DETERMINANTS OF CROSS-REGIONAL INCOME DIFFERENTIALS: THE CASE OF TURKEY

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Absract: The basic goal of this study is to enquire the major determinants of income and rate-of-growth disparities amongst Turkish regions. Accordingly, coming up with a number of policy proposals to tackle the question of cross-regional income distribution is modestly one of the next objectives. The method we opt for is the empirical estimation methods for panel data. To this end, a pooled data set of Turkish provinces for the period 1980-2000 is employed. It is objected to examine the main causes of income and growth differential among Turkish regions especially by taking into account the likely factors advocated in the literature by neoclassical theory, endogenous growth theories and new economic geography models. The coefficient of variations shows that the most varying factors amongst regions are the relative shares in total industrial output, industrial employment rates and demographic concentration, besides per-capita investment and income. Estimation results indicate that differences in physical and human capital accumulation, the industrial composition of employment and demographic variables are amongst the basic determinants of cross-provincial per-capita income disparity.

Key words: Regional growth, panel data, convergence, endogenous growth, new economic geography, coefficient of variation.

JEL classifications: O47, O52, O18, C33, R11

Introduction:

In recent years, the studies on regional growth has been increasing in numbers as a result of the rising literature on new growth theories and enlarging number of regional data. The question of cross regional income variation within countries has been as important an issue as income disparities amongst nations. However much some one country may overall display a stable growth pattern, uneven cross-regional growth can still cause

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considerable economic and social problems, particularly in the long run. Not all regions of a country necessarily have even capabilities in terms of per-capita income. Capital accumulation, human capital profile, geographical endowments, demographic patterns and the sectoral distribution of output often exhibit significant differences across regions. Many of these regional growth studies has concentrated on convergence theories which claim decreasing gap among per capita income level of regions in the long run. In contrast, regional growth studies which deal with the determinants of regional income differences are relatively less in number. The regional studies targeting to clarify the determinants of regional income differences can play more efficient role for the policy suggestions. In this respect, this study also targets to find out determinants of income differences in Turkish regions. It is objected to examine the main causes of income and growth differential among Turkish regions especially by taking into account the likely factors advocated in the literature by neoclassical theory, endogenous growth theories and new economic geography models. In other words we shall estimate a hybrid model to explain the regional income disparities in Turkey for the period 1980-2000 with panel data methods. Consequently, probable policy suggestions will put into argue.

The remaining parts of this paper are organized as follows. In the first part of this paper we shall make a brief overview of theoretical and empirical works on regional income determination. In the second part, a detailed examination of regional variation of Turkey in terms of various social, economic and demographic aspects will be implemented for the period 1990-2000. The estimation results of our per capita income differential equation will be presented in the third part of the paper. The last part concludes the analysis with policy suggestions.

I. Literature Review

In the literature there are various theories to explain regional growth. There is no consensus about main determinants of regional income disparities. Neoclassical growth theories (Solow 1956) care supply side factors in regional growth. According to these theories, while capital accumulation leads growth in the short run, population growth, migration of factors of production and technological innovations are responsible for the growth in the long run (Armstrong and Taylor, 2000). Therefore, rate of growth of labor

supply and capital stock and technological innovation are the main determinants of regional growth in neoclassical theory. Furthermore, neoclassical theory predicts the convergence of per capita income between regions in the long run (Kaldewei and Walz, 2001; Maier, 2001). Due to the assumption of constant returns to scale and perfect competitive markets, in the long run, marginal product of capital decreases and factor mobility between regions guarantee the equality of return of capital and wages between regions. Regional disparities can only persist in the short run; such disparities will halt with self correcting movement in prices, wages, capital and labor, which retrieve the tendency towards regional convergence (Borts and Stein 1964).

In the second group of regional growth theories namely pure agglomeration theories, contrary to the traditional neoclassical growth theories, it is claimed that income disparities may persist even in the log run (Myrdal, 1957; Kaldor, 1970; Dixon and Thirlwall, 1975). These theories are the hybrid of Perroux (1950)'s polarization theory, Kaldor (1970)'s export base model and Mrydal (1957)'s cumulative causation theories. According to these theories besides the availability of capital and labor, imperfect markets, externalities and economies of scale are responsible for the income divergences. If a leading sector or firm comes into existence in a certain region, labor, capital and thereby production may concentrate and grow multiplicatively in this region due to the externalities and economies of scale effects. An agglomeration of economic activities and factors of production stimulates further migration, demand, output growth and wealth. Once an industrial polarization starts to arise in a location, endogenous factors such as factor mobility, scale economies and externalities lead to cumulative increases in output and hence divergence in regional income levels in the long run. It is also stated that, at the beginning, the location decision of leading firms and sectors is probably the result of historical and geographical factors.

In recent years, new regional growth theories have been aroused by putting together the endogenous growth theories pioneered by Romer (1986, 1990) and Lucas (1986) and new economic geography models build by Krugman (1991). Both theories claim that regional growth differences are mainly resulted from increasing returns and thereby externalities and scale economies. Additionally, they point out the key importance of endogenous factors for productivity gains and increasing returns which

cause cumulatively increasing income gap between the regions and consequential regional polarization of income. According to advocates of endogenous growth theories, the various factors such as research and development activities and physical and human capital investments are the key elements of increasing returns and differences in regional incomes and growth. The new economic geography theories deal with spatial distribution of economic activities and effects of spatial factors on growth. According to this approach, regional growth differences result from the spatial factors and agglomeration effects, namely externalities and scale economies which depend on regional market size, transportation cost and migration of labor among regions (Fujita et al.1999; Baldwin et al 2003; Fujita and Mori 2005). The interaction of external economies of scale with transport costs is the key to explanation of regional industrial concentration and the formation of regional "centers" and "peripheries" (Martin and Sunley 1996). In the case of increasing returns and transport cost advantages, firms prefer to settle in the regions where the market size is big. In Krugman's words, "Because of the costs of transacting across distance, the preferred locations for each individual producer are those where demand is large or supply of inputs is particularly convenient - which in general are the locations chosen by other producers" (Krugman 1991: 98). As a result, economic activities and income level will be low in the peripheries regions relative to the center.

In sum, the new regional growth theories highlight the key role of human capital, R&D investments, and therefore, increasing returns, besides the spatial factors namely transport cost and market size to explain the income inequality across regions.

For recent era, there are wide spread empirical application of regional income and growth theories in the literature. The most of the empirical research on regional growth has been particularly focused on the convergence-divergence debate and various issues. The pioneers of empirical regional convergence works have been implemented by Barro and Sala-i- Martin (1991, 1992, and 1995). Barro and Sala-i- Martin have showed a robust pattern of β convergence in their famous studies for various regions. Following the work of Barro and Sala-i- Martin, various researches have been implemented in the field of regional income convergence by looking at different time periods and regions (Badinger, Muller and Tondl 2004; Trivedi 2002; Rodriguez and Oreggia 2002; Lall and Yılmaz 2001; Ferria 2000; Evans and Karras 1996; Chatterji and Dewhurst 1996;

Amstrong 1995). The results of these studies are not homogeneous. While some of them are supporting the regional income convergence hypothesis, the others obtain the results challenging with convergence advocates. For the most of the papers that use developed countries data namely US, EU and Canada demonstrate the results consistent with regional income convergence. By contrast, most of works focusing on regions of developing countries provide the evidence of persistent regional income disparities.

In the literature, there are also papers devoted to determine the factors effective on regional income disparities. However, the number of the researches on this field is relatively less. In this context, Cheshire and Carbonaro (1996) have done a work to clarify the likely determinants of per capita income growth in the provinces of EU, especially by emphasizing on new growth theories. They have observed that the rate of growth of country is one of the determinants of growth in its provinces, besides the clustering effects of growth performance of surrounding provinces. This research also has shown the positive growth effect of number of R&D institutions exist in the provinces. Also, Tondl (1999) prefers dynamic panel method to analyze the determinants of unbalanced growth in 38 regions of Southern Europe by employing the NUTS-II level regional data for the 1975-94 period. This work has some attempts to test regional implications of endogenous growth theories. According to the results of this study, the human capital and especially public investment beside private investment have growth promoting effect, while the share of labor force employed in agricultural sector has negative effects on regional growth.

In this field, Petrakos and Saratkis (2000) have objected to find out the factors effective on the growth differences of Greece regions for the period 1981-1991. They indicated that industrial employment, human capital, capital-labor ratio, and particularly the natural tourism endowments are responsible for the regional growth dispersions.

Also, Kaldewei and Walz (2001) examine the likely determinants of regional growth in Europe with a comprehensive model by employing NUTS-II level regional data for the period 1980-1996. In the growth regression they choose, regional human capital level, regional transportation cost, ratio of employment in financial sector to total employment, patent per capita, rate of migration, regional transfer payments, concentration and size of population, a dummy variable for agglomeration effect and

employment ratio in agriculture and service sector as main explanatory variables. In sum, they try to test regional growth hypothesis of both endogenous growth and new economic geography theories. Their results support some aspects of new regional growth theories by indicating positive impact of human capital on regional growth and agglomeration effects proxied with size of regional financial sectors.

The recent research of Badinger and Tondl (2005) investigates the growth factors of EU regions particularly focusing on endogenous growth factors. While the results support the hypothesis of endogenous growth theories, there are also findings associated with the new economic geography models. Capital accumulation and especially human capital accumulation show up as key factor for regional growth. Furthermore, it is indicated that human capital accumulation is a precondition for technology catch up with technology transfer. Technology transfer beside the regional innovation activities is observed as one of the essential factors effective on technological progress of high growth EU regions. In this context, the results show that foreign trade plays an important role for technological catch-up of EU regions. The result which supports the clustering and agglomeration hypothesis of new economic geography models is the highly dependency of regional growths on growth performance of surrounding regions.

There are also a number of researches on regional growth and income of Turkish regions. Most of the analyses on Turkish regional growth are in the sole context of convergence hypotheses. Indeed, income convergence of Turkish regions is not supported in the majority of these analyses. Berber, Yamak and Artan (2000), test both sigma and beta convergences for seven regions of Turkey for 1975-1997 period. They can not find evidences of convergence and instead divergence of regional income is the main result of their analyses. In the same context, the study belongs to Erk, Ateş and Direkçi (2000) does not obtain sufficient results to conclude income convergence for the Turkish provinces and for seven geographic regions. Şenesen (2002) also claims that instead of convergence process, there is a divergence and thereby polarization process among Turkish regions. According to the findings of Altınbaş, Doğruel and Güneş (2002), there is no income convergence and instead divergence in terms of sigma among the Turkish provinces for the period 1987-97. Similar results are obtained by Gezici ve Hewings (2002), according to their Theil Index findings, income divergence among Turkish

regions are getting larger. While Doğruel and Doğruel (2003) find income convergence in terms of beta for all provinces, they find sigma convergence only among high income provinces by employing panel data method for 1987-1999 periods. For the Turkish data of period 1987-1997, Gezici and Hewings (2004) also examine income convergence among Turkish provinces and regions by especially emphasizing the effects of migration, public investment and rate of growth of population. As to their findings, there is no income convergence among Turkish provinces and regions; and also migration, public investment and rate of population of growth do not have considerable effect on convergence. Similar results are obtained by Karaca (2004). Karaca also test Beta and Sigma convergence for Turkish provinces for period of 1975-2000. Findings of this study also support income divergence instead of convergence among Turkish regions.

In sum, so far various studies have been performed to analyze income and growth differences among Turkish regions. However, a quite large body of literature has dealt with regional income differences in the context of convergence hypothesis, and most of them do not able to provide evidence for converging income differences. In contrast to the aforementioned papers, we focus on the investigation of regional income determination in Turkey. For this purpose, in the next part, we shall make detailed examination of regional variation of Turkey in terms of various social, economic and demographic aspects.

II. Regional Variation in Turkey

In this part, we shall examine the various social, economic and demographic characteristics of seven Turkish regions. The aim is try to clear out prominent disparities between regions by making comparisons for the chosen indicators. For this purpose, the coefficient of variation will also be calculated for certain regional indicator. The data used in this part are provided in State Planning Office (1996, 2003a, 2003b) for seven geographic region of Turkey.

Per Capita Income

It is common to consider GDP per capita as a measure of regional prosperity. Measures of GDP per capita at the regional level are the key criteria used by European Commission in determining presence of regional disparity (Wishlade and Yuill 1997). In order to shed

some light on the regional income differences between Turkish regions we shall investigate two main regional income indicators. The first is share of each region in national GDP and the second is GDP per capita index which take national GDP per capita as a base.

Table 1: Income Indicators

Regions	**Share in National GDP %**		**Regional GDP per capita index**	
	1987-1993	**1994-2000**	**1987-1993**	**1994-2000**
Marmara	36,0	37,5	154	146
Aegean	16,5	16,9	123	124
Central Anatolia	16,3	15,8	93	94
Mediterranean	12,1	12,0	97	93
Black Sea	9,7	9,2	68	73
South East Anatolia	5,5	5,2	61	53
East Anatolia	3,9	3,4	41	40
Turkey	**100,0**	**100,0**	**100**	**100**

Source: SPO (2003b)

Table 1 show that there exist wide differences in terms of income parameters between Turkish regions. The share of Marmara region in total national output is roughly ten times of share of East Anatolia and seven times of share of South East Anatolia for both periods 1987-1993 and 1994-2000. Moreover, the variations in shares increased further from the period 1987-1993 to period 1994-2000. In the case of GDP per capita, the pattern is not different. For example, regional GDP per capita index ranges from 154 (Marmara) to 41 (East Anatolia) in 1987-1993 period. According to EU rules, in order to define underdeveloped regions the qualifying threshold is per capita GDP equal to or less than 75 percent of EU average (Wishlade and Yuill 1997). As we can see from the table,

three of the Turkish regions (Black Sea, East Anatolia, South East Anatolia) have GDP per capita below the 75 percent of Turkish average. Therefore, it can be claimed that there are three underdeveloped regions in Turkey for both periods 1987-1993 and 1994-2000. In sum, substantial regional income disparity, especially increasing income gap between Eastern and Western part of Turkey is one of the main futures and problem of economic development process.

Demography

In this subsection, regional share of population, population concentration in each region and population growth rate of each region will be examined with comparison roughly for the period 1990-2000.

Table 2: Demographic Indicators

Regions	Population Share		Average Annual Population Growth Rate		Population Density	
	%		‰		Person/Km^2	
	1994	2000	1985-1990	1990-2000	1990	2000
Marmara	24,76	25,61	23,60	26,70	183	241
Aegean	13,55	13,18	21,10	16,29	84	100
Central Anatolia	17,18	17,12	9,92	15,79	53	63
Mediterranean	12,71	12,84	24,99	21,43	79	98
Black Sea	13,32	12,45	0,19	3,65	70	73
South East Anatolia	9,55	9,75	32,62	24,80	68	88
East Anatolia	8,93	9,05	4,58	13,76	37	42
Turkey	**100**	**100**	**21,78**	**18,29**	**73**	**88**

Source: SPO (1996, 2003a).

The Table 2 shows that the most industrialized region of Turkey, Marmara region has the biggest share in total population for both years 1994 and 2000. The lowest shares belong to South East Anatolia and East Anatolia. Similarly, while Marmara region having the highest population concentration for all periods, it also shows highest increase in

population concentration between the periods 1990-2000. Such a high population concentration, approximately three times of Turkish average and six times of East Anatolia, is both due to the high population growth rate and high migration to this area. In sum, this table suggests that the Marmara region has the highest values in three demographic indicators and differences between demographic indicators for the period 1990-2000 increased further. Therefore, it can be concluded that, demographic indicators suggest pronounced regional differences in Turkey, beside the evidence of widening demographic gaps.

Distribution of Employment by Sectors

The examination of the sectoral distribution of employment by regions provides reliable clues about the structural differences between regions. To shed light on structural diversity among regions, we shall examine distribution of employment by agricultural and industrial sector in each region of Turkey.

Table 3: **Distribution of Employment by Sectors**

Regions	**Share of Agricultural Employment %**		**Share of Industrial Employment %**	
	1990	**2000**	**1990**	**2000**
Marmara	28,89	25,33	24,34	25,67
Aegean	54,07	50,48	13,80	13,84
Central Anatolia	50,48	46,81	11,19	10,55
Mediterranean	57,34	54,97	10,14	8,78
Black Sea	71,10	66,10	7,67	7,29
South East Anatolia	67,29	61,35	6,32	7,06
East Anatolia	71,93	66,41	3,98	3,26
Turkey	**47,10**	**37,60**	**15,90**	**17,70**

Source: SPO (1996, 2003a), SSI (1993, 2000).

From 1990 to 2000, share of industrial employment in total employment increased on average in Turkey. In Marmara region, industrial employment has highest share among all regions. The share of industrial employment in East Anatolia is the lowest of all regions and one eight of Marmara region. Similarly, the share of agricultural employment in East and South East Anatolia have highest two ranks among Turkish

regions. Share in these two regions are more than two times of share in Marmara region. Therefore, it shows that a considerable disparity exist among Turkish regions in terms of distribution of employment by sectors (Table 2). Furthermore, from the period 1990 to 2000 the disparities of sectoral share of employment between regions did not decrease even increased slowly (Table 2).

Industrial and Agricultural Output Shares

In the literature it is widely claimed unbalanced geographical distribution of industry can be among the main determinants of regional income inequality (Fujita et al. 1999; Venables 1999). It is argued that the increased regional disparity is accompanied by prominent increases in degree of regional specialization and industry agglomeration. Therefore, in this part, we are examining the share of industry and agriculture in regional output.

Table 4: Distribution of Output by Sectors

Regions	Share of Agricultural Ouput (%)		Share of Industrial Output (%)	
	1987	2000	1987	2000
Marmara	7,9	5,3	35,0	38,9
Aegean	21,8	16,1	25,7	27,7
Central Anatolia	18,8	12,8	15,9	18,7
Mediterranean	23,5	20,2	22,6	20,5
Black Sea	28,7	21,7	21,0	22,6
South East Anatolia	26,6	28,4	21,1	19,3
East Anatolia	28,8	26,9	17,8	16,2
Turkey	**17,8**	**13,4**	**25,8**	**28,4**

Source: SPO (2003).

From 1987 to 1990, the share of industrial output in total output has roused on average in Turkey (Table 4). In contrast, this structural change has not observed in East Anatolia and South East Anatolia. The share of industrial output in Marmara region is approximately twofold of it in South East Anatolia and East Anatolia. In the case of agriculture, however, the share of agricultural product in East Anatolia and South East Anatolia is approximately five or four times of share of Western region Marmara.

Similarly, the share of industrial output in Marmara region in 2000 is approximately one and a half time of share of industrial output in Aegean region which has highest second rank in share of industrial output among Turkish regions. As a result, it can be concluded that there are vast differences in share of industrial and agricultural output between Turkish regions.

Human Capital: Education

Within regional studies, education has received considerable attention among the factors effective on cross regional income variations. Traditional arguments give human capital a role as a main factor of production. There are other channels how human capital determines income level and growth. First of all, human capital is essential for further innovative activities and productivity improvements. In this context, we are examining the school enrolment ratios for Turkish regions.

Table 5: Human Capital

Regions	Primary School Enrolment (%)		Secondary School Enrolment (%)	
	1991-1992	2000-2001	1994-1995	2000-2001
Marmara	101,40	115,65	60,43	41,05
Aegean	96,00	100,07	47,81	39,67
Central Anatolia	96,40	92,95	50,11	41,58
Mediterranean	95,00	97,69	46,13	42,18
Black Sea	94,70	87,39	42,21	31,70
South East Anatolia	93,60	94,12	27,51	27,32
East Anatolia	91,40	86,41	33,37	26,33
Turkey	**96,10**	**98,01**	**46,52**	**36,92**

Source: SPO (1996, 2003a).

Similar with the other indicators, in education indicators Marmara region has the highest rates in school enrolment ratios among the other regions. As expected, South East and East Anatolia regions roughly have the lowest two ratios among the all regions. Nevertheless, from the 1990s to 2000, there is a relative improvement in both primary

and secondary school enrolment ratios of South East Anatolia, due to the efforts of some civil society institutions. The other point which needs attention is non existence of dramatic differences from the national average. For example, in period 2000-2001, the highest secondary school enrolment ratio which belongs to Mediterranean region is 42.1, while the lowest ratio is 26.33 in South East Anatolia. Therefore, it can be concluded that despite the existence of regional disparities in school enrolment ratios among Turkish regions, the diversity is not so immense.

For all investigation of various regional economic, demographic and social indicators point out the substantial gaps among Turkish regions. However, we do not have sufficient insights about the extent and comparison of these regional gaps. To make further analysis on regional disparities, we calculate coefficient of variation[1] for aforementioned indicators for two different periods 1990 and 2000. Coefficient of variation is calculated to obtain adequate information for the amount of variation in each indicator. By this mean we also become able to make comparison of extent of disparities.

Table 6: Coefficient of Variations

Coefficient of Variations			
	1st Period	2nd Period	Change
Demographic Indicators			
SHARE in TOTAL POPULATION	0,3482	0,3656	+0,0174
POPULATION DENSITY	0,5340	0,5991	+0,0652
Distribution of Employment			
AGRICULTURE	0,2440	0,2503	+0,0063
INDUSTRY	0,5602	0,6167	+0,0566
Human Capital			
PRIMARY SCHOOL ENROL.	0,0741	0,0948	+0,0207
SECONDARY SCHOLL ENROL.	0,2299	0,1819	-0,0480
Distribution of Output			
AGRICULTURE	0,3046	0,3995	+0,0949
INDUSTRY	0,2620	0,3057	+0,0437
Income Indicators			
SHARE in NATIONAL OUTPUT	0,6957	0,7390	+0,0433
PER CAPITA OUTPUT	0,3932	0,3908	-0,0024

[1] Coefficient of variation is calculated by dividing variance with mean.

According to the coefficient of variations (Table 6), the largest regional diversity is in income indicators and in sectoral distribution of employment for both periods. In more detail, share of regional output in total national output is the most diversifying variable among regions. Similarly, proportion of labor employed in industrial sector presents an immense gap between Turkish regions. By contrast, regional school enrolment ratios show out that inequality in regional human capital is significantly lower than inequality in other regional indicators. The calculation of coefficient of variations for two subsequent periods gives us the sights about the evolution of regional disparities over time. Change in coefficient of variations from 1990 to 2000 indicates that just two of the coefficient of variations has decreased among the ten. Only the regional dispersion of secondary school enrolment ratio and per capita output has reduced slightly from the period 1990 to 2000.

In the next section, we attempt to investigate likely determinants of the observed regional per capita income differentials in Turkey. In doing this, among others, we shall particularly focus on the diverging variables we examined in this part.

III. Model and Estimation

In this section, we shall estimate an income equation to test the effects of potential variables on the regional income disparity in Turkey. A pooled data set of 65 Turkish provinces for the five years (1980, 1985, 1990, 1995 and 2000) of period 1980-2000 is employed. Panel-data estimation method is performed. The main data set is obtained from State Institute of Statistics (2003). The model we prefer is compatible with different growth theories so as to nest both "augmented Solow model" and endogenous growth models as well as new economic geography models. Therefore, we establish the model by adding variables which are able to effect regional income variation, other than capital per worker. Specifically, beginning with Cobb-Douglas production function, let *y* equal per capita GDP, *k* equal capital per worker, *x* equal other determinants of per capita output so that $y=k^{\alpha}x^{\beta}$. Our dependent variable DGDPPC (GDP per capita difference) is obtained by dividing reel GDP per capita of each province with Turkish national average for each year. By this mean we attempt to grasp a measure of income difference of each region from national average. Also, all the explanatory variables are calculated by

dividing related regional value with national average value of this variable. Therefore, each explanatory variable indicates deviation from national average in terms of proportion. We estimate following income differences equation:

$$DGDPPC_{it} = \beta_1 + \beta_2(ELECPC)_{it} + \beta_3(PUINVPC)_{it} + \beta_4(INDEMP)_{it} + \beta_5(ROADL)_{it} + \beta_6(SSCHOOL)_{it} + \beta_7(POPSHR)_{it} + u_{it} \quad (1.1)$$

The first explanatory variable ELECPC is equal to the total industrial electricity per capita consumption of "i"th city in time "t" in proportion to total industrial electricity per capita consumption in Turkey in period t. Electricity consumption is used as a proxy of total capital stock. The variable PUINVPC represents the total amount of per capita public investment in "i"th province in time "t" relative to total public investment in Turkey for period "t". This variable is chosen to observe the effect of public investment on regional income disparities. The third explanatory variable INDEMP represents the share of industrial employment in total employment. This variable is calculated by dividing share in "i"th province in time "t" by the share in Turkey in period "t". The variable ROADL represents the total length of national and provincial roads and proxies transportation costs. To calculate ROADL variable, as a first step, total length of national and provincial roads of "i th" province in period "t" relative to the total size of province calculated. As a second step, total length of national and provincial roads of Turkey relative to the total size of Turkey calculated. As a final step, the provincial value calculated in the first step is divided by the national value calculated in the second step. The fifth variable SSCHOOL indicates secondary school enrolment ratio. It shows secondary school enrolment ratio in "i"th province in period "t" relative to national secondary school enrolment ratio in period "t". SSCOOL variable is used as a proxy for human capital. The last variable POPSHR is calculated by dividing total population of "i th" province in period "t" by total population of Turkey in period "t". We use this variable to observe the agglomeration and cumulative causation effects.

In the estimation process, we do not prefer logarithmic forms of variables, for the reason that all variables are in proportions and thus, have values between "0" and "1". Therefore, implicitly we assume that the explanatory variables are entered linearly into

the per capita income difference equation. Basically, for the estimation, the panel data method of two way fixed-effect model is performed. This model takes into account the cross-section specific and period specific effects. So, it presents the cross-section and period specific heterogeneity. A number of tests have been resulted to choose appropriate model among others[2]. Fixed effect specification is mainly used to account for time-invariant unobservable heterogeneity that is potentially correlated with dependent variable. Thus, we also expect to get rid of omitted variable problems in the regression, capturing the idiosyncratic factors that might have affected GDP per capita differences.

Table 7: Estimation Results

Dependent Variable: DGDPPC
Cross-sections included: 65
Total panel (balanced) observations: 195

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ELECPC	0.035664	0.012751	2.797020	0.0060
PUINVPC	-0.006037	0.006797	-0.888092	0.3762
INDEMP	0.166163	0.091498	1.816039	0.0718
ROADL	-0.221831	0.149790	-1.480942	0.1412
SSCHOOL	0.248262	0.110909	2.238416	0.0270
POPSHR	-0.151058	0.051649	-2.924694	0.0041
C	0.830449	0.227287	3.653744	0.0004

R-squared	0.967137	**Mean dependent var**	0.820727
Adjusted R-squared	0.947743	**S.D. dependent var**	0.443996
S.E. of regression	0.101497	**Akaike info criterion**	-1.457841
Log likelihood	215.1395	**F-statistic**	49.86683
Durbin-Watson stat	2.238119	**Prob(F-statistic)**	0.000000

Note: Estimation method is GLS (cross section weights); standard errors and t-statistics of coefficients are computed using White's heteroscedasticity consistent variance-covariance estimator.

According to estimation results (Table 7), electricity per capita variable (ELECPC) is significant with a positive parameter as predicted, for the reason that industrial electricity consumption is proxy for capital stock. This positive parameter indicates that when the industrial electricity consumption of any province increases

[2] F-test for the heterogenity of proviences and Hausmann test for either fixed effects or random effects are performed.

(decreases) in proportion to total consumption of Turkey, the proportion of per capita income of this province to the average per capita income in Turkey increases (decreases). This result is consistent especially with neoclassical theories of growth, as well as with all other theories of growth. However, the coefficient of this variable (0.035664) is relatively small, in contrast to the endogenous growth theories where marginal return of capital remains high in the long run.

The second explanatory variable PUINVPC with a negative coefficient is not a statistically significant variable in our GDP per capita difference equation estimation. It shows that public investment expenditures are not responsible for the regional income differences in Turkey for the period 1980-2000. It can be the result of decreasing government role in Turkey after the liberalization policies put into effect since 1980.

The coefficient of the other explanatory variable namely the share of industrial employment (INEMP) is significant, positive and relatively high. It shows that the unbalanced geographical distribution of industry is one of the main determinants of per capita income differences between Turkish provinces. In our model it presents itself as the higher the share of industrial employment in province relative to the average share in Turkey, the higher will be per capita income of this province relative to the average per capita income in Turkey. This result also imply supports to "new economic geography models" where industrial agglomeration may cause income disparities first by rising production and productivity, and second by creating positive externalities for further agglomeration and cumulative increase in concentration of industrial activities in region.

The other variable used for testing especially the hypothesis of "new economic geography" models is the road length variable ROADL. This variable is chosen as a proxy for transport costs. It is assumed that when the road length increases the cost of transport decreases. The "new economic geography" models suggest that high transport costs will act to prohibit the geographical concentration of production. With some reduction in transport costs, however, firms will want to concentrate in one site to realize economies of scale both in production and in transport. According to estimation results of our model, ROADL is an insignificant variable with a negative sign. This result may either indicates that Turkish data does not support hypothesis of "new economic

geography" model or evince that road length is not a good proxy for transport cost in Turkey where the quality of roads are not homogeneous throughout the country.

The proxy for human capital, secondary school enrolment ratio variable SSCHOOL is found to be a significant determinant of regional income differential. The positive estimated coefficient of that variable presents that for any province, the increase in enrolment ratio relative to the ratio in Turkey results in higher per capita income relative to the Turkish average. The relative size of the coefficient of this variable is also of interest with being the highest of among others. That points out the vast sensitivity of regional income variations to the changes in human capital levels. This result especially confirms with the hypothesis of endogenous growth models where human capital directly effect productivity and growth.

The final variable incorporated into the model is the demographic variable, namely population share of regions. The predicted sign of this variable is positive. It is assumed that population share is the measure of market size. The new economic geography models hypothesis that firms locate close to large markets to obtain the benefits of increasing returns. It creates externalities such as attraction of new people and firms into region. However, the estimation result of our model with significant negative coefficient does not support such hypothesis. In line with the findings above, one could argue that the market size effect of population density is not as important as the quality, and more specifically as the education of the people on the determination of regional income disparities.

Despite we do not state all the estimated fixed effects, it will be illuminating to indicate that the western provinces has positive fixed effects implying the existence of the other factors which make western provinces wealthier.

Conclusion

This paper has examined the determinants of variation in regional income across provinces of Turkey. The estimated model especially objects to test the hypothesis of both endogenous growth models and new economic geography models beside the neoclassical theories. A hybrid model is estimated including various explanatory variables pertaining to demographic profile, educational profile, regional industrial structure and geographic conditions and general economic condition of each province.

Panel-data estimation method employing a pooled data set of 65 Turkish provinces for the five years (1980, 1985, 1990, 1995 and 2000) of period 1980-2000 is performed**.**

The coefficient of variation analysis reveals the considerable gaps between Turkish regions in terms of the various economic indicators. There are especially vast differences between regions in the distribution of production and income, distribution of employment among sectors and density of population. In the case of school enrolment ratios, even though differentials exist between regions, the gap is not so big, relative to the differentiations in other indicators.

Our estimation results indicate that although the diversion of human capital between regions is not so large relative to the gap in other indicators, human capital has the highest share in the explanation of regional income differences. This imminent role of human capital formation in the determination of regional income differential is confirmed by number of studies in the literature (Takashi 2007; Trendle and Pears 2004; Tondl 2005; Kaldewie and Walz 2001). The other variable which has second highest explanatory power in our estimated model is the share of labor employed in industrial sector. This variable also shows high disparity among regions. Therefore, Turkish data highly supports the arguments which pay attention to the industrial clusters in regional income determinations. Also, electricity per capita consumption variable, the proxy for capital stock, is the other significant explanatory variable in our per capita income difference equation. Our estimation offers another result that the amount of public investments and total length of roads do not have any significant impact on cross-provincial per-capita income disparity in Turkey. As it turns out, the Turkish data, while supporting the theories of new growth and economic geography models, also verifies the basic hypothesis of neoclassical theory.

Thus, we suggest that the most effective policy mix for alleviating income inequality amongst Turkish provinces would be lessening educational differences and balancing the industrial composition of employment, whilst encouraging physical capital accumulation within the low-income regions.

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