A Convergence Test for Turkish Provinces

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Submitted to the
Institute of Graduate Studies and Research
in partial fulfillment of the requirements for the degree of

Master of Science
in
Economics

Eastern Mediterranean University
February 2022
Gazimağusa, North Cyprus

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ABSTRACT

The divergence and differences of income and as a consequence wealth level are not only observed on nation basis but also observed in smaller scope within the nation, regional basis. The convergence theory fundamentally argues that economies initially lower per capita incomes will grow faster. The purpose of the study is to test the existence of convergence among 81 provinces of Turkey during 2016-2019 period. The beta convergence of those provinces, that is the decrease of disparity in total sectoral growth rate between a high-level and low-level initial income of provinces, has been examined through comparison of their lagged Gross Domestic Product per capita, labor force participation rate, high school graduate ratio, migration, number of doctors and beds in hospital.

In this study, general overview to convergence theory is reviewed by discussing beta, sigma, club convergence as well as unconditional and conditional convergence and empirical literature study is conducted. Within the scope of convergence test, change in total sectoral growth of provinces are tested for three models by using panel data set.

Keywords: Turkish Provinces, Convergence, Growth, Panel Data

ÖZ

Ekonomiler arası farklı gelir ve dolaylı olarak refah düzeylerinin farklılığı sadece ülke bazında değil aynı zamanda ülke ekonomilerinin içinde her bir bölge arasında da gözlenmektedir. Literatürdeki yakınsama teorisi; temelde ulusal veya bölgesel ekonomilerin arasındaki gelir farklılığının ortadan kalkarak zamanla birbirlerinin seviyesine yaklaşacağını öngörmektedir. Bu tezin odak noktası, Türkiye'nin 81 ili arasında 2016-2019 yılları arası hane halkı verilerini kullanarak iller arasında yakınmasa olup olmadığını test etmektir.

Çalışmada yakınsama olgusu ve türleri olan beta ve sigma yakınsaması ile koşullu , koşulsuz ve beta yakınsaması kavramları ele alınmış ve literatür çalışmaları incelenmiştir. Türkiye'nin illeri arasındaki yakınsama testi kapsamında illerin Gayri Safi Yurtiçi Hasıla oranları çalışma içerisinde kısaca incelenmiştir. Çalışmada Türkiye'nin illleri sektörlerin toplam büyüme değişimleri açısından yakınsama gösterip göstermediğine ilşikin olarak panel verilerle üç farklı modelde test yapılmıştır.

Anahtar kelimeler: Türkiye İlleri, Yakınsama, Büyüme, Panel Veri Analizi

To My Beloved Family

ACKNOWLEDGMENT

I would like to record my gratitude to Assoc. Prof. Dr. Çağay Çoşkuner for his supervision, advice, and guidance of this thesis as well as giving me extraordinary experiences throughout the work. Above all and the most needed, he provided me constant encouragement and support in various ways. His ideas, experiences, and passions has truly inspired and enrich my growth as a student. I am indebted to him more than he knows.

I would like to acknowledge the members of my graduate committee for their advice and guidance.

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LIST OF ABBREVIATIONS

GDP	Gross Domestic Product
GDPPC	Gross Domestic Product per Capita
NUTS I	Nomenclature of Units for Territorial Statistic 12 region
NUTS II	Nomenclature of Units for Territorial Statistic 26 subregions
NUTS III	Nomenclature of Units for Territorial Statistic 81 subregions
OECD	Organization for Economic Co-operation and Development
TUIK	Turkish Statistical Institute

Chapter 1

INTRODUCTION

Gross Domestic Product per capita (GDPPC) has been frequently used as measurement tool in development economics and it is considered as the best indicator of living standards and welfare of a nation. The higher GDP per capita signals the advanced development level of an economy, while the lower GDPPC in the economy is considered as an underdevelopment. Economic data show that there is a great variability in GDPPC of the countries. While advanced economies may achieve an annual GDPPC of more than 40000$, some poorer nations have GDPPCs which are less than 1000$ per annum. Nevertheless, some of these less developed countries seem to grow faster so that they have transitioned from low-income to middle-income and further to high-income country status.

Convergence Theory in Economics looks at this issue. More specifically convergence theory states that pooper nations grow faster so that they catch up the GDPPC levels of the rich nations in future steady state. Convergence theory has been presented in literature with Solow Growth model and is an outcome of the Neo-classical growth model. The convergence theory essentially discusses the income divergence and come to conclusion that income convergence exists where undeveloped economies grow faster than the developed ones.

Convergence theory can be studied in two different ways: (i) Beta convergence and (ii) sigma convergence. Beta convergence studies regress the economic growth rate data on initial income levels as well as some other explanatory variables which

influences the growth. According to Convergence Theory, the countries with lower initial GDP per capital levels are expected to grow faster, so that coefficient sign of the initial GDP per capita is expected to be negative if the convergence is to exist among the countries. As for sigma convergence, this is basically studied via the standard deviations of the GDP per capita values, hence the name sigma. One can compute the variance or the standard deviation of GDPPC values among the Nations for each given year. If the standard deviation is declining over the years, this would imply a convergence among these nations.

Convergence theory can be studied as a cross-sectional or panel data study. Either way, convergence theory has been frequently studied as a comparison between countries. Much fewer studies have also been conducted on regional studies where one looks at the convergence of economic or social variables between the regions within a country. This thesis is in line with this second category. More specifically, the purpose of this thesis is to investigate if there is any convergence between the provinces of Turkey. As said, the present study intends to question the existence of regional convergence in Turkey during the period of 2016-2019 in terms of growth rate. Based on the geographical and administrative separation of the country into 81 provinces that is cities, the issue has been investigated employing the panel data of statistical classification of the regions. The beta convergence of those provinces, that is the decrease of disparity in growth rate between a high-level and low-level initial income of provinces, has been examined through comparison of their lagged Gross Domestic Product per capita, labor force participation rate, high school graduate ratio, migration, number of doctors and beds in hospital in this study.

A Panel data convergence is estimated by taking into account three different models; random effect, fixed effect and time-fixed effect models, and the study is conducted based on panel data collected from Turkish Statistical Institute.

Since "observed" imbalances among provinces in terms of economic development and growth are getting wider among cities in Turkey, understanding the process and dynamic of their growth is getting crucial to overcome these discrepancies. Composing convergence theory in growth rate and try to explain with income level, human capital factors and government incentive factors as a diverse perspective is the main intention to contribute in this study.

The study is composed on six chapters. In the first chapter, convergence theory and its relation with our study will introduce. In the second chapter general concepts related to convergence theory; sigma convergence, beta convergence, conditional and unconditional convergence and club convergence will be briefly discussed. In the third chapter; convergence theory literature based on countries and regions among Turkey will be reviewed and classified by based on convergence results. In the fourth chapter, estimation techniques and tests will be discussed. Following to this, in the fifth chapter, the convergence between provinces of Turkey will be tested in accordance with TUIK 2016-2019 data. Lastly, in chapter six, the interpretation of our finding based on model conducted will be discussed.

Chapter 2

CONVERGENCE THEORIES

2.1 Theoretical Background of Convergence and Growth Models

As a consequence of the spreading effects of global petroleum crisis, at the beginning of 80's the search of growth cycle in aspect of underdeveloped and developing countries has become urgent, therefore Convergence Theory became crucial and current issue. (Karakuş,2010) Convergence theory is associated with Neo-classical growth theory, formulated by Solow (1956), finding out the economic growth variables and defines their divergences particularly in terms of growth or income per capita. The theoretic background for the empirical scholarships of income convergence was the neo-classical growth theory. Essentially it indicates that all economies will converge to stable growth level regardless of their initial circumstances. In 1991, Barro and Sala-i Martin advance the notion of income convergence applying the inferences the Solow model and express that under certain conditions; the course of convergence will also occur in incomes per capita and economies with initially lower per capita incomes will grow faster. Extensions of the neoclassical model with globalization speed up the progression of convergence with the mobility of capital, labor and technology that implies poor economies catch up faster to wealthy ones. (Aldan,2005). Consequently, if a statistically significant negative correlation between initial incomes and growth rates of economies are observed, it is claimed that convergence exists.

2.2 Beta Convergence

Beta convergence studies look at the link between the economic growth rate and initial income levels. According to Convergence Theory, the countries with lower initial GDP per capital levels are expected to grow faster, so that coefficient sign of the initial GDP per capita is expected to be negative if the convergence is to exist among the countries. Neo-classical growth theory leads to mainly three testable converge theories: absolute convergence, conditional convergence and club convergence. Let us now review these concepts.

2.2.1 Absolute or Unconditional Convergence

Unconditional or so-called absolute convergence states that catch-up or convergence occur no matter what. According to absolute convergence the poorer economies grow faster than the richer nations, and thus all economies ultimately converge to the same steady-state income level regardless of the economic policies used and regardless of differences in country characteristics such as saving rates and population growth rates. It is assumed that all the economies end up shifting toward a similar level of steady-state due to technology is an exogenous factor of growth.

Absolute convergence states that all countries would converge to the same steady-state value of per capita income in future steady-state, which means that countries with lower initial GDP per capita must grow faster than the richer nations regardless of other conditions. Thus, in regression analysis where GDP growth rate is regressed on explanatory variables, one expects that there is a statistically significant negative coefficient estimate for initial GDP per capita variable while no other explanatory variable has any effect on the growth rate. This would imply that convergence would take place no matter what happens in terms of other explanatory

variables. As one would expect this is a too strong theoretical expectation. Indeed, Slow growth model rather imply conditional convergence.

2.2.2 Conditional beta convergence

In contrast of absolute beta convergence, conditional beta convergence claims that saving rate, technology growth rate, population and share of capital in output are economy-specific variables so; beside initial income per capita, explanatory variables is required as. Steady state varies among countries and region to region.

In the conditional convergence it is assumed that each economy has its own characteristic factors, thus conditional convergence indicates that economies that have similar structural characteristics but diverge in terms of their initial conditions, tend to converge to the same income levels in future steady state. On the other hand, if the countries have different country-specific conditions such as different population growth rates or saving rates, then these countries converge to their own country-specific steady state, hence there would be no convergence.

Therefore, this theory states that convergence would take place on the condition that countries have similar country characteristics. Thus most of empirical studies as well as Solow Growth model actually imply conditional convergence among countries or provinces rather than absolute convergence. (Salai-Martin, 1996). Many remarkable factors by referring to the initial capital level and factors of classical growth model, affect the regional convergence and divergence as technology, human capital, preferences, government incentives and institutions as different steady states.

2.2.3 Club convergence

In club convergence, countries are grouped into a number of categories according to their initial GDP per capita values. For example, countries can be classified as Low-Income, Middle-Income and High-Income countries. Within each

group, convergence takes place so that all countries in the same group (club) converge to the same income level. However, there is no convergence among the countries of different groups.

To sum up, the absolute convergence occurs even when the values such as technology level, saving rate, population growth rate and institutions assumed are not all the same between the economies. Whereas in the case of conditional convergence, convergence to the same income level is on condition that except for initial GDP per capita, countries have the same country characteristics. Otherwise, countries reach to a steady state of its own unique equilibrium. Similarly in the case of club convergence, countries reach to the same income levels in steady state provided that they have similar initial GDP per capita values.

3-Sigma convergence

The Sigma convergence takes dispersion of real GDP per capita as a base where standard deviation is used as measurement tool. Sigma convergence occurs whenever a gradual reduction in the variance of GDP per capita values of the economies over a particular time range. That is, constant diminishing of standard deviation expresses the sigma convergence while opposite occasion expresses the divergence.

The main difference between sigma and beta convergence is that; while beta convergence focuses on growth ability progress of economies, sigma convergence towards to continuation of income distribution of the economy.

Chapter 3

LITERATURE REVIEW

Many studies have been conducted on convergence theory. Baumol (1986), among the pioneers of the convergence studies, examined the correlation between balance of payments, unemployment and industrialization and unproductivity. Logarithm of per capita GDP between 1870-1979 is analyzed for unconditional convergence for 16 countries. According to the first test, the results confirm tendency for convergence.

Following Baumol's studies, Barro& Martin (1991), tested convergence among 48 USA states using GDP rates for the period of 1963-1986. Beta convergence is found and divergence between developed states and underdeveloped states shows diminishing rate of 2% rate is concluded.

Mankiw et al. (1992), In his important study, using natural logarithm of per capita Reel income between 1960-1985, tested for both conditional and unconditional convergence among three different income-level groups; small 98 countries, intermediate 75 countries and 22 OECD countries. According to the results, it emphasizes significant unconditional convergence for OECD countries while there is no indication for beta convergence for the other level countries. Similar study conducted by Islam (1995) by using same panel data and resulted similar conclusion to Mankiw's study. Indeed, the variables of population and technology growth and depreciation rate estimated coefficients are negative which leads to the implication of existence of conditional convergence.

Majority of empirical studies conducted in Turkey conclude a significant provincial convergence mostly focused on real GDP per capita as study's dependent variable. As a consequence of the coup d'état in 1960, economic development plans are taken over in action by State Planning Organization, at that time, aimed to decrease unemployment, raise qualified labor force, balance foreign transactions for the 5 years' periods. Serious development incentives and programs implemented in Turkey from 1960's, peaked especially in earlier 2000's with the process for joining the European Union where the most common regional diversions are based on geographical analysis for growth studies when Turkey reviewed regional statistical division adopted the European classification, whereby Turkey was separated into NUTS I (Nomenclature of Units for Territorial Statistics) (12 regions) , NUTS II (26 subregions) and NUTS III (81 provinces).

In the pursuit of Barro-Sala-i-Martin's study for the period of 1975-1995, the Pioneer study conducted in Turkey (Tansel and Gungor, 1998) emerged within considerable amount of convergence study literatures in Turkey, examines the provincial convergence in labor productivity and productivity growth rates in 67 provinces. The study concludes that there is unconditional beta convergence in productivities per worker among provinces both unconditional and the variances in steady states for human capital are found to rise the speediness of convergence.

Regional and sectoral convergence in Turkey studied by Filiztekin (1998) using 1975-1995 period's GDP. By using panel data and cross-sectional data and it is concluded the existence of conditional convergence with diminishing rate of 1,9% per year. There no evidence concluded for agriculture and service sector whereas significant evidence of convergence concluded for industry and construction sector.

On the other hand, one of the following research projects of Berber et al. (2000) concluded that the NUT 2 (26 sub-regions) of Turkey do not converge and indeed divergence is observed within regions by using panel data and cross-sectional data. Sigma and beta convergence both resulted as divergence for the 1975-1997 period, in terms of per capita income.

In framework of beta convergence, public expenditures is analyzed by Sağbaş (2002) on provincial growth rate by using time series analysis. The explanatory variables as public expenditure is used government spending, government investment, value-added taxes in manufacturing industry and municipal expenditures. According to the test result, growth realize positive relation thus no evidence for convergence is concluded between 1986-1997.

Gezici and Hewings (2004) explore the degree of the change in performance differences of peripheral provinces in Turkey in terms of convergence by considering GDP per capita over the 1980-1997 period. The analysis revealed that provinces resulting in the rejection of the both unconditional and conditional convergence since the growth rate and initial level of income capita are basically not correlated across those provinces. Adding some explanatory variables such as investment rate of neighbor regions in order to test conditional convergence does not change the results.

In 2004 study of Karaca includes the effect of 1960's government development incentives to income convergence among 67 provinces of Turkey during 1975-2000. Both sigma and beta convergence are tested. Beta convergence resulted as a 0,7% absolute divergence among regions indeed no evidence for conditional convergence. According to the sigma result, since rising standard deviation is found then divergence is concluded and counted for as ineffective government incentives implemented.

Yamanoğlu (2008) examined the effects of socio-economic factors on convergence among 67 cities in Turkey during 1990-2001. Explanatory variables used in the study is categorized as follows; Urbanization rate, migration, population growth and birth rate as demographic variables. Labor force participation rate, unemployment rate, agriculture-industry-trade volumes, employer rate on labor market as employment indicators. The length of asphalt road is used as the infrastructure variable. Loan rate Per capita, government incentives, government spending, net import volumes are used as economic variables. He concluded high significancy for absolute convergence among cities with economical, infrastructural, labor and demographical explanatory variables.

Yıldırım et al. (2009) examine regional income inequality and the convergence dynamics in Turkey for the time period 1987–2001. The findings support that there is a significant correlation between the income inequality among provinces and spatial clustering. Empirical findings of the study support both beta and sigma convergence theory that poorer provinces will have a higher speed of convergence than richer provinces. The conclusion part of the study reveals that Eastern and Southeastern provinces had higher speeds of convergence to illustrate.

Doğruel and Doğruel (2003) studied regional convergence income deviation among 67 cities for the 1987-1999 period. Concluded that the existence of both unconditional and conditional beta convergence by using panel data. To analyze the sigma convergence the study categorized the cities to three classifications; low-, middle- and high-income levels and concluded the sigma convergence only for high income level cities.

Another research by Abdioğlu et al. (2013) supports that no significant tendency for convergence along with GDP per capita on 26 sub-regions using panel data methodology during 2004-2008 period. Indeed, government incentives used for fair regional growth in poorer areas are not sufficient enough to converge to richer regions that invites high potential investments that leads more inequal distribution of income.

Zeren et al, (2011) concluded that there is both unconditional and conditional beta convergence for the average of the regional income of Turkey at the NUTS-2 level over the period 1994-2000. The ratio of deposits in GDP as a substitute for financial growth is used to enlighten the differences among the regions and concluded that there is both unconditional and conditional convergence exist for the average income of the regions.

The study investigated regional convergence at NUTS II level by Özgül et al. (2015), for the period between 1980 and 2001 by using cross-sectional data. The various dependent variables which are GDPPC, per person employed GDP and development index are implemented as the growth indicators for convergence test. The effects of illiterate population rate, high school graduated rate, public capital per person, population growth rate on convergence were studied. As a Result, the evidence of unconditional convergence found mostly, where the population growth rate has the most significant result.

Gömleksiz et al. (2017) investigated convergence in terms of GDP per capita across NUTS 2 which is 26 subregions for the 2004 and 2014 period, based on the panel data by including the government and fixed investment incentives as explanatory variables. As a result of the study, the convergence occurs at a regional level.

In the Tables below we present the summary of these papers. Table 1 presents some of the previous studies on convergence among the Turkish provinces while Table 2 highlights some of the papers on Cross-country convergence studies.

Table 1: Empirical Literature on Convergence Theory among Provinces of Turkey

study- year	method	unit	dependant variable	period	finding
filiztekin - 1998	sigma and beta convergence	67 provinces	GDP per capita	1975-1995	conditional convergence , sigma diverngece no absoulte convergence
tansel & Güngör - 1998	absolute beta convergence	67 provinces	Labor Productivity	1975-1995	absolute convergence
Berber et Al. - 2000	sigma and beta convergence	67 provinces	GDP per capita	1975-1997	beta and sigma divergence
Doğruel & Doğruel - 2003	sigma and beta convergence	67 provinces	GDP per capita	1987-1999	conditional convergence , absoulte convergence, sigma convergence only for high income level
karaca - 2004	sigma and beta convergence	67 provinces	GDP per capita	1975-2000	beta and sigma divergence
Gezici&Hewings-2004	sigma and beta convergence	67 provinces	GDP per capita	1980-1997	beta and sigma divergence
Yıldırım et Al.-2009	sigma and beta convergence	67 provinces	GDP per capita	1987-2001	conditional convergence , absoulte convergence, sigma convergence
sağbaş-2002	beta convergence	67 provinces	GDP per capita	1986-1997	no beta convergence
Yamanoğlu-2008	beta convergence	67 provinces	lagged GDP growth	1990-2001	absolute convergence
özgül et Al-2015	beta convergence	NUTS 2- 26 provinces	GDP per capita, GDP employed, development index	1980-2001	absolte convergence
gömleksiz et Al-2015	beta convergence	NUTS 2- 26 provinces	GDP per capita	2004-2014	unconditional convergence
abdioğlu et Al-2013	beta convergence	NUTS 2- 26 provinces	GDP per capita	2004-2015	no beta convergence
zeren et al-2011	sigma and beta convergence	NUTS 2- 26 provinces	GDP per capita	1994-2000	absolute and beta convergence

Table 2: Empirical Literature on Cross-country Convergence

study	method	unit	dependent variable	period	finding
Baumol - 1986	absolute beta convergence	16 countries	lag GDP per capita	1870-1979	absolute convergence
Barro&Martin - 1991	absolute beta convergence	48 USA States	GDP per capita	1963-1986	beta convergence
Mankiw et Al. - 1992	absolute and conditional beta convergence	group of countries	GDP per capita	1960-1985	unconditional convergence
lslam. - 1995	absolute and conditional beta convergence	group of countries	GDP per capita	1960-1985	beta convergence

To sum up, most of the convergence studies among provinces of Turkey concludes conditional convergence. To illustrate; Filiztekin (1998), Tansel (1998) , Doğruel (2003), Yamanoğlu (2008), Yıldırım (2009), Zeren(2011), Gömleksiz (2015) and Özgür (2015). In contrast, conclusion of nonexistence of convergence are following studies by Sağbaş (2002) , Abdioğlu (2003) , indeed , Gezici et Hewing (2004) and Karaca (2004) conclude beta and sigma divergence among provinces of Turkey.

Chapter 4

EMPIRICAL SPECIFICATION and DATA

4.1 Empirical Specification

In line with beta convergence studies and growth literature, in this thesis we use the following regression model given in Equation 1:

Equation 1

$$\textbf{Growth} = \beta_0 + \beta_1 \textbf{ log(lgdppc)} + \beta_2 \textbf{ LFPR} + \beta_3 \textbf{ HSGrad} + \beta_4 \textbf{ tax} + \beta_5 \textbf{ migration} + \textbf{ β6 doctor} + \textbf{β7 hbed}$$

where

"Growth" is the percentage change in the Total Sectoral output;

"lgdppc" is the Lagged Gross Domestic Product per capita for each province in constant Turkish Lira. Due to short span of data, it is used as a substitute for initial GDP per capita.;

"LFPR" is the Labor Force Participation Rate as a percentage value;

"HSGrad" is the high-school graduation rate as a percentage value;

"doctor" is the Numbers of doctors per 1.000 person;

"hbed" is the Numbers of hospital beds per 100.000-person;

"tax" is the percent change in Net Taxes (Taxes-Subsidies) and

"migration" is the percentage value for Net Migration Rate.

In the above equation, logarithm form of Lagged Gross Domestic Product per Capita intends to capture the convergence effect. The higher initial GDP per capita level signals the lower growth rate if the convergence is to exist. On the other hand, lower initial GDP per capita would imply higher growth rate according to convergence theory. Therefore, the expected sign on the coefficient estimate of LGDPPC is negative if there is to be a convergence among the Turkish provinces.

Labor Force Participation Rate shows the percentage of adult (working-age) population who wants to work. This shows economically active population as a percentage regardless of whether they are actually in employment and unemployed. Since labor is a resource for economic production; the implication is that the more the labor intends to participate in work life, the higher growth rate from the previous year. Thus, the expected sign for LFPR is positive.

Similarly, Migration is the net migration rate incoming to the Provinces, and shows an increase in economic resources in the Province over the previous year. Thus net migration would have positive effects on the growth rate of output in each Province. Since labor is one of key factor of economic resources on production function, when it increases with higher LFPR and migration, the total growth increases respectively. However, one also need to be aware of reverse-causality. Migration is also indicator of developing economy where enhanced employment opportunities rises. In other words it is also possible that faster growing Provinces attract higher migration through increasing job-availability. As said, this creates reverse causality.

Numbers of doctors per 1.000 person and Numbers of hospital beds per 100.000-person are the health service variables estimated numeric approximate data for the human capital investment. High school graduation is the percentage rate of education level among citizens for each province. This indicator is mostly used the

human capital investment therefore it is expected to increase growth rate for each period. Thus, for all three variables, the expected signs are positive. One needs to be aware of correlation problems though, given that these variables attempt to mainly capture the same human capital level of each province.

Tax variable is the change in difference between the percentage of taxes collected minus Subsidies received from the government for the province based on the previous year. The expected sign for the coefficient estimated of "tax" can be negative or positive. With direct causality; tax corelates negatively with growth rates of the provinces since it is a leakage and thus leads to a shrink in economic growth. However, there might be also reverse causality where tax correlates positively with the growth rates as higher growth rates may imply higher tax revenues. Therefore, the sign coefficient estimate of tax depends on which factor is more dominant.

We can sum up these in a summary table. Table 3 provides the theoretically expected signs for each explanatory variable:

Table 3: Theoretical Expectations of Explanatory Variables on Dependent Variable Growth

Explanatory Variable	Abbreviation	Expected Effect on Dependent Variable
Initial Lagged Gross Domestic Product per capita	LGDPPC	-
Labor Force Participation Rate	LFPR	+
Numbers of doctors per 1.000 person	DOCTOR	+
Numbers of hospital beds per 100.000 person	HBED	+
High School Graduate rate	HSGRAD	+
Change Ratio of (Taxes-Subsidies)	TAX	??
Migration Rate	MIGRATION	+

4.2 Data

This study makes use of a Panel data for the 81 Provinces of Turkey. The data covers the time period of 2015-2019. All data is derived from TUIK (Turkish Statistics Institute) regional statistics for the given period.

This thesis study has data limitation due to the fact that the data was only available for the time period from 2016 to 2019. Therefore, due to this short time period, some of the results are not as robust as it would be with a larger dataset.

The dependent variable in the regression equation of convergence is the growth rate of total sectoral output of provinces (Growth). Growth is the percentage change of total sectoral output volume based on the previous year. It is the aggregate of the following sectoral growth percentages: Agriculture, forestry and fishing, industry, Manufacturing, Construction, Services, Information and communication, Financial and insurance activities, Real estate activities, Professional, administrative and support service activities, public administration, education, human health and social work activities and other service activities classified by TUIK index.

The explanatory variables used in the study consist of logarithm of lagged GDP per capita based on the previous year figures in Turkish Lira and it covers 81 provinces

Turkey defined as administrative cities in 1999. LFPR is the labor force participation rate of each province, Migration is the change of net migration rate based on the previous year, HBED is the total hospital bed number per 100.000 people, DOCTOR is the total number of doctors per 1.000 people on the specified province driven from TUIK regional statistics. Tax is the change in net taxes which is deduction of subventions from taxes. HSGrad is the high school graduation ratio on the literacy rate in the provinces.

We use the logarithm of lagged Gross Domestic Product per capita measures while for all other variables we use them without logarithm since they are percentage values.

To give the reader an idea on how different the economies of each Province is, we provide a map of Turkish Provinces with their share in Turkish GDP. These can be highlighted as the following:

According to the data provided by TUIK; GDP by provinces and provincial GDP share by provinces in 2019. İstanbul has 30.7% of the total GDP share and have the highest GDP is 1.327.452.000.000.000 TL. Ankara is second province with 395.000.731.000.000 TL and 9.2% share among total. Following that İzmir has 6.1% of the total GDP share with 263.000.038.000 TL and. The last three provinces were Tunceli, Ardahan and Bayburt with 4.000.134.000.000 TL, 3.000.399.000.000 TL and 2.000.840.000.000 TL, respectively.

The highest GDP increase in 2019 compared to the previous year were Siirt with change ratio of 12.8%, and followed by Giresun with 10.6% percentage change and Artvin with 9.8% percentage change. The highest decrease occurred based on the previous year in Zonguldak, , Kırıkkale and Karabük with 8.9%,10.4% and 12.5% percentage change respectively. (TUIK,2019 https://cip.tuik.gov.tr/)

The below map highlights the GDP share rate among provinces of Turkey in 2019 where the dark blue provinces that is the top five provinces are accounted for 53.7% share in total.

Figure 2: The graph of GDP share rate among provinces of Turkey in 2019

Chapter 5

ESTIMATION TECHNIQUES

The values of the explanatory variables are registered at several time units for each province. Thus, this is a panel dataset which consists of both time series and cross-sectional data. There are considerable advantages of using panel data as opposed to using only time series or only cross-sectional data. In case of insufficiency of time series data and cross-sectional data, it brings out the common use of panel data that brings both methodologies together. The main advantage of panel data is that they combine the values of using both cross-sectional data and time series data and add benefit in terms of adding further information.

The most general and frequently used panel data estimation methods are: (i) fixed effects model and (ii)random effects model. This study has estimated Convergence by three models; random, fixed and time-fixed estimation methods.

5.1 Random Effects vs Fixed Effects vs Time-Fixed Effects

Random effects models are used in analysis of panel data when one assumes no fixed effects that allows for individual (country-specific or here province-specific) effects. Random effect models assist in controlling for unobserved heterogeneity when the heterogeneity is constant and not correlated with autonomous variables. The fixed effect assumption is that the individual-specific effects are correlated with the independent variables. Fixed effects models control for the effects of time-invariant variables with time invariant effects. Time fixed effects allow controlling for underlying observable and unobservable systematic differences between observed

time units in order to obtain unbiased estimates. For this reason; time fixed effects are standardly obtained by means of time-dummy variables, which control for all time unit-specific effects.

The empirical results of employed models are viewed and interpreted based on expected signs and whether the estimates are statistically significant or not. Before these, the variables have undergone particular econometric model testing, such as unit root tests for variables, Heteroscedasticity for whole model, F-test for the individual effect, Hausmann Test for fixed effect model and Breusch-Pagan test for time effects for the whole model.

5.2 Unit Root Test

The unit root test used for identifying a time series variable if it is non-stationary and possesses a unit root. In statistics and econometrics, an Augmented Dickey–Fuller test tests the null hypothesis that a unit root is present in a time series sample. The null hypothesis is defined as the presence of a unit root and the alternative hypothesis is that the data is stationarity. The Augmented Dickey–Fuller (ADF) statistic is a negative number and more negative it is, the stronger the rejection of the hypothesis at some level of confidence.

5.3 Correlation Test

The numbers of doctors per 1.000 person and numbers of hospital beds per 100.000-person might be correlated since they are all related to health investment. As a result, we run the correlation test, however, the correlation between the numbers of doctors per 1.000 person and numbers of hospital beds per 100.000-person turn out to be 0.55. Thus, our results do not suffer biases due to the fact that we use both “hbed” and “doctors” as explanatory variable in the same regression.

Chapter 6

ESTIMATION RESULTS

6.1 Unit Root Estimation Results

In this study for unit Root Test, Augmented Dickey-Fuller Test is implemented to our dependent variable Growth and all explanatory variables. The test is implemented on raw data as it is except for the lagged GDP per capita. For GDPPC, the test is implemented with the logarithmic form since this is the form that we use in our regression analysis. The unit-root test results for each variable show that p-values are less than the critical significance level of 5% (0.05). Thus we reject the null hypothesis and conclude that there is no unit root in our variables. That is each data is stationary. These results are as shown below in table 4. Thus, we can estimate the regression model by using the level data, that is without taking the first difference of the data.

Table 4: Unit Root Test Result

Augmented Dickey-Fuller Test	
Variables	**Result**
Growth	Dickey-Fuller = -12.356, Lag order = 2, p-value = 0.02
	Result p-val is less than 0.05, so reject null hypothesis and conclude that there is no unit root for growth variable. The data is stationary.
lgdpcc	Dickey-Fuller = -8.2057, Lag order = 2, p-value = 0.01
	Result p-val is less than 0.05, so reject null hypothesis and conclude that there is no unit root for lagged gdppc variable. The data is stationary.
data: Panel.set$HSGrad	Dickey-Fuller = -7.3571, Lag order = 2, p-value = 0.01
HSGrad	Result p-val is less than 0.05, so reject null hypothesis and conclude that there is no unit root for HSGrad variable. The data is stationary.
data: Panel.set$LFPR	Dickey-Fuller = -8.6197, Lag order = 2, p-value = 0.01
LFPR	Result p-val is less than 0.05, so reject null hypothesis and conclude that there is no unit root for LFPR variable. The data is stationary.
data: Panel.set$tax	Dickey-Fuller = -12.884, Lag order = 2, p-value = 0.01
tax	Result p-val is less than 0.05, so reject null hypothesis and conclude that there is no unit root for tax variable. The data is stationary.
data: Panel.set$migration	Dickey-Fuller = -10.823, Lag order = 2, p-value = 0.01
migration	Result p-val is less than 0.05, so reject null hypothesis and conclude that there is no unit root for migration variable. The data is stationary.

6.2 Breusch-Pagan test for heteroskedasticity

Breusch-Pagan test is used to test for heteroskedasticity in the model. Derived from the Lagrange multiplier test principle to test whether the variance of the errors from a regression is dependent on the coefficient of the independent variables. The test result show that the p-value is 0.75 which is greater than the critical significance level of 5% (0.05). Thus we fail to reject the null hypothesis. As a result it is concluded that the data is not heteroskedastic. The Breusch-Pagan test result is shown in Table 5 below.

Table 5: Breusch-Pagan test

data: growth1 ~ log(lgdppc) + LFPR + HSGrad + tax + migration + doctor + hbed + factor(province)
BP = 77.496, df = 87, p-value = 0.7572

6.3 Model Estimation Results

As mentioned earlier, many panel data estimation methods are centered on choosing between the fixed-effect or random effect model. One needs to use fixed-effect model if country-specific (here province-specific) effects are expected. Otherwise random effect models are used. Hausman Test can be used to identify whether the fixed-effect or random-effect are the right model for a panel study. We do employ this test also.

However, we also plot a boxplot distribution of our "Growth" data for each province. We also plot the boxplot distribution of the data for each time year. Since there are numerous provinces, the boxplot for provinces is divided into 5 separate graphs. Since they show similar effects, only the very first one is presented below in Plot 1. The boxplot of "Growth: across the years" is shown in Plot 2 below.

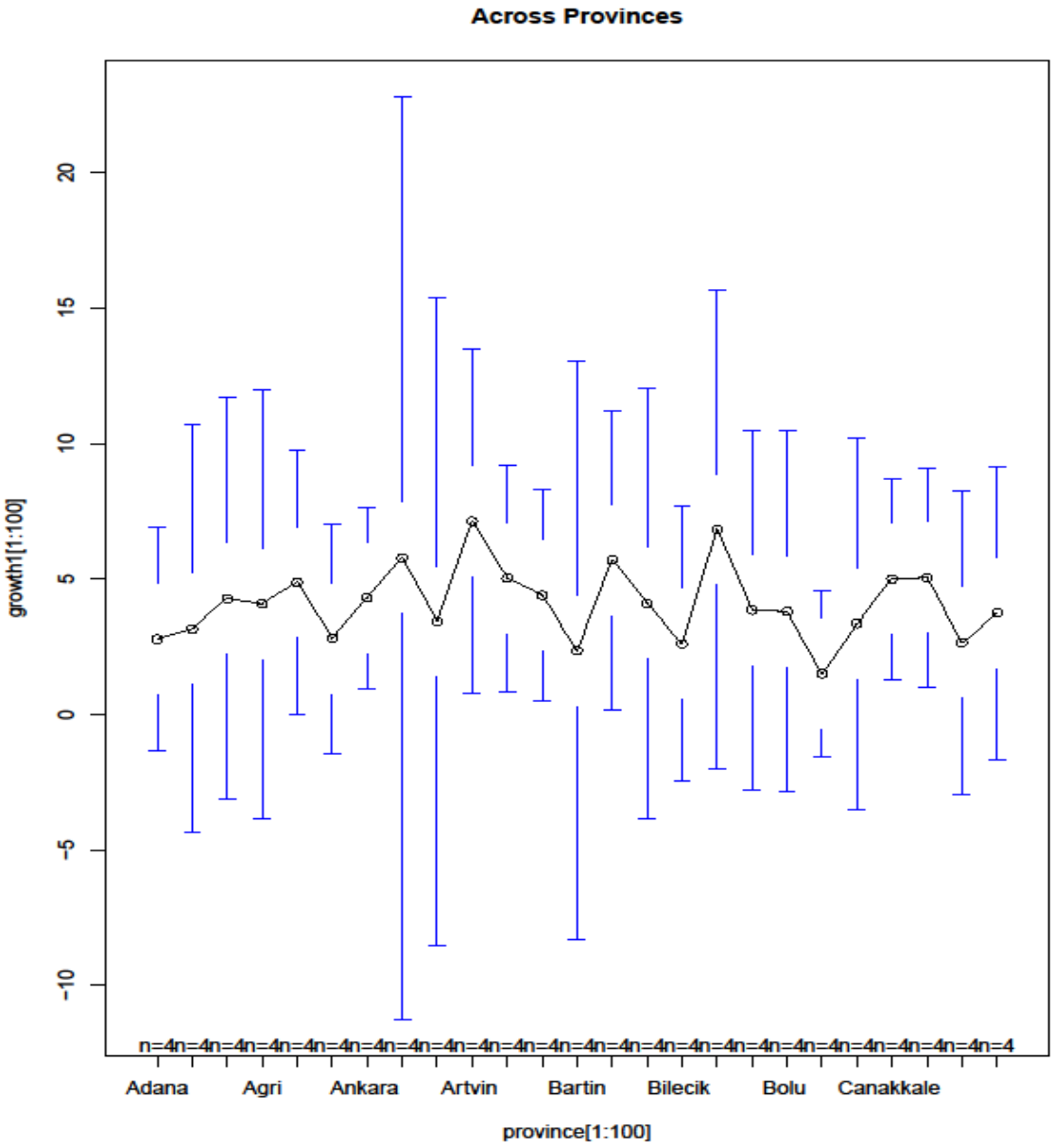

Figure 3: Plot 1, Growth data for each province

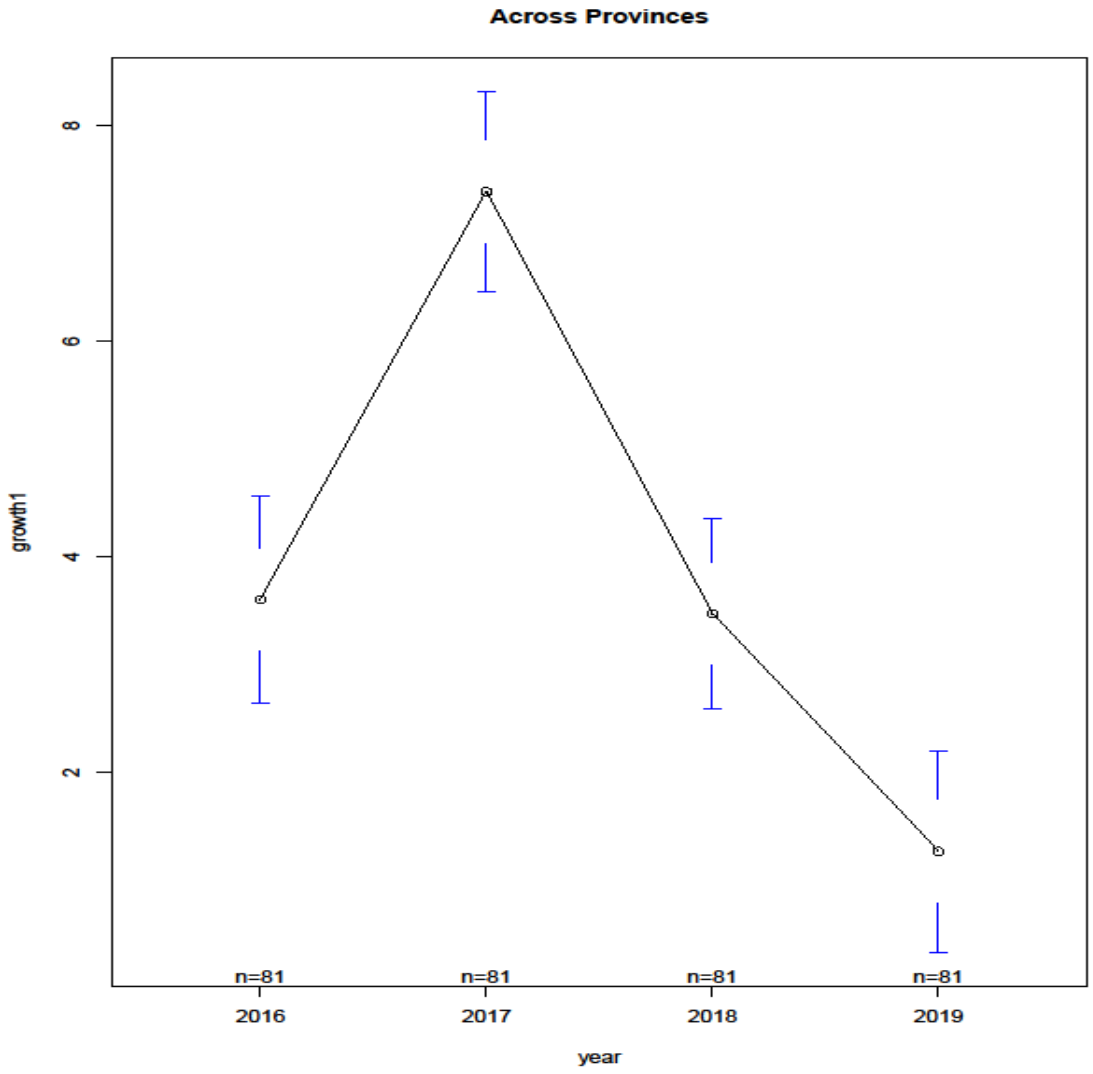

Figure 4: Plot 2, Growth: across the years

When we look at these plots, we see that, province-specific effects are less obvious while time-fixed effects are more marked. Although we have only 4 years in the data, indeed, the plot 2 reveals that Growth in 2017 and 2019 are markedly different than 2016 and 2018. 2017 seems to indicate higher growth rates while 2019 seems to indicate lower growth rates than the average. This convinces us to explore a time-fixed effect estimation also. At the end we conduct F-test and Breusch-Pagan Lagrange Multiplier Test to test the validity of this model.

Let us now, present these results in order. Empirical results found from random, fixed and time-fixed models are shown in the Table 6 below.

Table 6: Empirical Results of Random, Fixed and Time-Fixed Effect Models

dependant Growth	**Model 1 (Random)**	**Model 2 (Fixed)**	**Model 3 (Time-Fixed)**
log(lgdppc)	-2,37 (0,001276***)	-0,48 (0,9158)	-9,18 (0,0076***)
LFPR	15,35 (0,002198***)	57,51 (0,00029***)	16,10 (0,0815*)
HSGrad	-3,23 (0,59946)	65,86 (0,0009***)	12,36 (0,3758)
tax	0,82 (2,2***)	0,93 (2,2***)	0,90 (2,2***)
migration	0,25 (0,717818)	0,41 (0,62129)	1,6 (0,0013***)
doctor	0,61 (0,0903*)	1,85 (0,01306**)	0,27 (0,51807)
hbed	-2,37 (0,001276***)	0,03 (0,00619***)	0,002 (0,7916)
# the numbers in paranthesis are the p-values.			
***** shows significancy at 1% level.**			
**** shows significancy at 5% level.**			
*** shows significancy at 10% level.**			

Column 1 (Model 1) in Table 6 gives the results for random-effect estimation. The coefficient of logarithm of the one-year-lagged GDP per capita (proxy for initial GDP per capita) is found to be -2.37 and it is statistically significant at 1% significance level. This result is in line with our theoretical expectation and does indicate a n existence of convergence among the provinces of Turkey. More specifically, the 1% higher initial GDPPC would result with 2.37% lower growth rate for the provinces. Thus, smaller initial GDPPCs resulting in higher economic growth which demonstrates the catch-up or convergence effect. As for other explanatory variables; Labor Force Participation rate has a coefficient estimate of 15.35 and is significant at 1% significance level. This implies 1% increase in LFPR raises the growth by 15% and this is in line with theoretical expectation.

Coefficient estimate of Net Taxes is 0.82 and is significant at 1% significance level. This is the opposite of what we expected since we expect that higher taxes reduces the economic growth. However, we should note that these are not showing the tax rates but rather annual changes in taxes over the previous year. As such there might be a reverse-causality here, implying that higher growth rates are leading to higher tax collections and thus higher effective tax rates in the provinces. Migration and High-School Graduation turn out to be statistically insignificant even at 10% significance level. As for the number of doctors and number of hospital beds where both stand to capture the effects of human capital via health investments (thus one needs to be suspicious of correlation), the coefficient estimate for number of doctors per 1000 population, has a positive sign and is significant at 10% significance level, while the coefficient estimate for number of hospital beds per 100000 population has a negative sign and is significant at 1%. This is opposite of our theoretical expectation as we expected that investment in health would increase growth rate. To check for possible correlation biases, we run these regressions with only "hbed" and also with only "doctor". The results do not vary much, hence we report only the case where both are used.

Column 2 (Model 2) gives the results for fixed-effect estimation. The coefficient of logarithm of the one-year-lagged GDP per capita) is found to be -0.48. This result is not in line with our theoretical expectation and does not indicate an existence of convergence among the provinces of Turkey. More precisely, the 1% higher initial GDPPC would result with 0.5 % lower growth rate for the provinces. Thus, smaller initial GDPPCs resulting in higher economic growth which demonstrates the catch-up or convergence effect. As for other explanatory variables; Labor Force Participation rate has a coefficient estimate of 57.51 and is significant at

1% significance level. This implies 1% increase in LFPR raises the growth by 57% and this is in line with theoretical expectation.

Coefficient estimate of Net Taxes is 0.93 and is significant at 1% significance level. This is the opposite of what we expected since we expect that higher taxes reduces the economic growth. However, we should note that these are not showing the tax rates but rather annual changes in taxes over the previous year. As such there might be a reverse-causality here, implying that higher growth rates are leading to higher tax collections and thus higher effective tax rates in the provinces. As for the number of doctors and number of hospital beds where both stand to capture the effects of human capital via health investments (thus one needs to be suspicious of correlation), the coefficient estimate for number of doctors per 1000 population, has a positive sign of 1.85 and is significant at 5% significance level. The coefficient estimate for number of hospital beds per 100000 population has also positive sign 0.03 and is significant at 1%. This supports of our theoretical expectation as we expected that investment in health would increase growth rate. Even tough migration has a positive coefficient estimate sign of 0.41, Migration turns out to be statistically insignificant even at 10% significance level as an only variable.

As for the high school graduate rate stands to capture the effects of human capital, the coefficient estimate has a positive sign of 65.86 and is very significant at 1% significance level. This implies 1% increase in HSGrad raises the growth by roughly 66% and this is in line with theoretical expectation.

Column 3 (Model 3) in Table 6 gives the results for time-fixed-effect estimation. The coefficient of logarithm of the one-year-lagged GDP per capita (proxy for initial GDP per capita) is found to be -9.18 and it is statistically significant at 1% significance level. This result is in line with our theoretical expectation and does

indicate a n existence of convergence among the provinces of Turkey. More precisely, the 1% higher initial GDPPC would result with 9.18% lower growth rate for the provinces. Thus, smaller initial GDPPCs resulting in higher economic growth which demonstrates the catch-up or convergence effect. As for other explanatory variables; Labor Force Participation rate has a coefficient estimate of 16.10 and is significant at 10% significance level. This implies 1% increase in LFPR raises the growth by roughly 16% and this is in line with theoretical expectation.

Coefficient estimate of Net Taxes is 0.90 and is significant at 1% significance level. This is the opposite of what we expected since we expect that higher taxes reduces the economic growth. However, we should note that these are not showing the tax rates but rather annual changes in taxes over the previous year. As such there might be a reverse-causality here, implying that higher growth rates are leading to higher tax collections and thus higher effective tax rates in the provinces. High school graduate rate, the number of doctors and number of hospital beds turn out to be statistically insignificant even at 10% significance level. As for where all stand to capture the effects of human capital investments, the coefficient estimated for all have a positive sign as theoretically expected where they are insignificant at 10% significance level. As for the last explanatory variable; migration rate has a coefficient estimate of 1.6 and is significant at 1% significance level. This implies 1% increase in LFPR raises the growth by 1.6% and this is in line with theoretical expectation.

6.4 Hausman test

In order to choose between results of random effect model and results of fixed effect model, Hausman test is applied. In Hausman test, the null hypothesis states that Random-effect model is more suited for the data while the alternative hypothesis is that Fixed-effect model is more suited. It basically tests whether the unique errors are

correlated with the regressors, the null hypothesis is not correlated the null hypothesis is that the chosen model is random effects versus the alternative hypothesis the fixed effect model. Before deciding on the better regression method in between, the augmented regression test for endogeneity is tested by Hausmann Test.

Table 7 below give the test result of the Hausman test. Since the calculated p-value is 1.29X10^(-13), which is much smaller than 0.05, we reject the null hypothesis and conclude that fixed effect model is better.

Table 7: Hausman Test Result

data: growth1 ~ log(igdppc) + LFPR + HSGrad + tax + migration + doctor + ...
chisq = 72.435, df = 6, p-value = 1.293e-13
alternative hypothesis: one model is inconsistent

However, as we have seen in Plots 1 and 2, the high differences in growth rates at different years convinced us to use time-fixed effect model also. This produced results which were given in Column 3 in Table 6. To decide whether this is a valid model, we have conducted F-test and Breusch-Pagan Lagrange Multiplier Test in order to decide whether to use fixed effect model or Time-fixed model (where for each year, a dummy variable is used due to unbalanced variations as shown in Plot 2).

The validity of time-fixed model is subjected to statistical verifications such as F-test for individual effects and Lagrange Multiplier Test – Breusch-Pagan Test for time effects. These results are given below.

6.5 The Breusch-Pagan test result

The Breusch-Pagan test states that the null hypothesis is fixed effect and alternative hypothesis is time-fixed effect. The test result is given below in Table 8.

Table 8: Breusch-Pagan Test Result

Lagrange Multiplier Test - time effects (Breusch-Pagan) for balanced panels
data: growth1 ~ log(igdppc) + LFPR + HSGrad + tax + migration + doctor + ...
chisq = 2157.8, df = 1, p-value < 2.2e-16
alternative hypothesis: significant effects

Since the p-value of the test is less is than the significance level 0,05, then the null hypothesis is rejected and the alternative is accepted which states that time-fixed effect is suitable.

6.6 F-test to choose between Fixed-effect vs Time-Fixed Effect

Similarly, we run a F-test to decide between the Fixed-effect model and Time-fixed effect model. The test in this case uses the following null hypothesis is fixed effect and alternative hypothesis is time-fixed effect. The result for this test is given below in Table 9.

Table 9: F-Test Result

F test for individual effects
data: growth1 ~ factor(year) + log(igdppc) + LFPR + HSGrad + tax + ...
F = 144.69, df1 = 2, df2 = 154, p-value < 2.2e-16
alternative hypothesis: significant effects

Since the p-value of the test less is than the significance level 0,05, then the null hypothesis is rejected and the alternative is accepted which is time-fixed effect is suitable. Thus, both of the tests conducted do support the choice of time-fixed effect model.

Chapter 7

CONCLUSION

The economic convergence at subregion level topic has engrossed much attention in recent years. The existence and rising gap of wealth and income disparities across Turkish provinces is clearly noticeable ongoing debate issue. The concept of Convergence makes from the exogenous theory of the Solow growth model. The convergence theory essentially discusses the income divergence and come to conclusion that income convergence exists where undeveloped economies grow faster than the developed ones. Regional disparities have been one of the most important problems in Turkey, which is also recognized by the policy makers. In this paper regional convergence in Turkey has been analyzed by taking into account Education and health service data for Human capital investment, tax rate for government incentives, income indicator as lagged GDP per capita and migration and labor force participation rate as labor factors. indeed, the growth indicator was used as the dependent variable is the growth rate of total sectoral output of provinces which is the percentage change of total sectoral output volume based on the previous year capita.

This Panel data convergence is estimated by taking into account three different models; random effect, fixed effect and time-fixed effect models, and the study is conducted based on panel data collected from Turkish Statistical Institute. For our econometric verifications; the variables have undergone particular econometric model testing, such as unit root tests for variables, Heteroscedasticity for whole model, F-test

for the individual effect, Hausmann Test for fixed effect model and Breusch-Pagan test for time effects for the whole model.

The existence of convergence of the growth rate among 81 provinces is studied based on the panel data from period of 2016-2019 in Turkey. In this respect, the result that the lagged of the previous years' GDP per capita is significantly negative in the both fixed and time-fixed model is concluded. There is evidence of convergence even after conducting both fixed effect and time-fixed effect model. Indeed, the adjusted r-squares obtained from the time-fixed model is much higher (89,9%) than the fixed effect model (69%). Results of this study show that there exists evidence of convergence in Turkey in general. Most of the explanatory variables that are analyzed in the analysis have significant effects in regional growth in Turkey in general. Only the percent change in Net Taxes (Taxes-Subsidies) rate has positive sign in contrast that our expectation and insignificant result. The growth rate that used for initial income levels are essentially correlated across the provinces resulting in the accept of convergence for period 2015-2019. Our findings coincide with many previous empirical studies mentioned such as Filiztekin (1998), Tansel (1998) Gömleksiz (2015).

One of the critics may confront this study is the convergence analysis of long run data due to the fact that the difficulties in obtaining data. In addition to this, further studies might be enhancing by including other explanatory variables such as government incentives, the human capital investment, saving rates, regional trade, foreign direct investments that may affect the convergence course.

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