Locating Population Dynamics
in Explaining Regional Income Differentials:
Inferences for Regional Policies

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Abstract
The aim of this paper is to analyze regional income differences among provinces in Turkey in terms of both income and per capita income. Subsequently, the paper aims to put the effect of population dynamics as a force behind the process of convergence and discuss its importance for regional policies. Using a panel of 64 Turkish provinces from 1987 to 2000, results from a modified convergence analysis show that both income and per capita income between provinces indicate converging pattern. The convergence rates for the provincial per capita income, however, turned out to be about 50% larger than that of income. In order to examine this difference, the impact of population change in the growth process is incorporated using decomposition analysis. The findings suggest that 17% of the 100 percentage point growth of per capita income resulted from the change in population share in favour of the provinces with high per capita incomes. Therefore, we argue that the existence and pace of regional income convergence are directly related to the degree of relative population change.

Keywords: Convergence, population dynamics.

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I.   Introduction

The wide interest on regional income disparities, which has been the key issue in the literature since the first growth model of Solow (1956), gained a renewed emphasis after the 1980s. A considerable amount of empirical studies have emerged, which have directed attention to investigating growth rate differentials across countries and regions by using cross-section or panel data. These studies have directed attention to the evolution of economic disparities and the process of convergence between the advanced and poor economies.

This wide array of studies differed according to their point of emphases. One array of these studies have focused on the process of catch-up and emphasized the advantages of lagging behind to catch-up the leader economy (Baumol, 1986; Baumol, Blackman and Wolf, 1989; Verspagen, 1994), while another group emphasized the existence of some factors that contribute to faster growth of advanced regions, which impede the process of convergence between advanced and backward regions. Some of these studies took as reference the regions of the EU (Cappelen et al., 1999; Cheshire and Magrini, 2000; Cuadrado-Roura, 2001; Cuadrado-Roura et al., 2000), while some others referred to regions of different countries (Barro and Sala-I Martin, 1992; Benvenuti et al., 1999; Cuadrado-Roura et al., 1999; Sala-I Martin, 1996; Terrasi, 1999). More recent studies, on the other hand, have searched for the impact of European integration/enlargement and EU policies on regional inequalities (Amin et al., 1992; Camagni, 1992; Dunford, 1993, 1998).

Turkey is a country characterized by enduring differences among its regions. Typically, most attention has been paid to the east-west divide, though a further emphasis has been put on the polarization of wealth in certain metropolitan areas. However, there is no consensus on whether per capita income tended converge across regions in Turkey or not. While some researchers call for a tendency for regional differences to widen especially after late 1980s (Altinbas, Dogruel and Gunes, 2002), others point to a tendency for convergence (Sagbas, 2002). More recently, on the other hand, attention has been paid to the exclusion of some parts of the country not

only from the global networks but also from the rest of the country (see Eraydin and Saral, 2004).

In spite of the variety of issues that have drawn the attention of researchers working on regional disparities and the process of convergence, the dynamics of population in this process has not sufficiently been incorporated in the empirical work. However, population dynamics stand as a prominent concern especially in countries, where population movements prevail. Furthermore, population in such countries is usually concentrated in a few metropolitan areas as a consequence of cumulative processes. These regions are faced with the over accumulation of population, and this process, in turn, acts as a force blurring the process of regional convergence. This implies that the results on per capita income convergence should be interpreted by considering population dynamics.

The aim of this paper is to analyse regional income differences among provinces in Turkey in terms of both income and per capita income. Subsequently, the paper aims to put the effect of population dynamics on the process of convergence and discuss its importance for regional policies. Using a panel of 64 Turkish provinces from 1987 to 2000, results from convergence analysis indicated that both incomes and per capita incomes between provinces have indicated converging patterns during this period in Turkey. The pace of per capita income, on the other hand, came out to larger than that of income. We suggest that increase in per capita income may not necessarily be attributed to income increase. Change in the population structure may well be responsible for the per capita increase if population share of high per capita regions increases at the expense of low per capita regions. In fact, this is what's observed in Turkey.

The paper is structured as follows: The next part of the paper provides the background for a detailed investigation of regional income differences. It examines the main features of regional income and population distribution in Turkey. The third section makes use of beta convergence and attempts to investigate the process of convergence among the provinces in Turkey from 1987 to 2000 both in terms of GDP

and per capita GDP. The fourth part searches for the impact of population change per capita income growth. The final section concludes and presents inferences for regional policies.

II. Main features of the Distribution of Income and Population in Turkey

Regional income differences have always been of significant importance in Turkey. Besides large and persistent differences between the eastern and the western parts of the country, there is a strong polarization of wealth in certain metropolitan areas. Only Istanbul province contributes 22 percent of total GDP of Turkey and 5 provinces out of 81 contributes 55% of the Turkish GDP in 2000, although their share in total population is 30%. Only Istanbul province comprises 15% of the total population, compared to the other two most populated provinces, Ankara and Izmir, which comprise only 6 and 5%, respectively. Map 1 depicts the extent of the differences in per capita income between Turkish provinces in 2000, expressed relative to the Turkish average.

Map 1: Distribution of GDP per capita in Turkey, 2000 (relative to the national average)
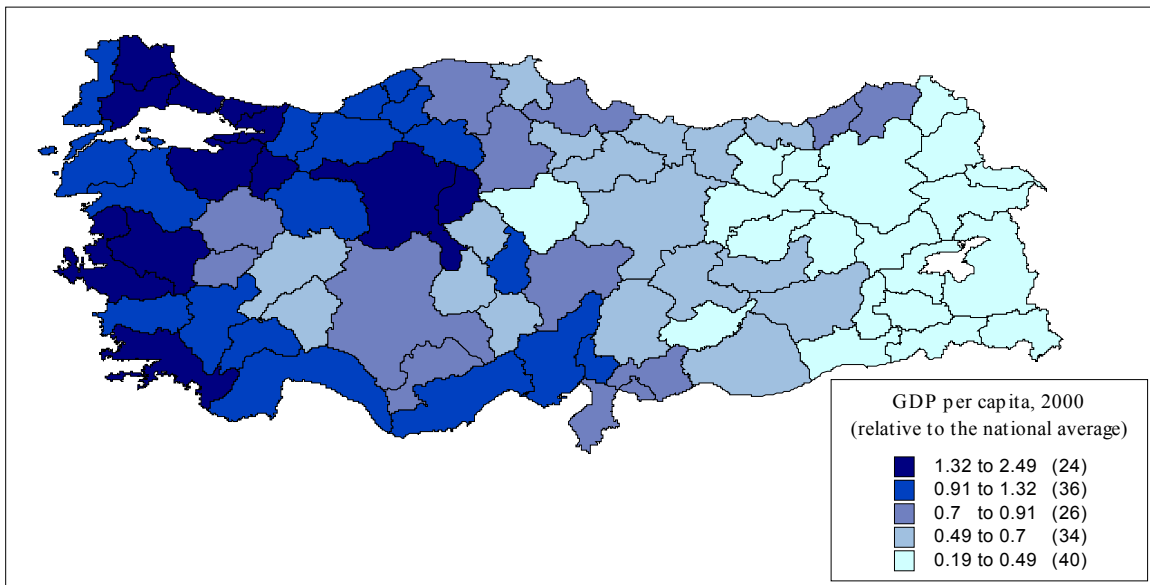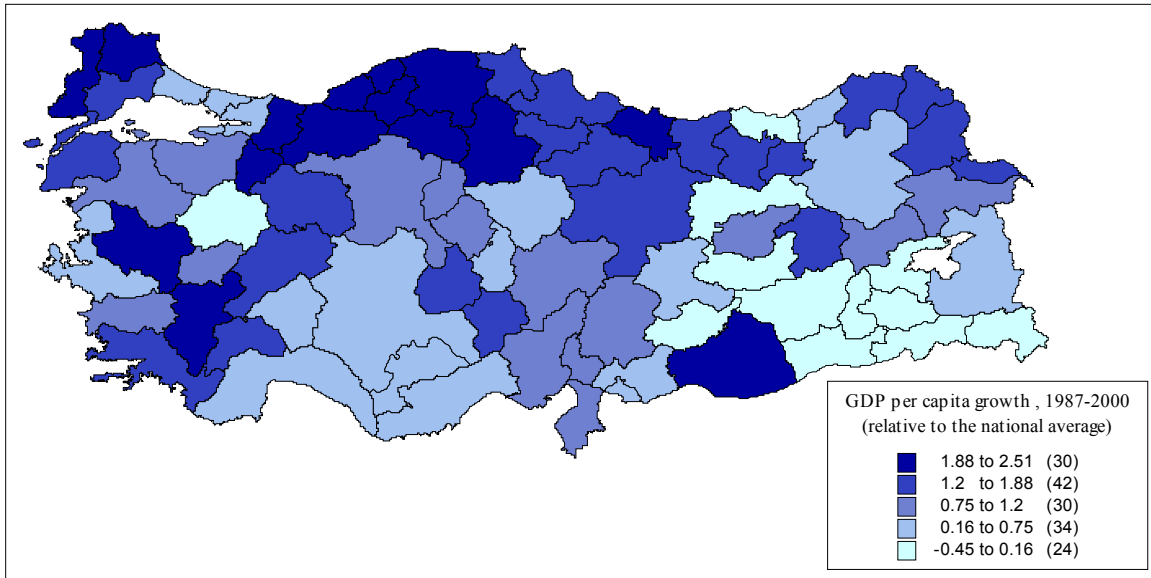

Source: Calculated from SIS, 2002.

The first feature of this map is the sharp east-west divide it reveals. While in the western part most of the provinces exceed 90% of the national average per capita income, only four provinces lay between 70 and 90% of the national average. In the eastern part however only seven provinces lay above 70% of the Turkish average per capita income while the rest hardly reached 50%. At the bottom are three provinces in the east which reached only 20% of the Turkish average per capita income followed by other three eastern provinces which had hardly 30% of the national per capita income. Seven provinces in the east and two Northern provinces on the other hand had 40% of the national per capita income.

The second feature that the map reveals is the concentration of per capita income in a few provinces in the west which accounted for more than 130% of the national average per capita income. In 2000, Kocaeli appears as the leading province in terms of its per capita income level which is equal to 248% of the national average. This is followed by Kirklareli, Izmir, Mugla and Istanbul which accounted for more than 150% of the national average per capita income. These provinces are followed by Manisa, Tekirdag, Bursa, Denizli, Bolu and Eskisehir with per capita income levels exceeding 140% of the Turkish average.

Map 2 depicts per capita income growth of provinces relative to the national average from 1987 to 2000. Comparing this map with Map 1, it is seen that provinces characterized by high per capita income growth over the 1987-2000 period are not the ones with the highest per capita income growth. In fact the latter indicated relatively small growth with growth levels following that of the eastern provinces which indicated the lowest per capita income growth. The provinces which indicated the highest per capita income growth are four provinces in the west, which took the advantage of the further decentralisation of industrial activity from Istanbul and Izmir metropolitan provinces; one province in the west, which indicated unexpected growth with its increasing export capacity after the 1980s; and a regional centre in the east.

Map 2: GDP per capita growth, 1987-2000 (relative to the national average)

GDP per capita growth , 1987-2000
(relative to the national average)

■	1.88 to 2.51 (30)
■	1.2 to 1.88 (42)
■	0.75 to 1.2 (30)
■	0.16 to 0.75 (34)
■	-0.45 to 0.16 (24)

Source: calculated from SIS, 2004

Considering the other provinces which indicated the highest per capita income growth are those whose income and population shows a tendency to decline until 1990s. Despite an increase in their income levels after then, their population continues to decline which in fact explains the high per capita income growth observed in these provinces. In terms of the provinces whose per capita income tended to grow in the range of 1.2 to 1.88 relative to the average, the increase is because of the declines in their populations, except the three provinces which took advantage of the decentralisation of industrial activity from metropolitan centres.

It would be interesting, at this point, to observe the dynamics of provinces with respect to the distribution of wealth and population over time. Figure 1 and Figure 2 show the distribution of provinces according to their per capita income growth and population share growth for two periods, 1987-1993 and 1994-2000. The comparison of the two figures clearly indicates the change in the position of provinces according to the growth of their per capita income and population share. One obvious characteristic of this picture is the increasing variation in the characteristics of the provinces in terms of their per

capita income and population share growths from the first period to the second. As opposed to a tendency of provinces to cluster in two categories in the first period, in the second period the distribution of provinces varied between four categories. To be more precise, between 1987 and 1993, there is a group of provinces whose per capita income and population share increased, as opposed to another group of provinces whose per capita income tended to grow due to declines in their population shares. The former group of provinces is composed of the economically active metropolitan regions of Turkey and some regional centers characterized by higher than average income levels and declining natural population increase. This latter group of provinces, however, is composed of those located in the eastern and northern part of Turkey, most of which lose population since they could not create employment opportunities for their population.

When we come to the second period, some provinces of the first period characterized by growing per capita income and population shares changed category with either declining per capita incomes or declining population shares. Nevertheless, provinces with increasing population shares are the ones with increasing population shares. A second group of provinces, on the other hand, are characterized by increasing per capita incomes accompanied by a decline growth in their population shares. Included in this group are some provinces located adjacent to the metropolitan or regional centers which take the advantage of decentralization processes and diffusion of knowledge from the core provinces. Nevertheless, it would be reasonable to say that for most of the other provinces in this group the growth of their per capita income is due to the decline in their population shares. A third group is comprised of provinces with increasing population shares accompanied by declining per capita incomes. It seems that the growth of their income does not supply the increase of their population resulting with declining per capita incomes. Figure 2, on the other hand, points to the polarization of some provinces from the others by declining per capita incomes in spite of a decline in their population shares.

The implication of the figures can be summarized as follows: First, the income and population share of provinces changed from the early to the late 1990s. The

Figure 1. Distribution of provinces according to average per capita GDP growth and population share growth, 1987-1993.
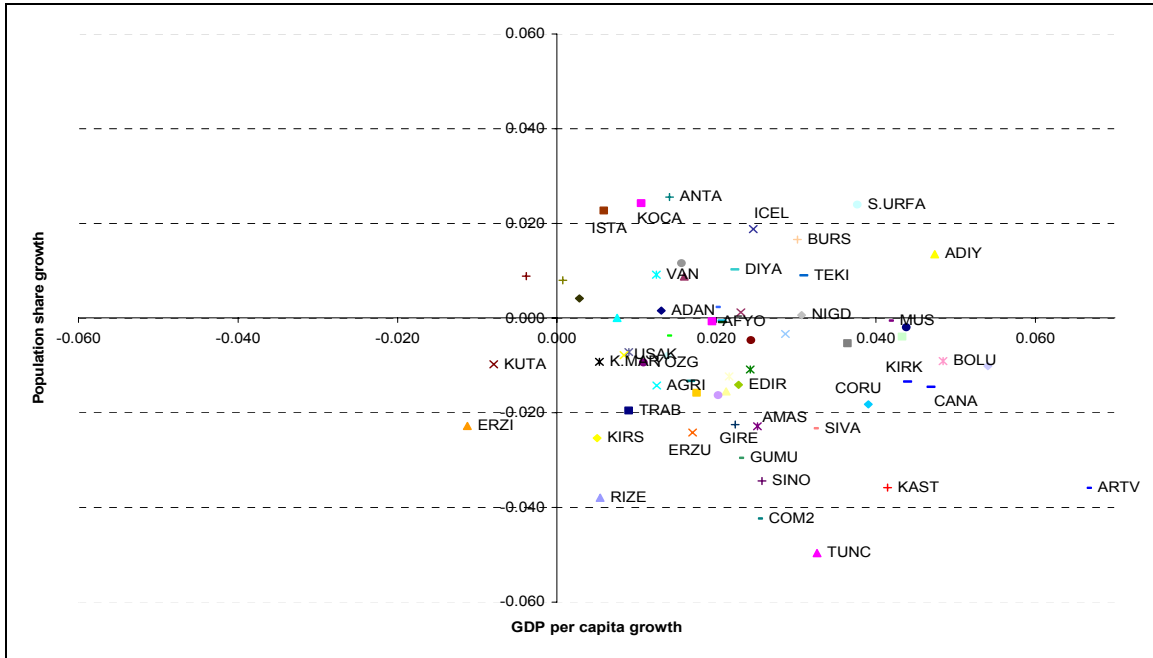
Source: SIS, 2004

Figure 2. Distribution of provinces according to average per capita GDP growth and population share growth, 1994-2000.
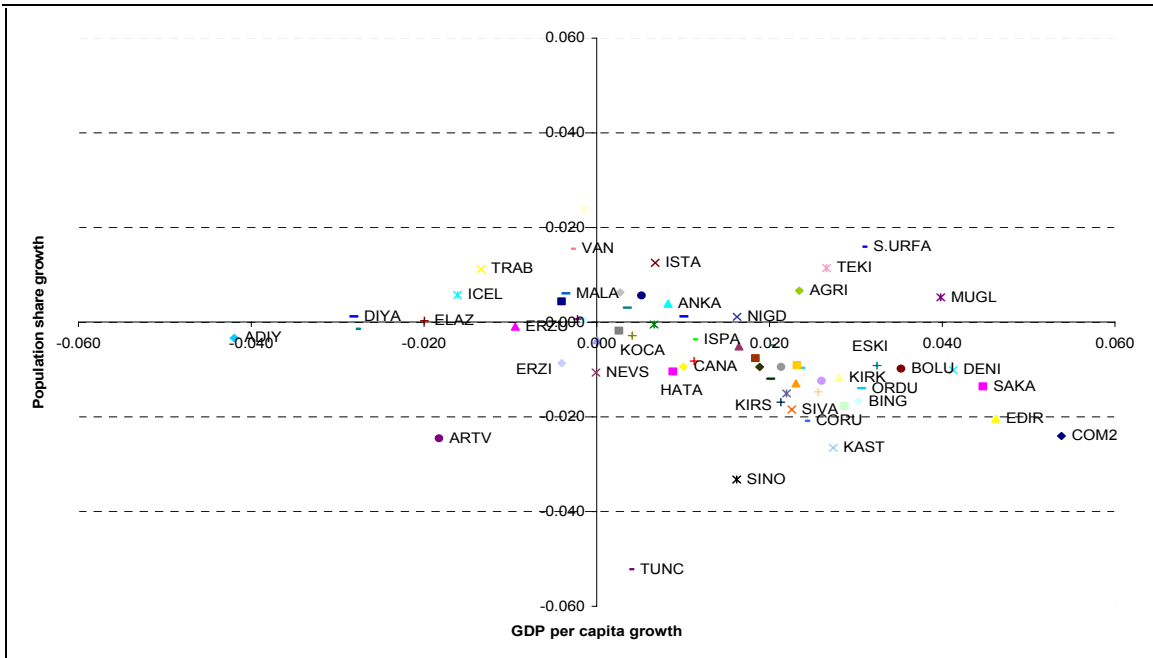
Source: SIS, 2004

distribution of provinces in terms of their income and population growth is more heterogeneous in the latter period. Second, despite this heterogeneity, in both periods, most of the provinces exhibiting per capita income increase also showed increase in population share. This, in fact, implies that increase in per capita income may possibly be the result of population decrease but income increase. This process may either be the result of population movements, declining natural population increase, or some region-specific problems.

III.   Convergence of Regional Income: Level vs. per capita income

In this section, we examine the existence and evolution of β-convergence/divergence in incomes of Turkish provinces by using a panel of 64 provinces from 1987 to 2000. Among the huge literature on convergence debate, following Barro and Sala-i-Martin (1992) Sala-i-Martin (1996), real income or per capita income of province i at time t ($y_{i,t}$) can be approximated by;

$$ln(y_{i,t}) = \alpha_i + (1-\beta)\ ln(y_{i,t-1}) + \varepsilon_{it} \qquad (1)$$

where α_i and β are constants, with $0<\beta<1$, and ε_{it} is the usual disturbance term.

Manipulating equation (1) yields;

$$ln(y_{i,t}) - ln(y_{i,t-1}) = \alpha_i - \beta\ ln(y_{i,t-1}) + \varepsilon_{i,t} \qquad (2)$$

The condition $\beta>0$ implies a negative partial correlation between growth and initial income, "conventional β-convergence".

Equation (2) may also be written for the national average income, $y_{TR,}$ as follows;

$$ln(y_{TR,,t}) - ln(y_{TR,t-1}) = \alpha_{TR} - \beta\ ln(y_{TR,t-1}) + \varepsilon_{TR,t} \tag{3}$$

subtracting equation (3) from (2), we obtained the convergence equation from a income-gap approach:

$$\Delta\ ln(y_{i,t}) - \Delta\ ln(y_{TR,t}) = (\alpha_i - \alpha_{TR}) - \beta\ \{ln(y_{i,t-1}) - ln(y_{TR,t-1})\} + (\varepsilon_{i,t} - \varepsilon_{TR,t}) \tag{4}$$

This equation may also be written:

$$\Delta\ ln(y_{i,t}) - \Delta\ ln(y_{TR,t}) = \alpha_i^{*} + \beta\ \{ln(y_{TR,t-1}) - ln(y_{i,t-1})\} + \varepsilon_{i,t}^{*} \tag{5}$$

In the model (5), the difference between the growth rates of a province and the nation is expressed as a function of the income-gap between the nation and a province, "modified β-convergence". Note that β coefficient obtained from model (5) is not the same as the conventional-β. Therefore, it should not be taken as a measure of the pace convergence into account. Keeping this in mind, a positive estimate of β coefficient, thus, reflects the existence of positive relationship between the income-gap and the income growth gap. In other words, a positive estimate of β coefficient shows the convergence pattern in incomes. A negative estimate of β coefficient, on the contrary, gives us the existence of divergence pattern in incomes.

Estimation results obtained by utilizing the model (5) are presented in Table 1.a-b. All versions of the estimations were obtained by using fixed effects panel regressions[1]. The implications of the estimation results may be summarized as follows: First of all, there is a convergence pattern in provincial incomes and per capita incomes from 1987 to 2000 (see Table 1.a-b). This basically implies that lagging behind is an advantage. Secondly, in order to be able to examine the possible

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[1] Intuitively, the relationship in such a data-structure can be better explained by fixed-effects models (see Baltagi, 2001). Hausman test for fixed vs. random effects specification also suggested the fixed effect model for our data.

Table 1.a: Income convergence among Turkish provinces, 1987-2000, (Fixed-effects model), dependent variable is the income growth-gap {$\Delta ln(y_{i,t})$ - $\Delta ln(y_{TR,t})$}.

Variable	Model I			Model II		
	Coeff.	Std. Err.	Prob.	Coef.	Std. Err.	Prob.
Income gap	0.298	0.026	0.000	0.287	0.026	0.000
Dum94				0.032	0.008	0.000
Dum99				0.008	0.008	0.294
Cons	-1.443	0.124	0.000	-1.398	0.124	0.000
# of provinces	64			64		
# of obs	832			832		
R^2 (within)	0.15			0.17		
σ_u	0.323			0.312		
σ_e	0.586			0.058		
$\rho(=\sigma_u^{-2}(\sigma_u^2\sigma_e^2))$	0.968			0.966		
Wald test of $\sigma_u = 0$	2.87		0.000	2.72		0.000
Wald test for the model	134.03		0.000	51.72		0.000

Probability values refer to the statistical significance level, two-tailed test.

Table 1.b: Per-capita income convergence among Turkish provinces, 1987-2000, (Fixed-effects model), dependent variable is the per-capita income growth-gap {$\Delta ln(y_{i,t})$ - $\Delta ln(y_{TR,t})$}

Variable	Model III			Model IV		
	Coeff.	Std. Err.	Prob.	Coef.	Std. Err.	Prob.
Per-capita income gap	0.378	0.029	0.000	0.371	0.028	0.000
Dum94				0.034	0.008	0.000
Dum99				0.024	0.008	0.002
Cons	-0.125	0.009	0.000	-1.398	0.124	0.000
# of provinces	64			64		
# of obs	832			832		
R^2 (within)	0.18			0.21		
σ_u	0.203			0.199		
σ_e	0.061			0.061		
$\rho(=\sigma_u^{-2}(\sigma_u^2\sigma_e^2))$	0.916			0.915		
Wald test of $\sigma_u = 0$	3.22		0.000	3.21		0.000
Wald test for the model	269.99		0.000	67.20		0.000

Probability values refer to the statistical significance level, two-tailed test.

effects of any shocks, we include dummy variables for the year 1994, a major financial crisis, and the year 1999, an earthquake took place in the most developed region of Turkey. The results show that there is statistically significant effect of the crisis of 1994 on the convergence pattern of both income and per capita income. The explanation of the reason behind the significant coefficient of year 1994 dummy is straightforward: During the period of economic crises, developed regions are affected negatively more than those of less-developed. More explicitly, rich regions face with a larger fall in their incomes relative to poor regions in the presence of crises. This, then, leads to decreases in income differentials between rich and poor regions. That is seen as convergence pattern at least in the statistics.

The effect of 1999 earthquake, on the other hand, is mixed. While it came out to be significant in the convergence of provincial per capita incomes (see model II in Table 2.b), in the level income convergence case, it turned out to be insignificant. This finding is indeed consistent with the starting point of this paper which states that convergence pattern may reflect dissimilarities with respect to the unit of analysis, i.e. income vs. per capita income convergence.

The other finding of this analysis on which our main argument is based is the difference between the coefficient of the income gap and per capita income gap. Note that the coefficient of the per capita income gap is about 50% larger than that of income gap.[2] We argue, in this study, that convergence of per capita income may be larger than the level incomes in a cross region or province analysis. Furthermore, even in a case of divergence between incomes, convergence in per capita income may possible emerge. The simple reason for such an outcome is that if there is no constraint on population mobility between regions or provinces, that is the usual case in a certain territory of a country, individuals, then, may prefer to move to rich

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[2] The difference between the β coefficients in the conventional β-analysis (model (2) above) came out to be even larger. We found the value of β coefficient to be (-0.127) and (-0.203) in the income and per capita income growth models without dummies, and (-0.072) and (-0.158) in the model with dummies. These figures imply that in the conventional β-convergence approach, convergence of per capita incomes is about two fold larger than level incomes.

provinces from the provinces with low per capita incomes. In the next section, analysis is based explicitly on this phenomenon.

IV. Accounting for the change in population structure: Decomposition analysis

This section of the paper examines the relationship between per capita income and population dynamics. By population dynamics, we mean the change in the quantitative structure of population among provinces, i.e. change in the shares of the population of each province in total. The contribution of the change in population structure to the growth of per capita income can be investigated by making use of decomposition analysis, or often called shift-share analysis (see Timmer and Szirmai (2000) and Peneder (2003) for the applications to labour productivity growth). This analysis allows one to decompose the change or growth of any variable by its sources.

Let Y_t and P_t be aggregate income and population at time t. Per capita income at time t, y_t, then, is defined as follows:

$$y_t = \frac{Y_t}{P_t} = \frac{\sum_{i=1}^{n} Y_t^i}{\sum_{i=1}^{n} P_t^i} = \sum \frac{Y_t^i}{P_t^i} * \frac{P_t^i}{P_t} = \sum y_t^i * w_t^i \tag{6}$$

where;

$$w_t^i = \frac{P_t^i}{P_t}$$ is the share of province i in total population.

The change in the level of aggregate per capita income may then be represented as:

$$y_t - y_{t-1} = \sum_{i=1}^{n}(y_t^i - y_{t-1}^i) * w_{t-1}^i + \sum_{i=1}^{n}(w_t^i - w_{t-1}^i) * y_{t-1}^i + \sum_{i=1}^{n}(y_t^i - y_{t-1}^i) * (w_t^i - w_{t-1}^i) \tag{7}$$

One could use mean weights to eliminate the third term in equation (8) (Syrquin 1984; 96). Then the change in the level of aggregate per capita income may then be represented as fixed-weight decomposition;

$$y_t - y_{t-1} = \sum_{i=1}^{n} (y_t^i - y_{t-1}^i) * \overline{w}^i + \sum_{i=1}^{n} (w_t^i - w_{t-1}^i) * \overline{y}^i \tag{8}$$

where;

$\overline{w}^i$ and $\overline{y}^i$ are the two averages of the share and per capita income of province i, respectively, at time t and t-1.

Equation (8) may be modified to reflect growth rates by dividing the whole equation by per capita income of previous year as follows:

$$\frac{y_t - y_{t-1}}{y_{t-1}} = \frac{\sum_{i=1}^{n} (y_t^i - y_{t-1}^i) * \overline{w}^i}{y_{t-1}} + \frac{\sum_{i=1}^{n} (w_t^i - w_{t-1}^i) * \overline{y}^i}{y_{t-1}} \tag{9}$$

Equation (9) decomposes aggregate per capita income growth into two parts: The first term on the right hand side of the equation, called *the within-effect*, gives the contribution of per capita income growth within provinces. The estimated value of this term gives the rate of growth in the case that the population shares of provinces remain constant. The second term, called *the between-effect*, measures the magnitude of per capita income growth resulting from changes in the allocation of population between provinces. This term will be positive/negative if the population shares of high per capita income provinces in total population increases/decreases at the expense of provinces with low per capita income. Note that a positive estimate of this effect may not be totally attributed to the physical movement population from low to high per capita income provinces. Change in the population share may result from different sources, i.e. different birth/death rates, internal migration, natural disasters and so on.

The results of the decomposition of aggregate per capita income growth from 1987 to 2000 are presented in Table 2.a-b. The results show that the between effect contributed positively to the aggregate per capita income growth in Turkey in all years except the year 2000 in the period under study. This means that the population share of provinces with high per capita incomes in total has increased relative to those with low per capita incomes from 1987 to 1999. The large negative value of this effect in the year 2000 may be explained by the possible consequences of the 1999-earthquake. More

Table 2.a: Annual decomposition of per capita income growth, 1987-2000.

Year	Per capita income growth	Within effect	Between effect
1987	…	…	…
1988	-0.001	-0.006	0.005
1989	-0.019	-0.024	0.005
1990	0.067	0.063	0.004
1991	-0.010	-0.015	0.004
1992	0.042	0.037	0.005
1993	0.060	0.056	0.004
1994	-0.072	-0.076	0.004
1995	0.056	0.049	0.007
1996	0.049	0.049	0.001
1997	0.079	0.078	0.000
1998	0.015	0.012	0.003
1999	-0.060	-0.063	0.003
2000	0.024	0.032	-0.008

Note: The two effects may not add to the per capita income growth due to rounding.

Table 2.b: Cumulative decomposition of per capita income growth for different sub-periods.

	1987-2000		1987-1993		1994-2000	
	Cum.[a]	Cont.[b]	Cum.	Cont.	Cum.	Cont.
Per capita Income growth	0.231	1.000	0.140	1.000	0.091	1.000
Within Effect	0.193	0.833	0.112	0.797	0.081	0.887
Between Effect	0.039	0.167	0.028	0.202	0.010	0.113

Note: [a] Cumulative growth, percentage; [b] Contribution of the effect to the per capita income growth. The two effects may not add to cumulative per capita income growth due to rounding.

14

specifically, from 1987 to 2000, 17% of the 100 percentage point growth of per capita income resulted from the change in population share in favour of the provinces with high per capita incomes (see Table 2.b). In other words, if the population structure of Turkey remained the same in this period, income per capita of Turkey would have grown 19% instead of 23% (see Table 2.b). We also found that while this contribution came out to be about 20% in the first sub-period, 1987-93, while an 11% contribution to the per capita growth is recorded in the second sub-period, 1994-2000. The decrease in this ratio may probably be due to the crises emerging in the second sub-period.

V. Conclusion

This paper provides evidence on the difference between the evolution of income and per capita income across provinces in Turkey. We observed that most of the provinces recording low per capita income growth in this period exhibited decreases in population shares. This implies that the increase in per capita income in provinces with relatively low per capita income is the result of relative population decrease rather than income increase. In addition to this process, increase in the population share of well performing provinces also helped in converging incomes between provinces.

We found the pace of convergence in per capita income to be much larger than level income from 1987 to 2000. Change in the population structure is found to be a vital source of per capita income growth in Turkey. More explicitly, the stronger convergence tendency of per capita income is more related to the change in population structure rather than income. The difference in convergence of income and per capita income may emerge explicitly when the unit of analysis is regions or provinces of a single country simply due to high variations in population shares. Explicitly, convergence of per capita income may not require the convergence of income between the provinces or regions of a country.

The concentration of economic activities and population in a few metropolitan provinces and the decentralization process from these provinces to their adjacent

provinces leaves the relatively remote areas with declining shares of income and population. This situation, in fact, signals serious problems for both well-performers and the losing regions. It, on the one hand points to risk of creation of local capacities or deterioration of existing ones for the losing ones, while on the other hand creates over-accumulation of activities and population in the latter and hinders restructuring and modernizing processes (Camagni, 1992).

Therefore, policies aiming at reducing income disparities among regions or provinces should seriously take population dynamics into account. Looking at the phenomenon only form the income perspective may produce the short run solutions the but long run.

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