# REGIONAL ECONOMIC CONVERGENCE AND ROLE OF GOVERNMENT: A CASE STUDY ON NUTS 2 REGIONS IN TURKEY

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**Abstract**

In regard to Neo-classical growth theory, convergence approach assumes that poorer countries' or regions' per capita incomes tend to grow at faster rates than richer ones. This study aims to empirically investigate convergence across NUTS 2 regions in Turkey for time period between 2004-2011. We also inquire into role of government in terms of regional investments and fixed investment incentives in convergence process. Due to poor database and absence of up-to-date data in regional level, we used regional gross value added (GVA) per capita instead of regional GDP. All the empirical results obtained by analysis support the regional convergence hypothesis. Also, in context to convergence process, role of government is likely to be decisive to meet the regional economic disparities.

**Keywords**: economic convergence, regional economic growth, regional gross value added, regional economic disparities.

## 1.Introduction

In regard to Neo-classical growth theory, convergence approach assumes that poorer countries' or regions' per capita incomes tend to grow at faster rates than richer ones. Therefore, all economies (countries, regions) should converge in terms of per capita income eventually. In recent years, such a catch-up mechanism has been often discussed in much of the growth studies. The growing attention to question of whether per capita income tends to converge over time across countries or regions is the main focus of these studies (Barro and Sala-i-Martin, 1991,1992; Mankiw et al., 1992; Lall and Yilmaz, 2000; Leo et al., 2004; Varblane and Vahter, 2005; Lopez-Rodriguez, 2008).

In regional economics, distribution of income is an important issue as well as sustaining economic growth. Convergence can be mentioned if only growth take place reducing inter-regional income disparities. Otherwise, increasing total income cause a 'divergence' effect across economies. In latter case, the role of both investments and incentives to less developed regions by public sector assumed to be a positive impact on efforts to close this gap. Myrdal (1957) and Hirschman (1958) stated that government affects both national and regional economies positively in terms of infrastructure, education and health investments. Thus, regional government investments may influence the share of income in regional level.

Regional economic disparities have been a long-time problem for most of developing economies such as Turkey. In literature, previous studies which mainly focused on regional disparities and process of convergence revealed different results for Turkey in various time periods. While some of the studies conclude a significant convergence between regions (e.g. Sağbaş, 2002; Yıldırım et al., 2004; Karaalp and Erdal, 2009; Zeren and Yilanci, 2011; Gerni et al., 2015; Özgül and Karadağ, 2015), some of those indicate that there is no tendency to converge across regions in Turkey (e.g. Filiztekin, 1999; Berber et al., 2000; Şenesen, 2002; Gezici and Hewings, 2004).

This study aims to investigate existence and degree of convergence among 26 NUTS 2 Regions in Turkey. We also empirically inquire into role of government in terms of regional investments and fixed investment incentives in convergence process. Due to poor database and absence of up-to-date data in regional level, we used regional gross value added (GVA) per capita instead of regional GDP for the period between 2004-2011 in the study. Data set used in analysis is based on Turkish Statistical Institute (TURKSTAT), the Ministry of Development and the Ministry of Economy databases.

The rest of the study is organized as follows. Section 2 presents the theoretical background of convergence theory and then data and methodology used in analysis is given in Section 3. Section 4 presents results from econometric modelling of convergence process in NUTS 2 Regions and the last Section discusses the results and concludes the paper.

## 2.Theoretical Background

In recent years, there have been much concern to convergence analysis in growth studies investigating growth components and spillover effect of growth across countries or regions over time. In general, following the studies of Baumol (1986) and Barro and Sala-i Martin (1991, 1992), concept of convergence states that per capita growth rate tends to be inversely related to the initial level of output or income per capita. Particularly, if economies are similar in respect to preferences and technology, poor economies may grow faster than wealthy ones (Barro and Sala-i Martin, 1992: 224). This phenomenon is also referred to as β-convergence in literature. In context of β-convergence, a pioneering study by Sala-i Martin (1996) which extends the empirical evidence on regional growth and convergence across the United States, Japan, and five European countries indicates that regions similarly tend to converge at a speed of approximately 2% annually. Another type of convergence is σ-convergence which emerge only if declines in dispersion of real per capita income across economic units over time (Sala-i Martin, 1996). In other words, σ-convergence is concerned with behavior of the cross-sectional standard deviation, or the coefficient of variation, of per capita output over time.

In empirical growth literature, there are vast amount of studies exploring convergence in both cross-sectional and panel data sets across countries and regions. In this respect, σ and β-convergence approaches have been subject to some debates in some of earlier studies. Quah (1993) and Friedman (1992) argued that the β-convergence is uninformative for a distribution's dynamics and due to regression fallacies, cross-section regressions can only represent average behavior of units. However, Sala-i Martin (1996) suggest that two concepts examine interesting phenomena which are conceptually different. Accordingly, σ-convergence discusses how the distribution of income evolves over time, and β-convergence focuses on mobility of income within same distribution (Sala-i Martin, 1996: 1328).

As a seminal paper, Baumol (1986) has introduced a basic method for testing the convergence within the framework of Neo-classical growth hypothesis in a cross-sectional regression given in below.

$$T^{-1}\log\left[\frac{y_t}{y_{t_0}}\right] = \alpha + b\log y_{t_0} \qquad (1)$$

In equation (1), $y_t$ and $y_{t_0}$ represent values of income per capita for latest and initial years in a given period of time respectively. Regressing the equation, the negative value of coefficient b indicates the evidence that economies with low initial income per capita have faster growth rates and converge to high income ones. A modified and expanded version of this approach, namely β-convergence, by Barro and Sala-i Martin (1991, 1992) assumes that there is an inverse relation between growth rate of an economy and distance from its' steady-state only if all the economies share same steady-state. Hence, convergence to same steady-state also calls as 'absolute' or 'unconditional' β-convergence. However, if the economies have different steady-states in terms of technological level or saving rate, then such an inverse relation will no longer in question. If ignorance of such cross-sectional differences can be reasonable, convergence occurs as 'conditional' β-convergence. This expression can be formulated as in below.

$$(T^{-1})\log\left[\frac{y_{i,t}}{y_{i,t_0}}\right] = \alpha - \left(1 - e^{-\beta T}\right)(T^{-1})\log\left[y_{i,t_0}\right] + u_j \qquad (2)$$

As shown in equation (2), the convergence can be estimated by regressing the average growth rate (left-hand-side of the equation) of a set of cross-sectional units (countries, regions) within period T (T= $t_0 \ldots t$) on the initial level of income ($y_{i,t_0}$). The convergence parameter β where [$-\left(1 - e^{-\beta T}\right)(T^{-1})$] is expected to have positive sign in convergence process and depends on technology and preferences. In other words, so long as the value of β is positive, convergence coefficient will be negative. Also in the equation α is a constant and $u_i$ is random error term.

Unlike the absolute β-convergence, if a group of economies differ in their fundamental dynamics and they will exhibit multiple steady-states (Magrini, 2004). In other words, the conditional convergence hypothesis depends on the specific characteristics of each economy and equilibrium is defined by the economy. Thus, each economy conditionally approaches its own but unique equilibrium. In this case, some specific explanatory variables which may potentially affect convergence process and represent proxies for the different steady states get involved in analysis. Such a conditional β-convergence is given in equation (3) where $X_i$ represents control variables of the model.

$$(T^{-1})\log\left[\frac{y_{i,t}}{y_{i,t_0}}\right] = \alpha - \left[\log\left(y_{i,t_0}\right)\right]\left(1 - e^{-\beta T}\right)(T^{-1}) + \beta_1 X_j + u_j \qquad (3)$$

Furthermore, it can be said that convergence analysis evolves with panel data techniques in recent studies (e. g. Islam, 1995; Lee et al., 1998; Gaulier et al., 1999; Michelis and Neaime, 2004; Piras and Arbia, 2007; Shen et al., 2008; Reza and Karimi, 2008; Cuaresma et al., 2011; Bonnefond, 2014). One of those used in the analysis is also mentioned in the next section.

**3.Data and Methodology**

In the study, we used a data set which includes both cross-sectional and time series data for 26 NUTS 2 Regions for the time period between 2004 and 2011. In context of income indicators, GDP data have not been calculated in regional level since 2001 and so, it can be said that there are not up-to-date data for this variable. Accordingly, we prefer regional gross value added (GVA) per capita instead of the regional GDP as income indicator in this study. In general, on the one hand, by regional GVA it is intended to measure total economic activity of productive units residing in a region. In this respect, GVA represent an indicator of producing power of an economic unit rather than measure of income. On the other hand, the only difference between GVA and GDP (by production or income approaches) is presence of Net Indirect Taxes (NIT= indirect taxes-subsidies) which are accounted in GDP calculations. Thus, GVA is a key indicator used in the estimation of GDP (GDP=GVA+NIT).

Also, on the purpose of investigating role of government in convergence process, we used total regional government investments and fixed investment incentives as control variables in analysis. All the data are expressed in Turkish Liras (₺) and obtained from Turkish Statistical Institute (TURKSTAT), the Ministry of Development and the Ministry of Economy.

As has already been mentioned in previous section, σ-convergence occurs when income differentiation between economies decreases over time. In this respect, it can be said that dispersion of income levels can be measured by standard deviation of income per capita among economies. Also, the coefficient of variation (CV) can be used instead of standard deviation. In analysis process, we used the coefficient of variation of G formulated as in below.

$$CV = \frac{\text{Standart Deviation}}{\text{Mean}} \qquad (4)$$

Additionally, we used a regression of trend line of CV for GVA per capita to verify decreases in dispersion over time. In equation (5), dependent variable is the coefficient of variation of GVA per capita levels across regions while the independent variable is the time variable (t=1…8) for the period between 2004 and 2011.

$$CV_{y_t} = \gamma_0 + \gamma_1 t + u_t \qquad (5)$$

For the purpose of investigating absolute, or unconditional β-convergence, we regressed the equation (6) based on cross-sectional data. In equation (6), where left-hand-side of the equation form represents average growth rate of region *i* in time period T (T=$t_0$…t). Also, $Y_{i,t_0}$is initial year of period T and $\gamma_0$is a constant.

$$T^{-1}\log\left[\frac{Y_{i,t}}{Y_{i,t_0}}\right] = \gamma_0 + \alpha_1 \log Y_{i,t_0} + \varepsilon_i \qquad (6)$$

Also we used a modified version of equation (6) in order to test conditional β-convergence considering specific characteristics of each region. In equation (7), where the $V_{i,t_0}$ is a vector of control variables which represents regional government investments and fixed investment incentives in the study.

$$T^{-1}\log\left[\frac{Y_{i,t}}{Y_{i,t_0}}\right] = \gamma_0 + \alpha_1 \log Y_{i,t_0} + \delta \log V_{i,t_0} + \varepsilon_i \qquad (7)$$

In panel data models, the choice of the model estimation is often discussed due to several reasons. In general, one can choose pooled ordinary least squares (OLS) or fixed effects (FE) or random effects (RE) in estimation step considering different assumptions. In this respect, a pooled OLS approach assumes that error term is independent of cross-sectional units and individually and identically distributed (i.i.d.). So, it does not take into account time-invariant specific effects. Instead, the FE or RE consider object-specific time-invariant effects (Wooldridge, 2010). Also, the FE model is often applied when the differences between regions can be viewed as parametric shifts of the regression (Greene, 2012). Thus, we estimate the regression form given in equation (8) which based on panel data in order to investigate convergence hypothesis.

$$\log Y_{i,t} - \log Y_{i,t-1} = \gamma_0 + \alpha_1 \log Y_{i,t-1} + \alpha_2 \log X_{1_{i,t}} + \alpha_3 \log X_{2_{i,t}} + \varepsilon_{i,t} \qquad (8)$$

In equation (8), where $Y_{i,t}$ represents GVA per capita in region *i*, and $X_1$ and $X_2$ are control variables which are regional government investments and investment incentives respectively. Also, following Barro and Sala-i Martin (1995), we can compute speed of convergence as given in equation (9).

$$\beta = -T^{-1}\ln(1 + \alpha_1 T) \qquad (9)$$

According to the equation, in case convergence occurs (α<0), higher initial income levels cause negative effect on final growth. Thus, β measure the annual convergence rate of an economy towards its steady-state income level.

**4.Findings**

In this section, we conducted some analysis based on the CV of regions, cross-sectional OLS and panel data in order to investigate and verify σ and β convergence approaches for 26 NUTS 2 Regions in Turkey. The models that we employed were estimated for different specifications, including pooled least squares and fixed effects estimators, that is, depending on different assumptions about the error term. The results from analysis are presented in sub-sections.

**4.1.σ-Convergence of NUTS 2 Regions**

Table 1 reports the results from the analysis of sigma σ-convergence for NUTS 2 Regions. As it is seen in Table 1, coefficient of variation and standard deviation tend to decrease when per capita GVA decrease across regions. In other words, during the process of growth, the GVA per capita levels of the regions become more equal and the variation between their GVA per capita levels decreases. Thus, one might say that σ-convergence exists across NUTS 2 regions in Turkey for the time period 2004-2011.

**Table 1: Per Capita GVA, Standard Deviation and Coefficient of Variation of NUTS 2 Regions**

| Year | Ln Per Capita GVA | Standard Deviation | Coefficient of Variation |
|---|---|---|---|
| 2004 | 8,6571 | 0,4259 | 0,0492 |
| 2005 | 8,7944 | 0,4188 | 0,0476 |
| 2006 | 8,9289 | 0,4290 | 0,0480 |
| 2007 | 9,0326 | 0,4302 | 0,0476 |
| 2008 | 9,1480 | 0,4284 | 0,0468 |
| 2009 | 9,1682 | 0,3911 | 0,0427 |
| 2010 | 9,2921 | 0,3660 | 0,0394 |
| 2011 | 9,4285 | 0,3821 | 0,0405 |

In Table 1, data shows that standard deviation of per capita GVA of regions was 0.492 in 2004 and decreased to 0.394 in 2010. However, the NUTS 2 regions tended to diverge in the last year and differentiation among regions in 2011. Therefore, it caused the s-divergence across regions as can be seen Figure 1. During 2004-2011, it can be said that sustainable growth rates in per capita GVA enabled lower income dispersion and it caused an s-convergence in regional level (Figure 1).

**Figure 1: σ-Convergence of GVA Per Capita in the NUTS 2 Regions**

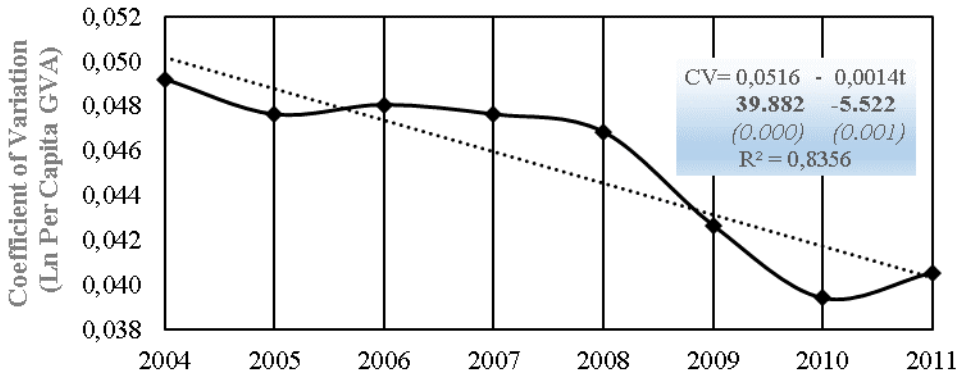



Figure 1 shows the coefficient of variation NUTS 2 Regions along with the trend line for the whole period 2004-2011. It indicates that the NUTS 2 regions revealed s-convergence during 2004-2010. The differentiation between the regions decreased over this period. Also, Figure 1 reports the trend line regression of regions in order to verify analysis. Accordingly, significant negative t-value of time variable (t) indicates the presence of σ-convergence.

### 4.2.Absolute and Conditional β-Convergence of NUTS 2 Regions

Table 2 shows the results of absolute (unconditional) β-convergence of NUTS 2 Regions. The model was estimated for cross-sectional OLS where explained and explanatory variables are associated with one period or point in time. So the variables are considered to be associated with a sequence of points in time. As the table shows, the parameter of the initial year GVA per capita is significantly negative. Therefore, it can be said that there is a clear evidence for presence of unconditional β-convergence across regions by means of this estimation method.

**Table 2: Cross-Section Estimation Results of Absolute β-Convergence in NUTS 2 Regions**

**Dependent Variable:** Average Growth Rate of GVA per capita
**Method:** Cross-Sectional OLS
**Included observations:** 26

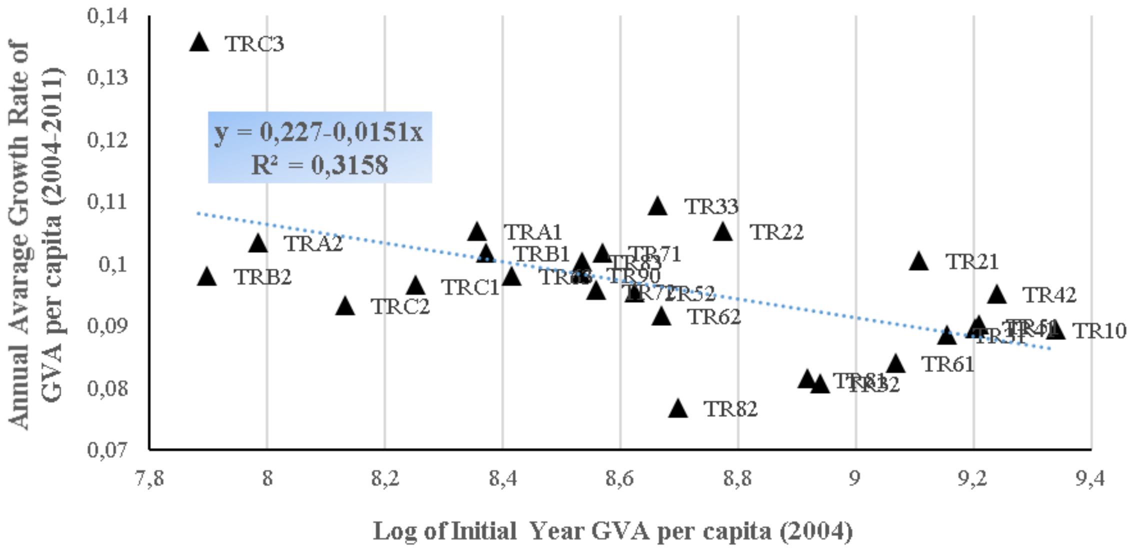
| | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| *Constant* | 0.2270 | 0.0393 | 5.3628 | 0.000 |
| *Log of Initial Year GVA per capita* | -0.0151 | 0.0045 | -3.3290 | 0.003 |
| **R-square** | 0.3159 | | | |
| **F-statistic** | 11.0828 | | | |
| **Prob. (F-statistic)** | 0.0028 | | | |
| ***Speed of Convergence (β)*** | 1.52 % | | | |

In Table 2, sign of coefficient of initial GVA per capita variable is as we expected (-0.0151). The explanatory power of the model is 31.6%[1] and the overall significance of the model (F test) is fitted. The results are also reported in Figure 2. As shown in Figure 2, the slope of the regression line implies that the estimated β coefficient for the whole period equals 1.52%. This means that the NUTS 2 regions reduce the distance towards the common steady-state by 1.52% annually. Thus, it is a low speed of convergence value comparing with those observed worldwide by Sala-i

[1] According to Wallace and Silver (1988: 123), when studying on cross-sectional data, it is often seen that the value of R-square is 0.3 or less than this value. Also Studenmund (1992: 47) argued that an R-square value of around 0.50 in a cross-sectional analysis is adequate for goodness of fit.

Martin (1996). In this regard, it can be said that regions experienced relatively a slow catching-up process for this period.

**Figure 2: Absolute β-Convergence of the NUTS 2 Regions**




The results of absolute β-convergence of NUTS2 regions is depicted in Figure 2 where the x axis is the annual growth rate of GVA per capita over the period 2004-2011 and y axis is log of the GVA per capita in 2004. Figure 2 also allows the comparison of the regions regarding β-convergence hypothesis. Following Barro and Sala-i Martin (1992), it assumes that pure differences in the level of technology do not affect β in case the underlying parameters of technology and preferences are likely to be similar but are different in other respects. So the assumption that steady-state value is same for all economies and technological progress do not differ across regions implies that poorer economies tend to grow unconditionally faster than rich ones (Barro and Sala-i Martin, 1992: 227). In 2004-2011 period, regions with lower initial GVA per capita (e.g. TRC3, TRA2, TRB2) experienced relatively higher average growth rates. Conversely, richer regions such as TR10 (İstanbul province), TR41(Bursa, Eskişehir, and Bilecik provinces), and TR42 (Kocaeli, Sakarya, Düzce, Bolu and Yalova provinces) recorded a relatively slow growth (also see the appendix for region codes).

**Table 3: Cross-Section Estimation Results of Conditional β-Convergence in NUTS 2 Regions**

**Dependent Variable:** Average Growth Rate of GVA per capita
**Method:** Cross-Sectional OLS
**Included observations:** 26

| | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| *Constant* | 0.2703 | 0.0445 | 6.0710 | 0.000 |
| *Log of Initial Year GVA per capita* | -0.0273 | 0.0060 | -4.5621 | 0.000 |
| *Log of Government Investments* | -0.0021 | -0.0025 | -0.8444 | 0.4075 |
| *Log of Fixed Investment Incentives* | 0.0053 | 0.0016 | 3.2388 | 0.004 |

| | |
|---|---|
| **R-square** | 0.5379 |
| **F-statistic** | 8.5367 |
| **Prob. (F-statistic)** | 0.001 |
| ***Speed of Convergence (β)*** | 2.77 % |

Table 3 reports the estimation results of conditional β-convergence based on cross-sectional data. Accordingly, coefficient of initial year GVA per capita has a significantly negative sign (-0.0273) implying existence of conditional convergence in regional level. The fixed investment incentives variable has a positive coefficient value at %0.4 significance level. This result refers that the fixed investment incentives provided by government is one of the determinants in regional growth. Among the other control variables, the sign of the coefficient of total regional government investments is estimated as negative and statistically insignificant. The coefficient of determination (R-square) is 53.8% and it is quite high vis-a-vis absolute convergence model. Lastly, the estimated speed of convergence is 2.77% and it is a much higher value compared with absolute convergence model.

**4.3.Panel Data Analysis of Convergence Approach**

In addition to the cross-sectional analysis of convergence, we tested convergence mechanism within the panel data approach. Generally, a panel data may include individual-specific or time-specific effects. If any of effect is the case, then a fixed or random effects estimation could be employed. Alternatively, a pooled OLS can also be preferred if there are no unique attributes of units and no well-accepted effects across time within the data set. However, overleaping any of the effects would lead to biased and inconsistent estimation results.

Table 4 shows the panel data results of β-convergence of NUTS 2 Regions. In estimation process, we used two control variables (i.regional government investments, ii.fixed investment incentives) and four models involving different combinations of the independent variables. The models were estimated for pooled least squares and fixed effects estimators in order to compare results. In Table 4, Model-I includes all the control variables. Model-II and III is derived from Model-I by eliminating the control variables one by one and Model-IV also does not include any of the control variables. In this respect, Model-IV aims to test absolute β-convergence by panel data approach. Lastly, the test statistics and Hausman test which checks whether the explanatory variables related to error terms in order to choose between fixed and random effects estimators are given at the bottom of the table.

**Table 4: Panel Data Estimation Results of Convergence in NUTS 2 Regions**

| | | **MODEL-I** | | **MODEL-II** | | **MODEL-III** | | **MODEL-IV** | |
|---|---|---|---|---|---|---|---|---|---|
| | | ***Pooled*** | ***FE (two-way)*** | ***Pooled*** | ***FE (two-way)*** | ***Pooled*** | ***FE (two-way)*** | ***Pooled*** | ***FE (two-way)*** |
| ***Constant*** | *(i)* | 0.275 | 3.031 | 0.340 | 3.297 | 0.207 | 3.063 | 0.346 | 3.319 |
| | *(ii)* | 2.409 | 5.788 | 4.721 | 6.210 | 1.861 | 5.842 | 4.711 | 6.251 |
| | *(iii)* | 0.017 | 0.000 | 0.000 | 0.000 | 0.064 | 0.000 | 0.000 | 0.000 |
| ***Log of GVA per capita (t-1)*** | *(i)* | -0.052 | -0.402 | -0.051 | -0.363 | -0.033 | -0.393 | -0.026 | -0.356 |
| | *(ii)* | -4.239 | -6.821 | -4.187 | -6.136 | -3.617 | -6.693 | -3.215 | -6.044 |
| | *(iii)* | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 | 0.000 |
| ***Investment Incentives*** | *(i)* | 0.010 | 0.005 | 0.011 | 0.004 | | | | |
| | *(ii)* | 2.258 | 1.320 | 2.707 | 1.115 | | | | |
| | *(iii)* | 0.025 | 0.188 | 0.007 | 0.266 | | | | |
| ***Government Investments*** | *(i)* | 0.005 | 0.030 | | | 0.010 | 0.029 | | |
| | *(ii)* | 0.739 | 3.071 | | | 1.642 | 2.993 | | |
| | *(iii)* | 0.460 | 0.002 | | | 0.102 | 0.003 | | |
| ***F-statistics (p-value)*** | | 6.178<br>0.000 | 11.228<br>0.000 | 9.016<br>0.000 | 10.674<br>0.000 | 6,566<br>0.001 | 11.458<br>0.000 | 10.338<br>0.001 | 10.951<br>0.000 |
| ***Number of obs.*** | | 182 | 182 | 182 | 182 | 182 | 182 | 182 | 182 |
| ***Number of cross.*** | | 26 | 26 | 26 | 26 | 26 | 26 | 26 | 26 |
| ***Periods*** | | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| ***R-square*** | | 0.094 | 0.722 | 0.091 | 0.704 | 0.068 | 0.718 | 0.054 | 0.701 |
| ***Hausman Test**** | | | $\chi^2$ (3): 42.936 (0.000) | | $\chi^2$ (2): 32.955 (0.000) | | $\chi^2$ (2): 41.805 (0.000) | | $\chi^2$ (1): 33.205 (0.000) |

Dependent variable: the growth rate of GVA per capita. (i):coefficient, (ii):t-statistic, (iii): prob. *Hausman tests for cross-section and period random effects.

Firstly, we report that coefficients of log of initial year GVA per capita in all the estimated models are significant and negative. Thus, we reached an evidence of conditional β-convergence for NUTS 2 Regions in Turkey between 2004-2011. In addition, estimated coefficient of Log of GVA per capita in Model-IV confirmed the presence of absolute β-convergence of the regions on panel data for the same period.

In Table 4, coefficients of control variables are positive in all the models but they differ by significance level in pooled OLS and fixed effects estimations. In context of pooled OLS estimations, coefficients of investment incentives (Model I and II) were found statistically significant despite the fact that fixed effects estimator produced insignificant results. Also, government investments variable had significant coefficients in fixed effects approach. Finally, considering explanatory power of the models, fixed effects estimators exhibited quite high goodness of fit in all the models comparing pooled OLS approach.

However, there is a vast debate on the literature referring the estimation problem of speed of convergence when using panel data models including pooled OLS and fixed effect estimators (Barro and Sala-i-Martin,1995; Canova and Marcet, 1995; Durlauf and Quah, 1999; Arbia and Piras, 2005; Piras and Arbia, 2007). In this respect, there is an evidence that speed of convergence estimations in panel data framework tend to be quite high vis-à-vis the results from cross-sectional approach (Barro and Sala-i-Martin, 1995). An earlier study by Islam (1995) which used fixed effect estimator to control for individual specific- time invariant effects produced extremely high convergence rates among economies. Arbia and Piras (2005) stated that in order to overcome such a problem, one should include a long time series in panel data. Nevertheless, it is yet another issue in panel data considering the difficulties to obtain long time series for data expressed at the regional level.

**5.Conclusion**

This study aims to empirically investigate convergence across NUTS 2 regions in Turkey for time period between 2004-2011. In this respect, we conducted some analysis based on the CV, cross-sectional OLS and panel data in context of σ and β convergence approaches. The econometric models were estimated for different specifications depending on different assumptions about the error term. Results of σ-convergence across the regions showed that CV tends to decrease when per capita GVA decrease across regions despite slightly diverge in 2011. Thus, we concluded that that σ-convergence exists across NUTS 2 regions in Turkey for the time period 2004-2011.

In the second part of the analysis, we tested both absolute and conditional β-convergence hypothesis based on a cross-sectional regression for NUTS 2 regions. In this respect, firstly we reached the result that parameter of the initial year GVA per capita is significantly negative in unconditional model. Therefore, it can be said that there is a clear evidence for presence of unconditional β-convergence across regions between 2004-2011. Also, the slope of the regression line showed that the estimated β coefficient for the whole period equals 1.52%. Comparing with the earlier results observed worldwide, it can be concluded that the regions experienced relatively a slow catching-up process for this period. Secondly, we explored conditional convergence and so role of government in growth process by means of control variables. Accordingly, significant negative sign of initial year GVA per capita in the model including control variables revealed the existence of conditional β-convergence across the regions. Also, the positive and significant sign of fixed investment incentives variable refers that the fixed investment incentives provided by government is one of the determinants in regional growth. Unlike investment incentives, coefficient of regional government investments estimated as negative and statistically insignificant. Lastly, the convergence rate obtained from conditional model is much more high (2.77%) than absolute one.

In addition to the cross-sectional analysis of convergence approach, we employed a panel data estimation in a range of models including control variables. The models estimated for both pooled OLS and fixed effects showed that coefficients of log of initial year GVA per capita are significant and negative. Thus, we reached the result that presence of both absolute and conditional β-convergence of NUTS 2 Regions in Turkey between 2004-2011 by means of panel approach. Also, coefficients of control variables were positive in all the models but they differed by significance level in pooled OLS and fixed effects estimations. Among the control variables, coefficients of investment incentives were found statistically significant despite the fact that fixed effects estimator produced insignificant results. Also, government investments variable had significant coefficients in fixed effects approach. Considering explanatory power of the models, fixed effects estimators exhibited quite high goodness of fit in all the models comparing with pooled OLS approach.

Finally, all the empirical results support the hypothesis of regional convergence. In context to convergence process role of government is likely to be decisive to meet the regional economic disparities. Despite the fact that the difficulties to obtain long time series for data expressed at the regional level in Turkey, some critics could be addressed to the study due to absence of long time series observation. However, a further research might be expanded by assessing other indicators that could be determinants of convergence process. Also, the present paper may be considered as a point of departure for some future studies on regional convergence.

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**References**

Arbia, G. and Piras, G. (2005). Convergence in per-capita GDP across European regions using panel data models extended to spatial autocorrelation effects, Istituto Di Studi E Analisi Economica, Working paper n.51.

Barro, R. J. and Sala-i-Martin, X. (1991). Convergence across states and regions, *Brookings Papers on Economic Activity*, 1, 107–158.

Barro, R. J. and Sala-i-Martin, X. (1992). Convergence, *Journal of Political Economy*, 100, 223–251.

Barro, R. J. and Sala-i-Martin, X. (1995). *Economic growth*. New York: McGraw-Hill.

Baumol, W. J. (1986). Productivity growth, convergence, and welfare: what the long-run data show. *American Economic Review*, 76(5), 1072-1085.

Berber M., Yamak. R. and Artan, S., (2000). Türkiye'de Yakınlaşma Hipotezinin Bölgeler Bazında Geçerliligi Üzerine bir Çalışma: 1975-1997, 9th National Regional Science Conference Proceedings, Trabzon.

Bonnefond, C. (2014). Growth Dynamics and Conditional Convergence Among Chinese Provinces: A Panel Data Investigation Using System GMM Estimator, *Journal of Economic Development*, 39(4), 1-25.

Canova F. and Marcet, A. (1995). The poor stay poor: non-convergence across countries and regions, Discussion Paper No 1265, Center for Economic Policy Research (CEPR), London.

Cuaresma, J. C., Ritzberger-Grünwald, D. and Antoinette Silgoner, M. (2008). Growth, convergence and EU membership, *Applied Economics*, 40(5), 643-656.

Durlauf, S. N. and Quah, D. (1999). The new Empirics of Economic Growth, in *Handbooks of Macroeconomics* (Eds) J. Taylor and M. Woodford, Vol. 1A, North-Holland, 235-308.

Filiztekin, A. (1999). Convergence Across Turkish Provinces and Sectoral Dynamics, Background paper for Turkey: Economic Reforms, Living Standards and Social Welfare Study, World Bank Report, Poverty Reduction and Economic Management Unit, World Bank.

Friedman, M. (1992). Do Old Fallacies Ever Die?, *Journal of Economic Literature*, 30(4), 2129-2132.

Gaulier, G., Hurlin, C. and Jean-Pierre, P. (1999). Testing Convergence: A Panel Data Approach, *Annales d'Économie et de Statistique*, 55/56, 411-427.

Gerni, C., Sarı, S., Sevinç, H. and Emsen, Ö., S., (2015). Bölgesel Dengesizliklerin Giderilmesinde Yatırım Teşviklerinin Rolü ve Başarı Kriteri Olarak Yakınsama Analizleri: Türkiye Örneği, International Conference On Eurasian Economies 2015 Proceedings, Kazan, Russia.

Gezici, F. and Hewings, G. J. D., (2004). Regional Convergence and Economic Performance of Peripheral Areas in Turkey, *Review of Urban and Regional Development Studies*, 16(2), 113-13.

Greene, W. H. (2012). *Econometric Analysis*, Seventh Edition, New Jersey: Prentice Hall.

Hirschman, A. (1958). *The Strategy of Economic Development*, New Haven: Yale University.

Islam,N. (1995). Growth empirics: A panel data approach, *Quarterly Journal of Economics*, 4,1127-1170.

Karaalp, S. and Erdal, F. (2009). Bölgeler Arası Gelir Farklılıklarının Azalmasında Yığılma Ekonomilerinin Etkisi: Beta Yakınsama Analizi, EconAnadolu 2009 Conference Proceedings, Eskişehir, Turkey.

Lee, M., Longmire, R., Matyas, L. and Harris, M. (1998). Growth convergence: some panel data evidence, Applied Economics, 30(7), 907-912.

Leo, M., Papadopoulos, A. P. and Papanikos, G. T. (2004). Regional convergence in Greece in the 1980s: an econometric investigation, *Applied Economics*, 36, 881–888.

Lopez-Rodriguez, J. (2008). Regional Convergence in the European Union: Results from a Panel Data Model, *Economics Bulletin*, 18(2), 1-7.

Magrini, S. (2004). Regional (di)convergence, in *Handbook of Regional and Urban Economics* (Eds) J. Vernon Henderson and Jacques Thisse, Elsevier, 2741-2796.

Michelis, L. and Neaime, S. (2004). Income Convergence in the Asia-Pacific Region, *Journal of Economic Integration*, 19(3), 470-498.

Ministry of Development (2015). *Kamu Yatırımlarının İllere Göre Dağılımı*, Yatırım Programlama, İzleme ve Değerlendirme Genel Müdürlüğü, Ankara.

Ministry of Economy (2016). İstatistikler ve Yayınlar, http://www.ekonomi.gov.tr/portal/content/conn/UCM/uuid/dDocName:EK-229074, date of access: 10.09.2016.

Myrdal, G. (1957). *Economic Theory and Underdeveloped Regions*, London: University Paperbacks, Methuen & Co Ltd.

Özgül, S. and Karadağ, M. (2015). Regional Convergence in Turkey Regarding Welfare Indicators, *Sosyoekonomi*, Vol. 23(24), 38-50.

Piras, G. and Arbia, G. (2007). Convergence in per-capita GDP across EU-NUTS2 regions using panel data models extended to spatial Autocorrelations Effects, Statistica, 67(2), 157-172.

Quah, D. T. (1996). Empirics for economic growth and convergence, *European Economic Review*, 40, 1353-1375.

Reza, R. and Karimi, Z. T. (2008). Evaluation of the income convergence hypothesis in ten new members of the European union: A panel unit root approach, *Panoeconomicus*, 55(2), 157-166.

Sağbaş, İ. (2002). Türkiye'de Kamu Harcamalarının Yakınsama Üzerindeki Etkisi, *Afyon Kocatepe Üniversitesi İ.İ.B.F. Dergisi*, 4(2), 137-148.

Sala-i-Martin, X. (1996). Regional Cohesion: Evidence and Theories of Regional Growth and Convergence, *European Economic Review*, 40, 1325–1352.

Şenesen, Ü., (2002). Türkiye'de Bölgesel Gelir Dağılımında Son Gelişmeler, 10th National Regional Science Conference Proceedings, İstanbul.

Shen, D., Wang, R. and Yi, N. (2008). Analysis of the Convergence of Regional Economic Growth in Beijing, *International Journal of Business and Management*, 3(10), 52-58.

Studenmund, A. H. (1992). Using Eonometrics: A Practical Guide, Second Edition, New York: Harper Collins Publishers.

TURKSTAT (2016). Merkezi Dağıtım Sistemi (MEDAS), https://biruni.tuik.gov.tr/medas/?kn=116&locale=tr, date of access: 10.09.2016.

Varblane, U. and Vahter, P. (2005). *An Analysis of the Economic Convergence Process in the Transition Countries*, Tartu University Press, Estonia (ISSN 1406–5967).

Vojinović, B., Acharya, S. and Próchniak, M. (2009). Convergence Analysis Among the Ten European Transition Economies, *Hitotsubashi Journal of Economics*, 50(2): 17-35.

Wallace, T. D. and Silver, J. L. (1988). *Econometrics: An Introduction*, Reading, Massachusetts: Addison-Wesley Publishing Company.

Wooldridge, J. M. (2010). *Econometric Analysis of Cross Section and Panel* Data, Second Edition, Cambridge: MIT Press.

Yıldırım, J., Özyıldırım, S. and Öcal, N., (2004). Regional Income Inequality and Economic Convergence in Turkey: A Spatial Data Analysis, 17th ERSA Regional Science Summer Institute Conference Proceedings, Split, Coratia.

Zeren, F. and Yilanci, V. (2011). Türkiye'de Bölgeler Arası Gelir Yakınsaması: Rassal Katsayılı Panel Veri Analizi Uygulaması, *Business and Economics Research Journal*, 2(1), 143-151.

**Appendix**

**Classification of Statistical Regional Units, NUTS 2 in Turkey**

| Region Code | Provinces | Region Code | Provinces |
|---|---|---|---|
| TR10 | İstanbul | TR71 | Kırıkkale, Aksaray, Niğde, Nevşehir, Kırşehir |
| TR21 | Tekirdağ, Edirne, Kırklareli | TR72 | Kayseri, Sivas, Yozgat |
| TR22 | Balıkesir, Çanakkale | TR81 | Zonguldak, Karabük, Bartın |
| TR31 | İzmir | TR82 | Kastamonu, Çankırı, Sinop |
| TR32 | Aydın, Denizli Muğla | TR83 | Samsun, Tokat, Çorum, Amasya |
| TR33 | Manisa, Afyonkarahisar, Kütahya, Uşak | TR90 | Trabzon, Ordu, Giresun, Rize, Artvin, Gümüşhane |
| TR41 | Bursa, Eskişehir, Bilecik | TRA1 | Erzurum, Erzincan, Bayburt |
| TR42 | Kocaeli, Sakarya, Düzce, Bolu, Yalova | TRA2 | Ağrı, Kars, Iğdır, Ardahan |
| TR51 | Ankara | TRB1 | Malatya, Elazığ, Bingöl, Tunceli |
| TR52 | Konya, Karaman | TRB2 | Van, Muş, Bitlis, Hakkari |
| TR61 | Antalya, Isparta, Burdur | TRC1 | Gaziantep, Adıyaman, Kilis |
| TR62 | Adana, Mersin | TRC2 | Şanlıurfa, Diyarbakır |
| TR63 | Hatay, Kahramanmaraş, Osmaniye | TRC3 | Mardin, Batman, Şırnak, Siirt |