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# Do Investment Incentives Promote Regional Growth and Income Convergence in Turkey?

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# Do Investment Incentives Promote Regional Growth and Income Convergence in Turkey?

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## Abstract

This paper contributes to the literature on the growth and income convergence effects of investment incentives in Turkey in four ways: Firstly, in addition to neoclassical conditional Beta-convergence, it modifies the Sigma-convergence approach to investigate the direct impact of investment incentives on regional convergence. Secondly, it applies Prais-Winsten regressions with heteroskedastic panels-corrected standard errors (PCSE) to address autocorrelation, heterogeneity, and endogeneity problems in a panel context. Thirdly, it investigates the significance of the lagged impact of investment incentives. Fourthly it uses the most recent investment incentives data from 2004-2018 for 81 provinces grouped into 6 regions. The estimation results indicate convergence, but investment incentives have significant time-lagged impacts in relatively high income regions only.

Keywords: regional income convergence; regional investment incentives; panel data analysis; Turkey

JEL Classification: R11; R50; O47; C23

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## Non-technical Summary

Regional development policy aims to build and sustain balanced economic development across regions. Governments either directly invest more in relatively less developed regions or design various investment incentive programs to achieve these goals. Regional and provincial income disparities have been a longstanding controversy for policy makers in Turkey. Yet, despite being one of the most debated issues, only a few empirical studies have been conducted, with mixed results. This paper examines income convergence dynamics among 81 provinces in Turkey for 2004-2018. Also, it focuses on the role that government investment incentive programs play in convergence.

The paper contributes to the limited literature on the impact of investment incentives on regional income growth and convergence in Turkey in five ways. Firstly, it utilize a new data set for 81 provinces grouped into 6 regions according to their economic development level. Secondly, it investigates the significance of the lagged impact of investment incentives. Thirdly, it applies Prais-Winsten regressions with heteroskedastic panels-corrected standard errors (PCSE) to address autocorrelation, heterogeneity, and endogeneity problems in a panel context. Fourthly, it examine the impact of trade openness as it creates significant heterogeneity across provinces and regions. Fifth, in addition to the neoclassical conditional Beta-convergence, it modifies the Sigma-convergence approach to investigate the direct impact of investment incentives directly on regional convergence.

The estimation results indicate income convergence across the provinces. However investment incentives have significant time-lagged impacts in relatively high income regions only.

## 1. Introduction

Regional development policy aims to build and sustain balanced economic development across regions. Governments either directly invest more in relatively less developed regions or design various investment incentive programs to achieve these goals. Investigating the impact of such programs on economic growth and convergence provides a wide range of research opportunities for researchers.

Regional and provincial income disparities have been a longstanding controversy for policy makers in Turkey. Yet, despite being one of the most debated issues, only a few empirical studies have been conducted, with mixed results. While some find evidence of convergence (e.g. Tansel and Güngör 1998; Sağbaş 2002; Doğruel and Doğruel 2003; Erlat 2005; Yıldırım 2006; Yıldırım and Öcal 2006; Yıldırım et al. 2009; Ersungur and Polat 2010; Önder et al. 2010; Zeren and Yılancı 2011; Aslan and Kula 2011; Gerni et al. 2015; Özgül and Karadağ 2015; Aksoy and Gönel 2016; Akçagün 2017; Gömleksiz et al. 2017), others indicate no such trend (e.g. Berber et al. 2000; Erk et al. 2000; Altınbaş et al. 2002; Gezici and Hewings 2004;Erlat and Özkan 2006; Filiztekin 2009) or even divergence (Atalik 1990; Filiztekin 1999, 2009; Temel, et al. 1999; Karaca 2004; Filiztekin and Çelik 2010; Karahasan 2017). Gezici and Hewings (2007) argue that although overall inequalities are decreasing, spatial dependence is becoming more dominant; in other words, while developed provinces exacerbate overall income inequalities, they have spread effects on their neighbors. Aksoy et al. (2019) recently reported neither absolute nor conditional convergence but convergence clubs across Turkish regions. Their results indicate a clear separation between Turkey's eastern and western regions, as reported earlier by Çelebioğlu and Dall'erba (2010).

In this paper, we examine income convergence dynamics among 81 provinces in Turkey for 2004-2018. We are also interested in the role that government investment incentive programs play in convergence. Since their implementation in 2001, investment incentive programs have been revised several times in recent years. One of the priorities has been to ensure regional economic and social harmony by eliminating regional income disparities.

Only a few of the studies listed above investigated the impact of government expenditure and investment incentives on regional and provincial economic growth and convergence. Using pre-2001 data, Önder et. al (2010) found a positive and significant effect of public capital on regional convergence whereas Sağbaş (2002) and Yıldırım (2006) reported no significant relationship. According to Yıldırım et al. (2009), government expenditure may even widen the gap between Turkey's eastern and western regions. Employing more recent data (since new investment support and incentive programs were implemented in 2004) Although Gerni et al. (2015) report that regional scale investment incentive practices have not significantly increased income convergence, Gömleksiz et al. (2017) still argue that government investment is likely to be decisive in solving regional economic disparities.

Investigations of the impact of investment incentives and regional growth and convergence using panel data face several issues. Firstly, estimations may be biased by reverse causality; that is, dependent variables, particularly investment incentives, are likely to be correlated with the dependent variable – economic growth in a neoclassical model. Secondly, omitting any variable (e.g. due to data availability) in the regression analysis that may affect regional income growth and convergence may create endogeneity problems if that variable is related with one of the independent variables. One possible solution is applying GMM or IV techniques with fixed effects of first-differences. However, such approaches have been criticized for being subject to the weak instruments problem, which is particularly problematic with panel data analysis (Stock et al., 2002; Dufour, 2003). The third issue is potentially biased results due to ignoring the regional spillover effect. Linkages between neighboring regions imply that regional economic variables are likely to be interdependent, which may put the validly of the estimation results in doubt. In studies of Turkey, only Yıldırım (2006), Yıldırım and Öcal (2006), and Yıldırım et al. (2009) have used spatial spillover analysis to control for these effects.[1] Fourth, as Mohl and Hagen (2010) show, the impact of investment incentives may be time lagged. However, this has not yet been analyzed for Turkey.

Given this background, we contribute to the limited literature on the impact of investment incentives on regional income growth and convergence in Turkey in four ways. Firstly, we utilize a new data set for 81 provinces grouped into 6 regions according to their economic development level. This allows us to examine the differential impact of investment incentives on regions supported at varying rates and over different time periods. We also compare our results to those for regions classified using NUTS-1, the most frequently used classification system in the literature.[2] Secondly, we account for the impact of time lags on investment incentive effects. Thirdly, we introduce additional spatial heterogeneity into the analysis by adding dummy variables for each region one by one to detect differences in the

[1] Only those studies investigating the relationship between investment incentives and growth are referred to above.
[2] In accordance with EU regional policies, the Nomenclature of Territorial Units for Statistics (NUTS) provides a geocode standard for referencing the subdivisions of countries for statistical purposes. Accordingly, Turkey regrouped its 81 provinces (NUTS - III) into 26 sub-regions (NUTS - II), and 12 regions (NUTS - I). The NUTS-I regions are listed in Appendix Table A2.

estimated coefficients. Fourthly, we examine the impact of trade openness because this creates significant heterogeneity across provinces and regions, which may affect the estimation results. None of the studies listed above considered this factor.

The significance of investment incentives on income growth and convergence can be examined using conditional Beta-convergence modeling, which focuses on identifying possible catching-up processes. However, Beta-convergence has a number of limitations.[3] In particular, it is likely that random shocks or differences in the fundamentals of provincial/regional economies lead them to converge towards different steady states. Alternatively, Sigma-convergence describes reductions of income disparities across regions for a given time frame. This approach has the advantage of directly describing the distribution of income across provinces/regions. Accordingly, in the first part of the empirical analysis, we examine conditional Beta-convergence for Turkey's provinces and regions. In the second part, we focus on Sigma-convergence. However, in contrast to previous studies, we compose an income convergence indicator with cross-sectional and time dimensions to investigate directly the impact of investment incentives on the regional convergence. Like Yıldırım (2006), Yıldırım and Öcal (2006), Yıldırım et al. (2009), and Gömleksiz et al. (2017), besides analyzing conditional Beta-convergence, we analyze income convergence. However, we conduct a regression-like examination between convergence and investment incentives.

Finally, we use Prais-Winsten regressions with heteroskedastic panels-corrected standard errors (PCSE) (Beck and Katz 1995), which has not been used in this literature before. PCSE is preferred to deal with the aforementioned issues, because the inclusion of both cross-

[3] See also Quah (1993).

sectional and time-fixed effects enables the regression analyses to account for unobserved common factors. In addition, by assuming a serial correlation of type AR(1), PCSE can deal with additional correlation issues across variables, including adding lags to the model, without losing the first observation.

The rest of the paper is structured as follows. Section 2 briefly reviews the theoretical background of the convergence hypothesis before briefly discussing investment incentive programs and regional income convergence. Section 3 describes the data while Section 4 presents the modeling issues and the results of the empirical analysis. Section 5 offers some conclusions.

## 2. Theoretical Background and Brief Review of the Relevant Literature

There are two basic approaches in the analysis of convergence. The first, the neo-classical growth theory (Beta-convergence), assumes that, in a group of countries or regions, poorer ones tend to grow faster than rich ones, which eventually leads to convergence in per capita income (Solow, 1956; Swan, 1956). This convergence is explained by the faster rate of diminishing returns to capital in production, which is relatively abundant in rich countries. Accordingly, growth should lead economies to reach the same long-run steady-state, called absolute Beta-convergence, characterized by a rate of growth that depends only on the (exogenous) rates of technological progress and labor force growth. In this case, funding or supporting accumulation of physical capital in capital scarce regions temporally boosts their growth along the transition to steady-state levels.

According to the endogenous growth theory (Romer 1986, 1990), the steady-state may depend on economy specific features, in which case convergence will still occur, but not necessarily at the same long-run level. Features such as factor endowment or institutions, or the utilization of technology, which can vary between economies or even over the long-run, determine the level of GDP per capita (conditional Beta -convergence). In this case, regional policy may play an important role in determining long-term growth rates if it promotes R&D or human capital capacity. Thus, Aschauer (1989) and Barro (1990) predict that if public infrastructure is an input in the production function, it may foster capital accumulation and growth.

In contrast to endogenous growth theory, the economic geography literature (Krugman 1991; Krugman and Venable 1995) argues that interregional transportation infrastructure stimulates trade between the regions by reducing transportation costs, affects industry location decisions, and favors agglomeration in richer regions. Once transportation costs fall below some critical level, then a "core-periphery" pattern emerges among regions whereby manufacturing firms tend to locate in those regions with high demand. This makes income grow faster in the core, leading to income divergence. As transportation costs continue to fall, firms will have the incentive at some point to move from the core to the periphery, thereby initiating convergence.

According to the trade theory of comparative advantage, countries or regions specializing in those sectors in which they have a comparative advantage benefit from trade and globalization. Hence, investment incentive programs to improve the comparative advantage of each region may contribute effectively to improving productive capacity and reducing income disparity between regions.

Since the seminal papers of Barro and Sala-i-Martin (1992) and Mankiw et al. (1992), the neo-classical growth model has become a benchmark in the convergence literature.[4] Basically, it measures the degree to which a region's GDP growth rate is related to its initial level (absolute Beta-convergence) and ultimately to a set of additional conditioning explanatory variables (conditional Beta-convergence).[5]

However, the neoclassical growth model has several shortcomings, such as lack of robustness in the choice of control variables, multicollinearity, heterogeneity, endogeneity, and measurement problems (Durlauf et al. 2005). Firstly, the use of regional datasets requires that the specific problems of spatial dependence be addressed. Regional economic variables are likely to be interdependent due to various factors, such as proximity, technology spillover, migration, and production linkages. These spatial effects therefore need to be controlled for in convergence analyses. Monfort (2008) suggests either introducing spatial lags, cross-regressive models (accounting for the fact that the growth rate of one region also partly depends on either the growth rate or income level of surrounding regions) or spatial error models (accounting for possible systematic measurement errors due to the spatial correlation of model variables that make the assumption of the spatial independence of the error terms too restrictive).

[4] Barro and Sala-i-Martin (2004), Duarlouf at al. (2005).
[5] Sala-i-Martin (1996) points that there is a regularity in the estimated speed of converge to steady-state at around 2% a year.

The second problem is that structural differences between regional economies may lead to spatial heterogeneity. This means that the economic relationship is not stable over space, indicating structural instability, and/or that the variances-covariance of the error term varies across observations, indicating group-wise heteroscedasticity. Spatial heterogeneity is characterized by the possibility of multiple, locally stable, steady-state equilibria to which economies with similar fundamentals converge (Durlauf and Johnson, 1995). This can be illustrated by specific geographical patterns, such as East and West (core-periphery) or the concept of convergence clubs.

Thirdly, Monfrot (2008) notes difficulties in drawing a single general conclusion from the vast panel of existing studies because, given the issues above, the Beta-convergence approach strongly depends on the specification adopted (absolute or conditional convergence, inclusion of independent variables, incorporation of spatial effects) and on the observations (period and regions considered, dataset used). Consequently, some economists argue that Sigma-convergence should be preferred in examining whether income distribution across economies is becoming more equitable (Friedman 1992; Quah 1996). That is, Beta-convergence examines a possible catching-up process whereas Sigma-convergence focuses on reductions in disparities among regions over time.

There are various alternative measures of Sigma-convergence in the literature, of which the most frequently used are standard deviation, coefficient of variation, and interquartile range. However, other indicators exist, such as the Lorenz curve, the Gini coefficient, the Atkinson index, the Theil index, and the Mean Logarithmic Deviation (MLD).

The coefficient of variation, which is a normalized measure of dispersion of a probability distribution, is defined as the ratio of the standard deviation to the mean. The interquartile range is a measure of variability based on dividing a data set into quartiles and computed as the difference between the upper and lower quartiles. For a symmetric distribution, the interquartile range is equal to the median absolute deviation.

The Lorenz curve, which may be the simplest representation of inequality, shows the percentage of income owned by x per cent of the population. Namely, the further away the Lorenz curve is to the 45-degree line, the more unequal is the distribution of income. The Gini coefficient measures the extent to which the distribution within an economy deviates from a perfectly equal distribution. It is computed as the ratio of the area between the Lorenz curve and the area under the 45-degree line. The Atkinson index measures which end of the distribution contributes the most to observed inequality. Intuitively, it represents the percentage of total income that a given society would have to forego to have more equal income shares. The index is formed by imposing a parameter to weight incomes, where greater weight can be placed on changes in a given portion of the income distribution by choosing the appropriate level of "inequality aversion”.

The Theil index, a special case of the generalized entropy index with a coefficient 1, is computed as the maximum possible entropy of the data minus the observed entropy. It can be viewed as a measure of redundancy, lack of diversity, isolation, segregation, inequality, non-randomness, and compressibility. In other words, it corresponds to the sum of average inequality within subgroups and inequality among those subgroups, a property referred to as “decomposability”. Similar to the Theil index, the MLD is a special case of the generalized entropy index with a coefficient 0. The MLD is zero when everyone has the same income and takes increasingly larger positive values as incomes become more unequal.

Note that the weighting schemes and implicit welfare functions vary across the measures. For example, the MLD is more sensitive to changes at the lower end of the distribution whereas the Theil index is more sensitive to changes at the upper end. The Gini coefficient is more sensitive to changes in inequality around the median whereas the coefficient of variation is responsive to changes at the upper end of the distribution. Consequently, ranking distributions and time series patterns may not be the same for different measures. The general approach is therefore to compute a variety of measures and then compare the outcomes.

The neoclassical growth model is commonly applied to analyzing the impact of investment on regional economic growth and convergence. The limited literature on Turkey generally follows this approach. However, Yıldırım (2006), Yıldırım and Öcal (2006), and Yıldırım et al. (2009) applied both conditional Beta-convergence, emphasizing spatial effects, and Sigma-convergence by computing the Theil index for different regions of Turkey. Gömleksiz et al. (2017), in the first part of their analysis, computed regional coefficients of variation. Overall, the literature reports a converging trend but notes a changing pattern in the growth rate of regional income over time.

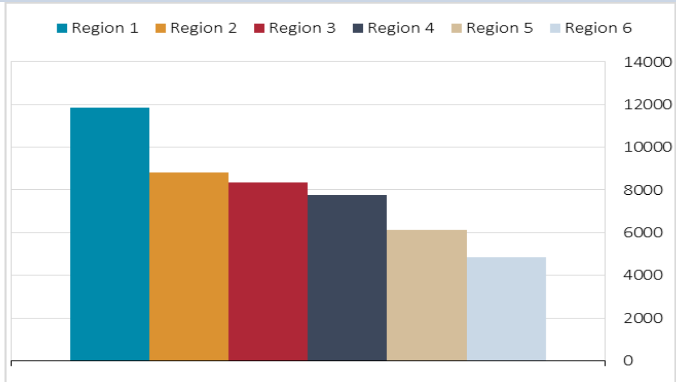
In addition to the shortcomings listed above, the Sigma-convergence approach also has some limitations for empirical analyses. Conditional Beta–convergence or the neoclassical models remain popular because it is practical to test the impact of several exogenous variables on economic growth. In contrast, Sigma-convergence measures cross-sectional income dispersion so that dispersion over time can be monitored. However, it is difficult to examine the impact of any regional or provincial specific factors on the dispersion.

The difference of our study from the literature is that, besides applying the neo-classical growth model, we modify the Sigma-convergence model to develop an approach that allows testing of the significance of exogenous province/regional specific factors on income convergence.

## 3. Investment Incentive Programs and Income per capita

Turkey's investment incentive programs, implemented in 2001 and later revised, comprise 4 different schemes: general investment incentive schemes, regional investment incentive schemes, priority investments incentive schemes and strategic investment incentive schemes. Each program offers different support measures (value added tax exemptions, customs duty exemptions, tax deductions, income tax withholding support, and land allocations) at different rates and over different periods (Appendix Table 1A). They have the following objectives: (1) allocating savings to highly productive resources; (2) increasing employment and income; (3) enhancing national competitiveness and productive capacity; (4) ensuring regional economic and social harmony by removing regional income disparities; (5) attracting more foreign investment and making all regions as equally attractive to them as possible.

### Graph 1. Average per capita GDP of Provinces in Turkey's Regions, 2005-2018 (USD Dollar )




Source: TurkStat

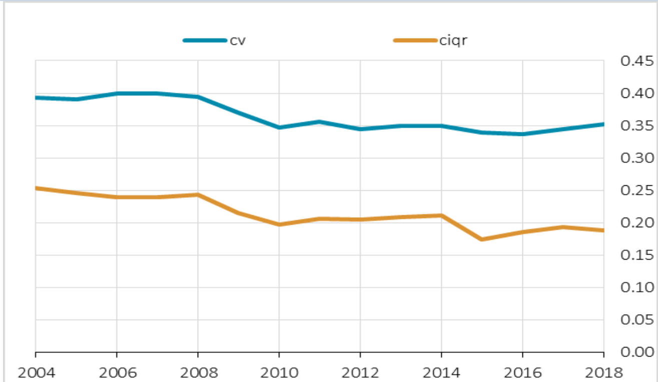
The investment incentive program groups Turkey's 81 provinces into 6 regions according to their economic development and provides support measures favoring lower income regions (Table 2A and 3A). However, as Graph 1 and Table 1 show, despite this, Region 1, which includes provinces with high per capita GDP, benefits the most from the support programs. In fact, there is a positive relationship between average income and fixed capital investment using these support programs.

### Table 1: Share of Regions in Fixed Capital Investment using Incentive Programs (%)

| | 2005-2009 | 2010-2014 | 2015-2018 | 2005-2018 |
|---|---|---|---|---|
| Region 1 | 49.6 | 49.9 | 38.9 | **46.6** |
| Region 2 | 14.3 | 16.6 | 16.1 | **15.7** |
| Region 3 | 14.9 | 12.5 | 20.8 | **15.7** |
| Region 4 | 5.9 | 8.8 | 7.9 | **7.5** |
| Region 5 | 6.9 | 5.7 | 5.0 | **5.9** |
| Region 6 | 2.4 | 4.1 | 3.1 | **3.2** |

Source: Ministry of Industry and Technology

Graph 2: Coefficient of Variation (cv) and Coefficient of Interquartile Range (ciqr) between Provinces' per capita GDP




Source: TürkStat and Our Computation

Graph 2 shows the income disparity across 81 provinces in Turkey using the coefficient of variation and coefficient of interquartile range indicators. The coefficient of variation is computed by dividing the cross-sectional standard deviation of per capita GDP by its mean. The coefficient of interquartile range measures relative dispersion by dividing the difference between the third and first quartiles of per capita GDP by the sum of the first and third quartiles of per capita GDP. As both indicators show, after a sudden drop in income disparity between 2008 and 2010, the rate has remained more or less stable.

## 4. Models and Results

### 4.1 Neoclassical Growth Model

In the first step, we apply the neoclassical Solow-Swan growth framework to estimate the relationship between investment incentives and growth. Similar to the empirical approach of

Enderveen et al. (2006), Bähl (2008), and Mohl and Hagen (2010), we estimate the following growth model:[6]

$$\ln(y_{i,t}) - \ln(y_{i,t-1}) = \beta_0 + \beta_1\ln(y_{i,t-1}) + \beta_2(n_{i,t-1} + g + \delta) + \beta_3 e_{i,t-1} + + \beta_4 trd_{i,t-1} \quad (1)$$

$$+ \beta_5\ln(inv_{i,t-1}) + u_{i,t}$$

$$u_{it} = \mu_t + \mu_i + \epsilon_{it}$$

$$\epsilon_{it} = \rho_i\epsilon_{it-1} + e_{it}$$

where the subscript i=1…81 denotes the province; t indicates the time index of the sample from 2005 to 2018; $y_{i,t}$ is the real per capita GDP of province i at time t; $n_{i,t-1}$ is the population growth rate; g and $\delta$ stand for the exogenous rate of technological progress and the rate of depreciation.[7] The rate of human capital accumulation, $e_{i,t-1}$, is proxied by the ratio of high school graduates and their equivalents to the total population in province i at time t.

Unfortunately, there is limited data at the province level for the explanatory variables. To the best of our knowledge, there are no updated saving or investment data at provincial level in Turkey. However, the related literature using regional data does not provide strong results regarding the existence of a statistically significant relationship between these variables and growth. The inclusion of lagged GDP in regressions may account for the effects of these structural variables.

Trade openness is a widely accepted indicator of economic productivity. The idea is that the more open the market, the stronger the competition, which results in more efficient use of

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[6] They investigated the impact of EU structural funds on regional economic growth.
[7] Following Mankiw et al. (1992), g and $\delta$ are assumed to be constant.

resources. Accordingly, to include further structural differences across the provinces, a trade openness indicator ($\mathrm{trd}_{\mathrm{i,t-1}}$) is added to the regression analysis, measured as exports plus imports divided by per capita GDP. Based on their claim that structural funds are beneficial when used in productive projects, Ederveen et al. (2006) included an interaction term for structural fund and trade openness in their regression analysis. In contrast, we include trade openness as a separate determinant of growth since it may influence the productive use of other explanatory variables as well.

The main variable of interest is the amount of funds spent on fixed capital investment using incentive programs ($\mathrm{inv}_{\mathrm{i,t-1}}$). In line with the measurement of other variables in the regression model we express it in per providence total population.[8] Note that the amount of investment included in this analysis includes completed and ongoing projects in the relevant year. For similar reasons, Mohl and Hagen (2010) note that structural funds projects, such as infrastructure investments, only become effective after a certain time lag. To deal with these issues in the regression analysis, we follow Mohl and Hagen (2010) approach and start the empirical analysis by excluding any investment variable before adding its lagged values to the model one by one, from lag one to five. However, the estimated individual coefficients and standard errors of investment cannot be interpreted because the inclusion of several lags leads to multicollinearity. Therefore, in line with Mohl and Hagen (2010), we calculate short-term elasticity as the sum of investment coefficients and long-term elasticity as the sum of the

[8] See also Esposti and Bussoletti (2008), and Mohl and Hagen (2010).

investment coefficients divided by (1- $\beta_1$). The significance of both long and short-term elasticities can be tested using Wald test statistics.

There are several issues in the panel data analysis of investment and income. For example, both shocks to an individual investment scheme and shocks to income level may be correlated across the panel members. To account for these issues, we use Prais and Winsten linear regression with panel-corrected standard errors (PCSE) for the empirical analysis (Beck and Katz 1995). This technique is an alternative to feasible generalized least squares for fitting linear panel models when the disturbances are not assumed to be independent and identically distributed. Instead, the disturbances are assumed to be either heteroskedastic or contemporaneously correlated across panel members. They may also be assumed to be auto-correlated within a panel while the autocorrelation parameter may be constant across panels or different for each panel member.

Accordingly, disturbances $\epsilon_{it}$ is assumed to follow a stationary AR(1) process, such that $|\rho_i| < 1$ and $u_{it}$ is i.i.d. Parameters $\mu_t$ and $\mu_i$ are time and cross-region fixed effects respectively. They are independent of $\epsilon_{it}$, so that $\epsilon_{it}$ can account for the remaining interdependency problems in the regression analysis. The summary statistics are shown in Table 2 below.

### Table 2: Summary Statistics

| | Mean | Std. Dev | Min | Max |
|---|---|---|---|---|
| Real per capita GDP growth | 0.122 | 0.052 | -0.09 | 0.312 |
| Ln real per capita GDP | 9.508 | 0.617 | 7.925 | 11.280 |
| Pop. growth | 0.964 | 1.737 | -10.8 | 16.28 |
| Education | 0.194 | 0.043 | 0.072 | 0.338 |
| Trade openness | 0.133 | 0.173 | 0.000 | 0.946 |
| Ln per capita investment [1] | 10.168 | 1.683 | 0.000 | 15.279 |

Note: Number of observations is 1,134 for real per capita GDP growth and 1,215 for other variables.
1. Fixed capital investment using support programs includes the number of completed and ongoing investment projects in the relevant period.

Data for income, population, education, and trade are taken from Turkish Statistics. These statistics are available on an annual basis from 2004 to 2018. Total fixed capital investment made using any of the investment incentive programs are taken from the Ministry of Industry and Technology.

Of previous empirical studies focusing on Turkey, our approach is close to Yıldırım et al. (2009). However, they employed a cross-sectional analysis in which the explanatory variables were computed as averages for 1990-2001. Our regional classification also differs. They used NUTS 1, 2 and 3 whereas we classify provinces according to the scheme used in the regional investment incentive program as a benchmark case. We then compare the results to those using the NUTS1 classification (Table A4). Moreover, we included different explanatory variables. They modelled growth rate as a function of average education level, fertility rate, unemployment rate, and regional per capita government investment expenditure.

### Table 3: PCSE Estimation Results for Equation 1

| Models | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| ln real GDP pc (t-1) | -0.0207** | -0.0206** | -0.0213** | -0.0219** | -0.0231** | -0.0269** |
| | *(-5.2900)* | *(-4.8400)* | *(-4.5600)* | *(-4.2300)* | *(-4.1400)* | *(-4.3700)* |
| Education rate (t-1) | 0.0741** | 0.0740** | 0.0736** | 0.0602* | 0.0516 | 0.0709* |
| | *(2.3900)* | *(2.3700)* | *(2.2300)* | *(1.6700)* | *(1.3500)* | *(1.6500)* |
| Pop. Growth(t-1) | -0.0028** | -0.0028** | -0.0029** | -0.0031** | -0.0030** | -0.0027** |
| | *(-4.0500)* | *(-4.0400)* | *(-4.2300)* | *(-4.3000)* | *(-4.0900)* | *(-3.5400)* |
| Trade (t-1) | 0.0244** | 0.0244** | 0.0244** | 0.0229** | 0.0259** | 0.0326** |
| | *(3.8300)* | *(3.8300)* | *(3.6400)* | *(3.1900)* | *(3.4500)* | *(4.4000)* |
| ln investment (t-1) | | -0.0001 | -0.0007 | -0.0007 | -0.0009 | -0.0011 |
| | | *(-0.0700)* | *(-0.7600)* | *(-0.6800)* | *(-0.8100)* | *(-0.9400)* |
| ln investment (t-2) | | | 0.0011 | 0.0010 | 0.0009 | 0.0006 |
| | | | *(1.2300)* | *(1.0600)* | *(0.8300)* | *(0.5200)* |
| ln investment (t-3) | | | | -0.0001 | -0.0001 | -0.0002 |
| | | | | *(-0.0600)* | *(-0.1100)* | *(-0.1400)* |
| ln investment (t-4) | | | | | 0.0000 | -0.0003 |
| | | | | | *(0.0000)* | *(-0.3000)* |
| ln investment (t-5) | | | | | | -0.0005 |
| | | | | | | *(-0.4200)* |
| Ln investment joint elasticity | | | 0.0004 | 0.0003 | -0.0001 | -0.0015 |
| | | | [0.7213] | [0.8410] | [0.9422] | [0.4486] |
| Ln investment long-term elasticity | | -0.0001 | 0.0004 | 0.0003 | -0.0001 | -0.0014 |
| | | [0.9438] | [0.7211] | [0.8410] | [0.9423] | [0.4495] |
| No. of observation | 1134 | 1134 | 1053 | 972 | 891 | 810 |
| Number of provinces | 81 | 81 | 81 | 81 | 81 | 81 |

Note: ** and * denote significance at the 5% and 10% levels, respectively. T-statistics and p-values are reported in parenthesis and square brackets, respectively.

The regression results for Equation 1 are reported in Table 3. For all models, initial GDP is negative and statistically significant, fluctuating between -0.021 and -0.026. The sizes of the estimated coefficients are comparable to those in Bähr (2008) and Ederveen et al. (2006) but smaller than those reported in Dall'erba and Le Gallo (2008) and Mohl and Hagen (2010). The respective estimate (conditional Beta-convergence) for the Turkish economy varies depending on the empirical method used in the regression analysis. For cross-sectional methods, the estimated coefficient varies roughly between -0.01 and -0.2. Only in Yıldırım et al. (2009), who takes heterogeneity and autocorrelation issues into account by employing alternative spatial regression methods, the size of the estimated coefficient is around -1.1. In contrast, Gömleksiz et al. (2017), who employ both pooled and fixed effect panel data analysis, report coefficient estimates of -0.01 from the pooled panel data analysis and -0.3 from the fixed effect model. [9]

A significant negative coefficient of lagged initial per capita GDP is evidence of convergence, i.e. conditional beta convergence, implying that provinces with a low initial per capita income grow faster than those with a high initial per capita income.[10] Although our results indicate convergence, Mohr and Hagen (2010) note that one should be cautious on deriving such solid predictions about convergence when the time period for the analysis is limited.

Furthermore, as expected, the estimated coefficients of education are positive and significant, except for one case. The size estimates vary between 0.05 and 0.07, which is larger than those reported in Yıldırım et al. (2009)[11], Bähr (2008), and Ederveen et al. (2006). The coefficients of population growth rate are negative and significant in all cases. The estimated coefficients are smaller than those reported in the relevant literature. Finally, trade openness is a significant growth enhancing factor in all cases. The trade openness coefficients vary between 0.02 and 0.03.

[9] Gömleksiz et al (2017) also perform cross-sectional analysis and their results are comparable to those from their pooled model.

[10] Convergence is evidence that the analysis covers a long enough time period (Baumol (1986), Barro (1990), Mankiw et al. (1992) and Sala-i-Mart´ın (1996) or set up using several 5-year averages (Islam (1995) and Ederveen et al. (2006)). Islam (2003) and Barro and Sala-i-Martin (2004) note that convergence is only valid for more or less similar economies on their convergence path.

[11] Their estimated results are 0.044 from the OLS and SAR and 0.029 from SEM regressions.

Turning to our key variable of interest, fixed capital investments made using incentive programs, Table 3 reports mixed findings. Depending on the lag structure, the estimated coefficients switch signs. None of the estimated coefficients for lagged investment are significant. The lower part of Table 3 shows that neither short-term nor long-term elasticities are significant. The lack of a significant impact of investment incentive for per capita GDP growth is consistent with Gerni et al. (2015). However, as noted in Dall'erbo and Le Gallo (2008), this result may be related to additional heterogeneities that our estimation techniques still cannot identify.

As noted above, incentive schemes are designed to support provinces in different regions that are classified according to their economic development. Investors in low income regions benefit from lower tax rates, exemptions, and lower interest rates for longer periods, in addition to other support items. Hence, similar to the empirical approach in Dall'erbo and Le Gallo (2008), Equation 1 can be modified as follows to account for the implications of incentive programs for 6 regions subject to different investment incentive schemes.

$$\ln(y_{i,t}) - \ln(y_{i,t-1}) = \beta_0 + \beta_1 \ln(y_{i,t-1}) + \beta_2 n_{i,t-1} + \beta_3 e_{i,t-1} + \beta_4\,\text{trd} + \beta_5 \ln(\text{inv}_{i,t-1}) \qquad (2)$$

$$+\theta_0 * D_r + \theta_1 * D_r * \ln(y_{i,t-1}) + \theta_2 * D_r * n_{i,t-1} + \theta_3 * D_r * e_{i,t-1}$$

$$+\theta_4 * D_r * \text{trd} + \theta_5 * D_r * \ln(\text{inv}_{i,t-1}) + u_{i,t}, \quad r=1\ldots6$$

$$u_{it} = \mu_t + \mu_i + \epsilon_{it}$$

$$\epsilon_{it} = \rho_i \epsilon_{it-1} + e_{it}$$

where $D_r$ is the dummy that takes the value of one if the province is in region r. In this case, βs measure the coefficient estimates for regions other than r while θs represent the differencing impacts. Thus, the coefficient estimates for region r are $\varphi = \beta + \theta$.

The estimation of Equation 2 reveals significant estimates of lagged real per capita GDP for all regions. Region 5 has the highest coefficient estimate followed by Regions 4 and 3. Table 4 reports the estimated coefficients for both short and long-term elasticities for investment, our key variables of interest, for each region.[12] For region 1, all the estimated coefficients are positive and significant while the estimated long-term elasticities vary between 0.005 % and 0.013 % and the size increases with the inclusion of lags. For region 2, estimated elasticities are significant and positive when one or two lags are included. The coefficients are larger in the first lag whereas, after the second lag, the impact of investment on regional growth decreases to become insignificant. For region 3, the estimated elasticities are significant only when restricted with one lag.

The results suggest that, although regions 4, 5, and 6 received better investment supporting measures, they did not benefit from the programs as much as expected. None of the joint coefficient estimates and long-term elasticities are significant. Dall'erba and le Gallo (2008) report no significant relationship between structural funds and income growth for neither periphery nor core. Our results are in line with economic geography theory predictions and suggest that investment incentives stimulate the agglomeration of economic activity in more developed regions. Table 5 shows that our results do not change even if we use the NUTS1 regional classification. The significance of the coefficients for the short and long-term effects of investment decreases as the per capita income of the regions falls (see Graph 2A).

[12] The results for the other explanatory variables are available on request.

## Table 4: PCSE Estimation Results for Equation 2

| Models | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|
| **Region 1** | | | | | |
| Ln investment joint elasticity | 0.0050** | 0.0074** | 0.0077** | 0.0082** | 0.0127** |
| | [0.0042] | [0.0023] | [0.0054] | [0.0115] | [0.0002] |
| Ln investment long-term elasticity | 0.0049** | 0.0072** | 0.0077** | 0.0081** | 0.0126** |
| | [0.0041] | [0.0022] | [0.0054] | [0.0114] | [0.0002] |
| **Region 2** | | | | | |
| Ln investment joint elasticity | 0.0029** | 0.0028* | 0.0021 | 0.0005 | -0.0009 |
| | [0.0395] | [0.0619] | [0.2041] | [0.7799] | [0.6764] |
| Ln investment long-term elasticity | 0.0029** | 0.0027* | 0.0021 | 0.0005 | -0.0008 |
| | [0.0384] | [0.0606] | [0.2024] | [0.7797] | [0.6768] |
| **Region 3** | | | | | |
| Ln investment joint elasticity | 0.0022* | 0.0016 | -0.0005 | -0.0018 | -0.0024 |
| | [0.0713] | [0.2192] | [0.7671] | [0.3156] | [0.2179] |
| Ln investment long-term elasticity | 0.0021* | 0.0016 | -0.0005 | -0.0018 | -0.0024 |
| | [0.0699] | [0.2177] | [0.7674] | [0.3173] | [0.2196] |
| **Region 4** | | | | | |
| Ln investment joint elasticity | 0.0016 | -0.0003 | -0.0019 | -0.0040* | -0.0032 |
| | [0.1537] | [0.8048] | [0.2713] | [0.0464] | [0.1496] |
| Ln investment long-term elasticity | 0.0016 | -0.0003 | -0.0018 | -0.0039* | -0.0031 |
| | [0.1520] | [0.2177] | [0.2726] | [0.0478] | [0.1507] |
| **Region 5** | | | | | |
| Ln investment joint elasticity | 0.0007 | 0.0000 | -0.0015 | 0.0002 | 0.0003 |
| | [0.4938] | [0.9731] | [0.4150] | [0.9147] | [0.9199] |
| Ln investment long-term elasticity | 0.0007 | 0.0000 | -0.0014 | 0.0002 | 0.0003 |
| | [0.4931] | [0.9731] | [0.4160] | [0.9147] | [0.9198] |
| **Region 6** | | | | | |
| Ln investment joint elasticity | -0.0010 | 0.0012 | -0.0073 | -0.0055 | -0.0268 |
| | [0.9107] | [0.9333] | [0.6699] | [0.7994] | [0.2953] |
| Ln investment long-term elasticity | -0.0010 | 0.0011 | -0.0071 | -0.0054 | -0.0259 |
| | [0.9107] | [0.9333] | [0.6997] | [0.7993] | [0.2943] |

Note: ** and * denote significance at the 5% and 10% levels, respectively. P-values are reported in square brackets.

## Table 5: PCSE Estimation Results for Equation 2 (NUTS1 Classification 12 Regions)

| Models | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|
| **Region 1** | | | | | |
| Ln investment joint elasticity | 0.0204** | 0.0309** | 0.0512** | 0.0153 | -0.0055 |
| | [0.0009] | [0.0492] | [0.0001] | [0.2785] | [0.7884] |
| Ln investment long-term elasticity | 0.0204** | 0.0313** | 0.0497** | 0.0154** | -0.0053 |
| | [0.0011] | [0.0533] | [0.0000] | [0.0000] | [0.7889] |
| **Region 2** | | | | | |
| Ln investment joint elasticity | -0.0014 | 0.0000 | 0.0042 | 0.0066* | 0.0091** |
| | [0.6892] | [0.9908] | [0.2862] | [0.0955] | [0.0423] |
| Ln investment long-term elasticity | -0.0013 | 0.0000 | 0.0041 | 0.0063** | 0.0087** |
| | [0.6898] | [0.9908] | [0.2824] | [0.0000] | [0.0382] |
| **Region 3** | | | | | |
| Ln investment joint elasticity | 0.0024 | 0.0033 | 0.0058 | 0.0060 | -0.0014 |
| | [0.5179] | [0.5203] | [0.3849] | [0.3690] | [0.8262] |
| Ln investment long-term elasticity | 0.0024 | 0.0033 | 0.0057 | 0.0058 | -0.0014 |
| | [0.5159] | [0.5177] | [0.3793] | [0.3629] | [0.8267] |
| **Region 4** | | | | | |
| Ln investment joint elasticity | 0.0105** | 0.0177** | 0.0172** | 0.0198** | 0.0129** |
| | [0.0009] | [0.0001] | [0.0007] | [0.0005] | [0.0495] |
| Ln investment long-term elasticity | 0.0100** | 0.0168** | 0.0165** | 0.0190** | 0.0126** |
| | [0.0008] | [0.0000] | [0.0005] | [0.0003] | [0.0445] |
| **Region 5** | | | | | |
| Ln investment joint elasticity | 0.0208** | 0.0188 | 0.0325* | 0.0262 | 0.0381 |
| | [0.0455] | [0.2071] | [0.0625] | [0.2071] | [0.1353] |
| Ln investment long-term elasticity | 0.0191** | 0.0172 | 0.0291** | 0.0238 | 0.0336 |
| | [0.0398] | [0.1951] | [0.0487] | [0.1838] | [0.1072] |
| **Region 6** | | | | | |
| Ln investment joint elasticity | 0.0048* | 0.0074* | 0.0100** | 0.0116** | 0.0155** |
| | [0.0840] | [0.0595] | [0.0330] | [0.0347] | [0.0117] |
| Ln investment long-term elasticity | 0.0047* | 0.0071* | 0.0095** | 0.0111** | 0.0146** |
| | [0.0812] | [0.0561] | [0.0297] | [0.0307] | [0.0093] |
| **Region 7** | | | | | |
| Ln investment joint elasticity | -0.0019 | -0.0072 | -0.0114* | -0.0031 | 0.0101 |
| | [0.5350] | [0.1273] | [0.0650] | [0.6596] | [0.2297] |
| Ln investment long-term elasticity | -0.0019 | -0.0071 | -0.0113* | -0.0030 | 0.0095 |
| | [0.5366] | [0.1331] | [0.0718] | [0.6618] | [0.2194] |
| **Region 8** | | | | | |
| Ln investment joint elasticity | -0.0011 | 0.0008 | 0.0021 | -0.0011 | -0.0021 |
| | [0.4179] | [0.6779] | [0.3895] | [0.6871] | [0.5064] |
| Ln investment long-term elasticity | -0.0011 | 0.0008 | 0.0020 | -0.0011 | -0.0020 |
| | [0.4189] | [0.6774] | [0.3872] | [0.6880] | [0.5087] |
| **Region 9** | | | | | |
| Ln investment joint elasticity | -0.0014 | 0.0002 | -0.0012 | 0.0054 | 0.0047 |
| | [0.7282] | [0.9589] | [0.8261] | [0.4614] | [0.5968] |
| Ln investment long-term elasticity | -0.0014 | 0.0002 | -0.0012 | 0.0053 | 0.0047 |
| | [0.7286] | [0.9589] | [0.8263] | [0.4600] | [0.5957] |
| **Region 10** | | | | | |
| Ln investment joint elasticity | -0.0033 | -0.0050 | -0.0080 | -0.0074 | -0.0137 |
| | [0.2967] | [0.1926] | [0.1056] | [0.2244] | [0.0369] |
| Ln investment long-term elasticity | -0.0033 | -0.0049 | -0.0080 | -0.0073 | -0.0135** |
| | [0.3009] | [0.1980] | [0.1126] | [0.2328] | [0.0435] |
| **Region 11** | | | | | |
| Ln investment joint elasticity | -0.0026 | -0.0028 | -0.0011 | -0.0036 | -0.0108** |
| | [0.2584] | [0.4275] | [0.7903] | [0.4698] | [0.0483] |
| Ln investment long-term elasticity | -0.0025 | -0.0028 | -0.0011 | -0.0035 | -0.0106** |
| | [0.2614] | [0.4305] | [0.7908] | [0.4735] | [0.0544] |
| **Region 12** | | | | | |
| Ln investment joint elasticity | 0.0015 | 0.0062 | 0.0025 | 0.0015 | 0.0068 |
| | [0.6076] | [0.1409] | [0.6391] | [0.8289] | [0.4100] |
| Ln investment long-term elasticity | 0.0015 | 0.0059 | 0.0024 | 0.0014 | 0.0063 |
| | [0.6065] | [0.1360] | [0.6373] | [0.8283] | [0.4030] |
| **N. of observation** | 1,134 | 1,053 | 972 | 891 | 810 |

Note: **and *denote significance at the 5% and 10% levels, respectively. P-values are reported in square brackets.

## 4.2 Estimation Results for the Conditional Sigma-Convergence

From the analysis above, we conclude that investment incentive programs support growth in Regions 1, 2, and to some extent 3 while having no significant impact on growth in Regions 4, 5, and 6. However, we also detected some signs of the convergence of income as the estimated coefficients of initial per capita GDP are significantly negative. In this part, we further investigate the impact of investment incentive programs on income convergence across the regions and provinces directly.

The following model can be formulated using the framework for Equation 1:

$$cmd\_y_{i,t} = \alpha_0 + \; + \alpha_2 cmd\_n_{i,t-1} + \; \alpha_3 cmd\_e_{i,t-1} + \alpha_4 cmd\_trd_{i,t-1} \qquad (3)$$

$$+\alpha_5 cmd\_inv_{i,t-1} + u_{it}$$

$$u_{it} = \mu_t + \mu_i + \epsilon_{it}$$

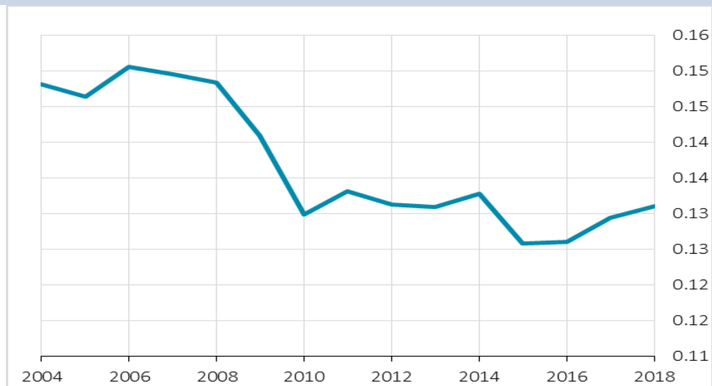
$$\epsilon_{it} = \rho_i \epsilon_{it-1} + e_{it}$$

where $cmd\_y_{i,t} = \frac{y_{i,t} - \bar{y}_{t-1}}{y_{i,t} + \bar{y}_{t-1}}$, $cmd\_n_{i,t-1} = \frac{n_{i,t-1} - \bar{n}_{t-2}}{n_{i,t-1} + \bar{n}_{t-2}}$, $cmd\_e_{i,t-1} = \frac{e_{i,t-1} - \bar{e}_{t-2}}{e_{i,t-1} + \bar{e}_{t-2}}$, $cmd\_trd_{i,t-1} = \frac{trd_{i,t-1} - \overline{trd}_{t-2}}{trd_{i,t-1} + \overline{trd}_{t-2}}$ and $cmd\_inv_{i,t-1} = \frac{inv_{i,t-1} - \overline{inv}_{t-2}}{inv_{i,t-1} + \overline{inv}_{t-2}}$, so that each variable in Equation 3 is expressed as a coefficient of the cross-sectional mean deviation ($cmd$) at time t. Values of the mean deviation of a variable, say $x$ ($x - \bar{x}$), may be affected by the size and number of observed values in the data set.[13] Thus, the mean deviation of two or more than two sets of data may differ. Therefore, to compare the degree of variation in different sets of data, we compute a relative measure, called the coefficient of mean deviation, and divide the mean deviation by the sum of the current period

[13] $\bar{x}$ is the mean of a variable $x$.

values and the cross-sectional mean $(x + \bar{x})$ for each province. All other model properties in Equation 1 are assumed for Equation 3 as well.

Graph 3: Cross-provincial Average of the Absolute Values of the Coefficient of Mean Deviation of per capita GDP




Source: TürkStat and Our Computation

Graph 3 shows the cross-provincial average of the absolute values of the coefficient of mean deviation computed using per capita GDP. There is about 97 % correlation between our new indicator ($cmd$) and $cv$ and $ciqr$ reported in Graph 2.

The estimation results for Equation 3 are reported in Table 6. The overall results are in line with expectations. Increases in the dispersion of education and trade have positive and significant impacts on income dispersion across provinces. The estimated coefficients for education and trade are largest when two lags are added to the model. The impact remains high for education but goes down for trade as the lag size increases to 5. No significant linkage was detected between population growth dispersion and income dispersion. Finally, Table 6 reports a strong contribution of dispersion in investment to dispersion in income among provinces. The magnitude of the estimated impact increases from 0.04 % to 0.15 % as the lag size goes up.

Table 6: PCSE Estimation Results for Equation 3

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Education rate ($cmd - e_{i,t-1}$) | 0.2307** | 0.4816** | 0.3888** | 0.3686** | 0.3957** | 0.3813** |
| | (9.6700) | (20.7000) | (14.4900) | (12.4600) | (13.5200) | (13.5500) |
| Pop. Growth($cmd - n_{i,t-1}$) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| | (0.2600) | (-0.0100) | (0.5100) | (0.5300) | (0.5600) | (1.0000) |
| Trade ($cmd - trd_{i,t-1}$) | 0.0765** | 0.0806** | 0.0680** | 0.0581** | 0.0547** | 0.0423** |
| | (11.3300) | (13.9200) | (9.2000) | (6.7800) | (6.6600) | (5.2100) |
| ln investment ($cmd - inv_{i,t-1}$) | | 0.0207** | 0.0193** | 0.0213** | 0.0219** | 0.0232** |
| | | (6.7400) | (6.7300) | (7.2300) | (7.2600) | (7.3300) |
| ln investment ($cmd - inv_{i,t-2}$) | | | 0.0196** | 0.0284** | 0.0303** | 0.0325** |
| | | | (6.7300) | (8.6100) | (8.8800) | (8.7400) |
| ln investment ($cmd - inv_{i,t-3}$) | | | | 0.0213** | 0.0315** | 0.0373** |
| | | | | (7.2300) | (9.3800) | (10.2200) |
| ln investment ($cmd - inv_{i,t-4}$) | | | | | 0.0237** | 0.0360** |
| | | | | | (8.1100) | (10.3800) |
| ln investment ($cmd - inv_{i,t-5}$) | | | | | | 0.0240** |
| | | | | | | (8.0100) |
| Ln investment joint elasticity | | | 0.0389** | 0.0710** | 0.1075** | 0.1530** |
| | | | [0.000] | [0.000] | [0.000] | [0.000] |
| No. of observation | 1134 | 1134 | 1053 | 972 | 891 | 810 |
| Number of provinces | 81 | 81 | 81 | 81 | 81 | 81 |

Note: ** and * denote significance at the 5% and 10% levels, respectively. T-statistics and p-values are reported in parenthesis and square brackets, respectively.

Next, we examine the difference in estimated coefficient with respect to the regions by modifying Equation 3 as follows:

$$cmd\_y_{i,t} = \alpha_0 + + \alpha_2 cmd\_n_{i,t-1} + \alpha_3 cmd\_e_{i,t-1} + \alpha_4 cmd\_trd_{i,t-1} \quad (4)$$

$$+\alpha_5 cmd\_inv_{i,t-1} + +\gamma_0 * D_r + + \gamma_2 * D_r * cmd\_n_{i,t-1}$$

$$+ \gamma_3 * D_r * cmd\_e_{i,t-1} + \gamma_4 * D_r * cmd\_trd_{i,t-1} + \gamma_5 * D_r * cmd\_inv_{i,t-1} + u_{it},$$

$$u_{it} = \mu_t + \mu_i + \epsilon_{it}$$

$$\epsilon_{it} = \rho_i \epsilon_{it-1} + e_{it} \qquad \text{r=1...6}$$

As earlier, $D_r$ is the regional dummy, taking the value 1 if the province is in region r. In this case, α's measure the coefficient estimates for the regions other than r, while γ's represent the differencing impacts. The coefficient estimates for region r will therefore be $\delta = \alpha + \gamma$.

Table 7: PSCE Estimation Results for Equation 4

| | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|
| **Region 1** | | | | | |
| Ln investment joint elasticity | 0.013** | 0.046** | 0.070** | 0.058** | 0.016 |
| | [0.028] | [0.000] | [0.000] | [0.016] | [0.641] |
| **Region 2** | | | | | |
| Ln investment joint elasticity | 0.015** | 0.023** | 0.055** | 0.095** | 0.103** |
| | [0.001] | [0.000] | [0.000] | [0.000] | [0.000] |
| **Region 3** | | | | | |
| Ln investment joint elasticity | 0.003 | 0.003 | 0.023* | 0.042** | 0.048** |
| | [0.474] | [0.722] | [0.087] | [0.018] | [0.038] |
| **Region 4** | | | | | |
| Ln investment joint elasticity | -0.001 | 0.002 | 0.004 | -0.006 | 0.005 |
| | [0.551] | [0.599] | [0.505] | [0.523] | [0.648] |
| **Region 5** | | | | | |
| Ln investment joint elasticity | -0.002 | 0.004 | 0.023** | 0.028** | 0.037** |
| | [0.559] | [0.517] | [0.014] | [0.020] | [0.010] |
| **Region 6** | | | | | |
| Ln investment joint elasticity | 0.002 | 0.011 | 0.029** | 0.052** | 0.079** |
| | [0.555] | [0.164] | [0.010] | [0.001] | [0.000] |
| **No. of observation** | 1,134 | 1,053 | 972 | 891 | 810 |

Note: ** and * denote significance at the 5% and 10% levels, respectively. P-values are reported in square brackets.

Consistent with the results in Table 4, at an early stage of investment, the estimated coefficients are positive and significant for high income regions (Table 7) when income dispersion across the regions is driven by the high investment performance of high income regions. The estimated coefficients only become significant and positive for low income regions when 3 or more lags are included in the regression analysis. In line with the results in Table 7, Table 8 shows that the coefficient estimates are significant for regions listed in both the upper and lower segments of per capita income.

## Table 8: PSCE Estimation Results for Equation 4: NUTS-1 Regions

| | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|
| **Region 1** | | | | | |
| Ln investment joint elasticity | 0.005 | 0.015** | 0.016* | 0.006 | -0.004 |
| | [0.212] | [0.036] | [0.079] | [0.531] | [0.151] |
| **Region 2** | | | | | |
| Ln investment joint elasticity | 0.004 | 0.019* | 0.057** | 0.093** | 0.111** |
| | [0.506] | [0.070] | [0.000] | [0.000] | [0.000] |
| **Region 3** | | | | | |
| Ln investment joint elasticity | 0.002 | 0.004 | 0.017 | 0.043 | 0.050* |
| | [0.852] | [0.738] | [0.391] | [0.104] | [0.073] |
| **Region 4** | | | | | |
| Ln investment joint elasticity | 0.003 | 0.015 | 0.030** | 0.063** | 0.061** |
| | [0.709] | [0.154] | [0.021] | [0.003] | [0.036] |
| **Region 5** | | | | | |
| Ln investment joint elasticity | 0.033** | 0.057** | 0.048 | 0.078* | 0.131** |
| | [0.031] | [0.049] | [0.250] | [0.066] | [0.000] |
| **Region 6** | | | | | |
| Ln investment joint elasticity | 0.006 | 0.007 | 0.002 | -0.010 | -0.044 |
| | [0.311] | [0.595] | [0.928] | [0.698] | [0.200] |
| **Region 7** | | | | | |
| Ln investment joint elasticity | 0.001 | 0.010 | 0.000 | 0.009 | 0.014 |
| | [0.746] | [0.200] | [0.974] | [0.499] | [0.461] |
| **Region 8** | | | | | |
| Ln investment joint elasticity | -0.002 | -0.002 | -0.002 | -0.027** | -0.036** |
| | [0.346] | [0.634] | [0.796] | [0.012] | [0.009] |
| **Region 9** | | | | | |
| Ln investment joint elasticity | 0.008 | 0.020* | 0.027* | 0.053** | 0.041* |
| | [0.233] | [0.065] | [0.083] | [0.002] | [0.062] |
| **Region 10** | | | | | |
| Ln investment joint elasticity | 0.006 | 0.024 | 0.036 | 0.045 | 0.038 |
| | [0.552] | [0.209] | [0.116] | [0.143] | [0.226] |
| **Region 11** | | | | | |
| Ln investment joint elasticity | 0.009 | 0.023** | 0.047** | 0.085** | 0.163** |
| | [0.102] | [0.049] | [0.002] | [0.000] | [0.000] |
| **Region 12** | | | | | |
| Ln investment joint elasticity | 0.003 | 0.011 | 0.021 | 0.044** | 0.066** |
| | [0.700] | [0.332] | [0.186] | [0.030] | [0.004] |
| | | | | | |
| **no. of observation** | 1,134 | 1,053 | 972 | 891 | 810 |

Note: ** and * denote significance at the 5% and 10% levels, respectively. P-values are reported in square brackets.

## 5. Conclusion

This paper evaluated the impact of investment incentives on convergence across 81 provinces in Turkey from 2004 to 2018. We approached the issue using both a conditional Beta and conditional Sigma-convergence framework. Our empirical results are based on panel methods that allowed us to control for both heteroskedasticity, serial and spatial correlation, and endogeneity. We were therefore able to evaluate the effectiveness of investment incentives designed to favor less developed regions.

Our estimation results demonstrate there is convergence, but only in high income regions with a significant impact of investment incentives. This implies that greater regional support efforts are not necessarily effective within less developed regions, at least in their current form. However, where there are uncertainties in global and domestic economies, investment incentives play crucial role in balancing economic conditions across regions. Indeed, it could also be argued that regional disparities could have worsened without these policies.

The empirical literature confirms the importance of regional interconnectivity. That is, the growth performance of a region (particularly if rich) also affects the GDP growth of neighboring regions. Therefore, these policies may be further developed to deepen interregional linkages or promote externalities to increase the effectiveness of incentives in poorer regions. Our results also show how important educational attainment and trade openness are for regional growth. Improving regional financial, technological, and management capabilities, strengthening institutional infrastructure, and easing formalities can also help strengthen interregional linkages, thereby removing regional disparities.

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## Appendix

### Tablo A1: Investment Incentive Programs and their Schemes

| Support Measures | General Investment Incentive Scheme | Regional Investment Incentive Scheme | Priority Investment Incentive Scheme | Strategic Investment Incentive Scheme |
|---|---|---|---|---|
| VAT Exemption | √ | √ | √ | √ |
| Custom Duty Exemption | √ | √ | √ | √ |
| Tax Deduction | | √ | √ | √ |
| Social Security Premium Support (Employer's Share) | | √ | √ | √ |
| Income Tax Withholding Support | √ | √ | √ | √ |
| Social Security Premium Support(Employee's Share) | | √ | √ | √ |
| Interest/Profit Share Support | | √ | √ | √ |
| Land Allocation | | √ | √ | √ |
| VAT Refund | | | | √ |

Source: Ministry of Industry and Technology

### Tablo A2: Classification of Provinces in Regional Incentive Program

| Region 1 | Region 2 | Region 3 | Region 4 | Region 5 | Region 6 |
|---|---|---|---|---|---|
| Ankara | Adana | Balıkesir | Afyonkarahisar | Adıyaman | Ağrı |
| Antalya | Aydın | Bilecik | Amasya | Aksaray | Ardahan |
| Bursa | Bolu | Burdur | Artvin | Bayburt | Batman |
| Eskişehir | Çanakkale | Gaziantep | Bartın | Çankırı | Bingöl |
| İstanbul | Denizli | Karabük | Çorum | Erzurum | Bitlis |
| İzmir | Edirne | Karaman | Düzce | Giresun | Diyarbakır |
| Kocaeli | Isparta | Manisa | Elazığ | Gümüşhane | Hakkâri |
| Muğla | Kayseri | Mersin | Erzincan | Kahramanmaraş | Iğdır |
| | Kırklareli | Samsun | Hatay | Kilis | Kars |
| | Konya | Trabzon | Kastamonu | Niğde | Mardin |
| | Sakarya | Uşak | Kırıkkale | Ordu | Muş |
| | Tekirdağ | Zonguldak | Kırşehir | Osmaniye | Siirt |
| | Yalova | | Kütahya | Sinop | Şanlıurfa |
| | | | Malatya | Tokat | Şırnak |
| | | | Nevşehir | Tunceli | Van |
| | | | Rize | Yozgat | |
| | | | Sivas | | |

Source: Ministry of Industry and Technology

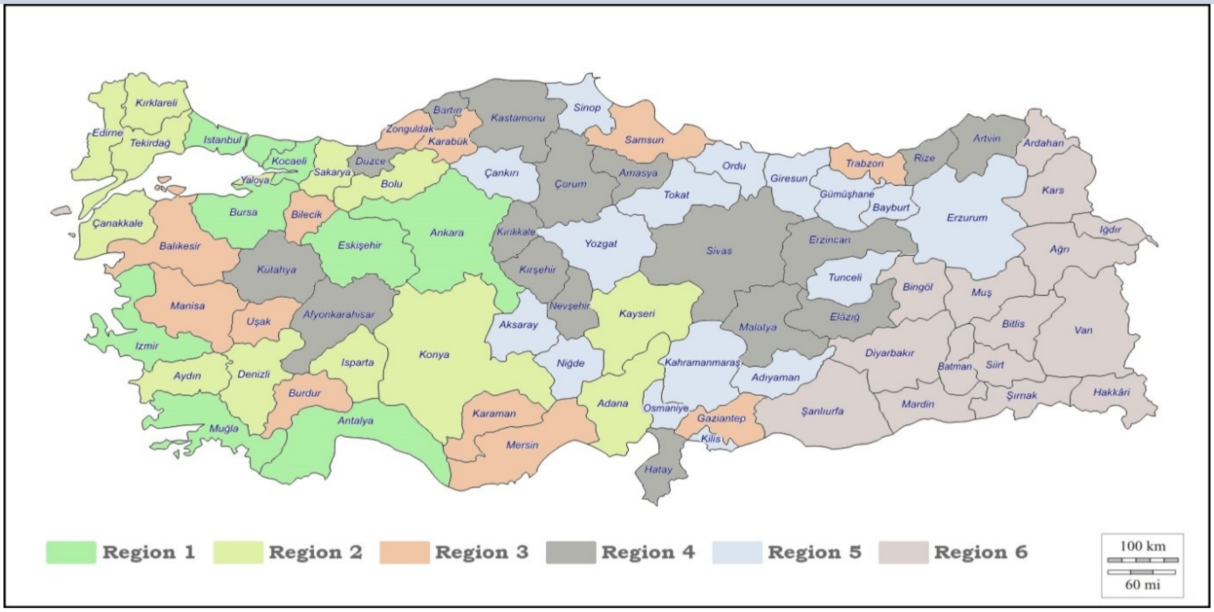
### Tablo A3: Regional Investment Incentive Schemes

| Support Measures | | | Regions | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | I | II | III | IV | V | VI |
| VAT Exemption | | | Yes | Yes | Yes | Yes | Yes | Yes |
| Customs Duty Exemptions | | | Yes | Yes | Yes | Yes | Yes | Yes |
| Tax Deductions | Rate of Contribution to Investment (%) | Out of OIZ or IZ | 15 | 20 | 25 | 30 | 40 | 50 |
| | | Within OIZ or IZ | 20 | 25 | 30 | 40 | 50 | 55 |
| Social Security Premium Support (Employer's Share | Support Period | Out of OIZ or IZ | 2 yrs | 3 yrs | 5 yrs | 6 yrs | 7 yrs | 10 yrs |
| | | Within OIZ or IZ | 3 yrs | 5 yrs | 6 yrs | 7 yrs | 10 yrs | 12 yrs |
| Land Allocation | | | Yes | Yes | Yes | Yes | Yes | Yes |
| Interest/Profit Share Support | Local Loans | | No | No | 3 point | 4 point | 5 point | 7 point |
| | FX Dominated Loans | | No | No | 1 point | 1 point | 2 point | 2 point |
| Social Security Premium Support(Employee's Share) | | | No | No | No | No | No | 10 yrs |
| Income Tax Withholding Support | | | No | No | No | No | No | 10 yrs |

Source: Ministry of Industry and Technology

Note: OIZ: Organized Industrial Zones, IZ: Manufacturing Investments and Specialize Industrial Zones.

## Graph A1: Regional Classification of Provinces in Turkey



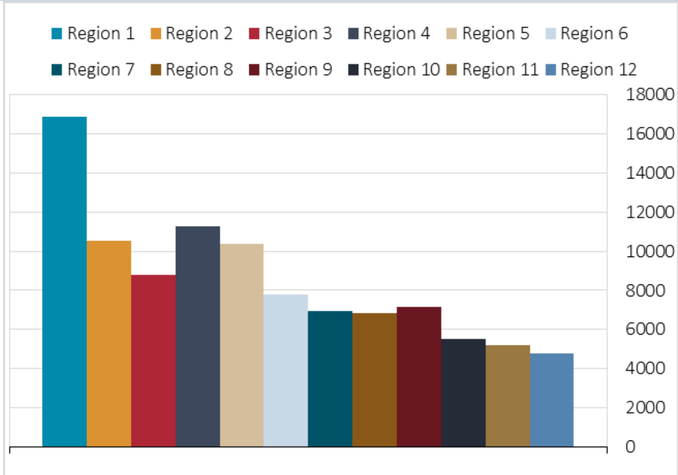

Source: The Ministry of Industry and Technology.

## Tablo A4: Regions NUTS1

| RN1 | RN2 | RN3 | RN4 | RN5 | RN6 | RN7 | RN8 | RN9 | RN10 | RN11 | RN12 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| İstanbul | Tekirdağ | İzmir | Bursa | Ankara | Antalya | Kırıkkale | Zonguldak | Trabzon | Erzurum | Malatya | Gaziantep |
| | Edirne | Aydın | Eskişehir | Konya | Isparta | Aksaray | Karabük | Ordu | Erzincan | Elazığ | Adıyaman |
| | Kırklareli | Denizli | Bilecik | Karaman | Burdur | Niğde | Bartın | Giresun | Bayburt | Bingöl | Kilis |
| | Balıkesir | Muğla | Kocaeli | | Adana | Nevşehir | Kastamonu | Rize | Ağrı | Tunceli | Şanlıurfa |
| | Çanakkale | Manisa | Sakarya | | Mersin | Kırşehir | Çankırı | Artvin | Kars | Van | Diyarbakır |
| | | Afyonkarahisar | Düzce | | Hatay | Kayseri | Sinop | Gümüşhane | Iğdır | Muş | Mardin |
| | | Kütahya | Bolu | | Kahramanmaraş | Sivas | Samsun | | Ardahan | Bitlis | Batman |
| | | Uşak | Yalova | | Osmaniye | Yozgat | Tokat | | | Hakkâri | Şırnak |
| | | | | | | | Çorum | | | | Siirt |
| | | | | | | | Amasya | | | | |

Source: TurkStat

## Graph A2. Average per capita GDP of Provinces in the Regions Classified according to NUTS1, 2005-2018
(USD Dollars)




Source: TurkStat

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