\log y_t)}{dt}\right)}{d\log y_t}\Big|_{y^{*}}(\log y_t-\log y^{*})$ where the first term is zero, since

income does not change in the steady state. Therefore, finding the second term from $\left(\frac{d(\log y_t)}{dt}\right)$ results $\frac{\dot{y}^*}{y}=\alpha\left(\frac{(1-\alpha)}{\alpha}\right)(n+g+\delta)(\log y^*-\log y)$ and $\frac{d\left(\frac{d(\log y_t)}{dt}\right)}{d\log y_t}=(-)(1-\alpha)(n+\delta+g)$. After substituting in the Taylor's expression we have $\frac{d(\log y_t)}{dt}=(-)(1-\alpha)(n+g+\delta)(\log y_t-\log y^*)$ which shows the speed of convergence. Convergence rate is defined as the proportioned change in the growth rate by a change in the initial income level. The convergence rate which shows the rate at which the level of income approaches its steady state is

$$\beta=(1-\alpha)(n+g+\delta) \tag{16}$$

In order to reach convergence equation we should do some more manipulation by using first order differential equation. $\frac{d(\log y_t)}{dt}=-\beta(\log y_t-\log y^*)$ when $\frac{d(\log y_t)}{dt}=0$ we have y=y* and $\frac{d(\log y_t)}{dt}+\beta\log y_t$ will result $y_t=e^{-\beta}c$. These are particular solutions in homogenous solution. The general solution is $y_t=ce^{-\beta t}+y^*$. At time zero $c=y-y^*$. After substituting in general solution we will have $\log\left(\frac{y_{i,t+T}}{y_{i,t}}\right)=\left(1-e^{-\beta t}\right)\log\left(\frac{y^*}{y_{i,t}}\right)$. If we substitute the steady state value of output into previous equation, we would have conditional convergence regression.

**APPENDIX G: Regressions for Conditional Convergence with (EL/E) and "e"**

We have shown the regressions in Table G1a where their results are reported in Table G1b. The worker effort has negative influences on convergence. When we add time dummies, the coefficients for worker effort level becomes insignificant.

**Table G1a: Regressions for Conditional Convergence with (EL/E) and e for TableIV.13b**

| | |
|---|---|
| $\frac{1}{T}\ln\left(\frac{y_{it}}{yi_{t-T}}\right) = \text{Constant} + \alpha\left(\frac{1-e^{-\beta t}}{T}\right)Ln\left(\frac{EL}{E}\right) + (1-2\alpha)\left(\frac{1-e^{-\beta t}}{T}\right)Ln(e) - \left(\frac{1-e^{-\beta t}}{T}\right)\ln(y_{it-T})$ | 1 |
| $\frac{1}{T}\ln\left(\frac{y_{it}}{yi_{t-T}}\right) = \varphi_1\text{Income Dummies for High} + \varphi_3\text{Income Dummies for Low} + \alpha\left(\frac{1-e^{-\beta t}}{T}\right)Ln\left(\frac{EL}{E}\right) + (1-2\alpha)\left(\frac{1-e^{-\beta t}}{T}\right)Ln(e) - \left(\frac{1-e^{-\beta t}}{T}\right)\ln(y_{it-T})$ | 2 |
| $\frac{1}{T}\ln\left(\frac{y_{it}}{yi_{t-T}}\right) = \phi_1\text{Time Dummies (1994)} + \phi_2\text{Time Dummies (2003)} + \alpha\left(\frac{1-e^{-\beta t}}{T}\right)Ln\left(\frac{EL}{E}\right) + (1-2\alpha)\left(\frac{1-e^{-\beta t}}{T}\right)Ln(e) - \left(\frac{1-e^{-\beta t}}{T}\right)\ln(y_{it-T})$ | 3 |
| $\frac{1}{T}\ln\left(\frac{y_{it}}{yi_{t-T}}\right) = \varphi_1\text{Income Dummies for High} + \varphi_3\text{Income Dummies for Low} + \phi_1\text{Time Dummies (1994)} + \phi_2\text{Time Dummies (2003)} + \alpha\left(\frac{1-e^{-\beta t}}{T}\right)Ln\left(\frac{EL}{E}\right) + (1-2\alpha)\left(\frac{1-e^{-\beta t}}{T}\right)Ln(e) - \left(\frac{1-e^{-\beta t}}{T}\right)\ln(y_{it-T})$ | 4 |

There is significant convergence with worker effort besides other control variables. However, the sizes of convergence coefficients are lower than previous findings when we add worker effort level in the regression. Fits of the model has some increases. However, we experience the negative coefficients for worker effort level. Since the coefficients of (EL/E) are insignificant, we use the coefficients of ln(e) to calculate alpha values. As long as alpha is greater than 0.5, it is reasonable to have negative contribution of ln (e) on growth rate.

We have observed alpha level between the range 0.059 and 0.50009. as seen in Table G1b, the regression with the income dummies besides (EL/E) and worker effort level result in higher value of implied-α, the regression without income dummies result in higher value of implied-α too. We have experienced higher convergence rate with only income dummies besides log($y_{t-T}$). Whenever we included only income dummies, we have higher convergence rate. Therefore, income

dummies cause more effects on the convergence rate than other additional variables. Worker effort indices negatively contribute to economic growth in the long run and the coefficients of (EL/E) with worker effort level becomes insignificant. Therefore, because of worker effort indices, any policies related with human capital and nutritional status have to have a long run provision. Speculatively, improvement of nutrition status is important in many aspects for economic growth since health and nutrition are interlinked.

**Table G1b: Convergence with Dummies, (EL/E) and "e"**

| Dependent variable: GDP per-capita growth rate | | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| $\log(y_{t-T})$ | -0.014 | -0.018 | -0.014 | -0.019 |
| | (2.89)** | (3.44)** | (2.91)** | (3.27)** |
| Income Dummies for High | | 0.113 | | 0.11 |
| | | (2.67)** | | 2.32 |
| Income Dummies for Low | | 0.108 | | 0.099 |
| | | (2.66)** | | 2.21 |
| Dummy for 1994 | | | 0.1 | -0.01 |
| | | | 1.63 | -0.41 |
| Ln(e) | -0.01 | -0.01 | -0.006 | -0.013 |
| | (7.18)** | (6.82)** | -0.79 | -1.45 |
| Dummy for 2003 | | | 0.09 | 0.01 |
| | | | (1.97)* | -0.41 |
| Constant | 0.075 | | | |
| | (2.04)* | | | |
| Ln(EL/E) | 0.001 | 0.001 | 0.001 | 0.002 |
| | 0.92 | 0.99 | 0.82 | 1.04 |
| Observations | 34 | 34 | 34 | 34 |
| Number of index | 2 | 2 | 2 | 2 |
| Log likelihood | 111.8 | 112.86 | 111.9 | 112.9 |
| Convergence Rate | 0.013 | 0.017 | 0.013 | 0.018 |
| Alpha-Value | 0.50007 | 0.50009 | 0.50004 | 0.50012 |

## APPENDIX H: TURKISH SUMMARY

Günlük yaşamımızda sıkça kullandığımız bir deyişin gerçek anlamını 1994 yılının son baharında kavradım. Bu "her şeyin başı sağlık" deyişi idi. Gençlik ve dayanıklılığımı çok güvenmem nedeni ile o yılarda bana maliyeti ne olursa olsun başarılı olmak azmindeydim. Ancak bu azmi karşılayacak yeterli donanıma ve fiziksel güce sahip olamamam nedeni ile yorgunluklar ve bagışıklık sistemimin zayıflaması sonucu küçük kazalar ve hastalıklardan çabuk etkilenmeye başladım. İngilizce sınavında yeterli başarıyı gösteremesem de çalışma azmim dolayısıyla bir mastır programına kabul edilerek derslere başladım. Kısa sürede daha önce alıştığım okul hayatından farklı bir ortama girmiş oldugumu fark ettim. Zaten yetersiz olan İngilizcenin yanına bir de derslerde daha yoğun kullanılan matamatik de eklenince akademik ve gündelik yaşamım bir kat daha zorlanmış oldu. Bununla birlikte bir bisiklet kazası sonucu ciddi bir incinmeye yaşamış, daha sonra da bağışıklık sistemimin zayıflaması nedeniyle verem mikrobu ile mücadele etmek durumunda kaldım. Bütün bunlar sağlığımızın gündelik ve akademik hayatım için olmazsa olmaz bir unsur olduğunu fark etmemi sağladı.

Bu dönem içinde ve Turkiye'ye döndükten sonraki hayatımda gözlemlediğim kadarı ile sağlıklı yaşam ile ilgili programlar nerede ise ekonomi programları kadar televizyon programlarında yerine almaktaydı. Sağlık programlarının konuları kadın hastalıkları, kalp rahatsızlıkları, şişmanlık, bebek ölümleri gibi çok daha fazla yelpazede konuları içermekte ve toplumun her kesiminin dikkati çekilmeye çalışılmaktaydı. Bir iktisatçı olarak kişinin geliri ile sağlığı arasında doğrudan bir ilişkinin olabileceğini düşündüm. Hatta ekonomik düzenlemelerde sağlık sektöründe yatırım, araç-gereç, personel vb. için ayrılan payları da dikkate alırsak ekonomik hayatın ve sağlık olgusunun ne kadar içiçe olduklarını fark ettim. Ayrıca toplumların zenginliğinin ayrıca sağlıklı bireylerle olacağını düşünmeme neden oldu.

Bu kişisel ve günlük hayat gözlemleriden sonra, profesyonel olarak neden bazı ülkeler diğerlerine göre daha zengin sorusuna iktisatçıların profesyonel yaşantısıntılarında cevap aradığı konulardan biridir. Bu bağlamda eğer ekonomik büyümeyi oluşturan faktörleri tespit edebilirsek toplumların geleceğini planlamamız da kolay olacaktı. Kişisel hayatımda yaşadığım sağlık problemleri sonucunda, bu faktörlerden biri sağlık olabilir mi diye sorgulamaya başladım. Neticede, sağlık sorunum olduğu dönemlerde yaptığım işe istememe rağmen yeterince yoğunlaşamamam ve gerektiği kadarı ile zaman ayırmamam nedeni ile ya yapılan iş yeterince iyi olmuyordu ya da zamanında bitmiş olmuyordu. Bu nedenlede kişisel deneyimim sonucu, sağlıksız bir beşeri sermaye ne bilgisini ve ne de becerisini yeterince işine yansıtabileceği sonucuna varmama neden oldu. Literatür incelememde Mankiw ve diğerleri (1992) sağlığın beşeri sermayenin önemli bir

bileşini olduğunu ifade ettiklerini gördüm. Yine konuyla ilgili alanyazınlarda da gelir ve sağlık harcamaları arasındaki kuvvetli ve pozitif yöndeki ilişkiye dikkat çekilmektedir (Howden-Chapmen and O'Dea, 2001; Strauss and Thomas, 1998; Bloom et al, 2001c; Muysken, et al., 2003, Von Z., and Muysken, 2001; Fielding, 2001; Erdil and Yetkiner, 2004; Wagstaff, 2005; Thomas, 2001; Sachs and Brundtland, 2002).

Eğer beslenmenin sağlıklı olma için olmazsa olmaz bir unsur olduğunu kabullenir isek, gelirin sağlıklı olmada ne kadar önemli bir faktör olacağınıda kabullenmiş oluruz. Sağlıklı olma konusunda ayrıca belirtmemiz gereken diğer bazı unsurları da şöyle sıralayabiliriz: genetik, ekonomik, sosyal, kültürel ve çevresel faktörlerin sağlık durumumuzu nasıl etkilediği, sağlıklı olamanın iş gücü verimliliğini, iş gücü piyasasını ve eğitim seviyesini nasıl şekillendirdi gibi değişkenler bu konuda dikkat çekmektedir. Bununla birlikte ne gibi kaynakların beşeri sermeye için ayrılabildiğini ya da diğer sosyal olayların ve kaynak transferlerin etkileri gibi konular da dikkate değerdir. Yine konuyla ilgili alanyazınlarda, bu gibi konuları inceleyen çalışmalara oldukça sık rastlamaktayız. Bu araştırmalar özellikle beşeri sermaye üzerinden yola çıkarak sağlık konusuna odaklanmışlardır. Sağlıklı iş gücü ya da sağlıklı beşeri sermaye, fiziksel ve mantıksal seviye bağlamında dinç olacağından, bireylerin verimlilik seviyesi yüksek olacak ya da artacaktır. Bu sağlıklı olma durumuyla da, bireylerin eğitim seviyelerindeki yükselme ve daha fazla profesyonelleşmelleri nedeni ile teknolojiden de daha fazla yararlanmalarına neden olacaktır. Bireylerin sağlıklı olmaları ayrıca eğitimlerine daha fazla zaman ve emek harcama imkânı vereceğinden daha iyi bir düzeyde yapmalarına neden olacaktır. Şöyle ki, derslere devamsızlık azalmakla birlikte öğrenme odaklı bir derse katılım sağlanarak eğitim yaşamında kalite yükselecektir. Sağlıklı olmak ayrıca hastalıktan dolayı doğacak harcamalalarıda azaltacağından, tasarruf ve tüketim dengesinide etkileyecektir.

Gelir, sağlığı doğrudan ve dolaylı olarak iki şekilde etkiler. Doğrudan etkileme Wagstaff (2001) ve Nixon (1999) çalışmalarında belirtikleri gibi iktisadi kaynaklardaki bir artış sağlıkla ilgili hizmet ve imkânların artışında kullanılabilecek olmasıdır. Dolaylı etkiler bağlamında sosyo-ekonomik yapılaşma, yapısal olarak kaynakların nereye yönledirileceğinde karar verme ve nasıl bir sosyal örğünün öngörüldüğü ile ilgili piyasa yapılanması konularından söz edilebilir.

Sağlığın beşeri sermayenin bir bileşeni olması ve beşeri sermayenin ekonomik büyümenin önemli bir unsuru olması nedeni ile bu çalışmada, beslenme düzeyinin sağlık göstergesi olarak kullanmak sureti ile kişisel gelir farklılıklarlarının açıklamada beslenme verileri ile oluşturduğumuz iş gücü performansı indeksi açıklayıcı bir rolü olabilir mi ve fakir ülkelerin zenginlerden hızlı büyüyüp büyümediğini açıklamada aynı verimiz açılayıcı bir değişken olabilir mi sorularına cevap aranmaya çalışılmıştır.

Mankiw (1995) son yıllarda neo klasik büyüme modeline yapılan bir kısım eleştiriler tartışmıştır. Neoklasik büyüme modelini, yakınsama konusu ile ilgili altyazınlarda genelde şartlı yakınsama bulunmasından dolayı deneysel olarak geçerliliği olmayan bir teori olarak görülmesi sonucu ortaya çıkmıştır. Mankiw'in (1995) tartıştığı aşağıda sıralayacağımız konulardan ikisini biz bu tezde inceleyerek çözüm önermeye çalıştık. Bu önerilerimizden birisi beşeri sermayeyi sadece eğitim verisi olarak değil aynı zamanda da sağlıklı olmasıda gerektiği koşulundan hareketle beşeri sermayenin yeniden ampirik olarak tanımlanmasıdır. Sağlıklı bir bireyin daha verimli olacağı beklentisinden hareketle beslenme verisi kullanılarak iş gücü performans göstergesi olarak beşeri sermayeyi tanımlamada kullanılmıştır. Bununla birlikte, çalışmanın literatüre önemli bir katkısı (veya çalışmanın özgün değeri), veri teknolojide fiziksel sermaye (K) ile beşeri sermaye (H) arasındaki ilişkiyi tamamlayıcı olarak tanımlanmasıdır. Diğer bir değişle, asıl olanın fiziksel sermaye ve beşeri sermayenin seviye büyüklüğünden ziyade bu iki sermayenin birbirine oranı olduğu vurgulanmaya çalışılmıştır.

Mankiw'in tartıştığı üç konu şöylece özetlenebilir:

- Uluslararası Gelir Farklılığının Büyüklüğü: Neoklasik model gözlenen gelir farklılaşmasından daha az bir farklılaşmasını öngörmesi: zengin ve fakir arasındaki gelir farkı için ülke bazında kullveığımız veri seti, zenginin 2527.3 kat gibi büyük bir fark demektir.

- Yakınsama Oranı: Neoklasik model duran denge noktasına ulaşmak için çalışmaların bulduğu orvean daha büyüğünü öngörmektedir. Ülke örneğimizin için bu oran 0.0001 ve 0.077 oranında gerçekleşmektedir.

- Getiri oranı: Neoklasik model getiri oranında ülkeler arasında gözlemlenen den daha büyük farklılıklar öngörmüştür.

Bu ilk iki konunun çözümlenmesi için, modellemedeki yaklaşımlarımızın ne kadar tutarlı olduğunu görebilmek adına, daha iyi düzeyde bir beslenmenin ekonomik büyümeyi artıracağını ortaya koyabilen bir model ortaya koymamız gerekmekteydi. Bunu yaparken kontrol değişkenlerinin bir birleri ile eş anlı bir ilişki içinde olabileceklerinin farkındaydık. Bu ilişki özellikle beslenme ile ilğili verilerimiz için daha belirğindi. Çünkü beslenme, ekonomik büyüme kesin positive bir ilişkiye sahip iken, kesinlikle dışsal olarak kabul edilebilecek bir değişken değildir ve dolayısıyla modellememiz ekonomik büyüme ve beslenme arasındaki iletişim mekanizmasını gösterecek bir modelleme gerektirmekteydi. Neticede, biz de Mankiw ve diğerlerinin (1992) de yapmış oldukları Augmened-Solow modelini temel alarak, modelimizi oluşturduk. Her hangi bir şekilde yakınsama bulgusuna ulaşmamızı değişkenler arasında

olabilecek eş anlı ilişkiye karşıt bir delil sayar iken, yakınsama sonucuna ulaşılamamasınıda değişkenler arasındaki eş anlı ilişkiye kanıt olarak değerlendirdik.

Dolayısıyla, ilk olarak sağlık göstergesi olarak kullandığımız iş gücü verimlilik indeksimizin Solow-Swan türü modelere ait bir değişken olup olmadığını araştırmak gerekti. Bunu toplam girdi verimliliği olarak kabul edilen regresyon kalıntısını açıklamada iş gücü performans indeksimizin etkisine bakarak anlama yolunu şeçtik. Neticede, ilk olarak iş gücü performans indeksimizin Solow-Swan türü modellemede ihmal edilen bir değişken olup olmadığı sorununa netlik kazandırmak gerekti.

Detaylı olarak inceleyeceğimiz konumuzda öncelikle iş gücü performans indeksimizin Solow-Swan türü modellemede ihmal edilen bir değişken olup olmadığı sorununa netlik kazandırmaya ayırdık. Araştırmamız; dünyadan 69 ülke ve Türkiye'nin 17 bölgeye kümelenmiş illeri üzerinde gelir farklılığı ve yakınsama çalışmasının yanında, beslenme verileri ve gıdanın gelir içindeki payını sağlık göstergeleri olarak tanımlayarak ve gelirdeki değişmelerin bu sağlık göstergeleri arasındaki ilişkiyi incelemeyi amaçlamaktadır.

Çalışmanın literatüre diğer bir katkısı ise çalışmada kullanılan verilerdir. 69 ülke için (1980, 1990 ve 2000 yılları) verileri kullanılır iken Türkiye'nin bölgesel hale dönüştürülmüş iller verisi de (1994 ve 2003 yılları) literatürde bir ilk olarak yerini alacaktır. Ampirik literatürde ülke düzeyindeki sağlık göstergeleri, ekonomik büyüme çalışmalarında kullanılmış olmakla beraber Türkiye ekonomisi için bu çalışma bir ilk niteliğindedir. Ülkeler düzeyindeki veriler şunlardır. Elektirik gücü (Kwh) verisi fiziksel sermayeyi temsil için kullanılır iken eğitim verisi beşeri sermayeyi temsil etmek için kullanılmaktadır. Kişi başına gelir (2000), elektirik gücü ve nüfus verisi World Development Indicators'den alınır iken eğitim verisi Barro-Lee veri setinden alınmıştır. İşgücü performans verisini hesaplamada kullanılan kişi başına günlük enerji arzı ve kişi başına günlük protein arzı verileri Dünya Gıda Örgütün'den derlenmiştir.

Türkiye için beslenme verisi bulmak nerede ise mümkün değildi. Bunun nedeni ise ulusal düzeyde böyle bir çalışmanın 1974 ve 1984 den sonra yapılmamış olmasıdır. Bu sorunu aşabilmek için giffen malı olarak tanımlanan yönteme başvurduk. Bu giffen malı yaklaşımı özetle şöyle açıklanabilir. Gelir arttıkça gelir içindeki gıda harcamasının payı da artmakta ancak bu artış daha düşük bir düzeyde kalmaktadır. Türkiye ölçeğinde fakir ailelerin daha çok ekmeğe dayalı bir beslenme eğilimi gösterir iken zenginlerin et ve ete dayalı gıdalarla beslenme eğilimi gösterdiği gözlemlenmiştir (Pekcan, 2001). 2002 ve 2003 hane halkı bütçe anketine göre, en zengin grubuna girenlerin gıda harcaması gelirlerinin %10 nu civarında iken bu oran fakirler için 2002 yılında %38.2, 2003 yılında ise %39.8 dir.

Rahman'ın (2002) Engel kanunu ile ilgili bulgulara vurgu yapması bizim giffen malı fikrimize desteklemiştir. Bu da gelir artar iken gıdanın payının azaldığının çok açık ve net olduğunu vurgulamıştır. Leibtag ve Kaufman (2003) bir başka açıdan konuyu algılamamızda bize yardımcı olmuşlardır. Fakirlerin gıdaya ayırdıkları pay ne kadar yüksek olursa olsun, bu gıdaların kalitesi zenginlerin tükettiğinden kat kat düşüktür. Regmi'nin çalışması (2007) ise, fakirlerin gıda fiyatlarından zenginlere nazaran daha çabuk ve kolay etkilendiğini göstermiştir. Bu konuları açıkladıktan sonra 17 bölgesel hale dönüştürülmüş illerin veri demetinde kişi başına gelir, gayri safi yurt içi hasıla, öğretmen başına düşen öğrenci sayısı, gelir içindeki gıda harcamasının payı Türkiye İstatistik Kurumundan (TUİK) alınmıştır. Sanayide kullanılan elektirik tüketimi verisi Türkiye Elektirik Dağıtım Anonim Şirketi (TEDAŞ) dan temin edilmiştir. Gelir içindeki gıda harcamasının payı hane halkı bütçe anketinde 17 bölgesel hale dönüştürülmüş iller bazında kişi başına ortalamaları tarafımızdan hesaplanarak çalışmamıza dahil edilmiştir.

Literatür taramamızda ilk olarak teorik olarak incelenmeye gidilmiş ve ardında ise veriler ampirik olarak değrlendirilmeye çalışılmıştır. Hem teorik hem ampirik çözümleme üç ana başlık çerçevesinde gerçekleştirilmiştir: Ek bir başlık olarakta nüfusal dönüşüm konusuna da kısaca değinilmiştir. Bu üç başlık şu şekilde adlandırılmıştır. Birinci konu sağlık unsurunun gelir üzerinden etkisi, ikinci konu gelirin sağlık üzerindeki etkisi ve son olarakta eş anlı bir etkileşim olarak belirlenmiştir.

Sağlık kriterinin gelir üzerinden etkisi ise dört alt başlık altında sunulmuştur. Bunlar; iş gücü verimliliği, iş gücü arzı, eğitim ile tasarruf ve yatırımdır. İş gücü verimliliğinin fiziksel ve mantıksal sağlık düzeyinin yüksekliği ile daha yüksek olacağı beklenmekte ve daha yüksek ücret elde edeceği öngörülmektedir. Alanyazın kısmında bahsettiğimiz çalışmalar ampirik olarak bu beklentinin gerçekleştiğini göstermektedir. İşgücü arzı konusunda ise sağlıklı olmanın iş gücünü artırıp artırmayacağı hakkında net bir yorum yapmanın zor olduğu ifade edilmiştir. Burada hem gelir hem de ikame etkisi söz konusu olmaktadır ve hangisinin daha büyük bir etki yaptığının tespitinin genelde zor olduğu ifade edilmiştir. Ayrıca, sağlıklı olmanın işgücü arzı konusuna bir başka etkisi ise, ikame ve gelir etkilerinin sıfır olduğu durumlarda da ortaya çıkar. O da, yaşam beklentisinde meydana gelecek bir artış iş gücü arzının artmasına neden olacaktır. Literatür kısmında bahsedilen ampirik çalışmalar iki şekilde bu konuya destek vermektedir. Hsatlıktan dolayı izinli olma sorunun giderilmesi ile birlikte azalmakta ve kronik ağrılar ve benzeri sağlıksızlıklardan dolayı iş ortamındaki işe odaklanamamadan kaynalanan iş gücü arzı kaybı iyileşmeden sonra azaldığı tespit edilmiştir. Ayrıca işçilerin sağlığında meydana gelen düzelmenin her zaman iş gücü arzına yansımadığını ve kendilerine ve ailelerine ayırdıkları zamanla değişime tabii tuttukları sonucu bulunmuştur.

Sağlığın eğitime etkisi, bir nevi iş gücü arzına benzemektedir. Sağlıklı birey hem fiziksel hem de zihinsel olarak daha zinde olacağından, dolayı daha yüksek eğitim imkânına sahip olabilmekte ve okula devam konusunda daha düzenli olabilmektedir. Ayrıca ailenin sağlık durumu çocuğun eğitim düzeyini de etkilemektedir. Eğer ebeveynler hasta ise çoçuklar okuldan uzaklaşıp iş hayatına kaymak zorunda kalmaktadır. Ayrıca yaşama süresi beklentisindeki yükselme, eğitimden beklenen getirinin yükselmesine neden olmaktadır. Bu konudaki literatürün, eğitim ve sağlık ilişkisini ampirik olarak da desteklendiğini görmekteyiz.

Tasarruf ve tüketim arasındaki tercih sağlıklılık durumuyla yakından ilişkilidir. Eğer birey sağlıklı ise hem sağlığına hem eğitimine hem de yaşamsal ortamına yatırım yapmaktadır ve bu tasarruf olarak da nitelendirilmektedir. Ancak sağlıksız birey, sağlıklı olmak için hem ilaç hem doktora yapılan harcamalar yatırımdan ziyade tüketime harcamaalarına girmektedir. Toplumsal olarakta sağlıklı ya da sağlıksız nüfus artışıda tassarruf ve tüketim eğilimini de direk olarak etkilemektedir. Literatür de örneğin Aguirre ve Hadley (2005) malaria hastalığının Afrikadaki ülkelere maliyeti gayri safi milli hasılalarının %1 ila %5'ne denk geldiğini vurgulamışlardır. Yatırımlardaki artış aile büyüklüğü ile yakından ilintili olduğunu savını Ruchlin ve Rogers (1973) ortaya koymuştur.

Ekonominin sağlığı etkilemesi doğrudan ve dolaylı olmak üzere iki şekildedir. İlki maddesel şartların hayatın biyolojik devamını katkısı. İkincisi ise yaşam koşulları ve güvenlik hissinin dolaylı olarak gelir tarafından etkilenmesidir. Maddesel anlamda hanehalkı düzeyinde gelirdeki artış; sağlığı koruma yöntemleri, sağlıklı yaşam eksersizleri ve sağlık hizmetlerinin daha etkin kullanılmasında da artışla sonuçlandığı öngörülür. Demir ve protein gibi dayanıklılığı artıran gıdalar daha çok hayvansal gıdalarda mevcuttur ve bu tür gıdalar birçok gıdaya göre, örneğin, ekmek ve kuru bakliyat gibi, fakir ailelerin alım gücünün dışındadır. Dolayısıyla yoksulluk, yetersiz beslenmeye neden olmakta ve bireysel ve toplumsal sağlıklılık ekonomik bir güce ihtiyaç duymaktadır.

Dolaylı etki, Turrel (2001) ve Wagstaff (2001) tarafından ele alınmış ve zıt psikolojik etki olarak nitelendirilmiştir. Örnek olarak ta, işsiz bir bireyin yüksek düzeyde stres ve gerilim yaşaması ve dolaylı olarak ta ümitsizliğe düşmesi olarak verilmiştir. Booysen ve Bacmann (2002), Wagstaff (2001) ve Turrel (2001) zenginlerin fakirlerden genel olarak daha sağlıklı olduğu düşüncesi ile üç alt başlıkla konuyu değerlendirmişlerdir;

- Sosyal ekonomik faktörler ya da sağlığı belirleyen alt faktörler: bunu aile içindeki kaynakların kullanılmasında sosyal ekonomik hiyerarşik yapılanma olarak tarif edilebilir. Burada sadece bu kaynakların miktarı değerlendirme sorunsal olarak görülmez aynı zamanda nasıl dağıldığı da sorunsal olarak değerlendirilir. Aile içinde kadın ve erkek

arasında bu sosyal yapılamanın nasıl olduğu aile ve çoçukların sağlık durumlarıyla yakından ilintilidir.

- Yatırımların yapılanmasında ve ekonomik ve maddesel kaynakların yatımlarındaki farklılıklar: sağlık durumu, beşeri sermaye ve piyasa yapılanmasında dolayısıylada maliyet, kalite, ulaşılabilirlik ve elde edilebilirlik unsurları tarafından etkilenirler. Örneğin temiz enerji yakacak ve ulaşım için kullanılırsa daha sağlıklı bir ortamdan dolayı toplumdaki bireylerin sağlık durumları etkilenmiş olacaktır.

- Sosyal birliktelik: toplumsal düzeydeki oluşan normlar hanehalkını etkileyecektir. Eğer toplumsal olarak sağlıksal konulardan olan sağlığı koruma ve sulama şartları yetersiz ise çevresel şartlardan dolayı hane halkı etkilenmiş olacaktır.

Bu bağlamda ampirik olarak şunlar söyelenebilir. Verem en çok ölüme neden hastalıktır ve toplumsal hastalıkların %80'ninde olmaktadır. Sorkina (1976) da yaptığı çalışmasında ölüm oranı ile gelir arasındaki yakın ilişkiye dikkat çekmiştir. Düşük gelirli kişilerin zengin olanlara daha uzun ve sık sürelerde hastalveığını ve 2000$ gelir altındaki ailelerin 2000$ üzerindeki ailelere göre (1000 kişilik nüfüs içindeki birey) dört kat kalp problemi ile karşı karşıya kaldıkları, altı kat pisikolojik ve stress kaynaklı hastalıklarla uğraştıkları, altı kat kireçlenme ve romatizma problemi müşaadesiyle tetkik edildikleri, altı kat yüksek tansiyon problemi ile karşılaştıkları ve sekiz kat görme problemi sorunuyla mücade etmek zorunda olduklarını rapor etmiştir.

Sağlık ve gelir arasındaki birlikte etkileşim konusu da literatürde değerlendirilmiştir (Bhargava, 2001; Ruchlin ve Rogers, 1973; Nixon, 1999; Erdil ve Yetkiner, 2004). Ancak sağlığın bir stok değişkeni olarak değerlendirilmesi ve genetik karekteristik bir özellik göstermesi konuyu değerlendirmekte güçlük yaratmaktır. Anne karnında başlayan süreçteki yetersiz beslenme ya da ailevi karekteristikler gelecekte de sağlıksal problemlere yol açabilmektedir. Ikincisi direk gelirle ilintili değil iken, anne karnından bebeklik çoçukluk ve yetişkinliğe kadar ki sürede gelirden dolayı yetersiz beslenme ve sağlık hizmeti daha sonraki hayat için engel teşkil edecektir. Dolayısla da hastalıklı olmak da iş gücü arzını ve kalitesini etkileyeceğinden bir sarmal oluşacaktır. Ampirik olarak literatürde bu eş anlı ilişki desteklenmiştir.

Nufüsün demografik dönüşüm konusu kısaca üç şekilde değerlendirilmiştir. Nüfus artışını bir engel olarak görenler, etkisiz görenler ve teknolojideki gelişmeden dolayı da tetikleyici olarak görenler diye ifade edilebilir. İlki nüfusun gıda arzından hzılı büyüyeceği fikrine dayalı olması nedeni ile engel olarak görmektedir. Ancak tetikleyici görüşe göre ise teknolojideki gelişme sonucu bu nüfusdaki artış ve gıda miktarındaki artış arasındaki uçurum artmayacaktır.

Ekonomik büyüme teorisi ile sağlıklığı özellikle beşeri sermaye ve sağlıklı birey üzerinen kurmaya çalıştık. Neticede ekonomik büyüme ve beşeri sermaye arasındaki ilişkiyi de tanımladık. Ayrıca Mankiw ve diğerlerinin (1992) yaptığı çalışma ile dışsal modeleme de beşeri sermaye ve büyüme arasındaki ilişkiyi ortaya konulmuştur. Ancak, içsel modellerde bu ilişki daha önceden modellenmiştir (Mankiw et al., 1992; Barro, 1997; Barro ve Lee, 1993, 1996; Lucas, 1988; Romer, 1986, 1990). Böylece, zengin ve fakir arasındaki gelir uçurumu beşeri sermaye üzerine de yüklenmiş oldu. Beşeri sermaye tetikleyici unsur olarak kabul edilence yazında nasıl tanımladığına baktık ve Özatağan, (2005) Fratianni ve Huang (1995) yaklaşımlarıyla özetlemeye çalıştık.

- Beşeri sermayenin sadece eğitim verileri ile açıklanması: Çalışmalarda 4 ayrı yaklaşım sözkonusudur. (1) 6 ila 19 yaş arası okullaşma oranı (Barro ve Lee, 1993), (2) öğretmen-öğrenci oranı (Barro, 1991; Barro ve Lee, 1996; Çeçen et al., 2003), (3) yetişkin okuma oranı (Coulombe et al., 2004) ve (4) her derecede toplem üniversite mezunu
- Öğrenme ve yenilik: En geniş teknolojik gösterge olarak araştırma ve geliştirme ve patent hakkı alma olarak vurgulanmıştır (Verspagen, 2000)
- Girişimcilik: Eğer bir birey daha çok eğitime sahip ise o bireyin girişimciliği artacaktır. Yeni firma kurulması, kendi işşyerine sahip olmak, yeni açılan bir firmada işe girmek girişimçilik olarak değerlendirilmiştir (Malecki, 1997).

Bu tanımlamalara artık sağlık göstergesininde eklenmesi gerektiği düşünülmüştür.

Yakınsama çalışmaları da altı ayrı yakınsama kavramı tanımlandıktan sonra dünya düzeyinde ve ülkemiz Türkiye özelinde değerlendirmiştir. Mutlak yakınsama, sigma yakınsaması, şartlı yakınsama, klüp yakınsaması hipotezi, yakalama mekanizması yolu ile yakınsama ve son olarak ta literatürde daha az vurgulansa da yapısal yakınsama olarak adlandırılıp betimlenmeye çalışılmıştır. Ayrıca diğer yakınsamaların sigma yakınsamasından neden önemli olduğu izah edilmiştir. Sigma yakınsaması gerçekleşmiyor olsa dahi diğer yakınsamalar gerçekleşebilir ve bu da ülkemizin hangi tür de bir ekonomiye sahip olduğunu ve ne yapılması gerektiği konusunda bir sonuca ulaşmamıza yardımcı olur. Dünya genelinde ve ülkemiz özelinde yapılan çalışmalar şartlı yakınsama sonucuna ulaşmıştır. Dünya genelindeki bulgular yakınsamanın %2 düzeyinde gerçekleştiğini göstermektedir.

Çalışmada ilk olarak tamamlayıcılık olgusu tanımlanmıştır ve beslenme verisi kullanılarak işgücü performansı indeksi elde edilmiştir. İşgücü indeksi beslenme verilerine dayalı azalarak artan bir fonksiyon olarak tanımlanmıştır ve bir ülkenin işçileri aynı varsayılarak o ülkenin ortalama etkin işgücünü gösterdiği düşünülmüştür. Fiziksel ve beşeri sermaye arasındaki tamamlayıcılık ilişkisi üretim sürecinin doğal bir sonucu olarak kabul edilmiştir. Örneğin, modern ve verimli bir tarımsal

üretim için gübre torbası üzerindeki kullanım kılavuzunun okuyup, okuduğunu bilgileri anlayacak, ekipmanların kullanımını, bakım ve tamirin el kitabını uygulayabilecek eğitilmiş insana gücüne ihtiyaç duyacaktır. Ayrıca, teknolojik bir gelişme aynı gelişmeyi yetenek olarak bünyesinde taşıyabilecek beşeri bir sermaye ye de ihtiyaç duyuracaktır. Bunun yanı sıra eğer kullanıcılar ve tüketiciler gelişen teknolojiyi anlamak ve takip edebilmek için yeterince bilgi ve eğitim donanımına sahip değillerse üreticilerin daha karmaşık ve gelişmiş ürünleri piyasaya sunmaları zor olacaktır. Bir başka unsur ise, fiziksel sermayenin yoğun olduğu zengin ülkelerden daha fakir ülkelere gitmemesi beşeri ve fiziksel sermaye arasındaki mevcut kuvvetli ilişkiye bir başka kanıt olacaktır. Kısaca insanların kendi yetenekleri üzerindeki kontrol gücü üretim süreci içinde fiziksel sermayede farklı bir durum ortaya koymaktadır. Bir benzetme şeklinde ifade eder isek, fiziksel sermaye daha itaatkâr bir karakter sergiler iken beşeri sermaye üzerinde bu etkiyi kurmak daha zordur. Fiziksel sermaye vesayet altına alınabilirse de beşeri sermayede bu pek mümkün değildir. Her iki sermaye rekabete dayalı bir yapıya sahip olduğundan ikisinde de dışlanabilirlik özelliği vardır ve buda iki sermayenin nasıl birlikte işlevsel hale geleceğini belirler. Dışlanabilirlik konusu için tablo H.1'de görülmektedir.

**Tablo H.1: Sermaye Türne Göre Dışlanabilirlik Derecesi**

| |
|---|
| Yüksek Yetenek |
| Özel uzmanlık gerektiren servisler (yüksek derecede yetenekli iş gücü) örnegin özel uzmanlık yapan profösörler, avukatlar doktorlar bilgisayar mühendisleri vediğer benzer işler. |
| Daha sıradan olan profosyonel hizmetler (daha az yetenekli iş gücü) örnegin avukatlık doktor ve diğer benzer işler |
| Çok daha sıradan olan profosyonel hizmetler (daha da az uzman iş gücü) örnegin daha genel davalara bakan avukatlık ve uzman olmayan doktor ve diğer benzer işler |
| Daha sıradan olan eğitmenlik |
| Daha sıradan olan memur işleri |
| Sıradan iş gücü |
| Düşük Yetenek |

Bu iki değişken Solow-Swan türü bir modelde kullanılmışlardır (Augmented-Solow model). Bu çalışma bu iki değişken ((K/H) oranı ve iş gücü performansı) kullanılarak kullandığımız modelin regresyon kalıntısını açıklamada işgücü performansının etkisinin olup olmadığı incelendi. Tamamlayıcılık yaklaşımı (K/H) üretim fonksiyonu içinde kullanılarak üretim fonksiyonun bileşenleri artırılabilen ve verimlilik olarak ikiye ana bölüme ayrılmıştır. Varyans ayrıştırma yöntemi kullanılarak bu iki unsurun etkisini kıyaslama imkânı elde edilmiştir. Özelde bu yöntemle işgücü performansının verimlik diye ayrıştırdığımız bileşin ne kadarını açıkladığını göstermemize yardımcı olmuştur. İş gücü performansı 69 ülke ve 17 bölgesel hale dönüştürülmüş iller verisi için regresyon kalıntısını açıklamada önemli bir katkı sağlamıştır ve modellerde ihmal edilmemesi gereken bir değişken olduğunu ortaya çıkmıştır. Seviye hesaplama yöntemi ise bize fiziksel sermaye ve beşeri sermaye oranın zengin ve fakir ülkeler arasındaki verimlilik farkını açıklamada ne kadarlık bir etkiye sahip olduğunu göstermek açısından faydalı olmuş ve

özelliklede işgücü performansının bu verimlilik farkını açıklamadaki etkisi ne kadardıra cevap vermemize yardımcı olmuştur. Bu yaklaşım bize verimlilik ya da gelir farklılığı açıklamada kısmen faydalı olsa da, faktörlerin neden farklı olduğu konusunda ise bir şey söylememektedir. Ayrıca, seviye hesaplaması yardımı ile artırılabilen faktörlerden biri olarak iş gücü performansının gelir farklılıklarına neden olduğu ortaya çıkarılmıştır. İşgücü performansının rolü, ülke ve bölge seviyesindeki uygulamlarda netleştirildikten sonra, yakınsama da nasıl bir role oynadığı incelemeye alınmıştır. Bu iki uygulamada iş gücü performans değişkeninin gösterdiği etki gelirdeki dinamik değişmeyi açıklamada kukla degişken olarak kullanılan gelir seviyesi değişkenlerin etkisi kadar büyük olmamıştır. Yakınsama yaklaşımı da bize zengin ve fakir arasındaki gelir farklılığının azalıp azalmadığını ve eğer azalıyorsa ne hızda azaldığı hakkında bir bilgi verir. Ayrıca kullanılan kukla değişkenlerinin istatistiksel olarak anlamlı olması da bize ekonomiye özel durumların giderilmesinin gerekip gerekmediği açısından da politika ipucu vermesi açısından da önemlidir.

Kısaca bulgularımızı değerlendirirelim.

Beslenmenin gelir üzerindeki direk etkisini ölçmek için varyans ayrıştırma metodolojisi fiziksel sermayenin beşeri sermayeye (K/H) oranı fikri ile birlikte uygulanmıştır. İş gücü performansının regresyon kalıntılarını açıklamada sağladığı katkı bütün alt örneklemeler içinde geçerlilik arz etmiştir. Kalifiye ve kalifiye olmayan işgücünün beslenmesinin iş gücü performansının katkısı genel olarak beklentilerimize uygundur. Ancak düşük-gelirli ülkeler için sonuçlar beklenti ile uygunluğu biraz değerlendirmek gerekmektedir. Özü itibari ile bu örneklemedeki nüfusumuz iyileşme ya da nekahat döneminde olabilir. Sadece yaşayacak kadar besine sahip iken üretime dönüştürülecek kadar besinleri olmayabilir. Dolayısı ile orta gelir grubu için besinlerin üretime dönüş süreci işlerken düşük gelir grubu için bu süreç tam gerçekleşmemiş olur. İllerin bölgesel verisinde de, ülkelerin genel düzeyi için görülen aynı pozitif eğilim görülmüştür. İş gücü performansının %43 oranında regresyon kalıntısını açıklama eğilimine sahip olduğu tespit edilmiştir. Bu veri için, (K/H) oranın kişi başına gelir içindeki katkısı çok düşük ve iş gücü performansının ise çok daha büyük bulunmuştur. İş gücü performansının katkısı (K/H) den 4 kat daha büyük olduğu görülmüştür.

Her iki örnek için, iş gücü performansı gelir farklığını açıklamada büyük katkı sağlamaktadır. İş gücü performansı, fiziksel sermayenin beşeri sermayeye (K/H) oranınından daha fazla gelir farklılığına neden olmaktadır. Sonuçumuz sermaye oranının üretim içindeki katkı payının seçimine duyarlı olduğu da vakidir. Bu farklı pay oranı seçiminin gelir farklığını açıklamadaki etkisi aynı payın oranı seçiminden daha büyüktür. Sonuçta, sadece iş gücü performansı değil sermaye oranının üretim içindeki katkı payı seçimi de gelir farklılıklarını ya da verimlilik farklılıklarını açıklamada çok önemli paya sahiptir.

Her iki veri setide yakınsama eğilimi göstermektedir. Yakınsama hızının ne olduğuna baktığımızda bulgularımızın genelde literatürdekinden farklı olarak daha düşük β-değeri göstermektedir. Yani, zengin daha yavaş büyürken fakir daha hızlı büyümektedir. Ayrıca farklılar arasındaki farklılıklar ne kadar önemli ise benzerler arasındaki farklarda o kadar önemlidir.

Bu çalışmada politika önerisi için üç temel noktaya ulaşılmıştır. Birincisi, incelenen ülkelerin çoğu verimlilik artışına neden olan beslenme farlılıklarına odaklanmalıdırlar. İkinci olarak, kalkınma aşamalarında beslenmeye bağlı iş gücü performansı önemli şekilde farklılık arz etmektedir. Yoğunlaştırılmış üretim fonksiyonunda gelişmiş ülkelerin iş gücü performansının etkisi az olurken, orta gelir düzeyi ülkelerde büyük etkiye sahiptir, ancak düşük gelir grubunda böyle bir etki görülmemiştir. Son olarak, üretim fonksiyonunun yapısı ekonomik gösterge için çok önemlidir.

Bu araştırmadan çıkarılabilecek sonuçlar 4 alt başlıkta toplanabilir:

- Beşeri sermaye için eğitim verisi yanında, sağlıkla ilgili bir veri de kullanılmalıdır ki bu bizim çalışmamızda işgücü performans indeksidir.

- İşgücü performans indeksi kişi başına gelir değişmelerinde ve gelir farklılıklarında güçlü bir etkiye sahiptir.

- İşgücü performans indeksi yanında üretim fonksiyonunun içindeki (K/H) oranı, önceki çalışmalara kıyasla, daha kavramsal bir şekilde yerini almalıdır.

- İşgücü performansı indeksi ve fiziksel-beşeri sermaye vekili olarak kullanılan (Elektirik/Eğitim) oranının yanı sıra ülke ve il özel karakteristikleri de önem arz etmektedir.

Ancak beslenme ve ekonomik büyüme ile ilgili önemli sonuçlar elde etmemize rağmen, beslenmenin eğitim üzerinden büyümeye etkisini ölçmek için bu konu ile ilgili verilere sahip olmak gerekliliği vurgulanmıştır. Neticede verilerin olması daha net sonuçlara ulaşmamıza yardımcı olacaktır. İşgücü performansının gelir üzerindeki ve gelirdeki değişmelerin bir kısmını açıklamada yardımcı olsa da hala örneklememizdeki gelir farklılığının açıklanmayan kısımlar mevcuttur. Gelecekte gelir gruplarına göre üretim fonksiyonunun farklı olmasına izin verilerek, β-yakınsama değerinin ve α-değerinin gelir gruplarına göre farklılık gösterip göstermediği ölçülebilir.

Ekonomiye özel etki olarak kullandımız sabit değişken ( $\left(1-e^{-\beta t}\right)Ln(A_0)$ ) iken ekonomik-zamandan bağımsız olarak kabul edilen sabit bir faktör olarak ( $g\left(t-e^{-\beta t}t_0\right)$ ) ifadesini koşullu yakınsamda kullanılmıştır. İlk ifade her iki veri seti içi kullanılır iken ikinci ifade sadece Türkiye için kullanılmıştır. Bunun nedeni de 1994 yılının bir kriz yılı olması ve 2003 yılının ise kriz sonrası bir yıl olmasıdır. İlk ifade her iki veri setinde istatistiksel olarak anlamlı bir etkiye sahiptir ve yakınsama hızını etkilemiştir. Bu bulgu bize fiziksel ve beşeri sermaye oranı ve beslenmeye dayalı iş gücü perfonmans indeksi yanında ekonomilerle ilgili özel durumların çok önemli olduğunu ve politikacıların bu özel durumların ne olduğunu tespit etmesi gerektiğine işaret etmektedir. Neticede model $\left(1-e^{-\beta t}\right)Ln(A_0)$ parametresi ile kişi başına gelirdeki farklılıkların giderilemesinde politika uygulanması gerekliliğini işaret etmektedir.

İllerin ve ülkelerin sabit kabul edilen konumları önemli olduğuna göre, ulusal ve uluslararası etkiler yakınsama oranını etkileyebilir ve sermaye oranın üretime katkısı da farklılık arz edebilir. Hükümetler, iç piyasa ve dış piyasa dinamikleri, ve tarihsel ve kültürel unsurlar eğitim politikasını, gelir düzeyini, vergi ve istihdam politikasını etkilemektedir. Her ne kadar gelir farklılığını açıklamak zor olsa da, sağlığın gelir ve gelir dağılımı ile ilişkisi önemlidir. Bu nedenle, beşeri ve fiziksel sermaye ve sosyal altyapıya yapılacak yatırımlar hem bireylerin hem de toplumun sağlık durumu için çok önemlidir. Toplumsal dayanışmanın az ya da çok olması, psikolojik yaklaşımların çeşitliliği (algıda seçicilik gibi) ve sağlıkla ilgili diğer unsurlarla alakalı yapılacak yatırımlar hem bireyin hem toplumun sağlık durumunu etkileyecektir.

Fiziksel sermaye içinde barındırılan teknolojik gelişme aynı zamanda onu işlevsel hale getirecek beşeri sermayeye ihtiyaç duyacak ve eğitsel bir yatırımla beşeri sermaye de artış sağlatacaktır. Az gelişmiş ülkelerdeki düşük seviyeli sermaye birlikteliği ve uyumu, bu ülkelerin gelişmiş ve teknolojisini yenileyen ülkelere kıyasla kısa dönemli hızlı bir büyüme sağlayabilir. Gelişmiş ülkeler için fiziksel sermayede ki gelişme nedeni ile yaşanacak kısa dönemli beşeri sermaye ve fiziksel sermaye uyumsuzluğu kısa dönemde yavaş büyümeye neden olacaktır. Bu da ekonomilerin büyümesinde *birdir bir etkisi* (dönemsel zıplamalar) diyebileceğimiz bir trendi doğal karşılamamıza neden olur. Bunu modelimizin parametrelerinde olan ekonomiye özel "At" parametrelerinin istatistiksel olarak anlamlı olan ve fiziksel ve beşeri sermayeyi etkileyen parametre ile de ilişkilendirebiliriz. Türkiye açısından, iller bazında bebek ölüm oranlarının ve doğum oranlarındaki farlılıklar, sağlık, imalat, sosyo-ekonomik ve eğitim seviyesindeki farklılıkların azaltılması gerekli demektir.

İllerin farklı farklı karekterlere sahip olması sağlık, imalat, sosyo-ekonomik ve eğitim seviyesindeki farklılıkların azaltılması gerekliliğini ortaya çıkarmıştır. Bir tarafta hızlı büyüyen

şehirler var iken diğer yandan gerileyen şehirler gözlemlenmektedir. Bu iki farklı olgu tablo H.2'de gösterilmeye çalışılmıştır. İllerin tasnifi 1994 yılında kişi başına gelirin 2000$ düzeyinin altında ve üstünde iller olarak yapılmıştır. 22 il üst gelir grubuna dâhil olur iken 59 il düşük gelir grubunda gösterilmiştir. Aynı zamanda göç oranı, sosyo-eknomik gelişmişlik, imalat sektörü büyüklüğü, sağlık ve eğitim sektörünün etkinliği gibi indeksler 2000 yılı verilerine göre DPT (2003a) tarafından ölçümlenmiştir. Bu ölçümler ve bizim alt ve üst gelir grubu tasnifimize göre, 22 üst gelir grubu iller için bu indekslerin ortalaması hep positive bir sonuç verir iken, diğer 59 il için ise bu ortalama değerler negatif olmuştur.

**Tablo H.2: İl düzeyinde bazı göstergeler (2000)**

| Yüksek Gelirli İller | Gözlem Sayısı | Ortalama | Düşük Gelirli İller | Gözlem Sayısı | Ortalama |
|---|---|---|---|---|---|
| Göç oranı | 22 | 11.25 | Göç oranı | 59 | -29.5 |
| sosyo ekonomik indeks | 22 | 0.715 | sosyo ekonomik indeks | 59 | -0.26 |
| imalat sektörü indeks | 22 | 0.49 | imalat sektörü indeks | 59 | -0.18 |
| sağlık sektörü indeks | 22 | 0.66 | sağlık sektörü indeks | 59 | -0.25 |
| eğitim sektörü indeks | 22 | 0.65 | eğitim sektörü indeks | 59 | -0.24 |

Kaynak:DPT (2003a)

Dördüncü bölümde, Tablo IV.6 da, Türkiye örneklememiz de kullandığımız verilerden $\log\left(EL/E\right)$ ) ve $\mathbf{Log}\left(EL/Ee\right)$ değerlerini ve değişim değerlerini gösterdik. 1994 den 2003 kadar $\left(EL/E\right)$ in büyümesi çoğunlukla negative olmuştur ve Bursa-Eskisehir-Bilecik, Gaziantep-Adiyaman-Kilis and Samsun-Tokat-corum-Amasya illeri için bu değerler pozitif olmuştur. Aynı yıllar için $\left(EL/Ee\right)$ deki büyüme bütün örnekleme için negatif olmuştur. Bununda nedeni, gelir içindeki gıda harcamasının düşmüş olması ve iş gücü performansındaki artışın büyük olmasından kaynaklanmıştır.

Yedi ana bölge için 1987'den 2001'e kişi başına ortalama büyüme ve varyansında DPT (2003b) tarafından rapor edilmiştir (tablo IV.10). DPT (2003b) ye göre yedi bölge arasındaki kişi başına gelir uçurumu azalmamaktadır. Ayrıca kişi başına gelirdeki bölgesel fark büyüktür. Bu oranın Türkiye oratalaması 0.43'tür. Doğu Anadolu bölgesi 0.50 gibi en yüksek orana sahip iken Akdeniz Bölgesi 0.28 gibi en düşük orana sahiptir

Gelir dağılımının toplumun sağlığı üzerindeki Turrell (2001) tarafından yapılan çalışmadan bazıları Tablo H.2'de özetlenmiştir. Hükümetlerin uygulayacakları politikalarla gelir dağılımındaki bozuklukları azaltabilirler. Örneğin, vergilendirme, düşük gelirliler için gelir desteklemesi, eğitim ve beceri kursları imkânı sağlama, iş imkânı yaratma ve yapısal uyum programları gibi şeçeneklerle gelir dağılımına hükümetlerce müdehale edilebilir. Gelir dağılımındaki bozukluklluğun azaltılması daha üstün ve daha eşit düzeyde yatırımların yapılmasına imkân verecektir. Dolayısıyla, beşeri sermaye, fiziksel sermaye ve sosyal altyapı üzerinde meydana gelecek yatırımlar hem birey hem toplum açısından önemlidir. Bu yatırımlar

daha önce bahsettiğimiz gelirin sağlık üzerindeki dolaylı üç etki yoluylada yapılabilir. Gelir dağılımın düzgün olması daha güçlü bir toplumsal birliktelik yaratacağı gibi daha etkin bir fiziksel ve beşeri sermaye yatırıma yol açacaktır.

**Tablo H.3: Gelir dağılımını belirleyen faktörlerden bazıları**

- Hizmet ekonomisinin oluşması ve bundan dolayı meydana gelecek kalifiye eleman ihtiyacı oluşacaktır ve bu kalifiye iş gücü kalifiye elamanada ihtiyaç duyacaktır.
- Yatırım ve sanayileşme tercihinde yapılacak değişiklik.
- Imalat ve sanayi bazlı ekonomik yapılanmadan servis bazlı ekonomiye dönme ve teknoloji, eğitim sistemi ve kalifiye eleman ihtiyacı oluşması
- Kalifiye elaman ihtiyacının kalifiye olmayana göre düzenli bir artış içinde olması
- Uluslararası finsansal piyasların artması ve imalat sanayinin azalması
- Sanayi politikalarındaki yapısal dönüşüm
- Eğitim politikası

Kaynak: Turrell, 2001

Türkiye ilişkin beslenme verisi bulmanın zorluğu ve 1974, 1984 ve 1997 yıllarından başka ulusal düzeyde çalışma yapılmaması verilerin temininde zorluk yaratmıştır. 1997 yılında yapılan çalışma sadece 7 ili kapsamaktadır. Dolayısla Türkiye gıda ile ilgili planlama yapabilmesi için ulusal düzeyde gıda tüketim haritası çıkarmalıdır. Türkiye de gıda tüketiminde yaşanan sıkıntının ilki gelirden ikincisi ise bilgisizlikten kaynaklanmıştır (Pekcan, 2001). Yoksul aileler ekmeğe dayalı bir tüketim eğilimi sergilemekte ve zenginler et, ete dayalı ve taze sebze ve meyve türü besinler tüketmektedir. Dolayısıyla Pekcan (2001) gıdanın toplum içinde eşit dağılmamasının asıl problem olduğunu vurgulamıştır. DPT (2003b) 1990 ve 1999 yılları arasında kişi başına et tüketiminin 16 kg dan 18 kg çıktığını, ancak kişi başına süt tüketimininde 171 kg'dan 157 kg'a düştüğünü rapor etmiştir. Ayrıca, günlük enerji sağlaycı tüketimin %50 ekmek ve kuru gıdadan sağlandığını ortaya koymuşlardır. Ancak et ve ete dayalı gıda tüketimdeki düşük seviye bize protein ihtiyacının sebze türü gıdalardan sağlandığını gösterir. Dolayısıyla Türkiye'de et ve ete dayalı tüketimin bireylere eşit şekilde yayılması sağlanmalıdır.

Kısaca; beslenme, sosyal örgü ve alışkanlıklarla yakından ilgilidir. Su ve kanalizasyon gibi alt yapı yatırımlarına önem vermek toplumun sağlığını etkilediği gibi iş gücü verimliliği ve gelir düzeyi için önemlidir. Ayrıca beslenme düzeyinin toplumlarda yaygınlaştırılması liderlik, eşitlik ve beşerin memnuniyeti gibi ekonomik faydalarının ötesinde fayda saglayacaktır. Liderlik olgusu bize topluma yön verebilecek bir bireyin yetersiz beslenme nedeli ile kaybolma ihtimalini gösterir. Beşerin memnuniyeti ise ekonomik olarak zor durumda olan insanların da yaşamlarından zevk alabileceğini ve bu memnuniyeti arkadaşlık, aşk, diyalog, sportif aktiviteler ve ebeveyniklik gibi duygularla yaşarlar. Bunlar hayat memnuiyetini gösteren ve ne sayılabilen ne de pazarlanabilen tüketim birimleridir. Ancak hasta bir insanın bu türden zevkleri yaşaması hastalığından dolayı zorlaşır. Beşerin memnuniyeti gelirden daha öncelikli bir ana ihtiyaçtır. Eşit dağılım ise hayat memnuniyetinin topluma yansımasını kolaylaştırır. Bütün bunlara ek olarak,

politika yapıcılarına ve ekonomistlere beslenmenin her zaman bir kaynak yetersizliliği problemi olmadığını, yeterince temizlik ve hijyen bilgisinin bireyler tarafından bilinmemesi ya da bilinse dahi ihmal edilmesi nedeni olduğunu hatırlatmak gerekmektedir. Bununla birlikte kadınların anne olarak yeterince bilgi ve eğitim ile donatılması gerekmektedir. Su ve sağlıksal alt yapıların yeterli olması, ebeveynler ve toplum tarafından talep edilecek gıda kadar önemlidir.

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**CURRICULUM VITAE**

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|---|---|
| **Aim:** | Health Economics, Economic Growth, Managerial Economics, Law and Economics |
| **Education:** | 2005, Ph.D. in Economics, Middle East Technical University, Department of Economics, Ankara, Turkey.<br>1998, MA in Economics, Indiana Universities, Department of Economics.<br>1991, MA in Economics (Uncompleted), Çukurova Universitesi Department of Economics.<br>1990, BA in Economics, Dokuz Eylül Üniversitesi, Department of Economics. |
| **İş deneyimleri:** | 2001 –2008Research Assistant, Department of Economics, Middle East Technical University (METU), Ankara, Turkey.<br>1993-2001, Research Assistant, Department of Economics Niğde Üniversitesi<br>1988-1989 Saygılı Rulman (İzmir): Marketing<br>1986-1989 Saygılı Rulman (Adana): Marketing<br>1990-1993 Kalyoncu Ticaret: Marketing<br>1993 Adana Orman Genel Müdürlüğü: Accounting |
| **Kazandığı burs yada Parasal destekler:** | The Higher Education Council of Turkey. Scholarship for Master Study |
| **Yabancı dil (seviyesi):** | English |
| **Articles:** | "Purchasing power parity in OECD countries: Evidence from panel unit root" Economic Modelling 25 (2008) 440–445.<br>"An empirical work on catch up by the diffusion of technology" Pakistan Journal of Applied Sciences" v.2 no:6 June 2002.<br>"Finansal Piyasaların ekonomik büyümeye etkisi ve Türkiye örneği (1989-2002) Gazi Üniversitesi ticaret ve turizm eğitim fakültesi dergisi |
| **Presentations:** | 5th INTERNATIONAL CONFERENCE ON HEALTH ECONOMICS, MANAGEMENT & POLICY, ATHENS. |