

# Observations on extending the definition of human capital as a source for explaining regional differentials in Turkey<sup>1</sup>

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## Abstract

This paper aims to analyze regional per capita income differentials in Turkey and the role of regional human capital differences in explaining these differentials. After a brief summary of evolution of per capita income differences among 64 provinces over the period 1980-2000, the paper captures a detailed account of human capital not only in terms of education but also with regard to innovation / learning and entrepreneurship. The findings showed that provinces indicated a differential growth pattern depending on their initial per capita income gaps from the national average and the education dimension of human capital is the basic factor behind this differential growth pattern. Based on this finding, which contradicts with the usual arguments in the literature emphasizing the role of innovation, learning and entrepreneurship, some discussions are made on the methodology used.

## 1. Introduction

The traditional interest in the literature on regional differentials has gained a renewed emphasis since the 1980s with the contributions of

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Romer (1986) and Lucas (1988). This renewed emphasis of the endogenous approach to the growth process has stimulated the attention to the endogenized factors behind the process of convergence or divergence among regions. A considerable number of studies appeared that underlined the role of human capital as an important part of the knowledge accumulation process and were directed to present evidence on the role of human capital in explaining regional disparities and the process of convergence (Barro, 1991, 1997; Barro and Sala-i-Martin, 1992; Benhabib and Spiegel, 1994; Çeçen *et al.*, 2003; Erk *et al.*, 1998; Gemmel, 1996; Güngör, 1997). The most commonly emphasized dimension of human capital by this literature is the skills obtained through formal education.

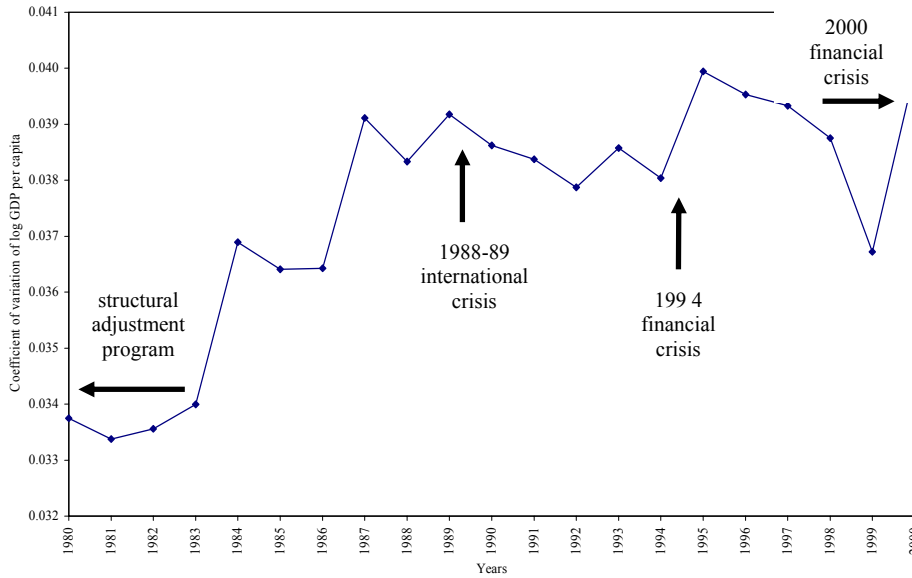
Since these attempts to theorize human capital as the major source of explaining differential growth, the definition of human capital has been widened by recognizing human capital as an important part of innovation and learning, and entrepreneurship. Instead of restricting the definition of human capital to skills obtained through formal education, this more inclusive and dynamic view acknowledges entrepreneurship, innovation and learning as key forms of human capital and important preconditions for economic growth.

This paper draws on this extended definition of human capital as a factor that underlies the differential per capita income growth pattern of the provinces in Turkey. To this end, the paper first outlines the trends in per capita income differentials and the prevailing per capita income growth pattern of 64 provinces in Turkey over the period 1980-2001. Second, it outlines the framework that underpins the extended definition of human capital. Different from many other research papers that build on the role of human capital towards explaining regional differentials, the paper takes a detailed account of human capital. Within this context, human capital is defined not only in terms of skills obtained through schooling but also in terms of innovation and entrepreneurship. The third section draws on a quantitative examination of the contribution of human capital differences towards explaining provincial per capita income differences. In the fourth section, the findings are synthesized and some discussions are made.

## 2. Trends in regional differentials in Turkey since the 1980s

Large and persisting regional differences have always been the characteristic feature of Turkey. Recently, however, this tendency has deepened. Figure 1 depicts the overall trend in regional differentials in Turkey since 1980. This figure plots the coefficient of variation of log

**Figure 1**  
Trend in Regional Differentials in Turkey, 1980-2000



Source: Calculated based on data from Özötün (1988) and SIS (2002).

GDP per capita as the indicator of the degree of inequality between the 64 provinces<sup>2</sup>.

Beginning with 1980, when a structural adjustment program was initiated after the late 1978-1980 economic crisis, provincial per capita income inequalities increased from 0.034 to 0.039 in 1989. The growth in regional differentials is not surprising when trade liberalization and export-oriented growth, defined as the major policy of the program, was further extended in the late 1980s by abolishing foreign exchange controls and quotas on imports and by the revision of tariffs<sup>3</sup>. Apparently,

<sup>2</sup> Data at the provincial level is problematic for Turkey in time-series studies. This is because of the changing number of provinces year by year. The number of provinces, which was 67 in 1980, was increased to 81 by 2000, with the definition of some previous sub-districts as provinces during 1990-2000. The creation of new provinces necessitated adjustments for GDP per capita data at the provincial level, between 1990 and 2000. The method used by A. Güngör (2001) is applied and GDP per capita figures are recalculated, by defining two composite provinces. Composite provinces are defined for cases where a new province is created from subdistricts of several provinces. The first composite province comprises Hakkari, Mardin, Siirt and their previous sub-districts, which became the provinces of Batman and Şırnak in 1991. The second composite province contains Çankırı and Zonguldak and their previous sub-districts, which became the provinces of Karabük and Bartın in 1996.

<sup>3</sup> See TEK (2003) on the economic growth performance of Turkey. See also, among others, Doğruel (2002), Kepenek and Yentürk (1996), Şahin (2000), Şenses (1994) and Yeldan

such a policy favored mostly the regions with relatively developed manufacturing capacities. As a result, major metropolitan centers, especially the İstanbul and İzmir metropolitan centers, grew as major growth centers and trade nodes, and were subject to increasing immigration from all over the country.

In 1989-1995 and 1995-2000 there were cyclical movements, with initial declines in inequality followed by even stronger increases. In spite of a slight reversal of this trend in the following few years after 1989, inequalities across provinces reached a level of 0.040 in 1995, after the financial crisis in 1994. The crisis conditions in 1994 caused a sharp decline in domestic demand and had severe effects in the metropolitan regions of the country as reflected in the increasing unemployment of white-collar workers, declining per capita income and a decrease in the growth rates of these areas.

After 1995, although regional differentials tended to decline in the following few years to a level of 0.037 in 1999, the level of inequality stayed higher than its initial level of 0.034 in 1980. In the 2000s, accompanied by another severe financial crisis due to the outflow of short term capital, the situation changed dramatically with a sharp increase in the level of inequality to 0.041; a level that was even higher than its peak level in 1995<sup>4</sup>.

Clearly, Turkey is characterized by an overall increase in per capita income inequalities across its provinces since 1980 when Turkey underwent a transition from import-substitution to export-oriented growth and trade liberalization policies, which was a turning point in the Turkish economy. It would seem reasonable to say that the benefits of export-oriented growth and trade liberalization were restricted to a few regions. And when accompanied by frequent crises especially since the mid-1990s, these benefits were hardly distributed to the relatively less developed areas which resulted in an increase in variations in the per capita income level across provinces.

### 3. Regional growth differentials in Turkey: Convergence or divergence?

In the previous section we outlined the overall trends in per capita income differentials across the provinces of Turkey. In this section the aim is to examine the per capita income growth patterns of the provinces. Particularly, we will investigate the differences in the per capita income

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(2001) for details on the Turkish economy after the initiation of the structural adjustment program.

<sup>4</sup> See among others Alper (2001) on 2000 liquidity crisis and Şenses (2003) on its effects on income distribution.

growth performances of 64 provinces over the period 1980-2000 and the extent to which this performance is related to the differences in their initial per capita income levels<sup>5</sup>.

Table 1 gives the results of the regressions. The beta coefficient is statistically significant at the 5% level and the initial income difference explains 11% of the variation in income growth differences. The resulting beta coefficient, which is significantly greater than zero, implies that over the period 1980-2000 there was no tendency for per capita GDP growth of provinces to converge to the national average. In fact, the trend is rather the reverse: GDP per capita growth in provinces show a tendency to fall behind the national average.

**Table 1**  
Results of Absolute Beta Convergence Analysis

Dependent variable: $\Delta Y_{it} - \Delta \bar{Y}_t$		
Independent variables	Coefficient (s.e.)	Sig. t
Constant	0.000752 (0.002620)	0.0046
$\log Y_{it0} - \log \bar{Y}_{t0}$	0.032960 (0.011216)	0.7749
R <sup>2</sup>	0.122	
Adjusted R <sup>2</sup>	0.108	
Standard error	0.017	
Degrees of freedom	1	
F-statistic	8.63588	
Sig. F	0.0046	

Despite this overall trend, however, Figure 2 gives an idea about the dynamics of the provinces in Turkey in the period between 1980-2000 in terms of their per capita income growth rates and initial per capita income levels. The figure gives the scatterplot of the growth rate differentials in terms of per capita GDP for the analyzed period versus the log of initial

<sup>5</sup> The method used is the one employed by Cuadrado-Roura *et al.* (2000) and Cuadrado Roura (2001) and is described in the appendix. It should be noted that the beta coefficient obtained in this model is different from the standard beta convergence model and thus should not be taken as a measure of the rate of convergence.



accompanied with growth rates higher than the national average. Among these provinces are those located in proximity to the metropolitan regions that took advantage of the decentralization of facilities from the metropolitan regions; those provinces defined as the success stories of the country following a self-development path after the 1980s based on their local capacities; as well as some regional centers. It would be reasonable to say that this group of provinces succeeded to reactivate their capacities, adapted well to the changing conditions and changed their unfavorable initial per capita income levels in favor of higher per capita income growth rates.

Despite this increase in the number of economically dynamic regions, there are a considerable number of provinces that compose the third group, *lagging regions*, defined as regions with both initial per capita income levels and per capita income growth rates lower than the national average. This group, consisting mostly of provinces in the eastern and northern parts of Turkey, is both geographically peripheral and economically backward. These provinces are not effective in activating their resources and capacities, and integration into the more competitive markets since 1980 has enlarged the gap between these economically backward regions and the nation as a whole. These regions, it seems, suffered comparatively more from the competitiveness of the economy and from other regions taking advantage of the new opportunities. The inequalities between these lagging regions and the rest of the country increased as a result.

In fact, evidence of the overall income growth process between 1980 and 2000 has shown that although a group of provinces with lower than average levels of initial income showed a renewed dynamism for widening their competitive base and achieving successful growth reflected by above average income growth rates, income growth differences persisted from the 1980s until 2000. The existence of a large group of provinces with very low initial conditions and income growth rates pointed to a dichotomy where a group of provinces diverged and fell behind the rest of the country. Clearly, the former were more capable of adapting to the rapidly changing conditions of the increasingly liberalized and competitive markets after the 1980s, while the economic conditions in this period were unfavorable for the latter, which resulted in a divergence process for them from the rest of the country.

The next section is devoted to the reasons of this differential growth pattern with particular emphasis on human capital. The aim is to investigate whether human capital differences are the major source of the differential per capita income growth across provinces in Turkey. But before that, we shall direct our attention to define human capital, which will provide the basis of our quantitative inquiry.

#### 4. Towards an explanation of regional growth differentials: Extending the definition of human capital

The reference given to human capital as a major factor behind the growth pattern of countries and regions has been renewed with various contributions from the new growth literature (Barro, 1997; Barro and Lee, 1993, 1996; Lucas, 1988; Romer, 1986, 1990). The most commonly emphasized dimension of human capital by this literature is the skills obtained through education (Barro, 1991, 1997, Barro and Sala-i-Martin, 1992; Benhabib and Spiegel, 1994; Çeçen *et al.*, 2003; Erk *et al.*, 1998; Gemmel, 1996; Güngör, 1997). Since these attempts to discuss and quantify human capital as the major source for explaining differential growth, the definition of human capital has been widened. Instead of restricting the definition of human capital to skills obtained through education, this more inclusive and dynamic view acknowledges innovation and learning, and entrepreneurship as key forms of human capital and important preconditions for economic growth. Human capital is important due to its relation with innovative activities, due to its role in facilitating learning and as a source of investment that maintains adjustment from disequilibrium to equilibrium (Piazza-Georgi, 2002).

It is this inclusive view of human capital that this paper builds on to explain the differential growth pattern of provinces in Turkey. The idea is that education obtained through schooling needs to be complemented by other capacities. Capacities to learn and innovate as well as entrepreneurial capacities are important in the development of human capital attained by formal education. The indicators of human capital used in this analysis are determined based on a three-fold definition of human capital, in terms of education, learning and innovation, and entrepreneurship.<sup>7</sup>

As for the first dimension, the concept of human capital embodies *education*. Four variables are determined to estimate the relation between regional growth differentials and regional differences in human capital, when human capital is defined in terms of education. The first variable, combined school enrollment ratio, is the number of students enrolled in primary and secondary schooling as a percentage of the population between ages 6 to 19. School enrollment ratios are used in most of the studies to measure the accumulation of these flows. It reflects flows of education, the accumulation of which creates future stocks of human capital (Barro and Lee, 1993). Because of the long time lag between these flows and stocks, this variable is used with 10 years time lag.

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<sup>7</sup> A summary of the variables used in the analysis is given in the appendix.



Another indicator in terms of schooling, most widely used in studies, is the quality of basic schooling. Teacher-student ratios are used to measure differences in the quality of schooling across countries or regions (Barro, 1991; Barro and Lee, 1996; Çeçen *et al.*, 2003). This is defined here as the number of teachers per student in primary and secondary schooling. A higher teacher-student ratio indicates a higher quality of schooling and thus higher human capital.

On the other hand, in most of the studies, adult literacy rates are used to measure the initial and current stocks of human capital for adult population. However, literacy is the initial stage in the development of human capital. For this reason, instead of this measure, the number of university graduates per 10 000 population are included in this analysis in order to measure the stock of human capital.

Besides university graduates, the number of graduates at master's and doctorate levels are included in the analysis to measure stocks in a higher stage of the path of human capital formation. As concepts of learning and innovation become more important as ways of responding to the rapidly changing conditions of today's economic environment, it is assumed that the highest levels of education will provide the necessary sources of knowledge and capacities of learning. University and higher level graduates are assumed to embody the capacities of academic research that are expected to facilitate the diffusion of knowledge and technology.

Three variables are determined in terms of the definition of human capital with regard to *learning and innovation*. The most widely used technology indicators in studies on innovation are R&D and patenting. These two indicators are assigned different roles. R&D measures are related with both innovation and imitation, while patenting measures are associated directly with new knowledge creation (Verspagen, 2000).

Having this differentiation in mind, two proxies for human capital related with innovation are the share of R&D personnel in total employment and the number of academic personnel per 10 000 population. Regions with higher rates of employment in R&D and higher numbers of academic personnel are expected to have a higher capacities to innovate and thus higher per capita income growth performances. It is assumed that regions with higher shares of R&D personnel and higher number of patents per population have higher human capital capacities that generate new knowledge<sup>8</sup>.

Besides schooling and innovation, *entrepreneurship* is referred to as one of the prominent features of economic development since

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<sup>8</sup> Unfortunately, R&D employment, as an indicator of human capital that contributes to innovation and imitation is not available at the provincial level. Instead, the number of patents per 10 000 population is used as an indicator.

‘entrepreneurs respond to market opportunities left unfilled by large enterprises’ (Malecki, 1997). It is seen as one of the major characteristics of the post-industrialized economy. Many studies taking as reference different countries and regions document the significance of entrepreneurship in shaping the future growth of a region (Malecki, 1997; Mawson, 1991). On the other hand, these studies emphasize human capital as one of the factors influencing regional variations in entrepreneurship (Armington and Zoltan, 2002; Fotopoulos and Spence, 1999; Georgellis and Wall, 2000). This is because, it is argued, more educated people have more capacities to use in an enterprise (Malecki, 1997) and regional human capital is important.

Entrepreneurship is usually defined as new firm formation and measured by self-employment, employment in newly opened firms, or firm birth rates<sup>9</sup>. Mawson (1991: 73) highlights that “new firms are frequently considered to be more flexible, dynamic and innovative than larger established firms. They are said to be more responsive to shifts in demand, prices and technology, and quicker to adapt to changing economic conditions.”

In the case of entrepreneurship, the human capital performance of a region is defined as its capacity of new firm formation. New firm formation is assumed to give an idea about the human capital performance of regions. A relatively high regional rate of new firms indicates higher human capital performance of regions. The proxy for entrepreneurship used in this study is the rate of newly opened firms in total firms. This includes five types of companies defined by SIS, namely joint stock companies, general partnerships, limited partnerships, limited liability companies and cooperatives. Besides this, the rate of new joint stock companies in new firms is used as an indicator of regional collective relations in entrepreneurial activities, which is underlined as an important human capital capacity in associational economies.

The other indicators defined under entrepreneurship are the rate of firms with foreign capital and the rate of exporting firms. These measures are used to reflect the external relationships that are believed to facilitate the diffusion of external knowledge. Accessibility to and ability to use external knowledge are emphasized to ease the transfer of knowledge and stimulate the growth of regions. Regions with higher ratios of exporting firms and firms with foreign capital are assumed to have capacities to connect to the external world, and thus higher human capital capacities.

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<sup>9</sup> Firm birth rate is defined as the rate at which new firms are being established’ (Armington and Zoltan, 2002: 34)

## 5. The role of human capital in explaining regional growth differentials

In order to include the contribution of human capital differences in explaining per capita income differences of provinces, we make use of the following equation, the derivation for which may be found in the appendix:

$$\Delta Y_{it} - \Delta \bar{Y}_t = \beta_{0i} - \beta_1 (\log Y_{it0} - \log \bar{Y}_{t0}) - \beta_2 (\Delta HC_{it} - \Delta \bar{HC}_t) + v_{it} \quad (6)$$

where  $HC$  refers to a vector of human capital variables;  $\Delta HC_{it}$  is the growth rate of the human capital variables in region  $i$  and  $\Delta \bar{HC}_t$  corresponds to the national average growth rate of human capital variables.

Data for these ten variables is prepared for the period 1990-2000<sup>10</sup> for 65 provinces, which includes two composite provinces<sup>11</sup>. In order to eliminate the problems of normality and homoscedasticity, variables are used at log levels. The analysis is preceded with three models. The first model takes into consideration only the traditional indicators of human capital, while the second and third models include new components of human capital in the analysis of beta convergence. The former takes in innovation variables as well as schooling, while the latter further includes variables of entrepreneurship.

Table 2 gives the results of the initial regression analysis. The  $VIF$ <sup>12</sup> values indicate that there is no problem with multicollinearity, given that the values are lower than the critical value of 5 (De Vaus, 2002: 345). All models are significant at 5% level. On the other hand, when the adjusted  $R^2$  values are evaluated, it is seen that human capital differences explain a considerable share of the variation in regional income growth differentials in the first model (38%). The findings suggest that human capital differences in terms of education determine the per capita income growth differences among the provinces of Turkey.

<sup>10</sup> The analysis could not be preceded for the period 1980-2000 since data for most of the variables was not available for the year 1980. Hence, analyzing the role of human capital differences on income growth disparities would be more reasonable for the period 1990-2000. Although we are aware of the possibility that the ten year period may not be adequate to capture the long run relationships between per capita income growth and these variables, we believe that the analysis provides us with an understanding of the extent to which human capital differences contribute to explaining per capita income growth differences between provinces in the period 1990-2000.

<sup>11</sup> For an explanation of how a composite city is defined, see footnote 1.

<sup>12</sup>  $VIF$  is an estimate of multicollinearity and is defined as  $1/(1-R^2)$ . The definition implies that large values of suggest a problem of multicollinearity and a value of 5 is used as a critical value (De Vaus, 2002: 345).

On the other hand, once the innovation and learning component of human capital is taken into consideration in the second model, the adjusted  $R^2$  value indicates that the addition of innovation variables does not contribute to explaining the variation in regional income growth differences. Yet, the adjusted  $R^2$  value declines to 36% and the variables are not significant at the 5% significance level. Neither capacities of new knowledge creation, represented by the patent dummy, nor academic capacities that contribute to the generation of new knowledge help explain regional income growth disparities.

With the inclusion of indicators of entrepreneurship in the third model, the model explained 40% of the variation in income growth rate differences among provinces. Still, at the 5% significance level, education is a significant factor in explaining income growth disparities, while innovation and learning component of human capital does not have a significant role in explaining income growth differences among provinces in Turkey. Other variables, which explain regional income growth differences, are factors of entrepreneurship. Among these, differences in the rate of joint stock company open-ups have a significant relationship with income growth differences; while regional differences in the rate of newly opened firms, the rate of exporting firms and the rate of firms with foreign capital appear to be insignificant. The significance levels indicate that only the addition of the rate of newly opened joint stock companies as a variable contributed to explaining income growth differences among the provinces in the period 1980-2000.

Overall, the results indicate that human capital differences, in terms of education, account for a substantial part of the income growth differences between the provinces in Turkey. Regions, which have substantial human capital differences, are those, which have had the greatest income growth differences. This finding signals the importance of increasing basic schooling capacities, although a very simple endeavor, as a way to reduce income growth differences and eliminate the differential income growth pattern among the provinces of Turkey.<sup>13</sup> The results of the analysis provide a basis for arguing the urgent need for regional and national policies directed to increase the educational capacities of especially the lagging regions so as to decrease per capita income growth differences among the provinces in Turkey. This finding is not surprising when the results of the empirical studies are considered. Çeçen *et al.* (2003) for example show the positive impact of education on economic growth of Turkey with an approximate lag of five years. Erk *et al.*'s cross-country study (1998) shows the possibility of

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<sup>13</sup> See also discussions in Çeçen *et al.* (2003), Erk *et al.* (1998), Güngör (1997) and Kasnakoğlu and Erdil (1994) for an account of education.

faster growth if physical capital growth levels matches with human capital growth levels.

However, what is surprising is that variables included in our model as indicators of the innovation and learning component of human capital and as the entrepreneurial component of human capital did not contribute to our explanation of income growth differences among the provinces in Turkey. This result appears to contradict with the arguments usually emphasized in the literature on regional growth that academic capacities facilitate both the diffusion of knowledge and the creation of new knowledge, which together stimulate the growth performances of regions.

These results, obviously point to important questions in terms of theoretical arguments and in terms of the data used in such analyses and will be discussed in the concluding section.

## 6. Concluding remarks

This paper attempted to investigate the regional income differentials in Turkey by making use of the convergence hypothesis within the framework of the new growth models, using a version of the standard growth regression. The findings provided evidence for a differential per capita income growth pattern among the provinces of Turkey since the 1980s, which leaves a considerable number of provinces, most of which are located in the eastern and northern part of the country at the other extreme against the dominance of a group of provinces composed of metropolitan cores and an adjacent group of dynamic provinces, which tended to catch up to the former. The differential growth pattern persisting since the 1980s, briefly sketched in this paper, signals the urgent need for regional development strategies that aim for the integration of the lagging regions into the national economy and the transformation of this differential pattern of per capita income growth towards that of convergence.

The results of the paper went further, by identifying the role of a broader concept of human capital, defined not only in terms of education but also of innovation and learning and entrepreneurship, in accounting for this differential growth pattern. Analysis of the contribution of broadly defined human capital differences among provinces towards explaining per capita income growth differentials suggested the importance of regional and national policies directed toward increasing educational capacities so as to decrease per capita income growth differences among the provinces in Turkey; while regional differences in innovation and learning capacities and entrepreneurship did not explain income growth differences significantly. Obviously, these results contradict with the findings and discussions in the literature, most of

which draw upon the results of face-to-face questionnaires, which mention the local innovation capacity, entrepreneurial culture, informal and cooperative relationships as the success factors behind regional growth (Camagni, 1991; Cooke, Uranga and Etxebarria, 1997; Eraydın, 2002; Florida, 1995; Malecki, 1997; Morgan, 1997; Nijkamp, 2003). This contradiction brings to the foreground some questions about the methodology used and underlines the importance of some points.

First is related with the basic assumption of the convergence theory that units (in this case, provinces) of analysis are homogenous. However, when working with more heterogeneous units, as it is in the case of Turkey, working on growth rates becomes problematic and the interpretation of findings of such analyses based on growth rates may lead to wrong conclusions. In such cases, a minor improvement in the indicators used in the analysis from one year to the other is reflected by considerable increases in growth rates, although its real effect does not mean much. Especially when using indicators of high-level education, innovation and entrepreneurship besides per capita income the analysis becomes more sensitive to such changes. As a result, the analysis is flawed and it becomes difficult to find the predictions of the model empirically.

The second point also related with the homogeneity of the units of analysis is the distribution of population. Cole and Neumayer (2003) for example point to the necessity of weighting for differences in population size in cross-country convergence analysis. Their findings from population-weighted income levels show a trend towards convergence across countries over the period 1960-1996, a finding that contradicts with findings from unweighted cross-country convergence analyses. The recognition of population becomes more important for regional convergence analyses in countries that face significant population movements. Turkey is a country that still faces population movements towards high-income areas. The most recent migration data shows that, over the period from 1985-1990, while metropolitan provinces in the west were centers of net migration, most of the provinces in the east and north faced population losses (SIS, 2005). In such cases, the agglomeration of population in certain areas may be an important factor in distorting the capital index used in the analysis. Kılıçaslan and Özatağan (2005) for example identify the agglomeration of population in high income provinces as a factor that may lead to a finding towards per capita income convergence across the provinces of Turkey. Their results from the decomposition of per capita income show that the growth of population in favor of high per capita income provinces accounts for 17% of the 100 percentage point growth of per capita income over the period 1987-2000. These examples show the importance of recognizing the

impact of migration and its drawbacks both in capital index calculation and in the interpretation of findings.

The third point, which may distort the results of such analysis is the data used. Such models are based on formal data, which is rough and unfortunately insufficient to take into account the detailed incorporation of human capital based on innovative and entrepreneurial capacities. In the former, human capital is incorporated with R&D personnel and researchers. However, for some sectors and regions process innovation is more frequent than product innovation, which is not possible to include in the model due to the use of formal data. On the other hand, as recognized by recent research, it is usually the engineer or the person taking part in the production process, who introduces the new knowledge rather than a group of researchers. In these situations human capital does not necessarily mean R&D researchers or highly educated people but a different component of human capital seems to be more important in the introduction of new knowledge. Besides, especially for the less developed regions, existing innovative capacities are not formalized as patents. Edquist *et al.* (2002) point to some reasons, especially for small firms, for not applying for a patent even though there exist new knowledge that contributed to the economic growth of the firms and the region.

A similar argument holds for entrepreneurship. The use of firm open-ups may be too rough to analyze the role of entrepreneurship, since other forms of entrepreneurship are emphasized in the network economy to be important in regional growth (see Nijkamp, 2003 for a recent, detailed work on entrepreneurship). For example, Plummer and Taylor (2000) emphasize that entrepreneurial culture is not only composed of processes of new firm formation and new job creation but also of cooperation that brings people together to exploit business opportunities. Apparently, the data used in standard regression models and its variations ignore these issues and lead to unsuccessful and statistically insignificant results in most of the studies.

It seems that the role of human capital in spurring regional growth is more complex and requires a more in-depth focus on the innovative and entrepreneurial capacities of these regions as components of human capital is necessary to be taken into account in the models to understand the growth dynamics of these regions. In a world where integration into the increasingly globalizing system becomes the major aim; and policies and strategies to increase the innovation, learning and entrepreneurship capacities of regions becomes the core of new growth and development models, a focus on the upgrading of the existing human capital capacities through the enhancement of educational capacities, although simple, is still an important endeavor, especially for some regions whose growth pattern significantly differs from that of the rest of the nation. On the

other hand, when the long time lag between human capital investment and returns to human capital especially with regard to education is considered, a reduction in income growth differences would come out in the long run, such a focus may seem simple but necessary. It is only after these regions are provided with basic human capital capacities that they can be endowed with further capacities.

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## Appendix A

### The model

While analyzing beta convergence in terms of per capita income levels, the annual growth rate of per capita provincial GDP is regressed on the initial level of per capita GDP. The equation to estimate absolute beta convergence can be written as

$$1/t (\log Y_{it} - \log Y_{it0}) = \alpha_i + \beta_1 \log Y_{it0} + \varepsilon_{it} \quad (1)$$

where  $1/t \log(Y_{it} / Y_{it0})$  is referred to as the annual growth rate of per capita GDP of province  $i$  at time  $t$  and can be symbolized by  $\Delta Y_{it}$ ;  $\log(Y_{it0})$  is the log of per capita GDP of province  $i$  at the beginning of the period under analysis. Assuming other things constant,  $\varepsilon_{it}$  is the disturbance term, which encapsulates the influence of neglected variables and statistical errors. A negative  $\beta_1$  value in this equation implies a negative correlation between per capita income growth rate and initial per capita income, which indicates beta convergence.

If we take averages of the second equation, the equation becomes:

$$1/t (\log \bar{Y}_t - \log \bar{Y}_{t0}) = \alpha_i + \beta_1 \log \bar{Y}_{t0} + \bar{\varepsilon}_{it} \quad (2)$$

This equation gives the average per capita income growth rate of Turkey as a function of its per capita income level in the initial year under analysis. Calculating the difference between equations (2) and (3), we arrive at the following equation:

$$\Delta Y_{it} - \Delta \bar{Y}_t = \beta_1 (\log \bar{Y}_{t0} - \log Y_{it0}) + v_{it} \quad (3)$$

To estimate absolute beta convergence of per capita income growth with cross-section data, the equation can be written as:

$$\Delta Y_{it} - \Delta \bar{Y}_t = \beta_{0i} + \beta_1 (\log \bar{Y}_{t0} - \log Y_{it0}) + v_{it} \quad (4)$$

or

$$\Delta Y_{it} - \Delta \bar{Y}_t = \beta_{0i} + \beta_1 (\log Y_{it0} - \log Y_{it0}) + v_{it} \quad (5)$$

where  $\Delta \bar{Y}_t$  indicates average per capita GDP growth rate between time  $t$  and time  $t_0$  and  $\log \bar{Y}_{t0}$  refers to the log of average per capita GDP at the beginning of the analyzed period.  $\beta_1$  shows the tendency for the provinces of Turkey to converge to the GDP per capita level of the national average (Chatterji and Dewurst, 1996). In the revised equation, the difference in the per capita income growth rate between the nation and the province depends on the difference of the initial level of per capita income

between that of the province and the nation. In equation (4), a  $\beta_1$  value that is significantly greater than zero implies that convergence exists (Cuadrado *et al.*, 2001). Then, for equation (5) an estimated  $\beta_1$  coefficient that is smaller than zero will indicate that convergence took place in the analyzed period.

## Appendix 2

### Summary of the Variables Used in Analysis

Indicator	Year
<i>Education</i>	
Combined school enrollment ratio	1975-1992
Student-teacher ratio	1992-2000
Number of university graduates per 10 000 population	1992-2000
Number of graduates of Ms and PhD per 10 000 population	1992-2000
<i>Innovation and Learning</i>	
Patent dummy	2001
Number of academic personnel per 10 000 population	1992-2000
<i>Entrepreneurship</i>	
Rate of open-up firms	1991-2000
Rate of open-up joint-stock companies in open-up firms	1991-2000
Rate of exporting firms in total firms	1989-2001
Rate of foreign firms in total firms	1980-2003

## Özet

### Türkiye’de bölgesel farklılıkların kaynağı olarak insan sermayesinin tanımını genişletmek üzerine gözlemler

Bu çalışma 1980-2000 yılları arasında Türkiye’de bölgelerarası kişi başı gelir farklılıklarını ve bu farklılıklarda insan sermayesinin rolünü incelemektedir. Bu çerçevede çalışma, insan sermayesi kavramını sadece eğitim üzerinden değil, aynı zamanda yenilik, öğrenme ve girişimcilik üzerinden tanımlayarak, bu farklılıkların bölgelerarası kişi başı gelir farklılıklarını ne derece açıkladığını araştırmaktadır. Çalışmanın bulguları incelenen dönemde Türkiye’de bölgelerin büyüme kalıplarının önemli ölçüde farklılaştığını ve insan sermayesinin eğitim boyutunun bu farklılıkları açıklamakta istatistiksel olarak anlamlı olduğunu, ancak yenilik / öğrenme ve girişimcilik boyutlarının bu farklılıkları istatistiksel olarak anlamlı açıklamadığını göstermektedir. Yazında yenilik, öğrenme ve girişimciliğin bölgesel gelişmedeki önemini vurgulayan tartışmalarla çelişen bu bulgulara dayanarak, kullanılan yöntem üzerine bazı tartışmalar yapılmaktadır.