ISTANBUL TECHNICAL UNIVERSITY ★ INSTITUTE OF SCIENCE AND TECHNOLOGY

ECONOMIC GLOBALIZATION AND REGIONAL INEQUALITIES IN TURKEY: A SPATIAL ANALYSIS ON PRODUCTIVITY GROWTH AND CONVERGENCE

Ph.D. Thesis by
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Programme : Urban and Regional Planning

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İSTANBUL TEKNİK ÜNİVERSİTESİ ★ FEN BİLİMLERİ ENSTİTÜSÜ

EKONOMİK KÜRESELLEŞME VE TÜRKİYE'DE BÖLGESEL EŞİTSİZLİKLER: ÜRETKENLİK ARTIŞI VE YAKINSAMA ÜZERİNE MEKANSAL BİR ANALİZ

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OCAK 2010

Sevgili Annem Suna AKIN'a…

To my dear mother, Suna AKIN…

FOREWORD

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ABBREVIATIONS

AIC	**:** Akaike Information Criteria
CV	**:** Coefficient of Variation
EDA	**:** Exploratory Data Analysis
ESDA	**:** Exploratory Spatial Data Analysis
EU	**:** European Union
FDI	**:** Foreign Direct Investments
GAP	**:** Güneydoğu Anadolu Projesi (Southeastern Anatolia Project)
GDP	**:** Gross Domestic Product
GIS	**:** Geographic Information Systems
MNC	**:** Multinational Company
NAFTA	**:** North American Free Trade Agreement
NEG	**:** New Economic Geography
OLS	**:** Ordinary Least Squares
TL	**:** Turkish Lira
TNC	**:** Transnational Company
SIS	**:** State Institute of Statistics, Turkey (TURKSTAT)
US, USA	**:** United States of America
USD	**:** U.S. Dollars
WCV	**:** Weighted Coefficient of Variation
WLS	**:** Weighted Least Squares

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ECONOMIC GLOBALIZATION AND REGIONAL INEQUALITIES IN TURKEY : A SPATIAL ANALYSIS ON PRODUCTIVITY GROWTH AND CONVERGENCE

SUMMARY

The theme of this study is economic globalization and regional inequalities in per capita productivity rates in Turkey during 1990-2000.

Economic globalization has wide spread socio-economic and spatial effects throughout the world. Theoretical debates on globalization point to emergence of a transnational system that is formed by a set of global cities and their immediate neighbor regions, where most of the economic activities are agglomerating. As new countries open up to international trade, similar spatial changes occur in these countries as well. Among the most influenced countries are those emerging market economies which have rapidly integrated to global economic system. Empirical studies find that many of these countries experience similar spatial developments during the course of economic integration. Turkey, being one of them, has experienced strong spatial structural changes in terms of employment and productivity.

The relationship between economic integration and regional inequalities in per capita productivity rates (or, per capita income) is since long studied. One of the major lines of research in this field is the neo-classical theory and post neo-classical theory. While the neo-classical approach assumes absolute convergence and thus a decrease in regional inequalities, post-neo-classical theory assumes that regional inequalities may not diminish due to existence of endogenous technological progress, local spillovers and spatial spillovers to neighboring areas. Furthermore, the role of FDI on agglomeration of economic activities is also often questioned and is tought to have an impact on regional productivity growth.

In this framework, one of the objectives of this study is to evaluate the productivity growth differences and their causes in Turkey. As a supplementary objective, differences in regional employment growth in Turkey is also studied, to evaluate the agglomeration patterns in economic activity.

This study aims to contribute to the body of knowledge on regional employment growth and regional productivity convergence in Turkey, by making use of spatial econometrics toolbox, and by introducing new variables.

The results of the study suggest that employment growth is clustered, at metropolitan areas and their immediate neighbors. On the other hand, productivity growth is not the highest in large cities. Infact, large cities have much lower rates of productivity growth, and even declining labor productivity.

This study shows that enterpreneurial activity and FDI are important elements both in the growth of employment and labor productivity. The role of entrepreneurship on

employment growth is arbitrary, but it has a strong positive role in the growth of productivity. Excessive growth of scientific, technical and creative professionals contributes significantly to productivity growth, while, as expected, growth of population hampers regional productivity growth. Presence of larger FDI companies are also likely to have some positive influence on productivity growth in general. Furthermore, there is evidence that different spatial externalities are active on different sectors. Knowledge spillovers in manufacturing industries are likely to span longer distances than in services. In general, it can be concluded that initially poorer regions that are closer to richer regions enjoy productivity growth more, pointing to presence of initial advantages and spatial spillover effects.

The role of the state on regional productivity inequalities can not be under estimated. While Western Turkish provinces experience higher productivity rates due to weight of urban sectors, improved infrastructure in the Southeast and East seems to have increased productivity per capita in agriculture, helping to decrease regional inequalities. As in rural areas participation to workforce is higher and large populations still work in agriculture, productivity growth in agriculture in remote regions seems to have been influential in decreasing regional inequalities.

Still, underdevelopment of services and manufacturing industries in the North-East, East and South-East is an important reason for long-lasting regional inequalities in Turkey.

EKONOMİK KÜRESELLEŞME VE TÜRKİYE'DE BÖLGESEL DENGESİZLİKLER: ÜRETKENLİK VE YAKINSAMA ÜZERİNE MEKANSAL BİR ANALİZ

ÖZET

Bu çalışmanın konusunu ekonomik küreselleşme ve Türkiye'de 1990-2000 dönemindeki kişibaşına üretkenlikteki bölgesel dengesizlikler oluşturmaktadır.

Ekonomik küreselleşme, dünya genelinde geniş sosyo-ekonomik ve mekansal etkileri bulunan bir olgudur. Küreselleşmeye ilişkin teorik tartışmalarda küresel kentler ve yakın çevrelerinde ekonomik faaliyetlerin yığıldığı bir kümenin yarattığı, ulus-ötesi bir sistemin ortaya çıkışına neden olduğuna işaret edilmektedir. Yeni ülkeler de uluslararası ticarete açıldıkça benzer mekansal etkilerle karşılaşmaktadırlar. Bunlar içinde en çok etkilenenler, küresel ekonomik sistemle hızlı bir şekilde bütünleşen gelişmekte olan piyasa ekonomileridir. Ampirik çalışmalar, ekonomik bütünleşme süreci boyunca bu ülkelerin çoğunda benzer mekansal gelişmeler olduğunu göstermektedir.

Ekonomik bütünleşme ve kişibaşına düşen üretkenlik (ya da gelir) düzeyleri uzun zamandır araştırma konusudur. Bu alandaki önemli araştırma çizgilerinden birisi, neoklasik teori ve post neo-klasik teori çerçevesinde yürütülmektedir. Neo klasik teori bölgelerarası farklılıkların zaman içinde azalacağı tezini savunurken, post neo-klasik teori bölgelerarası farklılıkların, içsel teknolojik ilerleme süreçleri, yerel bilgi taşmaları, komşu bölgelere bilgi taşmaları gibi süreçler nedeniyle azalmayabileceğini savunmaktadır. Ayrıca, yabancı sermaye yatırımlarının da bölgesel üretkenlik düzeyleri ve istihdam artışı konularında önemli etkileri olduğu düşünülmektedir.

Bu çalışmanın amacı, Türkiye'de bölgesel üretkenlik düzeylerindeki artış farklılıklarının ve bunların nedenlerinin incelenmesidir. Ayrıca esas çalışma amacını destekleyebilmek için, ekonomik faaliyetlerin mekansal yığılmasını değerlendirebilmek için bölgesel istihdam büyümesi de incelenmiştir.

Bu çalışma, mekansal ekonometrik yöntemler ve yeni değişkenler yardımıyla Türkiye'de bölgesel istihdam artışı ve bölgesel üretkenlik artışı üzerine mevcut bilgi birikimini artırmayı hedeflemektedir.

Çalışmanın sonuçları, metropoliten kentler ve çevresinde istihdam artışının kümelenmiş bir şekilde gerçekleştiğini göstermektedir. Diğer yandan, üretkenlik artışının en hızlı olduğu yerler metropoliten kentler değildir. Hatta, büyük kentlerde genel olarak üretkenlik artmamıştır.

Bu çalışmada, girişimciliğin ve yabancı sermayenin üretkenlik artışı ve istihdam artışında önemli roller oynadığına işaret eden bulgular bulunmuştur. Girişimciliğin istihdam artışındaki rolü çok kesin olmamakla beraber, üretkenlik artışında olumlu ve belirgin bir etkisi olduğu gözlenmiştir. Ortalamanın üzerinde bir ilmi-teknik personel sayısı artışı da kişibaşına üretkenliğin artmasında ciddi rol oynamaktadır.

Beklendiği üzere, hızlı nüfus artışları, üretkenliğin azalmasına neden olmaktadır. Büyük yabancı sermaye şirketlerinin bulunduğu bölgelerde olan illerde üretkenlik artışı daha fazladır, ancak bu etki zayıftır. Ayrıca, farklı sektörlerde farklı mekansal taşma etkileri olduğu gözlenmiştir. İmalat sanayi ve diğer sanayilerde taşma etkileri hizmet sektöründen çok daha uzun mesafeleri kapsamaktadır. Genel olarak, başlangıçta fakir olan ancak zengin illere yakın olan bölgelerin daha hızlı geliştikleri, bunun başlangıç avantajlarına ve mekansal taşma etkilerine işaret ettiği söylenebilir.

Devletin bölgesel üretkenlik farklılıkları üzerindeki rolü hafife alınmamalıdır. batıdaki iller kentsel faaliyetler nedeniyle yüksek üretkenlik düzeylerini korurken, güneydoğu ve doğudaki illerde geliştirilen altyapının tarımsal üretkenliği artırarak bölgelerarası genel üretkenlik farklarını azaltmaya yardımcı olduğu düşünülebilir. Kırsal bölgelerde işgücüne katılım daha yüksek olduğundan ve geniş kitleler tarımsal üretimde istihdam edildiğinden, uzak bölgelerdeki tarımsal üretkenlik artışlarının bölgelerarası eşitsizliklerin azalmasında rolü olduğu düşünülmektedir.

Yine de, hizmet ve sanayi sektörlerinin kuzeydoğu, doğu ve güneydoğu'da az gelişmiş olması, Türkiye bölgelerarası eşitsizliklerin kalıcılığının önemli bir nedeni olarak karşımıza çıkmaktadır.

1. INTRODUCTION

The theme of regional inequlities is a wide field of research and has many implications for policy making. This section is intended to provide a framework to the reader and clarify the limits and scope of the study.

1.1 Subject of the Study, Theoretical and Methodological Approaches

This study is about regional productivity growth and associated regional inequalities in Turkey, and focuses on a period of rapid integration to global economy: 1990-2000. Turkey is a country who is often mentioned among those so called emerging market economies.

The concept of regional inequalities, as its name implies, is about inequalities between spatial units. These may be about unequal distribution of economic activities, technology levels, human resources, education levels, life expectancy, income levels and many other indicators concerning wealth or development. The definition of regional inequality is tough ambitious: it has to be clarified both in terms of the spatial units for which the distribution of the phenomenon is evaluated, and in terms of the quantity and quality of inequality. While doing so, regions should not be taken as individual organisms. Though regions are often well defined administrative units, the distribution of the phenomenon under investigation does not have to fully reflect the spatial borders of these administrative units. It should always be kept in mind that social organisms like individuals, households, firms, institutions, social groups always interact and bring out results that are not uniformly distributed in space. However, some regional features may be significantly important for explaining underlying distribution; if regions are large enough to capture differences in space, are well defined geographical units and bare administrative or institutional capacity differences.

Regional inequalities are important especially for nation-states because of the threat they impose for the presence of a nation-state. A nation-state's ultimate goal is to create wealth for all of its citizens. Although economic activity can not be expected

to be perfectly homogenously distributed in space, large regional disparities are naturally often a cause of social tensions and reactions. Therefore, serious regional inequalities pose a threat to equal distribution of wealth and quality of life. There is of course the possibility of low regional inequalities but high inequality between different social groups in a nation-state, that would create similar threats. Therefore, regional inequalities and inequalities between different social groups should be taken as complementary issues rather than counteracting issues. Increasing inequalities within a nation-state often leads to serious debates on its policy of development and integration to global economy.

The second half of 1980'es until today is a period when studies on regional inequalities have exploded. Regional inequality issue attracted so much attention because it is often associated with the globalization processes that are highly influential on each nation-state.

The relationship between economic integration and inequalities in productivity levels is since long studied, at global, international and national (regional) levels. One of the major lines of research in this field follows the neo-classical theory and assumes that integration will eventually lead to a decrease in inequalities in per capita productivity rates between regions. Neo-classical theory assumes this under conditions of perfect competition, decreasing returns to scale, perfect mobility of labor and capital across regions, and freely available and exogenously growing technology. A more recent body of work on the other hand focuses on more realistic assumptions about the regional economy, and assumes that there is also a possibility of increasing inequalities under economic integration. Martin and Sunley (1998) briefly name this new body of work as Post Neo-Classical Theories.

Post Neo-Classical Theories feed from a large theoretical background, spanning from industrial organization to urban and regional development studies. The methodological toolbox they use depends mostly on the toolbox first used in the assessment of the neo-classical theory, but in recent years many new methodologies are also introduced in the analysis of regional convergence and inequalities.

The usual tool for assessing regional convergence in productivity rates is the unconditional beta convergence model used in the neo-classical approach. This model is further developed in the post neo-classical research agenda by incorporating real world assumptions into it. This type of models are commonly known as the

conditional beta convergence models. Furthermore, developments in spatial econometrics and incorporation of spatial effects can be counted as some of the most important developments that enabled a large body of empiricial work to be held.

The spatial econometrics toolbox allows us to take into account the problems related to spatial data, as well as modelling spatial relationships like spatial externalities and spillover effects. This new toolbox has helped in assessing importance of knowledge spillovers, pecuniary externalities and eliminating problems associated with the mismatches between the actual distribution of data and the borders of spatial administrative units for which data is collected and aggregated. The use of these models proved that there are different spatial dynamics undergoing at different levels of settlement hierarchies. Growth in productivity is usually clustered, pointing to spillovers and agglomeration effects, and regional inequality issue is not as simple as it once was thought to be. As an example, Lopez-Baso et al. (2004) have found that in European Union, spillover effects on regional productivity growth are usually effective within 600 km and mostly within the same country.

The empirical research shows that there are convergence clubs rather than overall convergence. That is, some countries, regions or cities are converging to each other in terms of productivity levels. Usually at the regional level, the cause of such convergence is an agglomerated growth pattern, where, rich regions grow together with surrounding regions and very poor regions converge to each other.

Despite the excellent works held both theoretically and empirically, the literature is also full of cross-referencing of growth of employment and growth of productivity (Bishop and Gripaios, 2009). These two different but similar aspects are often cross-referenced, and sometimes taken as the one and the same thing which is not true. Despite their being closely related issues, they are totally different phenomena and may have serious influences on each other. Thus, growth of employment and growth of productivity should be assessed jointly in order to fully understand the spatial structural changes associated with economic phenomena, such as economic globalization and integration.

On the other hand, there have been an increasing number of empirical studies focusing not only on the developed world, but also on the so-called emerging market economies. These are the few but rapidly growing countries which are integrating to

world economy. Emerging market economies have attracted attention of many researchers recently.

Turkey is also mentioned often as an emerging market economy (Alper and Öniş, 2001; Erçel, 2006), due to policy changes and its involvement in economic integration processes. As a result, it also experiences similar influences of economic globalization to those countries like China, Brasil, or Mexico. As expected, regional convergence and inequalities on Turkey has become an interesting research area since the end of 1990'es. There is now a body of literature that evaluates regional convergence and regional inequalities at different geographical levels and for different periods. These studies focus on a time period spanning from 1975 to 2000. Most of these studies are focused on income convergence rather than productivity growth and convergence. The usual finding is that absolute (income) convergence is not evident, or it is very weak. On the other hand, conditional beta convergence models indicate that there is conditional convergence of income per capita across regions. As parallel to the literature, different variables are tested as conditioning variables to assess if there is conditional convergence or not among Turkish regions. These studies point that there is conditional beta convergence in Turkey. One of the striking findings is that these effects work different at different spatial levels, like NUTS I or NUTS III level regions (Gezici and Hewings, 2007; Önder et al., 2007; Yıldırım et al., 2009).

Although there are many studies that focus on income convergence, there are just few studies focusing on productivity of labor in Turkey. Contrary to the empirical findings on income divergence, there are findings that there is convergence in regional productivity levels (Tansel and Güngör, 1997; Temel et al., 1999). However, this does not mean that all regions are converging to same productivity levels.

In line with the international research agenda, recent studies on Turkey have also started to make use of spatial econometric toolbox, and received the prize of it. Some studies find that spatial externalities are important in the convergence process, indicating that there are spatial spillovers. Yet, there is still some scope for research because there is a limited number of studies making use of spatial econometrics toolbox and best to the knowledge of this study's author, no studies exist which assess both employment growth and regional productivity growth at the same time.

Furthermore, the use of different variables usually lead to different results. Usual problems of lack of data, or controversial interpretation of results depending different theoretical backgrounds are some of the facts that also show that there is still some scope for research. Another issue that should be evaluated is the extent in which spatial spillovers are effective. All studies about Turkey take into account only first order neighbors, and do not take into account higher order spatial relationships.

Other important aspects of the literature on Turkey is that the roles of entrepreneurial activity, human capital and FDI are not adequately addressed, although these are thought to be very important factors influential on productivity growth at the regional level. Their influences should have major implications on the evolution of inequalities in Turkey. Productivity growth is closely associated with income growth and increasing quality of life. Thus, the causes and dynamics of productivity growth at the regional level has to be studied if higher income levels and quality of life are targeted.

Studying evolution of regional inequalities and growth in space is an important issue in the field of urban and regional planning. At the regional level it may provide information on whether if regions are subject to long term periods of backwardness, or are being influenced by their neighbors could be an interesting issue for local administrators and central planners of the state. On the other hand, city governments may become more aware of their regional weaknesses and implement policies to improve their economic situations.

In the case of Turkey, the ongoing EU integration process and new relations with other trade partners are becoming increasingly influential on regional and urban development. Legislative changes on urban and regional governance to the favor of strategic planning and interregional partnerships have made research on regional productivity and employment growth even more important than before. Now, municipalities and regional administrations are more eager for interventions to create employment and wealth. All these developments have increased the need for research done by different theoretical and methodological approaches.

This study aims to contribute to the body of knowledge on regional inequalities, regional employment growth and regional productivity convergence in Turkey, by making use of spatial econometrics toolbox, and by introducing new variables. Another contribution is the use of a wider body of literature that is not purely focused

on economic theory, but on geography of urban and regional development. This study also aims to assess the importance of spatial externalities at different distances, by using different assumptions on the spatial reach of economic activities.

It should be noted here that acquiring spatial data from TURKSTAT and Treasury of Turkey has been a challenge. Although data is collected, it is often of poor quality and aggregated. It is hard to capture spatial effects on NUTS III level regions which provide only 81 cases. The number of cases decrease even further since number of regions have to be reduced to 67 in studies like this, which introduces a great challenge for the use of spatial econometrics toolbox. Good quality data on FDI is not always easy to acquire from the Treasury of Turkey although it is available and has been used in other studies. It is believed that these obstacles will be overcome in time.

1.2 Research Process, Hypotheses and Results

The research process for this study started with an initial literature review which brought out that there are many different research approaches to regional inequality issue. The broad area of investigation is then narrowed to the issue of productivity growth and regional convergence. Then, a more detailed literature survey is done to evaluate basic theoretical approaches to regional growth and convergence. The detailed literature survey covered an assessment of mainstream theoretical approaches to productivity growth and convergence, as well as empirical survey on different countries. The theoretical framework was then narrowed to neo-classical and post-neo-classical theories on regional growth and convergence. The detailed literature survey showed that the literature was rich of both theoretical and empirical approaches, but with some mismatches in concepts and empirical findings.

An initial evaluation of empirical research on Turkey showed that similar problems in the literature were evident. First of all, employment growth and productivity or income growth were sometimes taken as similar issues, despite the obvious differences of these phenomena. These closely related but different phenomena had to be assessed separately. On the other hand, some important factors contributing to regional productivity growth and employment growth are identified in the theoretical and empirical literature. Two different sets of hypotheses were generated and different research designs were made to evaluate these two phenomena in different

sections. By use of secondary data obtained for suitable spatial analysis units, the hypotheses were tested and proved to be valid and competent to literature.

An initial look at the employment growth data revealed that employment growth was excessive in and around 4 major metropolitan regions with good access to international markets. The first set of hypotheses covered those related to aggregate regional employment growth and answers were sought for the following questions:

- Is distance to major metropolitan centers an important determinant of excessive employment growth, and is employment growth clustered around metropolitan regions?
- Is entrepreneurship important in explaining excessive employment growth or decline?
- Is there a relation between excessive population growth and excessive employment growth?
- Is the cumulative amount of FDI in a region associated with employment growth?

The results of the study suggest that employment growth is clustered, and is mostly associated by excessive growth of population at metropolitan areas and their immediate neighbors. Locations that are advantageous for accession to international markets are key points of growth in employment. Ankara,despite being less advantageous as an inland region, is also a growth pole, probably due to its good connections but also because of its unique role as a capital city.

Following employment growth, the changes in regional productivity rates and the inequality pattern is analysed. An initial look at productivity growth rates on the map of Turkey reveals that productivity growth is not the highest in large cities. Infact, large cities have much lower rates of productivity growth, and even declining productivity per capita levels. Despite this, they are still the centers of production and experience higher than above average productivity levels.

A descriptive evaluation of regional inequalities in productivity levels is held by using sigma convergence approach. The results suggested that at the aggregate level there was convergence but for three sectors the results were different. Unconditional beta convergence analysis also proved similar results. It was understood that

different spatial externalities could play a role for productivity growth in different sectors. Following these results, theory and empirical literature on Turkey, a conditional beta convergence analysis is held to answer the following questions:

- Do initially less productive regions grow faster?
- Do regions initially surrounded by richer regions grow faster?
- Do regions that are surrounded by fast growing regions also grow faster?
- Do regions that experience excessive rates of growth in knowledge workers experience faster growth?
- Do regions where entrepreneurial activity has risen experience faster productivity growth?
- Do regions which attracted large FDI companies experience faster productivity growth?
- Does high population growth hamper productivity growth?

An evaluation of the spatial pattern of development suggests that productivity growth in the west follows a different path than the east. While in the West, neighbor regions of metropolitan areas within the 500 km distance are likely to enjoy productivity growth, in the East there are few centers which enjoy productivity growth as well as employment growth. Among these is Şanlıurfa as the most striking example.

This study suggests that enterpreneurial activity and FDI are important elements both in the growth of employment and labor productivity. Excessive growth of scientific, technical and creative professionals employment also contributes to productivity growth, pointing rising importance of knowledge workers, as well as potential knowledge externalities created by such workers. On the other hand, diversity effects are confusing. The mutual presence of manufacturing, services and agriculture does not seem to be an important explanand of regional productivity growth. Excessive growth of population probably hampers regional productivity growth, but for few regions it could also have positive effects.

1.3 The Structure of the Dissertation

The study is presented in this dissertation as in the following order:

The second section reivews the literature on economic globalization and its impacts on developing countries, ad provides some results from empirical literature as well. It also provides some basic information about the post 1980 period conditions in Turkey.

The third section focuses on the theory of regional growth and convergence, with a special emphasis on the post-neo-classical approach. The section is concluded after presenting empirical evidence at the global level as well as national levels, by examples from both the developed and developing world. This section includes review of empirical studies on employment growth, regional distribution of productivity rates, and convergence and productivity growth, under separate titles.

The fourth section focuses on employment growth in Turkey. It starts with a review of empirical research and points to potentially important factors that contribute to employment growth. Then, with the help of descriptive statistics and basic evaluation of distribution of data, a simple model is offered to evaluate employment growth in Turkey. This section does not deal with inequalities, which is left for evaluation in the fifth section.

The fifth section starts with a detailed assessment on the empirical research on regional income inequalities and regional inequalities in productivity levels in Turkey. The studies selected focus on the post 1975 period, which is a good start point for studying influence of economic globalization. Some differences between these studies are emphasized and important factors on regional productivity growth are pointed. Then, a sigma convergence analysis is held both at the NUTS III level and at the level of 7 geographical macro –regions. The sigma analysis covers both the aggregate economic productivity as well as productivity in sub branches of manufacturing, services and agriculture. Findings suggest that in general regional inequalities in productivity levels are decreasing, and there are some differences across sectors. This study contributes to the literature with this detailed analysis of sigma convergence on Turkey, including sub-economic sectors, but also by

introducing a weighted analysis of sigma convergence based on size of employment in regions.

The fifth section then continues with evaluation of beta convergence first by running unconditional beta convergence analysis at the macro level and for each three sub-economic activity groups; manufacturing, services and agriculture. To the best of the knowledge of the author of this study, the variables used here are new and there is no previous study evaluating these three sectors separately. Spatial diagnostics are held for each unconditional beta convergence model. An interesting but expected finding is that different spatial regimes are working for different sectors.

The fifth section continues with, a conditional beta convergence model, in which important factors such as human capital, entrepreneurial activity, FDI, population growth and spatial spillovers are taken into account. Briefly, except population growth, all these factors play a role in regional productivity growth, and point to presence of conditional beta convergence. The role of population growth is ambigous and needs to be further assessed.

The final section concludes, providing scope for further research, and finally policy recommendations for enhancing regional productivity growth while avoiding further increases in regional inequalities.

2. ECONOMIC GLOBALIZATION AND ITS IMPACTS ON SPATIAL DEVELOPMENT IN DEVELOPING COUNTRIES

2.1 Scope and Definitions

In this section the concept of economic globalisation, the driving forces behind it, and its implications on the geography of production, employment and regional inequalities are briefly discussed.

An overview of the concept of economic globalisation is provided in the next sub-section. Then, its implications on the geography of production and regional development is discussed, together with some examples from so-called emerging market economies like China, Brasil and Mexico. Finally, a brief section on Turkey provides some information on Turkey's integration to global economy and the spatial economic structure.

2.2 Economic Globalization

There are many definitions of globalization which are rather complementary to each other than conflictory. These definitions mostly focus on the division of labor, changes in ownership of capital, flow of goods and capital between countries, integration of production and consumption systems, and, location – relocation of economic activities. Hence, they imply that globalization is a process in which the world economy is restructured politically, socially, and spatially.

Some scholars regard globalization as nothing new, but an ongoing process taking place since a long time. Williamson (1996) believes that late nineteenth century was the beginning of the modern globalization as technological breakthroughs in transportation and communication technology led to large increases in international trade, and increased the speed of cultural and economic integration. After the deglobalization process between 1914 and 1950, he believes that globalization gained an impetus leading to convergence, or in other words, decrease in inequalities of income between countries. Wallerstein (1974) sees globalization as a process that

started even earlier, within the Western Europe-Americas system in the 16th century, and expanded in the following period. As a result of this process, an international system consisting of core, semi-peripheral and peripheral countries has emerged. Wallerstein identified also another group called externals, which did not integrate to this system. However, by the second half of 1980'es, collapse of Soviet bloc lead to integration of most of these countries.

According to Teeple (2000), globalization is the resulting confliction between an ever expanding capital and the national social and political systems. Though capital seeks opportunities of expansion, national capital and the sovereignty of nation-state provides contradictory interests.

Ryner (2002), identifies neo-liberal globalization as a trans-national historical block that emerged within the crisis of the liberal Pax – Americana Block. Trans-nationalisation means that international relations are more and more executed between non-governmental, local government and private institutions, entities and organizations. Companies, municipalities, NGOs, universities and many other institutions build horizontal relationships for their strategic needs.

Ryner (2002) argues that a new transnational hegemony is being established through the development of high technology infrastructures and the increasing flexibility and dispersion of production. The basic goal of this system is the commodification of social life and its reorganization within a self-organizing market logic.

According to general view of economists, globalization encompasses declining barriers to trade, migration, capital flows, Foreign Direct Investment (FDI) and technology transfers (O'Rourke, 2001). In this sense globalization of today is still far behind that of the beginning of the 20th century, when large masses of people immigrated to other countries, and very large capital flows from the core to the peripheral countries took place.

Pointing to both spatial and social dimensions, Duranton (1998) adresses that according to the popular opinion, globalization entails:

> i) A redistribution of the roles and the ranks of nations in the world. Some countries, mainly the developed ones along with a bunch of dynamic developing economies form the 'core' of the world trading system. Outside the core, the 'periphery' is deemed to be more and more 'excluded'.

ii) Within the core, inequalities are widening between the educated and the less educated who suffer from the competition of 'underpaid' third-world workers (This may somewhat contradict the first assertion.) (Duranton, 1998).

Harris (1993) defines economic globalization as "the increasing internationalisation of the production, distribution and marketing of goods and services". This definition is true while perhaps not enough to emphasize the complexity of the issue. Globalisation is not merely about internationalisation, but also regionalisation at different hierarchical levels encompassing continental trade blocks, cross-border regions, sub-national regions and cities as well as rural areas.

Globalization is a multi-faceted, complex process which entails social, environmental, cultural and economic issues in a complex environment. In this study the focus is on "economic globalization" and regional inequalities in labor productivity.

The growing power of the transnational hegemony under the logic of self-organizing markets that Ryner (2002) addresses is often seen as a challenge to the sovereignity and future of the nation-state. Although self-organizing markets are seen to be the best way for efficiency and increasing wealth for everybody, globalization is often accused to be the cause for increasing regional and social inequalities. This is mostly because of the inconsistencies between the theoretical grounds of the institutional and political framework that imposed a self-organizing market structure and the actual evidence observed in the spatial economy.

2.2.1 Theoretical grounds and political framework

Most of the institutional framework that shapes today's global economy is based on the "Washington Consensus" that has set up a neo-liberal agenda. Based on orthodox trade theories, this agenda is usually criticised in its influences on the global economy and regional inequalities. As an example, Kazgan (2004) criticises that these orthodox theories oversimplify reality in order to support the idea of free trade and liberalism.

Most of the orthodox trade theories depend on certain assumptions such as;

- Diminishing returns to scale, that is, any production function is subject to diminishing returns as its scale grows.
- Labor is perfectly mobile between sectors within a country, but perfectly immobile across countries.
- Only goods move between countries, but not capital or labor.

- Markets are perfect, that is there are many firms competing with each other, such that until they equalize costs to income, they compete with each other.
- Technology is assumed to be available for everybody, and everbody is assumed to have perfect information, as the markets are perfect (Krugman and Helpman, 2000; Gandolfo, 2004).

In this context, neo-classical regional growth model assumes that regional inequalities might decrease between initially poor regions and the richer regions as labor and capital flows between regions. Therefore, the following policy recommendations to developing countries were widely implemented;

- Liberalization of markets,
- Removal of barriers to trade and opening of local markets to international competition,
- Financial deregulations and allowance of foreign direct investments,
- Decentralization of governance.

Many countries including Turkey have implemented these policies. Wide scale implementation of these policies at the world scale has led to significant changes in the geography of production.

In orthodox trade theories it is assumed that trade plays a crucial role in growth rates and leads to income (or productivity) convergence between partner countries in the long run as in Grossman and Helpman, (1991). Storper (2000) urges that empiricial evidence on growth and convergence is not evident at world level, and theory has therefore turned to note that convergence can only happen among economies within a certain range of "structural" similarity. This structural similarity can be between countries, but also between regions or cities.

Lutz (2001) discusses that although much of the neo-classical economic literature supports convergence between countries through trade opennes and globalization, there is no clear evidence of convergence in productivity rates.

There are many studies and reports that show that in the post 1970'es both in the developing and developed world, in general, interregional income inequalities are widening, together with inequalities among countries (Bourguignon and Morrison, 2002; Quah, 1997; Kanbur and Venables, 2005).

Bhatta (2002), has analysed global income inequality between countries during 1960-1989 using Penn World Tables data by applying multivariate time series regression that assumes a simple linear relationship between inequality and trade. He measures

globalization by opennes to trade. Depending on Korzeniewicz and Moran (1997) he claims that most of the income disparity in the world derives from between country inequality, so, even though his study does not deal with within country inequalities, the results of his study can be applied to overall global inequality. Some of the poorest countries are not included in his study, as the Penn World Tables lack such data for 1960-1989. This is the major setback of the study.

Using Summers and Heston (1991) data, Bhatta (2002) uses a spatial variant of Gini Coefficient, in which instead of individuals, spatial units (nation states) are used. For measuring trade openness, he uses the ratio of total world exports plus imports to world real GDP. He then uses opennes variable and population ratio variable in the multiple regression analysis over a time series, controlling with necessary tests.

His conclusion is that although world inequality has decreased during 1960-1989, how trade opennes affected inequalities remain unclear. Indeed inequality was shown to increase with openness, but the relationship was not statistically significant. Differential population growth rates between the rich and poor countries had a statistically significant negative relationship with inequality as expected. He adresses that a look at the Worldbank Data (1999) until year 1997 reveals that inequalities continue to decline, but the gap between the richest 20% and the poorest 20% continue. He mentions FDI and other capital flows should be considered in inequality research.

Quah (1997) investigates world inequality using the same dataset as Bhatta (2002), and compares log of per capita incomes of 105 countries to the world average per capita income for each year between 1960-1988. He finds that a twin peak structure was existent at 1960, where rich and poor countries concentrated in each peak. During the period, he mentions that the middle-income countries have been loosing, and the twin peak structure continues to develop. He also addresses that using population weighted distributions, a three peak distribution is emerging. A two peak population distribution could be an indicator of polarization, while three peaks could rather be mentioned as stratification, in Quah's (1997) words. The three peaks remind the core-semi-periphery and periphery trichotomy in Wallerstein (1974).

2.2.2 Impact on the geography of production

As a result of neo-liberal policies and removal of trade barriers, the private company has become the key global actor in determining the place and scope of production. Sideri (1997) points that globalisation implies both multilateralism and micro-economic phenomena. While multilateral trade liberalisation progresses, the multinational company (MNC) that was based in the developed country and owned by national capital transformed into a trans-national company (TNC), operating at global space, and owned by global capital. TNC's segmentation of production processes into multiple partial operations (which are tied onto each other by cheap and fast transportation and communication networks) has created a new global production system. The rise of the trans-national companies and their location choices presents the most visible aspect of globalization, since their decisions can not totally be constrained or controlled by particular nation-states (Hirst and Thompson, 1992, 1995).

The deployment and re-location of manufacturing, distribution and other activities have created large economic clusters in certain regions of developed and developing countries, interconnected through high capacity transportation and communication channels. Firms usually tend to form clusters and then cumulative causation mechanisms work to reinforce these clusters, which can not be understood without reference to competition and the new role of location and agglomerations in a global economy (Porter 1998; Fujita and Thisse, 2002).

This is the point where the assumptions of orthodox theories are criticised: integration to world markets and opening up to trade does not guarantee equal development and diminishing inequality everywhere, because the current production system has become highly dependent on externalities and economies of scale that necessitates spatial agglomerations, as economics of agglomeration is place-specific. These agglomerations are often places where key sectors are tied to TNCs. Locating in such agglomerations introduce competitive advantages and lead to increasing returns to scale. These agglomerations often grow at the expense of other regions within a nation-state.In this kind of world, it is hard to talk about perfect competition and decreasing returns to scale which are key components of orthodox trade theories that foresee regional convergence in the long run.

Therefore opening to trade may have diverse spatial and social effects for groups of countries, regions and cities.

The change to flexible production forms in a global rather than national setting is one of the key forces that reshapes the spatial structure of production. Eraydın (1992) below provides a brief picture of the spatial impacts of flexible production (table 2.1).

Table 2.1: Spatial features of Fordist and flexible production.

Spatial Features of Fordist Production Mode	**Spatial Features of Flexible Production Mode**
Functional Spatial Specialization	Spatial agglomeration and clustering trends
Spatial division of labor	Spatial integration
Independent regional labor markets	Diversification of labor markets according to the regions
Labor-production relations that are independent of the cultural structure and social relationships of place	Making use of cultural structure and social relationships of the place of production for the production process
Imported Creativity	Creativity generated within the place of production
Healthy working and living environment	Quality and identity of the working and living environment
Centralized governance	Increased importance of local governments (decentralized governance)

Source: Eraydın, (1992)

On the other hand, flexible production does not only imply a breakdown in the value – chain, but also implies achieving higher economies of scale. TNCs enter different markets either by establishing new plants or offices, or acquire local ones through company mergers and acquisitions. The result is a large number of facilities usually controlled through headquarters often located in another city, and probably in another country, depending on the size and hierarchy of the TNC. As different functions have different location decisions and benefit different spatial externalities, the resulting pattern is a spatially deconcentrated specialisation. Producer and financial services which require complex relationships, large labor markets, knowledge spillovers and intensive face to face communications, agglomerate in global city regions. Other functions that do not benefit such externalities or require such intense forms of communication are likely to scatter to nearby peripheral areas.

The shift from “Fordism” to “post-Fordism” implies a new rearrangement of productive forces where the main driver is the decisions of the TNCs. But this shift

also creates some opportunities for few regions which are capable to use their own potentials through entrepreneurship, learning by doing, local innovations and local productive interdependencies, and may develop from below through localized endogenous development (Garofoli, 1992).

If the forces that influence decision of TNCs and spatially concentrated decentralization of economic activities are investigated, it is found that most commonly accepted forces (that drive economic globalization) are;

- the reductions in the transport and communication time and costs,
- removal of policy barriers to trade and capital flows, both within and between countries,
- multi-nationalization and flexibilization of production. (Rodrik, 1997; Frankel, 2000)

The reduction in the cost of transfer of physical products and the transfer of codified information has enabled the TNC to reach distant regions both as markets and as production sites.

On the other hand, increasing complexity of production and distribution still necessitates high degrees of face to face contacts, and physical proximity to a large variety of producer and distributer services. Hence, while distance plays a role in transfer of production to distant regions in other countries, it also plays a role in establishment of new agglomerations in these countries.

Scott, (1996) argues that globalization tends to strengthen the role of regions as spatial sub-national economic units. In this framework, particular metropolitan cities have grown through agglomeration of economic activities creating global city-regions all over the world, especially in developing countries. These city-regions function as gateways to global economy for their host countries, as well as dinamos of economic growth (Hall, 1999; Sassen, 2000; Scott, 1996).

Despite the declaration of death of distance (Cairncross, 1997), in the age of telecommunication; Frankel (2000) points that distance is still important. Distance plays a key role not only in transportation of goods but also transmission of knowledge, which enables economic processes. He points to the geographical agglomerations of industries which try to benefit being close to each other and enjoy

increasing returns to scale in production. This is even so for those industries where physical transport costs are negligible as in financial services or computer software. Distance plays a role also in international trade between countries. This is so for both physical distance and cultural distance. As Frankel (2000) summarizes, adjacent countries are likely to trade in higher volumes with similar but distant countries. Historical ties like colonial past, language and other cultural links also play a key role in trade, although their influence seems to diminish over time. This in turn, influences the locational choices of TNC.

Gianetti (2002) points that in the EU, whereas integration brought convergence at the country level, its implications were different within the country level. The main reason she argues is that regions might benefit knowledge spillovers differently, that regions in a country with advanced economic background was likely to benefit international spillovers more than regions with traditional sectors. Her empirical study shows that more advanced regions did benefit more from integration while regions with traditional sectors lagged behind.

Storper (2000) points that analysis of locational choices of production networks is necessary as trade theory alone is not sufficient alone to understand the current effects of globalization and economic liberalization. He emphasizes that physical units of production rather than the firm as an entity plays a crucial role in understanding the new geography of globalization and international trade. Industries that have high levels of input-output relations at either intra-sectoral or intersectoral levels would accept increasing costs and agglomerate to achieve a more productive system, due to hard and soft externalities like proximity to markets, interpersonal relations or knowledge spillovers. One way to ensure immediate availability of a wide range of external resources with low search and transaction costs is via securing the geographical proximity of suppliers.

On the other hand the TNCs do not only partition their production processes into new production units and relocate elsewhere. Both TNCs and smaller companies have been as well outsourcing some inputs from other companies. These are the inputs which are necessary, but whose production do not add to the core competence of the company. These include accounting and human resources services, logistics services, some simpler intermediate products and the like. These intermediary goods and services are outsourced from other companies. Some of the producer services have

turned into TNCs themselves, and located their offices in most of the so-called global cities to serve locally to other TNCs. It is because such services have to be consumed as they are produced and can not be exported or imported totally.

Low value added parts of the production process, which requires basic manufacturing skills and relatively lower technology and capital requirements are usually outsourced from small and medium sized enterprises (SMEs) which operate either formally or informally. Since 1990'es until today SMEs played a key role in the growth of employment in metropolitan areas and their surroundings (Glaeser et al., 1992, Audretsch, 2002). They create a vast amount of the intermediate goods and services, and thus play a key role in growth of economic clusters.

At this point the role of FDI as a tool in shaping economic geography should be mentioned. The transformation of the MNC to TNC is parallel to the transformation of the geography of flows of capital. At the pre-1980 period of globalization, most of the FDI has flown into other advanced countries, either through mergers or acquisitions, reciprocally, in the form of intra-industry investments of MNCs. Beginning from the 1980'es, however, a significant amount of FDI belonging to TNCs has been flowing to emerging developing countries, which equals to a larger share in GDP of these new hosts. FDI also is distributed unevenly between these emerging countries, where China takes the largest share in absolute amounts (Shatz and Venables, 2000).

In this framework, distribution of FDI has become an important indicator in assessing how the regions of an emerging market economy are connected to the global economy.

The change in the pattern of FDI flows is a direct result of the change in the production mode after 1970'es. Specialised production functions continuously are being spatially divided from their parent company, while agglomerating in new locations in other countries. This process was facilitated by flows of FDI. The transfer of different phases of production from developed countries to developing ones through FDI is rather complicated, with different paces of growth, different patterns of integration to global markets.

FDI is sectorally selective as it aims high returns with low risks. FDI flows into sectors with high growth potentials, high amount of codified knowledge, and less

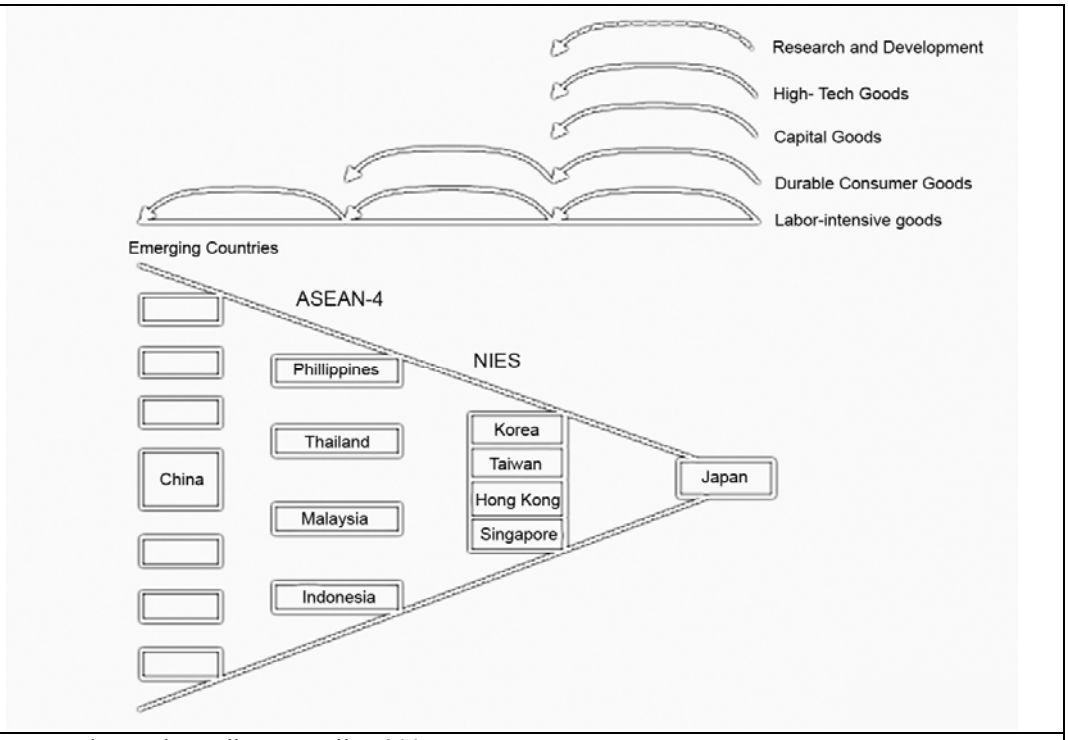
organized labor as well as less restrictions on environmental protection, ethical issues and transfer of capital.

FDI is not only sectorally but also locationally selective. Its locational selectiveness arise not only due to geographic properties but also on its choices regarding its sectoral selectiveness. It tended to concentrate in certain regions in the developed countries, and recently in developing countries which have similar properties (Wei and Leung, 2005; Sassen, 2000). Such properties are not only geographic, but also related to size of population, existence of skilled labor and (unorganized) unskilled labor, availability of high-end producer services, suitable infrastructure for international flows, political favouredness of the region, and easy exit options in case of political problems.

A simple look on the "Flying Geese" approach to development in Asia reveals much about the pattern of diffusion of FDI. Industries in the core developed countries have been progressively relocating, while the whole value chain restructures. Such relocations feed new agglomerations in new countries, namely globalizing city-regions. As an example, FDI is concentrated in coastal regions in China in the post 1980 period (Ge, 2009), and in the border regions to the USA in Mexico after NAFTA agreement (Sanchez-Reaza and .Rodriguez-Pose, 2002).

Fujita (2007) provides the following schema that draws an impressive picture of the period, focusing on the relocation of Japanese capital in different sectors with different technology levels. Labor intensive goods production has first decentralized from Japan to surrounding countries and then to more distant countries with large population and cheap labor. Finally it then moved to China. Other phases of production follows roughly the same pattern as in figure (2.1).

It is this earlier stage which start the cumulative agglomeration process in the recipient countries. In the earlier stages of economic globalization, the intra-firm division of production functions progressed, management, R&D and other white collar works remained concentrated in the developed countries' metropolitan centres, and part of production in which transfer of knowledge is relatively easier is moved to less developed countries.



Source: redrawn depending on Fujita, 2007

Figure 2.1 : The Flying Geese.

In manufacturing, the relocation of such labor intensive components of production process created new agglomerations, but on a wider regional basis within the recipient countries. Most of the initial FDI in manufacturing industries belonged to low-technology and less sophisticated activities like textiles and leather apparel, recently more sophisticated industrial sectors like chemicals-pharmaceuticals, automotive-machinery industries and electrical-electronical equipment industries increase their shares in the global FDI flows (Hirst and Thompson, 1996). These industries require complex input-output relations and thus concentrate on large regions within recipient countries.

In services, the new branches of the TNC in the recipient countries have concentrated within much smaller regions due to the nature of the services industry and the development of telecommunication technologies. Administrative bodies of manufacturing industries often also concentrate in these same regions, which enable maximum opportunities and least costs for both local and global connections (Sassen, 2000; Hall, 1999). One can assume that spatial proximity of manufacturing industries and producer services also enhance aspatial factors that identify core-periphery relations as it becomes possible to contact to distant foreign regions even easier than regions that are spatially closer but aspatially distant. Copus (2001)

emphasises that aspatial peripherality has become a key issue in understanding today's production systems. Although this view seems to contradict to what Frankel (2000) says, if taken together, it is rather complementary. That is, production is being dispersed in the world, but by creating new clusters at certain places. In the case of Europe, where borders have little influence, these clusters may be transnational clusters, extending their borders beyond a single country. These larger clusters of regions are becoming aspatially closer to other clusters elsewhere in the world, establishing the hegemony of the global cities network.

Foreign direct investment is not only about transfer of production. It also is about transfer of consumerism, identical products and market rules and structures (Sideri, 1997). Thus, FDI is not only focused on business services but as well on retailing in large metropolitan areas. Since labor intensive manufacturing industries (in mature sectors) grow and often relocate to the periphery of the metropolitan areas, they create a large market for both business and consumer services. Services fill in the gap. Evidence of FDI concentration are mentioned in a variety of studies (Wei and Leung, 2005; Sassen, 2000).

On the other hand FDI requires special channels to enter a country, which serve as gateways to local economy. Producer services today make it easier for FDI to enter a country, and decrease risks. It is thus easier to locate to cities which have good international connections and developed producer services. This in turn, brings in a circular causality of investment to gateway cities.

Political willingness to attract FDI in certain locations also adds to the phenomenon (Wei and Fan, 2000; Keyder and Öncü, 1993; Demurger et al., 2002; Li, (1988) as cited in Fan, 1997). Political choices such as financial deregulations and removal of trade barriers also play a key role in the way FDI moves into a country through different mechanisms. One of the mechanisms is related with the gateways mentioned above. As financial deregulation enables private firms to operate in financial sector, they tend to concentrate in certain locations and create gateways to local economy, both by financing international trade and enabling FDI to enter the country.

The picture, then, drawn by the orthodox theories of development and the picture we face today are quite different. Scott and Storper (2003) stresses that a new scholarship of economic geography over the 1980's and 1990's has helped to

revitalize and improve the older heterodox approach by a thorough reconstruction of the theory of agglomeration that is ongoing. A variety of recent work shows that agglomeration is part of successful development, either in developed or developing countries, and that it is key to explain different regional growth levels within different settlement or spatial administrative hierarchies.

Agglomeration is, anything but something new. What is new today is that the ingredients and the mechanisms might have changed, as well as its dimensions. It is seen that similar to rank size rule, different economic sectors within the value chain create different agglomerations at different spatial levels, due to changes in the organization of production, consumption patterns, international trade and large capital flows and increased labor mobility. All these are the major ingredients of so-called phenomenon "economic globalization".

Under the process of economic globalization, the role of prime cities have not degraded and inequalities levelled. The world is not flat as in Friedmann (2005), but is spiky (Florida, 2005). High concentrations of economic activity and population still dominates the global space. Most of the technological developments and innovations are created in largest cities (Florida, 2005) and diffused throughout the city networks. As Scott and Storper (2003) points out, economic globalization has not decreased but reinforced the role of cities.

Any debate on regional inequalities and globalization should thus take into account the role of agglomerations and thus local externalities, and pay attention to inequalities between members of the global city regions and the peripheral areas.

It may be claimed that a local production system in a specific region may benefit economic globalization through technology spillovers, learning by doing, increased opportunities for global contacts, and increased political power which is necessary to attract public investments and different forms of subsidiaries or promotions. Hence, it becomes possible to talk about the integration of a network of regions to the global system. In this framework, other regions who remain out of this process become peripheralized as they exhibit slower growth or recession in employment, if not productivity growth, either because they can not compete as they can not provide economies of scale and scope,and/or they loose their skilled workers and their markets shrink relative to the others. Thus, economic globalization is thought to be associated with regional inequalities. These processes are likely to be effective in

different spatial hierarchies from groups of countries to interregional levels. It is also likely that these processes do not only take place within countries but also across countries. A transnational city network is likely to benefit globalization more while rest of the regions are experiencing difficulties in growth and development.

2.3 Economic Globalization and Emerging market economies

Emerging countries are those that attract new foreign investments and catch higher growth rates. Most emerging countries attract significant amounts of capital invested in the production of services, durable consumer goods, labor-intensive parts of the value chain or high-tech goods, depending on the time of its initial integration to world markets as well as its location.

Emerging countries are also those who continuously liberalize their economies through privatizations and legal arrangements, increase their exports as well as imports. Among the mostly mentioned emerging market economies are China, India and Brasil. Turkey, Mexico and a variety of other countries are also usually mentioned as emerging market economies.

At the regional level, Kanbur and Venables (2005), emphasize that in many developing countries regional inequalities are increasing due to effects of globalization and trade opennes. Disparities are high between rural-urban and geographically advantaged-disadvantaged regions in these countries. They figure out while there are efficiency gains from concentration of economic activities in coastal areas or urban centres, the associated regional inequalities immensely contribute to overal inequalities.

Kopp (2000a,b), and Siebert and Kopp (2000) claim that in developing countries, urban structures have been distorted in favor of the large metropolitan areas resulting in a deficit of relatively small cities. In the cases of Mexico and China, any reduction of this distortion (by an increased spread of the highly skewed city size distribution), leads to a higher aggregate growth of the respective country. Higher rates of national growth goes hand in hand with higher regional inequalities in emerging countries. One questions if this is desirable or stable in the long run?

Fujita and Hu (2001), using GDP and industrial output data show that in China during 1985-1994 globalization and economic liberalization has led to the fast

development of the coastal regions (including Beijing), and a convergence between coastal regions. Though they mention other studies usually claimed interregional disparities decreased in the 1980'es, they remind that until 1984 agriculture was the driving force behind development, but after then industrial development played a major role. They attract attention to the increasing disparity between those regions (coastal) that are highly integrated to world economy and other (interior) regions. They emphasize that cross-region migration limitations also play a role in the increasing disparity between interior and coastal regions.

Using Theil Index, Fujita and Hu (2001) show that the catching up of coastal regions partially hides the overall inequalities in the country, but indeed regional disparities increased between the coastal and interior regions. Furthermore, using B-convergence analysis, they found no convergence at national level during this period.

Fujita and Hu (2001) also found that most of the regional disparities were caused by industrial growth and agglomeration (%55) and increasingly by services sector (%30) development in the coastal areas. As between 1984-1993, 80% of FDI inflows were to the coastal regions, and 42% of FDI was concentrated in these regions. Coastal regions also attracted most of the local investments. They show textiles and leather industries were concentrated in the coastal regions despite their labor-intensive nature. Transportation equipments, chemical fibers, electrical and electronics industries, which largely use imported intermediate inputs and which attracted high amounts of FDI were also concentrated in the coastal regions.

They also show that producer services have strongly self-agglomerated within the largest port, Shanghai, which was also the largest centre of finance and international trade in the 1930'es. Therefore, the end of the history argument is not valid. Inter-firm transfers and control of trade of other provinces play a key role in this agglomerations. Finally, they emphasize that a regionally imbalanced growth policy was due to the policy choice in the 1980 which aimed to use the full regional comparative advantages and allow regional imbalances to prevent weak points. The policy included opening up of special zones, FDI promotion and decentralized government in the coastal regions.

Kanbur and Zhang, (2005) show that after 1978, trade opennes in China has lead to a return to increasing regional disparities.

Using a decomposed Gini index, Huang et al. (2003) point that uneven development of secondary sector has a major role in increasing regional disparities in terms of GDP per capita in China during 1991-2001 period.

Ge's (2009) findings support other studies. He shows that degree of industrial agglomeration increased between 1985 to 2005, mostly because of the concentration of FDI and exporting industries. Export oriented industries and FDI companies are clustered more than other industries.

Storper (1991) discussed how regional inequalities increased and continued to exist in Brasil through the effects of globalization.

The high share of Sao Paolo in national GDP has been 35% in 1949, increased to 40.2% in 1975 and then decreased to 36% after 1986. However, meanwhile, surrounding regions have benefited from disagglomeration economies in Sao Paolo and thus the concentration of economic activities have actually enlarged.

Azzoni (2001) points that together with these surrounding regions the share of this larger agglomeration was 50% and reached to 55% in 1975, then decreasing again. Thus, the deconcentration of economic activity in Brasil takes place within a rather small area of the country. While he concludes that regional inequalities are decreasing through this period, his study also shows that between 1990-1995 there is divergence between regions. Using a north-south classification of regions and Theil index, he finds mixed results. Finally, there is increasing internal inequalities within poor (north) regions, and inequalities have stabilized between 1980-1992 in rich regions which previously experienced increasing internal inequalities. Post 1990 period in Brasil, under these conclusions should probably face increasing regional income inequalities due to faster rates of growth and increased FDI flows.

Hanson's (1996) findings show that after Mexico changed its 40 years old import substitution model, traditional manufacturing belt around Mexico City broke up and new industry centres developed in Northern Mexico where there is better market access.

2.4 Economic Globalization and Spatial Development Patterns in Turkey in the Post 1980 era

In the post 1970 period, Turkey also faced similar structural problems like Latin American countries. The import substitution policy was cancelled by 1980 to change the growth strategy to base on export oriented industrial growth. The post WWII strategy of Turkey has already put Turkey in close relation to Euro-Atlantic system, as a member of OECD and a possible future member of the prospected European Union.

Turkey in the last twentyfive years have been one of the emerging countries which represents some similarities with others through structural change, political reforms, financial liberation, increasing exports and it has become a relatively small but important FDI destination compared to Brazil or China. For these reasons, Turkey experiences similar effects of globalization together with those countries like China, Brazil, India or the like. Though growth in Turkey has followed a relatively volatile route, it has recently experienced very high rates of growth. Loots (2001) classifies Turkey as a passive globalizer among with those countries like China, Brazil, India, Egypt, Peru, Argentina and Columbia, using WorldBank indicators. Similarly, Lemoine and Ünal-Kesenci (2003) compares Turkey to India and China in their trade and technology transfer structures.

Although at the 1970's the largest trade partner of Turkey was Iran, most of the exports of Turkey was based on agricultural products. The changing global economic environment under Washington Consensus and the changing flow of capital to developing countries due to the rise of the flexible production systems as well as low growth rates in the developing countries, had put Europe as a target market for Turkish exporting industries, while also put Turkey as a target market for European companies. In this context Istanbul and İzmir became quite advantageous places due to presence of ports and other infrastructure, location, and well established international trade roots.

Among developments in free trade and integration, Turkey's accession to the EU and its participation to UN programs and policies had another impact on regional development, reinforcing current metropolitan systems. A decentralization of governance policy reinforced the metropolitan governments and enabled them to

build trans-national relationships with other metropolitan areas. In this context, Istanbul established many strategic partnerships with far more metropolitan cities than other cities in Turkey, both with metropolitan cities in neighboring countries like Odessa, but also with cities as far as Rio de Janeiro. These partnerships often reinforced transnational private sector relations, through associated events and agreements, and lead to bilateral investments(Erkut and Baypınar, 2007).

Table 2.2: Economic periods in the late Ottoman Empire and Turkey.

Period	Regional Development Pattern	National Economic Choice
1838-1923	Regional development through international trade (Dinler, tablo 5.6, s. 183, Çavdar T. s.86 alıntı, s. 184, Eldem.V. s.305 alıntı)	Imported industrial goods and exported agricultural goods
1923-1950	Etatist period, Heavy industries like iron and steel and basic textile industries. Ankara prevents excessive migration to west, and grows. Private sector prefers to develop in Marmara Region and Istanbul, where markets are large and infrastructure is developed.	Statism – State owned heavy industries
1950-1960	Liberal era, no plans, continued agglomeration of private sector in the west.Illogical location decisions of state owned enterprises throughout the country.	Liberal trade and state-owned heavy industries.
1960-1980	Planned era – Establishment of State Planning Organization and collaboration with The Ministry of Housing and Construction. • 1963-1967 Plans for Eastern Marmara Industrial Development, Tourism Development in Antalya, Agriculture and industrial development in Çukurova (Adana-Mersin) Industrial development in Zonguldak • 1968-1977 Moving away from regional interventions.	Import substitution model
1980-today	Decreasing role of state in production, rise of private sectors, SMEs, development of exporting industries. Metropolitan growth. • 1979-1983 – Development of local capital, large key projects for underdeveloped regions. • 1985 – 1989 – Decentralization zones around Istanbul and Izmir, promotion of private sector. The beginning of the Souteastern Anatolia Development Project • 1990-1994 – Organized industrial districts to decrease regional disparities indeed do concentrate in already developed regions. Economic Crisis of 1994. • 1996-2000 – Emergency action plan for Eastern Anatolia due to closure of international trade – Iraq war. Emphasis on regional inequalities and their negative influence on national unity. • 2001-2004 – Regional planning and regional development mentioned without any strong legislative changes, • 2004-2006 – Some legislative changes are made influencing regional administrations. A Preliminary National Development Plan for 2004-2006 is made to harmonize with the EU Budget. • 2007- 2013 – 9th National Development Plan Orientation to EU budget, Regional development and legislative changes.	Export oriented industrial growth model, international tourism

2.4.1 Changes in spatial and sectoral concentration of economic activities

Economic integration had consequent effects like the relocation of existing company headquarters in Turkey as well as concentration of FDI. As in China, growth was stronger in regions which had historical ties to international trade, like the north-western and western Turkey, and at a minor role, Middlesouthern Turkey (Mersin, Gaziantep), where there was better access to European markets. Both manufacturing industries and services created larger agglomerations in especially north-west and western regions, due to second nature geographical effects[1].

Figure 2.2 : Turkey, 81 provinces.

In Turkey not only FDI concentrated in certain areas, but local capital also moved to these centres as it wanted to compete and take part in international trade. Holdings' and headquarter's relocations played a key role in spatial development of manufacturing industries and services. As an example, Tekfen Holding moved to Istanbul from Ankara at 1967, Sabancı Holding moved to Istanbul at year 1974 from Adana, Mais Motor Company (Renault) moved first from Ankara to Bursa and then to Istanbul in 1970 and many examples follow. It should be noted that most of these companies were connected to Western economic and political system even before 1970'es and then turned into global players. As an example, Tekfen started construction business through NATO projects. Sabancı Holding had investments in Bridgestone and Hilton, but then started businesses with Toyota, Mitsubishi, Heilderberg and other international trademarks.

It should also be noted that the first wave of movers were rather industrial companies but some companies also had some investments in finance industry, or, they invested

[1] South-Southwestern Turkey, meanwhile has witnessed the development of tourism industries, which based on first nature geographical advantages (Muğla and Antalya)

in financial institutions on the way along. Relocation of large financial institutions' headquarters to Istanbul followed a little later. The movement of İşbankası, one of the largest banks was a very important event. Previously state-owned banks like Şekerbank, and other private banks also moved to Istanbul. Many private banks were opened in Istanbul later, which some of them later were acquired by TNCs.

The privatizations of large public manufacturing companies and the expansion of the private sector have changed the locational logic of firms and their plants, in the favour of market-oriented decision making. Many large companies preferred to have their headquarters separated from production units and locate in Istanbul and other metropolitan cities. This did not only provide them opportunities to benefit high-end producer services that enabled them to trade with the Western World, but also helped in the expanding international operations of Turkey based companies in the North-African, Balkan, Black Sea and Middle East Region. As an example Bucharest in Romania and Odessa in Ukraine attracted many investments from companies located in Istanbul (Erkut and Baypınar, 2007).

Turkey has entered the 1980'es with a fundamental change in its development policy, leaving an industrialization policy that depended on an import substitution model in favour of an export oriented industrial growth model. A rapid expansion of manufacturing industries and private sector has followed immediately (Table 2.3). One particular aspect of expansion was that Turkey specialized in labor intensive industries like textile, wearing apparel and leather industries (table 2.4 and 2.5).

By 1990, Istanbul's share in total GDP in Turkey was 20.7%, Ankara's share was 8.5% and Izmir's share was 7.4% approximately. By 2000, Istanbul's share rose to 22.7% while Ankara and Izmir's shares remained as they were. Shares of two neighbor reigons distant from the West; Adana and İçel (Mersin), dropped slowly. Therefore, Istanbul's position as a global gateway continuously strengthened. Government policy has as well supported and still is supporting Istanbul's growth as a global city.

Initially there has been a spectacular rise of Textile, wearing apparel and leather industry in the early periods of export oriented industrial growth period after 1980.

Textile, wearing apparel and leather industry was dominated by large public enterprises in the pre-1980 period (Baypınar, 2003), with low levels of export. It has

become the largest manufacturing sector in Turkey in the post 1980 period, and still is. During 1980-1998 period, its exports have folded 13 times, making Turkey Europe's first trading partner in textiles. SMEs and many large private companies opened, which preferred to concentrate in only a few locations in the country.

Table 2.3: Public and private enterprises share in all manufacturing industry workplaces in Turkey.

		1980			1998		
		Public	**Private**	**Total**	**Public**	**Private**	**Total**
Workplaces*	Number	408	8,299	8,707	302	12,030	12,332
	Share	4.69%	95.31%	100.00%	2.45%	97.55%	100.00%
Employees	Number	287,189	499,806	786.995	143.516	1.062.648	1.206.164
	Share	36.49%	63.51%	100.00%	11.90%	88.10%	100.00%

*Workplaces with 10 or more workers
Source: own table using TURKSTAT Annual General Census of Industries 1980 to 1998

Table 2.4: Number of employees in manufacturing industries.

Number of Employees in Manufacturing Industry*		**1980**	**1998**	**Change (%)**	**Contribution to Overall Increase (%)**
31	Food, beverages and tobacco	185,794	186,166	0.20	0.09
32	**Textile, wearing apparel and leather industries**	**184,224**	**416,836**	**126.27**	**55.49**
33	Wood and wood products, furniture	16,745	27,657	65.17	2.60
34	Paper products, printing and publishing	28,285	36,168	27.87	1.88
35	Chemicals and chemical, petroleum, coal, rubber and plastic products	74,747	109,329	46.27	8.25
36	Non-metallic minerals	58,707	79,414	35.27	4.94
37	Basic metal	74,181	66,462	-10.41	-1.84
38	**Fabricated metal products, machinery and equipment**	**161,235**	**275,832**	**71.07**	**27.34**
39	Other	3,077	8,300	169.74	1.25
Grand Total		786,995	1,206,164		100.00

*in firms with 10 or more employees
Source: Baypınar, 2003

Though manufacturing industries expanded rapidly, compared to population of country, a very large part of the population still worked in agriculture. Industries hence remained largely concentrated within and around metropolitan areas, with differences according to sub-sectors.

Table 2.5: Manufacturing industry exports in Turkey.

Industry export (000USD)		1970	1980	1998	Contribution to Overall Increase (%)
31	Food, beverages and tobacco	250,267.175	1,033,992.022	3,660,071.400	11.32
32	**Textile, wearing apparel and leather industries**	**203,712.014**	**810,861.183**	**10,877,964.064**	**43.41**
33	Wood and wood products, furniture	3,772.887	8,394.031	151,948.822	0.62
34	Paper products, printing and publishing	210.975	3,013.838	178,127.079	0.76
35	Chemicals and chemical, petroleum, coal, rubber and plastic products	13,382.877	129,991.927	2,205,012.141	8.95
36	Non-metallic minerals	3,847.904	75,611.132	937,782.898	3.72
37	Basic metal	11,455.109	58,800.870	2,215,546.531	9.30
38	**Fabricated metal products, machinery and equipment**	**2,911.962**	**96,851.249**	**4,900,470.858**	**20.71**
39	Other	712.444	3,861.879	286,628.198	1.22
Source: Baypınar, 2003					

The automobile assembly industry and chemical industries have also developed in the same period, and have also substantially increased their exports in the post 1980 period. Today fabricated metal products, machinery and equipment industries compete with the exports of the textile, wearing apparel and leather industries.

Turkey has not been able to attract electrical-electronical equipments industries as succesfull as Asian emerging countries, indeed. Thus, though it has attracted some FDI, it lacked the opportunity to benefit from this high demand sector (Lemoine and Ünal-Kesenci, 2003).

Empirical outcomes of a study by Baypınar, (2006) provides some information about the changing structure of the spatial economy during 1992-2002.

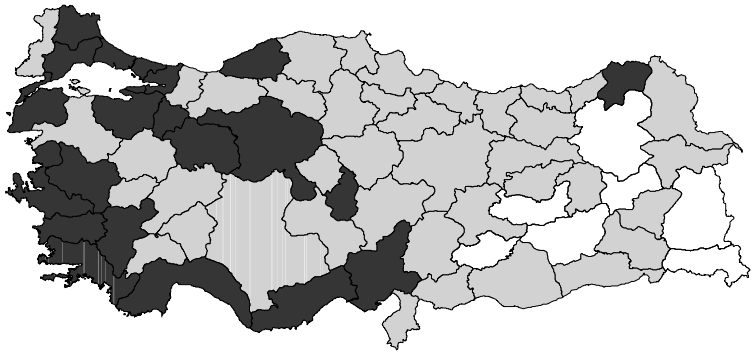
Core metropolitan regions of Istanbul, Ankara and Izmir have stregthened their position in financial services throughout the period. The subsequent concentration of financial activities after financial regulations in 1989, has led to a decrease in the number of regions with strong financial services. Bank mergers and acquisitions have also played a role in this concentration.

Baypınar's study shows that two new industrial regions, Denizli and Tekirdağ have emerged which have strong shares in private R&D services relative to their population share at year 2002. Denizli and Tekirdağ have both attractaed industries and emerged as competitive regions. Kocaeli has still a distinguishing feature, while

Bursa has lost its stregth in R&D services' share. Core regions (Ankara Istanbul Izmir) have still high shares in both R&D services and manufacturing industries.

In the share of administrative, legal and other services, while the three core regions still were the most important regions by 2000. Kocaeli, Bursa, Denizli and Tekirdağ possess higher shares in manufacturing industry and important shares of such services. These services included headquarters of companies, which shows that the region is more connected to global networks. Bilecik, Kırklareli and Rize formed a subgroup, which were in usual highly specialised in few industries.

GDP Per Capita Groups in Turkey at 1997



	Regions whose GDP Per Capita increased between 1990 and 1997 and was above the national average at 1997		Regions whose GDP Per Capita increased between 1990 and 1997 but was below the national average at 1997		Regions whose GDP Per Capita decreased between 1990 and 1997 and was below the national average at 1997

Source: Baypınar, 2003

Figure 2.3 : GDP per capita groups in Turkey at 1997.

An initial look at the geography of production reveals that growth of urban sectors is strong in and around existing metropolitan areas, and stronger in the West. This should likely make spatial inequalities rather persistent. The evolution of regional inequalities in Turkey will be discussed and studied in detail in the fifth section, therefore, here only a brief schema on distribution of regional growth of income is be presented in figure (2.3) above.

2.4.2 Spatial and sectoral concentration of foreign direct investments

Erden's (1996) study shows that most of the FDI companies were attracted to Turkey due to its proximity to different markets like the Europe, Black Sea, Central Asia, Middle East and Eastern Mediterranean.

It may be claimed that Turkey has been a good place to attract TNC because it had a large market within itself and it was a good location to trade with other surrounding

large regions. High share of FDI in services firms should have led to higher concentrations within the country. Geniş (2004) shows that almost all of the FDI in producer services was concentrated in Istanbul at 2002.

Privatizations, abolishment of state monopolies and financial liberalization acts have played key roles in the penetration of FDI into Turkey, which focused on acquisition of previously state owned manufacturing industry plants, mines, banks as well as opening of new companies in a variety of manufacturing industries and services.

The pattern of the development of manufacturing industries in Turkey follows the general outline in the emerging world. Indeed the pattern of development of services also follow the same route. In Turkey, while at the 1980 there were only 78 MNC, in 2000 the number increased to 5,328. As of end of March 2006, 10,278 foreign companies or branches were allowed to invest in Turkey and 2,158 Turkish companies were allowed for joint foreign direct investments. Thus, the total number of FDI companies reached to12,436. Moreover, only between 17.06.2003 and 31.12.2004, 154 foreign companies were allowed to open offices in Turkey, of which 120 choose to settle in Istanbul (Republic of Turkey Prime Ministery, 2005).

In 1995, 70% of firms with foreign direct investments were in the services sector, and only 28% was in the manufacturing sector (Deichmann, Karidis and Sayek, 2003). In 2004, when 2,136 companies, branches or offices were allowed to be opened, 361 were in manufacturing industries, 1,564 in services and 211 in other sectors (Republic of Turkey Prime Ministery, 2005). The manufacturing industry companies' share dropped to 16.9% while those in services sector rose to 73.2 % In terms of invesment amounts, of 569.6 million USD investment in 2004, 436.3 million USD went into manufacturing industries (76.6%) and 84.5 million USD into services (14,8%).

Although the numbers of 1995 and 2004 should be taken with caution due to a new law in 2003(Act. No. 4785), still the pattern of investment has not changed. Most of the investment is in manufacturing industries, due to higher costs of technology transfer, establishment or modernization of production plants and size of Turkish companies bought or joined. This was accompanied by bank acquisitions or mergers, and the opening of many smaller companies that enabled import of foreign products in Turkey. Most of these firms in the services sector were either financial institutions that allowed foreign capital to invest in Turkey, either in financial or real estate

assets, or trading companies that imported foreign products into Turkey. Thus, their basic locational logic depended on being within the large metropolitan markets. Nevertheless, there are also other firms which provided producer services for exporting companies. These firms also preferred to locate basically in large metropolitan centers due to their proximity needs to headquarters of manufacturing industries and other services.

Between 1990-2001, Istanbul attracted 46,3% of foreign direct investment permissions in terms of amount of USD, and 71,9% of foreign trade permissions.

Apart from these small trading company branches (which are representatives of very large MNC), between 2001-2007, many large Turkish banks have been either sold totally or partially to multinational companies. This is important all these banks' headquarters are located in Istanbul, which creates an enourmous agglomeration of foreign direct invesments. It is a particular feature of a globalizing city, in which one might expect to find a high degree of concentration of foreign controlled financial institutions that play a key role in the integration to global economic system.

The rest of the country was virtually a desert of foreign investment, in the pre-2000 period, has not attracted significant amounts of services with FDI, and experienced certain difficulties in the growth of services sector. Such FDI movement basically reinforces current agglomerations of economic activity, rather than creating new clusters that would decrease overall regional inequalities in the country.

The concentration of FDI not only creates a scale economy that rises initial investment costs for new clusters to emerge elsewhere in Turkey, but also creates barriers to entry to such markets for companies located outside the globalizing core Istanbul and a few other locations due to advantages in the globalizing core such as easy access to foreign capital, highly sophisticated knowledge stock, and political power that comes through the size of the agglomerations.

The pattern of FDI distribution seems to follow the general route elsewhere in the world, with large concentrations in certain gateway cities, and surrounding hinterland. The core of the global gateway city provides a good location for services, especially that like financial, real estate or retail&wholesale companies. The immediate periphery of this small core attracts FDI in manufacturing industry due to proximity to large metropolitan markets, easy import-export through sea or airports,

or land routes, and proximity to the producer services that enable transfer of financial capital as well as transfer of knowledge and technology.

Table 2.6: Cumulative amount of FDI.

	number of companies	% in total	cumulative fdi stock (TL)	percentage of cum. Fdi stock	fdi/company (TL)	fdistockpercapita00 (TL)
Marmara Region	3,864	66.15	2,737,178,629	81.33	708,380	157.62
Aegean Region	665	11.38	260,187,083	7.73	391,259	29.10
Interior Anatolia Region	638	10.92	209,644,346	6.23	328,596	18.05
Mediterranean Region	536	9.17	93,229,554	2.77	173,936	9.22
Black Sea Region	79	1.35	50,577,782	1.50	640,225	5.99
Southeastern Anatolia Region	44	0.75	14,507,685	0.43	329,720	2.78
Eastern Anatolia Region	15	0.25	185,923	0.01>	12,395	0.03
Source: Yavan and Kara, 2003						

2.4.3 Conclusion on Turkey

An initial look to Turkey has shown that, as elsewhere in the world of emerging market economies, spatial agglomeration of economic activities continue, and the structure of regional inequality is rather persistent.

This preview to Turkey demonstrates that economic activities agglomerate in and around certain metropolitan areas to form larger global city regions, and most other regions experience weak growth in employment. In accordance, growth of per capita income is also clustered, and core and semi-peripheral regions seems to have improved their relative positions in the distribution of per capita income.

2.5 Conclusion

Economic globalization is a long-term process, shaping the geography of settlements and economic activities. Though it has been a long term process, much attention is paid to its last 40 years. Especially after 1970'es, more countries have adopted neo-liberal policies, leading to rapid integration and spatial structural changes. In this period, a group of developing countries experienced stronger impacts of economic globalization.

Economic globalization is thought to reinforce long –established urban systems, but metropolitan cities and surrounding areas which have relatively better access to international markets are more prone to influences of economic integration. Integration to international economy leads to specialization in a variety of industries and introduces development of services. The spatial development of such economic activity is surely not even, neither across countries, nor across regions within countries. The emergence of a trans-national city network through market forces introduces new challenges for nation-states. Existing regional inequalities are likely to persist, while new forms of inequalities also seem to emerge.

The next section provides a deeper look into theory and empirical findings that try to explain regional growth.

3. REGIONAL GROWTH, CONVERGENCE AND INEQUALITIES

There is a large body of theoretical and empirical literature on regional growth, convergence and regional inequalities. With growth, often two things are mentioned: employment growth and growth in the productivity of labor. In many studies, income growth is taken as the focus instead of productivity of labor, due to differences in theoretical approaches. Convergence and inequalities are mostly, about productivity rates or income levels of regions.

Today, most of the empirical work which uses formal spatial or non-spatial econometrics toolbox on regional growth is done within the framework of the neo-classical growth theory, and theories that have developed as a reaction to it. Among these are the Endogenous Growth Theory, New Economic Geography and New Growth Theory. The methodology of the empirical studies in line with these new theories usually find their grounds in the neo-classical growth model.

There are also other approaches like evolutionary economic geography, and ne-marxist approaches in geography. Despite their advantages, in this study the focus is on the post neo-classical literature and the associated methodology.

In the first section below theories on regional growth and regional inequality are evaluated. First, it is attempted to distinguish between different schools of thought and continue with the assumptions of neo-classical and post neo-classical theories.

In the second section, the focus is on the methodological toolbox used in empirical research. In this section methodological approaches are classified by the phenomena they focus, such as estimation of factors associated with regional labor productivity growth, regional employment growth or differences in regional distribution of labor productivity.

In the third section a summary of empirical findings on the issue of regional productivity growth, regional employment growth and differences in regional productivity levels is provided.

3.1 Theories on Regional Growth and Regional Inequality

Regional inequalities can be studied in many ways. Differences in the productivity, education, and other indicators are all subject to inequality research. Regional inequalities are a result of spatial socio-economic, and sometimes, natural processes that play a key role in the productivity of regions. Inequality is therefore often associated with development and growth.

Martin and Sunley (1996) identify three main groups of researchers that have different approaches to the regional inequalities. The first group's opinions depend on the Neo-Classical School (NC). NC assumes that in a given closed and integrated economy, regional inequalities could grow initially due to growth of some few regions, but then poorer regions would grow faster. Thus at the long run, regional inequalities could diminish.

The second group thinks that in a capitalist economy, divergence is more likely in the long run rather than convergence. This group of scholars argued that if market forces were left to their own devices, they would be spatially disequilibrating. Martin and Sunley (1996) evaluate the second group of convergence literature up to date in two sub-groups. One group refers to the "club-convergence" while the other focuses on the "conditional convergence".

At this point it is necessary to distinguish between different concepts related to measurement of inequalities. From a methodological point of view, briefly two different approaches in dealing with the inequality issue can be identified (Sala-i Martin, 1996; Cuadrado Roura et al., 1999). The term "convergence" has long been used as a reduction of the differences in income per capita between regional (or national) economies. Therefore, this concept was related more with the distribution of data. Recently, this type of convergence is called sigma convergence to distinguish it from other concepts of convergence, like the "beta convergence" mainly aroused by the neo-classical and post neo-classical studies.

The sigma convergence is usually measured by indexes such as the coefficient of variance, GINI or the Theil index, which provide us information about the size and the distribution of the inequality, while beta convergence is measured usually by spatial or non-spatial econometric models where the dependent variable is the growth rate of productivity of labor at the regional level. As an example, Theil index enables

to partition the social or economic groups in a country into urban and rural sectors, or into primary, secondary and tertiary sectors, or genders, and evaluate the contribution of within-set and between-set inequalities. Recently it is also used to asses income inequalities between different sets of regions within a country. Coefficient of Variance (CV) is used to evaluate the dispersion of the data, while a similar method, Weighted Coefficient of Variance (WCV) is used when either population (or workforce) weights of regions need to be taken into account. These methods are used and discussed in the fifth section. A time series analysis can be used to understand the direction of change by using CV, as an example. Recently, another approach, spatial markov chains are used to understand the distributional dynamics and time-space relations of inequalities.

The "club convergence" studies mainly use this first group of methodologies that focus on sigma convergence. While these approaches offer us information about how much the inequality is, they don't help us in answering the question why regions differ in their productivity rates, income levels, or other observed features.

The second approach, "beta convergence" is related to growth of productivity (or, income per capita) and the catching up processes, i.e. that of a poorer region growing fast and catching richer regions in terms of productivity. In its simplest form, this is called "unconditional beta convergence". In the unconditional beta convergence models, the dependent variable is the growth rate of per capita productivity of regions and the explanatory variable is the initial per capita productivity rates. Thus, it is used to assess whether if poorer regions grow faster than richer regions. If this catch up process is conditioned by other variables, the model is then called "conditional beta convergence" (Cuadrado Roura et al., 1999). This approach tries to evaluate the role of underlying factors on the observed data, depending on theories of regional growth. In this way, it is possible to asses which factors contribute to size of the observation, but it doesn't provide information about the distribution of the subject observation. Therefore, both sigma and beta convergence approaches are often used complementarily to evaluate the amount and direction of regional inequality in time, and potential factors that lead to growth or decline of inequalities.

As an example to the "club-convergence" group, Chatterji (1992) provided that there could be a "club convergence" that only counries that had similar initial conditions and similar structural characteristics converged to one another, such as those richer

OECD countries being one convergence club, developing countries being another, and underdeveloped countries yet being another. While these countries were converging each other within their groups, there need not be convergence between these groups. These findings indeed point to persisting inequalities among countries despite the growing world trade. Furthermore, they point to a polarized income distribution at the international level, that instead of all countries converging each other, a rather stable twin or multi peak distribution of productivity levels (or, income per capita) is possible (Martin and Sunley, 1996; Chatterji 1992; Quah, 1996; Galor, 1996; Marcet, 1995).

Martin and Sunley (1996, 1998) refer that a third group; which became popular among geographers during the 1970'es and early 1980'es challenged both of these views. They call this group to be part of the Marxist account of uneven regional development. They refer to Harvey (1982), Massey (1984) and Smith (1984). These theories emphasized that regional economic evolution was neither convergent and nor divergent in the long run, but episodic. From time to time, the accumulation crises in the capitalist system change the course of capitalist development in favour of a new spatial, technological, social and political structure and thus lead to growth and decline of regions.

Since the focus in this study is on a shorter time period, and the study period chosen (1990-2000) does not span between two different episodes, it is preferred here to focus on the empirical research line established in by the first two groups of scholars, and to the post 1970 period.

To ease the discussion, the beta convergence approach above is chosen as the focus and two different aspects of development and growth is discussed. Most of the economic activities in space is agglomerated, that is, they have grown in size in a certain place. The variable to measure the size could be the amount of total production or absolute employment. On the other hand, the output per capita, created by these activities is more associated with the development level, input quality and technology. Technological progress, infrastructure and human capital are some of the important factors that are associated with the productivity issue. In the literature sometimes these two different aspects are discussed in parallel, or sometimes there is confusion. Therefore, per capita productivity growth is discussed in parallel with growth in absolute employment, to assess evolution of regional inequalities.

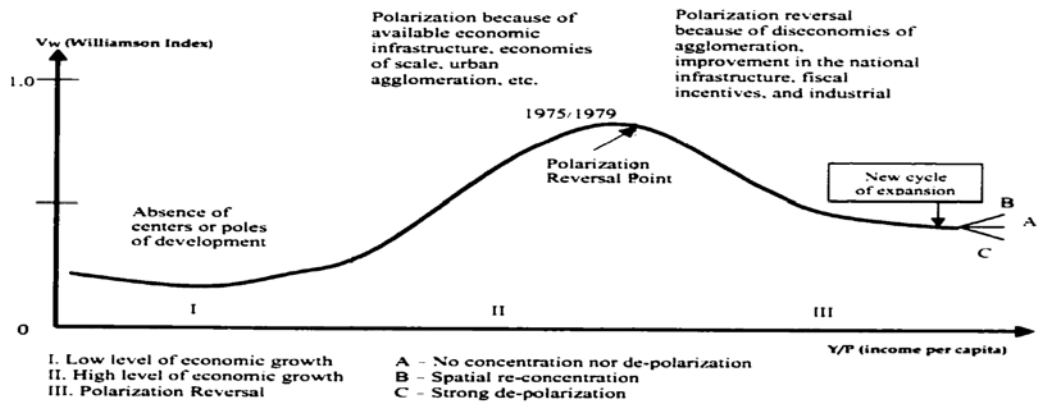
Most referenced growth model is that of Solow's (1956) NC growth model. This model is established by two functions, of which one is the production function and the other is the capital savings equation. Solow employs a production function which is subject to constant returns to scale and where labor and capital can be substituted. Both capital and labor are subject to decreasing returns. Technological progress and population growth are exogenous factors. The economy operates under perfect competition. It is a closed economy where savings equal to investments.

In this model firms in a region employ labor until the marginal product of labor is equal to the wage, and employ capital until the marginal product of the capital equals to interest rate. To sustain production, firms have to invest in such a level that would keep the amount of capital to labor against the growing population and depreciation of capital goods. Investments grow until capital to labor ratio is equalized. This is called the steady-state. In the steady state, there is no growth in per capita productivity, if there is no technological progress.

In this framework, there should be no regional inequalities because in the long run regions reach to their steady states. Technological progress is thought to have same impact for each region, since technology is assumed to be freely available for everybody, at everyplace at anytime. If there are two regions with identical population growth rates, investment rates and similar technology levels, but one of these regions were initially poorer, it will grow faster than the richer region, because it will experience higher rates of return to capital under diminishing returns to capital. At the end, they will all converge to the same steady – state. This implies that regional inequalities decrease as regions converge to their steady-state (Jones, 2001). The Solow model does not allow externalities, and assumes closed economies where labor and capital flows are not allowed.

A serious problem with the NC model is that it creates a perception of world economy that is much different than the reality. Countries do not need to develop technologies, because if they catch the same investment rates and lower population growth, they will all converge to the same steady levels. Its assumption of a closed economy is even more problematic at the regional level, because within a country usually population and capital movements are quite easy. On the other hand, following Florida (2005), technology is not produced everywhere, but mostly concentrated in metropolitan regions in few locations.

Hirschman (1958) and Williamson (1965) described the changes in regional disparity as an inverted U-curve. In Williamson, (1965) "regional income differentials increase in early development stages, then stabilize, and then diminish in mature periods of growth". It should be noted that Williamson's work bases on comparison of developed and developing countries using a cross-section approach, rather than observing the whole development pattern of countries. Due to issues such as path-dependency, initial advantages, increasing returns to scale associated, it is suspicious that every country would follow the same pattern of development, and experience the same structural changes in "within-the-country" inequalities. Even if they do, this might not follow that inequalities between countries would diminish at future phases of economic integration.



Source : Haddad (2003)

Figure 3.1 : Williamson's Curve.

In order to reach to their steady states, poorer regions have to grow faster for some time, until capital and labor flows equalize the production and consumption flows.

Richardson (1973) criticized that the Neo-Classical Growth model is problematic since the background assumptions of it are inapplicable to the regional economy. Perfect competition can not be assumed in regional economic analysis, because space and existence of transportation costs limit competition. He claimed that neoclassical model tells us nothing about the characteristics of regional economies, gives no hint about the importance of agglomeration economies, interdependence of location decision, and metropolitan-regional relationships. Richardson (1973) also pointed that the neoclassical theory has neglected the diffusion of technology while it has paid so much attention to interregional factor (labor and capital) mobility. On the

other hand, the neoclassical growth equation, according to Richardson (1973, p.28) may still be useful as a mater of definition.

A group of scholars like Perroux, Myrdal and Kaldor argued that, in a capitalist economy, divergence was more likely in the long run rather than convergence at the regional level; if market forces were left to their own devices, they would be spatially disequilibrating (Richardson, 1973; Martin and Sunley,1996). Their arguments based on the forces of cumulative causation mechanisms that arise due to economies of scale and agglomeration economies. Regions which started growing (in terms of employment and production) would attract more investment and they would benefit economies of scale while those regions which lagged behind would face higher entry costs in the long run. These scholars argued that despite congestion effects in the developed regions, and cost advantages of less developed regions, uneven regional development would likely dominate and regional inequalities could persist under market forces. If regional productivity level is dependent on economies of scale and technology is not freely available, it is very unlikely that there should be convergence. In such an environment, the interplay between positive and negative externalities that arise due to agglomeration might lead to improved or deteriorated productivity rates.

In this framework, productivity growth has to be thought together with agglomeration of economic activity, and externalities that arise due to agglomeration. Growth in the number of firms and employees introduces other opportunities that play a key role in increasing productivity levels. As an example, in a large metropolitan area, a large variety of intermediate products, a larger labor pool and technical expertise, sophisticated infrastructure and institutions may be available, so that more sophisticated products may be produced, firms easily find workers and production continues smoothly due to easier maintenance. The spatial proximity of the large variety of products brings in benefits to firms, enabling them to produce complex products cheaper and faster. This kind of externalities are usually called static externalities, which arise due to localization economies (Küçüker, 1998) and urbanization economies (Goldstein and Gronberg, 1984).

Apart from static externalities that arise due to agglomeration, dynamic externalities are also thought to be an important element in productivity growth. Dynamic externalities refer to knowledge externalities, which is closely associated with

phenomena like diffusion of technology and innovation, or, learning by doing. As technology is assumed to be an exogenous factor of productivity growth in the neo-classical theory, dynamic externalities are neglected. In the absence of such externalities, the assumption of decreasing returns to scale and perfect mobility of labor and capital between regions eventually leads to convergence in regional productivity rates in the neo-classical model.

Many scholars have argued that the assumptions of neo-classical growth theory is not applicable to the real world situation. The assumption of decreasing returns to scale is relaxed in new theories like endogenous growth theory (EG) or the new growth theory (NG). These theories treat knowledge at least as partly endogenous, that technological progress does not only occur as an exogenous process. Moreover, growth is partly due to learning by doing processes, which are not only specific to the firm level, but also work at the industry or even metropolitan levels (Arrow, 1962; Romer, 1986; Lucas, 1988; Krugman and Obstfeld, 1997). In this framework, there are knowledge externalities from other firms located nearby that firms enjoy.

Most of the studies focus mainly on three types of externalities (Glaeser et al., 1992; Fann and Scott, 2003; Dekle, 2002).The first type is the Marshall – Arrow – Romer (MAR) type externalities which occur between firms within the same industry. The spatial proximity and the local labor market facilitate knowledge spillovers from innovating firms to other firms, hence improve overall productivity. This is also known as localization effects. (Glaeser et al., 1992; Fann and Scott, 2003)

The other one is the urbanization effect, which refers to positive spillovers from other industries to the industry under consideration. This type of externalities are usually known as Jacobs externalities since Jacobs (1969) defended the idea that innovations which most of the economic sectors benefit are usually created in other economic sectors. Labor market pooling and intensive small inter-firm relations create externalities that work for the benefit of other firms than the original innovator (Fann and Scott, 2003).

Although many believe that face to face communication is important and cross-fertilization of ideas may lead to innovation, such innovations can be diffusing not only within a city but rather in a city network. Thus, cities which keep central positions within an urban network could be places where such spillovers happen more often. It may be thought that such a process could reinforce urban hierarchy

rather than development of smaller and less productive settlements which are not in close proximity to such cities. Furthermore, urbanization effects may not be evident in very small settlements. Se-il Mun and Komei Sasaki (2001) in their work for Japan have found that threshold population size is 200,000 for a region for agglomeration economies to work.

The third type is the externalities that arise due to local competition. Porter (1990) and Jacobs (1969) claim that local competition is beneficiary for firms, since they force companies to adopt quicker to innovations and gain a competitive advantage against other companies elsewhere in the world. On the other hand, MAR approach claims that competition creates a disincentive for innovation as in the absence of a monopoly, firms can not fully internalize the benefits that arise from innovative activity.

Utterback (1994) points that knowledge spillovers are more important in the early stages of the industry life cycle. Following this, Glaeser et al. (1992) suggest that if externalities are important only in early stages of industry's life cycle, they would not be captured (by the econometric model).

When industries are standardized and matured, there is little scope left for innovation. Most of the information is codified and it becomes easier to move the production to other places which have lower costs of input such as labor and land. Depending on the size of the benefits, either a neighbor region or a distant region with good access to global city system could be attractive for such industries. Furthermore, if the subject mature industry covers a labor intensive part of the value chain, the information required in the production processes will be readily supplied by the TNC and it will have little to gain from local externalities. These type of industries may grow by size in the mentioned regions, but it doesn't necessarily mean that their growth leads to growth in labor productivity.

Referring to Henderson (1986), Glaeser et al. (1992) point that there could be static localization externalities which may account for city specialization but not for growth.

Fan and Scott, (2003) count externalities that arise due to economies of scale as a distinct type arising from the urbanization and concentration of economic activity. The larger the number of firms and number of employees, the larger and more

complex the infrastructure becomes. Externalities arise due to common consumption of this complex infrastructure. However, there could be strong limits to these kinds of externalities. If infrastructural artifacts are not upgraded and expanded in pace with employment growth in these places, over concentration can easily lead to negative externalities and may lead to declines in productivity. If industries grow in size (both in terms of production and employment) some producer services might benefit this growth. These could be engineering services, financial or legal services. Thus, absolute growth in employment could be beneficiary in the longer run in creating employment, while increasing intensity of labor could be hampering productivity in the shorter run.

Henderson (1986) found that the productivity of firms increases with the size of the industry as measured by industry employment. Ciccone and Hall (1996), on the other hand, believe density is a better proxy. They claim:

- Density of employment increases average labor productivity.
- Density can be the cause of increasing returns for technologies that have constant returns if transportation costs increase by distance.
- Density also creates externalities and makes it easier for others to benefit.
- Density enhances specialization.

Glaeser et al.,(1992) point that increase in employment density could be a better source of positive externalities at the infancy of an industry. It may well be a source of negative externality for large metropolitan areas and mature industries.

Another important factor influential on employment growth and productivity growth is thought to be entrepreneurial activity. The role of entrepreneurs has been long discussed in creating employment. According to Wenneker and Tunnick (1999), it was Schumpeter who has most prominently drawn attention to the “innovating entrepreneur”. Porter (1990) believes that invention and entrepreneurship are important elements for a competitive national economy.

The role of the entrepreneur is often discussed in the NG theory as an innovator and facilitator of knowledge diffusion. Entrepreneurs are sometimes taken as a form of capital, human capital as in Romer (1990), or as in the form of new firms as in Acs and Armington (2004).

Entrepreneurial activity may be higher in areas where people live within an entrepreneurial culture, where local social and institutional structures support risk taking and individual success (Baumol, 1990). Thus, the initial concentration of entrepreneurs could be an important factor in explaining further entrepreneurial activity within a region.

Maier (2001) shows how the early stages of development lead to path dependencies and agglomeration of economic activities. If some important production function prefers to locate at a given point, others will probably follow, leading to a concentration of economic activity. Following agglomeration, positive externalities are likely to start working on further reinforcing the agglomeration by improved productivity levels and associated competitive advantages. The spatial outcome of such a process would be the persisting productivity differences between certain metropolitan regions and other regions.

Audretsch and Keilbach (2004) discuss the importance of entrepreneurs in making use of knowledge which has an economic value, and creation of diversity. By doing so, entrepreneurs facilitate knowledge spillovers and hence labor productivity increases in certain places with higher entrepreneurial activity.

On the contrary, entrepreneurs may be just profit seeking and not interested in innovative activities at all. Baumol (1990) provides that the conditions in a country may alter the role of entrepreneurs which may have different effects on growth. This might effect where and which sectors they will prefer to invest in.

Finally, Fann and Scott (2003) emphasize that place specific institutional factors may also promote localized growth. They point that in non-western world, dense industrial clusters derive both from local entrepreneurial efforts and FDI, making large city regions home of the most vibrant industrial districts.

In this framework, depending on the role of agglomeration on productivity growth, the role of FDI and local entrepreneurs seem to have either direct (by transferring technology, establishing new linkages between companies and making use of knowledge externalities) and indirect (by agglomerating in certain places to benefit static externalities) effects on the productivity growth.

Belderbos and Carree (2002) found that in China in the electronics industry, there is a tendency of export oriented smaller companies following larger plant locations in

the electronics industry, and locate to regions with ports that are closer to Japan. Controversially, large plant locations are decided by the multinational (Japanese) companies they are connected to. Head et al. (1995) have found the similar results for Japanese automobile industries in the USA.

The empirical findings and theory, briefly, suggests that agglomeration of economic activity, and employment growth is often clustered in space. Benefits associated with static externalities play a role in this process. Productivity growth may arise due to dynamic externalities created through either spatial specialization and/or diversification of the local economy, and knowledge spillovers from foreign direct investments. Since the role of knowledge spillovers on productivity growth is usually emphasized, it is likely that productivity growth in knowledge intensive production modes are likely to be more open to dynamic externalities.

3.2 Methodological Approaches

The literature on productivity and growth in regions is a bit confusing since similar but different concepts are often cross-referenced, as also pointed by Bishop and Gripaios (2009). As an example, there are many studies which focus on a certain point in time and try to explain the causes of differences in productivity levels of regions or countries (Fann and Scott, 2003; Henderson, 1986; Ciccone and Hall, 1996). Such studies use a static cross-section analysis approach, where the differences in current productivity levels of regions are explained by incorporating current conditions at a given year. But it does not take into account the impact of initial conditions or growth of other factors on the growth of productivity. This approach could be useful in assessing structural changes in time, if it is held for two discrete time points. Making comments on long term growth depending on results of such studies, may introduce problems because they only focus on the distribution of data at a certain point in time.

Another source of confusion comes from studies that focus on employment growth rather than the productivity growth per capita. However, employment growth is usually source of other effects that play a role on productivity growth. Growth of employment at the regional level may bring in aggregate productivity growth since labor moves from primary activities to secondary or tertiary activities. However, at the sector level, it does not have to imply productivity growth at all. Labor could be

concentrating in more labor intensive industries or excessive growth could lead to negative externalities.

Employment growth and productivity growth are two different but related phenomena, which are usually evaluated using similar methodological toolbox. Since the original growth models aim to explain growth of regional productivity per capita, and employment models follow a similar approach, only models aiming at explaining convergence and growth in regional productivity rates are discussed below.

The Neoclassical assumption of absolute convergence in productivity growth is empirically tested by the unconditional beta convergence model. In discrete time, the formula as in Sala-i Martin (1996) is :

$$\log(y_{it}) = a + (1-\beta).\log(y_{it-1}) + u_{it} \qquad \textbf{(3.1)}$$

Where *i* denotes regions and *t* denotes time, y_{it} is the productivity per capita at the subject year, a and β are constants, with $0<\beta<1$. Since annual growth rate $\log(y_{it}/y_{it-1})$ is inversely related to the $\log(y_{it-1})$, a higher and positive β here implies a greater tendency for convergence. That is poorer regions grow faster and catch the rich regions. It is assumed that the error term u_{it} has mean zero, same variance for all economies and is independent over time (and across regions).

In Barro et al. (1990) the unconditional beta convergence model in a dynamic cross section form is as in equation (3.2).

$$(1/T).\log(y_{it0+T}/y_{it0}) = a - [(1-e^{-\beta T})/T].\log(y_{it0}) + u_{it0,t0+T} \qquad \textbf{(3.2)}$$

In this model, the average growth rate of per capita output is the dependent variable, where y_{it0+T} is the productivity per capita at final year and y_{it0} is the productivity per capita at the initial year, and T is the time between the initial and the final year. The error term is shown as $u_{it0,t0+T}$. The independent variable is the logarithm of the per capita output at the base year. If $\delta = [(1-e^{-\beta T})/T]$, following Paas et al. (2006), the speed of convergence, then, *s* is calculated as

$$s = -\ln(1+T\delta)/T \qquad \textbf{(3.3)}$$

and the half-life of convergence may be calculated by:

$$\tau = -\ln(2) / (\ln(1 + T\delta) / T) \quad \textbf{(3.4)}$$

If β is positive and significant, (the coefficient δ is positive and significant), this implies that regions with initially lower per capita output experience faster growth rates, which in time would raise them to similar rates of productivity with rich regions.

As well known, data on regional economy is collected and aggregated according to administrative boundaries. Administrative boundaries usually do not perfectly match the actual geographic distribution of economic units such as workplaces. This, in turn, may create spatial dependencies in a regression model. These problems are detected using spatial diagnostics methods. Armstrong (1995) and Quah (1996b) point to the significant spatial clustering of productivity growth and their relevance to spillover effects. Neo-classical theory neglects such spillover effects. If there are spatial clusters, spatial dependencies have to be diagnosed.

There are two common forms of spatial auto-correlation that have to be taken into account. One occurs when the dependent variable is spatially auto-correlated. This represents for example, in a model where the dependent variable is growth in productivity, the growth rate of a region is dependent not only to the independent variables but also to the growth rate of neighbor regions. If detected, this kind of spatial auto-correlation is taken into account by introduction of a spatial lag model. In the unconditional B convergence model, the spatial lag model is as follows:

$$\log(y_{it0+T} / y_{it0}) = a + \delta \log(y_{it0}) + \rho W \log(y_{it0+T} / y_{it0}) + u_{it0,t0+T} \quad \textbf{(3.5)}$$

A similar spatial lag form as in Magalhaes et al. (2005) is:

$$(\ln(y_{i,t)+T} / \ln(y_{i,t)}) = \alpha + \beta \ln(y_{i,t)} + \rho W (\ln(y_{i,t)+T} / \ln(y_{i,t)}) + \varepsilon_t \quad \textbf{(3.6)}$$

Here the ρ is the coefficient and W is a weight matrix containing information on the neighborhood structure of the region. Thus, the growth rates of the neighbors of each region enters the equation as a new variable. The significance of the parameter ρ is interpreted as the existence of spillovers between regions. The detection of such

spillovers depends on their presence as well as the spatial relationships identified by the weight matrix.

In the case of spatial error, the unconditional convergence model becomes as in Magalhaes et al. (2005):

$$\left(\ln(y_{i,t})+T/\ln(y_{i,t})\right)=\alpha+\beta\ln(y_{i,t})+(\mathrm{I}-\lambda W)^{-1}u_t \qquad \textbf{(3.7)}$$

In the model above in equation (3.7) the I is the identity matrix, W is the weight matrix incorporating information about neighbors and u is the error term. This kind of model usually points to measurement errors or omitted (spatially correlated) covariates. Measurement errors could b due to a mismatch between the actual geographic distribution of a phenomenon and the administrative borders that define the way data is collected.

The spatial lag and error models can not be solved through ordinary least squares methods, and require the use of maximum likelihood method, or other methods. Therefore, the correlation coefficient of the unconditional least squares model without spatial effects can not be directly compared to the correlation coefficient of the models which incorporate spatial effects.

Another version is the spatial cross-regressive model, in which the spatial spillovers arising from initial conditions can be assessed (Yıldırım and Öcal, 2006):

$$\log(y_{it0+T}/y_{it0})=a+\delta\log(y_{it0})+\tau W\log(y_{it0})+u_{it0,t0+T} \qquad \textbf{(3.8)}$$

In the formula above, τ represents the spatial spillovers.

Lopez – Baso et al. (2004) prefer to use a different form where the initial productivity levels of neighbor regions are thought to have an effect on the productivity growth in the subject region.

$$\log(y_{it0+T}/y_{it0})=a-(1-e^{-\beta T})\log(y_{it0})+\theta_{Wy}\log W(y_{it0})+u_{it0,t0+T} \qquad \textbf{(3.9)}$$

In this form the weight matrix W contains information about neighbors of region i. Since the weight implies that average (unweighted) initial productivity level of neighbor regions is used, the form $\log W(y_{it0})$ (natural logarithm of the average initial productivity level of regions) is preferred rather than $W\log(y_{it0})$.

Another approach is to filter variables to eliminate spatial effects. Battista and De Vaio (2007) chose to use spatially filtered variables in their model. This approach is not going to be used or discussed in this study.

Apart from the models above, if geographical location is thought to be an important factor in explaining differences in the dependent variable, Geographically Weighted Regression is another tool that can be used.

Many researchers prefer the conditional convergence model, to the unconditional model, due to recent theoretical approaches, which Martin and Sunley (1996) briefly calls Post-Neo Classical Endogenous Growth Theory. Basing on the neoclassical unconditional beta convergence model, it is possible to get around the unrealistic assumptions of the neo-classical theory, and incorporate effects like endogenous technological progress, human capital formation, specialization of industries, owhich indicate to knowledge spillovers, and externalities that arise due to diverse urban economies.

For example, the Mankiw-Romer-Weil model by Mankiw et al. (1992) is a conditional B-convergence model which is modified from the Solow model that is based on a production function of Cobb-Douglas type, and includes other variables such as human capital, labor, capital.

Following Barro et al., (1990), Romer, (1990) Barro et al., (1991), Mankiw et al., (1992), other researchers have incorporated other variables into these models to explain important factors that cause differences in productivity growth. As an example, Petrakos and Saratsis' (2000) model includes many variables related to initial conditions and structural differences of regions:

$$\ln(y_{i1}/y_{i0}) = \beta_0 + \beta_1 \ln y_{i0} + \beta_2 x_{2i} + \beta_3 x_{3i} + \beta_4 x_{4i} + \beta_5 x_{5i} + \beta_6 x_{6i} + \beta_7 x_{7i} + \beta_8 x_{8i} + \beta_9 x_{9i} + \beta_{10} x_{10i} \quad \textbf{(3.10)}$$

As usual, y_{i0} is the initial productivity level of regions. Variables x_{2i} is the share of the secondary sector in the prefecture's total employment, x_{3i} is the share of the tertiary sector in prefecture's total employment, x_{4i} is the quality of the labor, indicating initial advantages. Variable x_{5i} is the share of employment in manufacturing in declining branches, x_{6i} is the average value of the capital intensity per manufacturing enterprise, x_{7i} is the average value of the capital intensity per

worker in manufacturing, x_{8i} is an indicator of tourist resources, x_{9i} is a composite transport infrastructure indicator and x_{10i} is an indicator of invesment incentives. The model incorporates initial advantages and structural differences, but does not consider any spatial dependencies.

Spatial autocorrelation of the dependent variable or the error term should still be checked in these models. Moreover, there is a possibility that explanatory (independent) variables may have spatial autocorrelation with the dependent variable. This is possible as the growth rate in productivity may be influenced not only by own assets of a region, but also by the assests of neighbor regions. As an example, a region may benefit the human capital in the surrounding regions if there is a possibility of commuting between these regions. Ertur and Koch (2006) uses such a model:

> This kind of specification, including the spatial lags of exogenous variables in addition to the lag of the endogenous variable, is referred to as the spatial Durbin model (SDM) in the spatial econometric literature. More specifically, we refer to this model as the global spatial Durbin model when all speeds of convergence are identical and then all parameters are homogenous. In contrast, when the speeds of convergence are specific to each country, we refer to the equation (..) as the local spatial Durbin model with heterogenous parameters. (Ertur and Koch, 2006)

Ertur and Koch (2006) uses a Spatial Durbin Model, reminding that the model could be estimated by Maximum Likelihood, Instrumental Variables (as in Kelejian and Prucha,1988), and Bayesian estimation method (as in Le Sage, 1997).

The spatial durbin model as in Le Sage and Fischer, (2007) provides the basis for a growth regression model which allows three types of spatial interdependencies in the growth process:

- Spatial effects working through the dependent variable (income growth)
- Spatial effects working through the initial variable.
- Spatial effects working through a set of conditioning variables.

The basic model in Le Sage and Fischer (2007):

$$y = \rho W y + \alpha i + \mathrm{X}\beta + W\mathrm{X}\gamma + \varepsilon \qquad \textbf{(3.11)}$$

Here y is the n by 1 matrix for observed growth rates of n cases. The n by k matrix contains k explanatory variables excluding the intercept vector. The matrix W is a n

by n non-stochastic, non-negative spatial weight matrix. The weight matrix' diagonal is set to zero and it is row standardized so that *Wy* in the model contains linear combinations of growth rates of spatially related regions. The parameter ρ is expected to have a positive sign which is less than one, indicating that the growth rates of the neighbors have a positive influence on the growth rate of the case region. This captures the first type of spatial effects mentioned above.

The *WXy* component is used to identify if initial income levels of neighbors have an influence on the income growth rate of the case region. This captures the second type of the spatial effects mentioned above.

The matrix *X* contains data on the initial year's explanatory variable values. This is because it makes it easier to avoid simultaneity and to model initial regional characteristics as endowments that explain variation in future regional growth rates. This captures the third type of the spatial effects mentioned above.

The model also includes an error term, which is represented by an n by 1 normally distributed, constant variance disturbance vector. Thus, this model does not contain a spatial error term. If the spatial error is considered, the model becomes spatial Durbin model as in Anselin (1988):

$$y = \rho Wy + (I - \rho W)x(\beta + \gamma) + v$$
$$v \sim \mathrm{N}(0, \sigma_v^2 I_n) \qquad \textbf{(3.12)}$$

Imposing the restriction $\rho=0$ on the model implies that there is (spatial) independence between growth rates of regions, but other characteristics of the related regions still are included which are shown in *WX*. Imposing the restrictions $\rho=0$ $\gamma = 0$ leads to a non-spatial regression growth model assuming no spatial interdependencies on regional growth rates.

Finally, Basile (2008) has employed a semi-parametric Spatial Durbin model to analyze the growth behavior of 155 European regions between 1988-2000, depending on the original model proposed by Gress (2004) and Basile and Gress (2005). He uses this specification to accommodate both spatial dependence and non-linearities. The model aims to test for the spatial externalities on the process of economic growth of European regions, while maintaining the functional form as flexible as possible to detect the heterogeneity in convergence speed and growth

behavior. The model also allows the interaction between the characteristics of each region and its neighbors. Basile's (2008) model is in general form as follows:

$$\Upsilon y = \beta \ln y_0 + \psi X + \pi Z + \varepsilon \tag{3.13}$$

Where $Yy = T^{-1}(\ln y_T - \ln y_0)$ is the per capita growth rate of gross domestic product between periods T and 0, $\ln y_0$ is the initial GDP per capita, X is a vector of structural variables which includes physical and human capital accumulation rates, population growth rates and a constant term, Z is a vector of additional control variables allowing for predictable heterogeneity in the steady state growth path and/or initial technology and ε is the vector containing normally identically distributed errors. The unknown paremeters β, ψ, and π are estimated by using ordinary least squares (OLS), generalized least squares (GLS) to account problems related to heterogeneity, and instrumental variable (IV) and generalized method of moments (GMM) to deal with the problems associated with endogeneity and measurement.

Basile (2008) unlike Ertur and Koch(2006) prefers to use semi-parametric techniques to identify non-linearities rather than by imposing a functional relationship between parameters and spatial weights. The semi-parametric spatial Durbin Model (SP-SDM) he employs finally is in the following form.

$$\begin{aligned}\Upsilon_y = {} & s_1(\ln y_0, W \ln y_0) + s_2(\ln s_h, W \ln s_h) + \beta_1 \ln s_k + \\ & \beta_2 W \ln s_k + \beta_3 \ln(n+g+d) + W \ln(n+g+d) + \beta_4 \ln(agr) + \\ & \beta_5 W \ln(agr) + \rho W \Upsilon_y + \varepsilon\end{aligned} \tag{3.14}$$

Where Υ_y is the growth rate of per capita GDP in the region, $\ln y_0$ is the initial per capita GDP, $\ln s_h$ is the average percentage of the working-age population in secondary schools, $\ln s_k$ is the average share of gross investment in value added. The variable $\ln(n+g+d)$ is the effective rate of depreciation with n as the average growth rate of population and the growth rate of technology and depreciation (g+d) is accepted as 0.05. The growth of population, technology and the depreciation rate are assumed to be exogenous variables. $\ln(agr)$ is the percentage of workers employed in agriculture. W is the usual weight matrix. Among linear components, there are non-linear components as $(\ln y_0, W \ln y_0)$ is a thin plate regression spline regarding the initial GDP per capita of the region and its neighbors, $(\ln s_h, W \ln s_h)$ is a thin plate

regression spline regarding the initial human capital level of the region and its neighbors. This model is solved by applying a maximum likelihood estimation method.

Basile (2008) uses 5 explanatory variables for 155 NUTS II regions. He uses 10 nearest neighbors k-matrix for the spatial weights, but also tests for other number of neighbors.

Until now, cross-section models are discussed. A variety of other approaches are also available. Of these panel data analysis and spatial panel data analysis models are more promising wherever time-series data is available.

3.3 Empirical Studies on Regional Productivity Growth, Employment Growth and Regional Inequalities

One of the challenges of studies related to regional growth and inequalities is that productivity growth differs between sectors. Most of the studies focus on aggregate productivity growth. On the other hand, empirical evidence suggests that certain industries show different location and agglomeration patterns. For example, while manufacturing industries are spreading over large areas, producer services like finance, insurance, advertisement are being concentrated in very small areas. Furthermore, productivity of labor in every sector is quite different.

The vertical disintegration of the firm in a globalizing world adds more complexity to the studies on regional productivity growth. Headquarters of companies are usually spatially separated from their manufacturing plants and low value services, and concentrated in the metropolitan centers. Low value services like back-offices and manufacturing industries are usually moving to cheaper land in nearby areas, or other countries.

In this framework, the spatial administrative borders define the quality of data which regional scientists use in assessing productivity differences. Often, time series data is not available. The limited number of cases depending on the number of regions in a country also posses another problem related to econometric analysis.

As it was mentioned above, another problem is that most of the literature on regional productivity differences, productivity growth and employment growth is cross-referenced. Usually same factors are used to explain these different phenomena.

Since all these phenomena are interrelated there is a level of endogeneity, but still the confusion in the literature makes it difficult to distinguish the individual effects of such factors on employment growth and productivity growth.

Keeping all these issues in mind, a detailed literature survey is presented below on empirical findings on:

- employment growth,
- regional productivity differences and inequality in productivity levels, at a given point in time, and,
- regional productivity growth within a time period.

3.3.1 Spatial-temporal studies on regional employment growth

These studies focus on growth of employment rather than growth in labor productivity. However, usually similar variables are used in both approaches. An example is Glaeser et al. (1992) study although the case is the USA and the period is 1956 to 1987. This study is important since it is a reference for other studies including that of Kıymalıoğlu and Ayoğlu (2006) in which employment growth in Turkey is studied.

Glaeser et al. (1992) define a production function where labor is the only input. Then, they define a growth function where growth in employment is the dependent variable, growth in wages, growth in national technology, regional specialization, competition, diversity and initial conditions are independent variables. Specialization, competition and diversity are measures for externalities in the industry and city level. In this way the model uses similar variables in a model where productivity growth is the main concern.

They find that rapidly declining city industries were more regionally concentrated than the rapidly growing ones. Industries grew faster in diversified cities than in specialized ones. Fast growing city industries were more competitive. The results suggest that in none of the industries within-industry knowledge spillovers (MAR externalities) were important. Diversity, instead, helps in growth in employment. Since the sample studied (USA cities) mostly accommodate mature and declining industries, they claim these results should be taken with some caution. Another point

that should be mentioned about this frequently cited study is that the average growth of employment was zero for USA cities.

In another study by He (2004), it is found that neither specialization nor diversity had positive effects on employment growth in the US. Entrepreneurship, education, pro-business policy and geographic advantages played a more important role in growth in employment in US cities.

Acs and Armington (2004) made an empirical study for the US using a model on employment growth. They use employment growth as the dependent variable and entrepreneurial activity, agglomeration effects and human capital as independent variables. They emphasize that although in their model the causation runs from entrepreneurial activity to economic growth, it might be also the other way around, since economic growth may also lead to new firm formation.

They find that higher levels of employment growth rates are found to be strongly and positively associated with entrepreneurial activity and initial level of human capital, and negatively associated with agglomeration effects (specialization and density) in all sectors of the economy except manufacturing. They find that correlation between human capital and employment growth increased over the decade suggesting that the source of employment growth has been shifting to more knowledge based activities. In manufacturing industries, entrepreneurial activity has insignificant effects on employment growth, and impact of competition has weaker effects to growth. Specialization has a positive but insignificant effect on employment growth in manufacturing, but it has a significant negative effect on other industries. Density has a negative impact, while larger number of new firms has a strong and positive impact. Acs and Armington here report that considering industries generally, when the variable on number of new firms is omitted, other variables loose their explanatory power.

Bishop and Gripaios (2009) studied 23 industries in Britain using OLS and maximum likelihood spatial models. They found that specialization has a generally negative impact on employment growth, whilst the impact of diversity is heterogeneous across sectors. Strong local competition has a typically positive impact.

3.3.2 Cross-section studies on determinants of regional productivity differences

These studies focus on a single time section or two discrete time sections and evaluate the distribution of regional productivity differences over space. The dependent variable is the regional productivity level at that given time and the explanatory variables represent certain factors that are thought to represent scale economies, economic specialization and diversity, density, distance from a certain location, institutional and cultural factors. These studies focus on spatial differences but do not take into account temporal dimension. Therefore, these studies do not inform us whether if poor regions are catching up with richer regions, and if there is beta convergence or not. These studies are briefed here because they provide some insight on differences in productivity rates and regional characteristics.

Henderson (1986) found that the productivity of firms increases with the size of the industry in a region as measured by industry employment.

Ciccone and Hall (1996)[2] believe spatial density is a better proxy for specialization. The idea is that even if the sector uses technologies that have constant returns, in a world where transportation costs increase by distance, increasing spatial density may lead to increasing returns. Furthermore, density enhances specialization and creates externalities and makes it easier for others to benefit such externalities.

Ciccone and Hall used two models to test the importance of externalities on labor productivity growth in the USA. They take into account local geographical externalities, diversity of local intermediate services and spatial density. They find that;

- Public capital does not affect productivity at the state level significantly.
- Density effects seem to be more important then size effects at county level.
- They suggest growth of density could be an important factor in growth.

Fann and Scott (2003) use value added per labor force as the dependent variable and capital to labor ratio and Herfindhal index as independent variables to evaluate the externality effects in China. Both of the coefficient signs are positive, with an R^2 of

[2] Ciccone and Hall (1996) used an instrumental variable approach and used some historical factors as a determinant of agglomeration following Rand McNally (1993).

0.41, indicating that higher diversity may be a determinant of higher productivity. They also test the influence of specialization by using location quotient and population of the largest city in the region as an indicator of scale. They find that specialization plays a key role in explaining productivity levels in especially textiles, leather, electric equipment and machinery industries. Large population also is positively associated with higher productivity.

Since this study captures static effects, it is not clear whether if increasing diversity, population and specialization might lead to increasing productivity levels in time. There is a possibility that some of these effects could be due to static externalities.

Fann and Scott (2003) refer to Y. Chen's (1996) study on China where impact of agglomeration on productivity rate was found to be positive and high for the machinery industry but lower for less technology intensive industries such as food manufacturing.

3.3.3 Spatial-temporal studies on regional productivity growth and convergence

In this methodological setting the growth rate of productivity per capita and /or employment in time is the dependent variable. Both spatial and temporal dimensions are taken into consideration in this way. This type of studies are directly linked to theoretical assumptions of neo-classical and post neo-classical growth models, focusing on growth of productivity through a time period, while studies discussed in the previous section are merely interested in the differences of regional productivity levels at a given point in time. Therefore, these methods are those that are used in assessing beta convergence: whether if poorer regions are catching up with rich regions. Details about the methodology were given above in section (3.2).

In a cross-section setting, the growth rate is calculated by averaging the difference between the logarithm of the final year and the logarithm of the initial year, as shown above in the methodological approaches section. In a conditional beta convergence model, explanatory variables include the initial productivity level per capita, initial conditions that are thought to create a regional advantage, and growth rate of other factors (such as knowledge stocks, FDI, population). Petrakos and Saratsis (2000), was given as an example in the previous section. As seen above, in most of the recent studies, spatial dependencies are also taken into account.

These type of studies restricts the analysis of convergence to sets of economies (Martin and Sunley, 1998). These sets of economies are created by realistic assumptions that similarity of institutions, tastes and technology holds. The hypothesis is that since these economies are similar, they should be converging to the same steady states (Barro and Sala-i Martin 1995 p. 382, as in Martin and Sunley, 1996).

Table 3.1: Summary of some major studies on regional convergence.

The Empirics of Regional Convergence: Summary of Some Major Studies						
Study	U.S. States	Japanese Prefectures	European Regions (NUTSI)	European Regions (NUTSII)	Canadian Provinces	Australian States
Barro and Sala-i Martin (1995a)	1870-1990 β=0.027					
	1980-1990 β=0.001	1985-1990 β =-0.001	1980-1990 β =0.010			
Sala-i Martin (1996b)	1870-1990 β=0.017	1955-90 β =0.019	1950-1990 β =0.015		1961-1991 β =0.024	
Armstrong (1995)	1963-86 β=0.023		1975-1993 β =0.006	1975-1993 β =0.003		1953-1991 β =0.009
						1977-1993 β =-0.017
Source: Petrakos and Saratsis, 2000						

Petrakos and Saratsis (2000) provide a summary of some major studies in table 3.1. It should be noted that these studies sometimes differ with the dependent variable they use. As in the NC, full employment is assumed, usually gdp per capita income is taken as the same thing with productivity per capita. Often, purchasing power parity data is used for GDP. In other studies, sometimes value added data is used for economic sectors, and it is divided to the population to find per capita productivity. Or, value of added created in a sector in a region is divided to number of employees wherever specific data is available. Often, little attention is paid to these differences in the empirical literature. Keeping this in mind, results of some empirical studies are presented below.

3.3.3.1 Studies for European Union and the USA

Armstrong (1995) found that convergence during 1975-1991 was faster in NUTS 1 level but only 0.4% per annum for NUTS 2 regions in Europe. Martin and Sunley (1998) point that there is evidence of geographic clustering of regional growth rates

in both Europe and the United States. That is, fast growing regions tend to be closer to fast growing regions while slower growing regions closer to slower ones (Martin and Sunley, 1998).

Braunerhjelm and Borgman's (2004) study on labor productivity growth in Sweden takes into account regional absorption capacity, population, change in specialization, change in the share of employment, average firm size, education level, and entrepreneurship. They use Gini index, Ellison-Glaeser index and Herfindhal index in calculating the variables. Since such studies usually face problems of heteroskedasticity, they use an OLS model corrected with White's method. They find that productivity grows faster in regionally concentrated industries, and this is especially so for knowledge intensive manufacturing, network industries and industries that intensively uses raw materials. Regional entrepreneurship and regional absorption capacity are also found to be important explanatory variables, while impact of the skill level and economies of scale is more mixed.

Not surprisingly, they also find that knowledge intensive industries are more concentrated than manufacturing industry. In manufacturing industry, agglomerations connected to natural resource proximity, network industries and knowledge spillovers seem to have strong relations with labor productivity growth. Impact of spatial autocorrelation on the regression results is very small in their study.

To include issues like path dependency, usually initial conditions are tested as factors of growth. Following Glaeser et al. (1992), Dekle (2002) tests the importance of dynamic externalities as initial advantages on total factor productivity growth in manufacturing in Japan during 1975-1995. He uses initial productivity level, own industry concentration of output (or employment) at initial year, as a ratio of own industry output (or employment) to the total effective urban land area for testing MAR externalities. He uses a Herfindhal index to take into account the Jacobs externalities. By Herfindhal index, he tries to capture the externalities that arise from a diverse economy. For Porter externalities (the competition effects), he uses the number of firms relative to the size of production in the region and rates it to Japan. He also uses wage data from an industry specific database.

Although he finds that externalities play a role in productivity growth, for manufacturing industry, he surprisingly finds no dynamic externalities of any type. However, he goes on with a panel data estimation, and finds MAR and Porter

externalities, but no Jacobs externalities to be important in explaining productivity growth. He points that omitting the capital stock can lead to omitted variable bias. Dekle's opinion on growth in manufacturing productivity is as follows:

> The evidence suggests that the cross-fertilization of ideas is especially important for non-manufacturers, and that there will be a tendency of further geographic concentration in industries such as financial services. The manufacturing industry is characterized by low or no dynamic externalities. Thus, the manufacturing industry should continue to disperse geographically, both domestically and internationally.(Dekle, 2002)

Audretsch and Keilbach (2004) has found that high entrepreneurship rates lead to higher rates of growth of labor productivity in Germany.

Basile(2008) study provides that there are strong non-linearities in the initial per capita incomes and schooling attainment levels. Human capital investments have a positive impact only when the schooling attainment levels are above the EU average. Those regions which have below the average school attainment levels seem to benefit from neighbors' human capital, leading to faster growth in these regions then their counterparts. Regions surrounded by richer regions are expected to have higher growth rates then regions surrounded by poorer regions. This is inline with the decentralization of industries and establishment of back-offices in services sectors.

In the non-parametric model he employs, Basile (2008) finds strong spatial externalities across Europe. Although he finds that there is significant conditional convergence, he also finds that the growth of regions are influenced positively by the initial gdp per capita rates of their neighbors. The population growth of neighbors and capital and human capital accumulation of the neighbors are also important for the growth of a region, while its own population growth is not. His findings are in line with the negative externalities that could be associated to increasing population and the drop of GDP per capita, movement of industries to nearby peripheral areas and knowledge spillover effects. As expected, the share of agricultural employment played a negative role in the growth of the per capita GDP.

Later, Basile (2008) employs the semi-parametric spatial Durbin Model (SP-SDM) which was discussed above. By employing this model, he finds that although poorer regions grow faster, rich regions surrounded by rich regions are those which grow fastest. He reports that these findings are in line with Lopez-Bazo et al. (2004) and Ertur and Koch (2006). He finds that at least there are three groups of convergence,

which is in line with the findings in the literature of "club-convergence". The club convergence hypothesis implies that regions that are identical in their structural characteristics converge (in terms of gdp per capita) to one another in the long run provided that their initial conditions are similar. The results also suggest threshold levels such that the secondary school attainment in a region has to be above the average to be an explanatory variable for regional growth. But, since there are spatial externalities, regions with lower secondary school attainment could also grow fast if they are surrounded by regions where secondary school attainment is higher than average.

Basile (2008) also applies robustness tests using different number of regions and finds that the model is quite stable. However, he points the difficulties in including foreign and domestic neighbors. He mentions that Overman and Puga (2002) find that foreign neighbor regions matter as much as domestic neighbors.

3.3.3.2 Studies for Newly Integrated Countries and Emerging Market Economies

Without any suspicion, China is by far the most interesting case for researchers, due to its size and its rapid growth and integration to world markets. Being the largest emerging market economy, a brief on some key studies will be presented here.

Bai and Li, (2004),using a panel data set, found no unconditional beta convergence during 1985-1999 on industrial productivity levels. When they took into account the human capital factor, they found that industrial productivity of labor has converged during 1985 – 1999.

Jefferson et al. (2008), found that, firm entry-exits contributed substantially to China's overall industrial productivity growth during 1998-2005. Thus, entrepreneurial activity has contributed to substantial productivity catch up with the coastal region by many of the interior provinces.

Wang, (2004), on a basis of overall GDP per capita productivity, finds that there is divergence during 1991-1999, by employing a panel data set and a generalized method of moments estimation (GMM) to an unconditional beta convergence model. By introducing conditional variables such as capital investment, population growth and time – dummy, they find beta convergence.

McErlean and Wu, (2003), find that there was an increasing sigma divergence between 1985-1992 and sigma convergence between 1992-2000 in agricultural labor productivity, for 29 regions in China. The conditional beta convergence model provided that convergence was insignificant for the entire period, but there was significant divergence between 1985-1992 and significant convergence between 1992-2000 in agricultural labor productivity. They conclude that the relaxation of the enforcements in the migration policy has eased rural to urban migration and thus helped in reducing disparities between regions in agricultural productivity levels.

Although Greece is not considered as an emerging market economy, due to its similarity to post 1980'es Turkey, some studies about Greece will be briefly reviewed as well. Greece was also characterised by a dualist spatial economic structure, and integration to Europe had significant effects on the spatial structure of the economy.

Siriopoulos and Asteriou (1997) studied unconditional and conditional beta convergence for the period before Greece entered to the European Community (EC), 1971-1981, for 1981-1996, after Greece entered the EC, and the whole period from 1971 to 1996. They found that although β coefficient showed convergence, it was never statistically significantly different from zero for any period in the unconditional model. When a dummy variable for structural differences in North and South was introduced, but still there was no significant convergence across Greek regions. After introducing share of capital investments in GDP, share of GDP in manufacturing sector and share of GDP in the industrial sector, they find that after EU integration there was conditional convergence. That Northern regions converged to each other and Southern regions converged to each other. Therefore, the dual structure continued. The rate of convergence was very slow: 0.4% per annum. It is similar to the findings of Armstrong (1996) for Europe, but the unit of analysis in Greece was NUTS III and that in Armstrong's study was NUTS II.

Later, Petrakos and Saratsis (2000) held a study for 1981 – 1991. They first indicate that the coefficient of variation for GDP per capita did not change during 1971-1981 (0.24) but then decreased to 0.19 at year 1991. Despite the decline, they point that at 1991 the prefecture with the highest prosperity still exhibited a GDP per inhabitant which was 2.5 times greater than the prefecture with the lowest prosperity.

Petrakos and Saratsis (2000) then use a conditional convergence model to asses beta convergence on income in Greece for the period 1981-1991. They use a cross-section approach to assess conditional convergence. They prefer to use the domestic consumption of electricity per individiual as and indicator of per capita income levels, because they don't find GDP data satisfactory. They find that regional inequalities decreased during the period. Prefectures with a strong presence of the secondary sector at initial year (1981) grew at faster rates, but not so for prefectures where tertiary sector is strong. They conclude that if tourism is excluded, the predominantly public and retail oriented services sector do not create preconditions for faster economic growth. In line with literature, they find that prefectures with good stocks of human capital have grown, and specialization did not have a significant effect. They also claim that manufacturing industries were hit by competition due to integration, and thus regions with large manufacturing plants suffered. On the other hand, regions where manufacturing industries were capital intensive, productivity grew. Last, they don't find a statistically significant relationship between transport infrastructure, or public incentives and the growth rate of income per capita.

Neither of the studies on Greece above have assessed the importance of spatial dependencies in their models, but the findings of Siriopoulos and Asteriou (1997) present a spatial dualism in the Greek economy characterised by a North-South divide which is also a concern for studies made for Turkey, in the form of a Western-Eastern duality.

3.4 Conclusions

The review of the literature showed that growth has different dimensions. Growth of employment and growth of productivity or income per capita are two main concerns of empirical studies.

Regional inequality is more an issue related with either productivity or income per capita growth. The NC foresees that regional inequalities will be diminishing in the later phases of integration, due to faster growth of productivity in the less productive regions. Since productivity and income are taken usually as the same thing, in other words it could be said that the income per capita of the poorer regions will be growing faster than richer regions. The major reasons for this are the flows of capital

and labor between regions under perfect competition and exogenous technological progress.

Post neo-classical theories point to importance of endogenous technological progress, that arise due to a variety of factors such as specialization, diversity, competition, technological diffusion and transportation costs. The quality of human capital is one of the most important factors in increasing productivity growth. Recent studies also point that these factors could be effective beyond the borders of a region and there could be spatial externalities influential across regions. For a given region, the progress of neighbors is an important matter.

Empirical evidence suggests that there could be convergence or divergence in the course of integration. Most plausible findings are that there could be convergence clubs, and productivity growth could be clustered. One important detail is that the level of analysis is highly influential on the outcome of research in this field. Such growth clusters could be detected in one level of settlement hierarchy but there may not be such clusters in another level. This is mostly due to other factors such as the size of the economy and the unique geographical features of a given study area.

On the other hand, employment growth tells another story. Some studies focus on employment growth, and evaluate growth differentials in a similar manner with productivity convergence. This is thought to be problematic since employment growth is something different than productivity growth.

Employment growth seems to be also clustered, especially in newly integrating countries. The findings on the determinants of employment growth is mixed. One important issue is that the relationship between employment growth and productivity growth is not well studied. In the newly integrating countries, employment is clustered and few centers are growing in urban sectors. Since productivity of urban sectors are usually higher than agricultural sectors, it should have strong implications on aggregate regional productivity growth. But while many people move to urban areas, less people are left behind in the rural areas.

In this setting, the pattern of employment growth and the productivity growth should be studied hand in hand. Globalization and integration favor few places as location of production. These places are likely to benefit technology transfer and low transportation costs to international markets more than other regions in a newly

integrating country. Path dependencies are likely to be influential in the future phases of integration. However, international trade implies also specialization in certain industries for a newly integrating country. The industries in which a country specializes will have a major impact on the differences of productivity levels of regions within a country. Therefore, employment growth and productivity growth are studied separately in the following sections.

4. REGIONAL EMPLOYMENT GROWTH IN TURKEY

Turkey's experience in regional employment growth bears some similarities with other emerging market economies. First of all, spatial pattern of growth of employment is clustered. Second, it favors metropolitan regions which have better access to international markets. Third, a dualist spatial economic structure between East and West seems to be persistent.

In this section, regional employment growth in Turkey during 1990-2000 is investigated. First, a review on empirical studies about Turkey are given. A descriptive data analysis is executed to support literature review. Then, the factors contributing to employment growth is investigated by a cross-sectional multiple regression model, supported by Exploratory Spatial Data Analysis (ESDA) and spatial diagnostics.

4.1 Empirical Studies on Employment Growth in Turkey

Filiztekin (2002) studied manufacturing employment growth during 1980-1995 in Turkey using a TOBIT model. The dependent variable in his study was the logarithmic differences of employment growth between years 1980-85, 1985-90 and 1990-95. His study covers manufacturing employment in establishments which have 10 or more employees, because it uses data from General Census on Industries. When all industries are considered, his results suggest that employment growth is positively influenced by proximity to urban centers and population density. Subsidies to agriculture are likely to deteriorate employment growth in manufacturing industries in agrarian regions. The level of education promotes employment growth, but high share of young population hampers growth. It may be suggested that this is likely because a high number of military personnel are counted in population census of the period.

In the sub-industry level, higher technology industries are strongly associated with education level. Localization economies are not found to be a significant determinant of employment growth. So are urbanization economies. For all manufacturing

industries, as well as heavy industries, forward and backward linkages have a positive effect on employment growth. Density, has only a significant and negative effect for employment growth in heavy industries. At the aggregate level, competition does not have a significant impact. For heavy industries, it has a negative, for high tech industries, it has a positive impact on employment growth. Average establishment size has a negative impact for all industries. Presence of state owned industries did not induce growth except high tech industries. Although Filiztekin suggests that this is likely because the highly trained personnel in state owned enterprises attract high tech industries, this might be also because state owned enterprises themselves either were shut down, privatized or shrank in size (as an example on textile industries, see table 2.7). Last, lower wages do not induce employment growth, in none of his models. Filiztekin here suggests that low wages could be associated with lower productivity levels.

In the same study, Filiztekin (2002) introduced time lags and found that specialization played a negative role in the short run and a positive role in the long run.

Kıymalıoğlu and Ayoğlu (2006) studied the importance of economies of localization and economies of urbanization on agglomeration of manufacturing employment in 1985-2000. Following Goldstein and Gronberg, (1984), they refer to two types of agglomeration economies within the framework of static externalities. The first one, economies of localization (in a similar manner to regional specialization), reflects externalities within the industry. The second one, urbanization economies, refer to size effects, and have wide effects covering all the companies within a city.

Among static externalities, they refer MAR externalities and Jacobs externalities as two main types, and refer to Porter externalities as a meso-status. MAR externalities, as mentioned above, are related to knowledge spillovers that arise within the same industry, while Jacobs externalities are related to knowledge spillovers that arise due to diversity in an urban area. In this framework, Porter externalities are thought to arise due to existence of a competitive market structure, but in an environment where industries are specialized.

Kıymalıoğlu and Ayoğlu (2006) followed Glaeser et al. (1992) in this study, to evaluate employment growth in eight industries. The industries are two-digit industries categorized in the *International Standard Industrial Classification of all*

Economic Activities, Revision 2. Their dependent variable is the growth in employment. Their explanatory variables are as follows:

- A variable distinguishes coastal regions from interior regions, since coastal regions enjoy port facilities,
- Growth in wages,
- initial employment level, as an indicator of localization,
- specialization level in the subject industry indicated by location quotient, as an indicator of MAR and Porter externalities (as in Glaeser et al., 1992),
- Diversity index, as an indicator of Jacobs externalities (as in Glaeser et al., 1992),
- An indicator for forward and backward linkages, reflecting other industries' employment in the subject region,
- Density of employment, as another indicator for negative impacts of agglomeration in space,
- Competition, as an indicator of either Porter and Jacobs externalities (if positive) or MAR externalities (if negative),
- Efficiency, as per employee value added (it is not clear if it is an initial year value or final year value),
- An indicator for geographical concentration, similar to location quotient but compares relative density of a sector. This indicator is used for MAR externalities,
- An indicator of education level, which is the ratio of students to population in a region (Kıymalıoğlu and Ayoğlu, 2006).

At first sight there are too many variables (11) per cases (67). They use a panel data set and general method of moments approach to evaluate the importance of externalities. Thus, the number of variables should not be a major problem. Kıymalıoğlu and Ayoğlu here use the same production function and similar explanatory variables as in Glaeser et al. (1992) as a basis of their analysis. A usual problem is that most of the variables are calculated using same data sets, such as employment, density and population, which might bring in problems of

multicollineraity or endogeneity. Since R^2 and other diagnostics are not reported, only the results will be discussed here. Employment growth in two important industries for Turkey, the textiles and basic metal industries, is likely to be influenced by regional specialization. Since there is no information on the year of specialization, it is difficult to comment on this finding. If, the location quotient is calculated by the final year, specialization could be a result of employment growth rather than a cause of it.

Increase in wages is likely to have a negative impact on employment growth in machinery and metal products industry. Diversity is likely to have a negative impact on textiles and apparel industry, food and dairy products industry, and soil-mineral based industry. Forward and backward linkages are important determinants of employment growth in food and dairy products and metal products industry. Density of employment has a positive impact on basic metal industry employment growth. Competition has a negative effect for food and dairy products, and textile and apparel industries. Geographic concentration has a positive impact on machinery and metal products industry. Efficiency is positively associated with employment growth in all industries except basic metal industry. They point that for furniture, paper and chemical products industries, efficiency is the only factor that has a significant impact on employment growth. The students ratio is not an important determinant of employment growth in manufacturing industries. As a conclusion, they suggest that only localization economies and MAR externalities played a role in growth of employment in manufacturing industries in Turkey during 1985-2000.

Yıldırım and Öcal (2009) used a seemingly unrelated regression (SUR) approach to evaluate regional manufacturing employment growth in Turkey. They use SUR to overcome potential problems associated with omitted variables. They have used an unconditional beta convergence model to evaluate the importance of initial levels of employment in three sectors. Furthermore, they apply interaction effects, by introducing initial employment levels of other sectors in the subject sector. Their approach is helpful in understanding whether if regions that were specialized in a certain industry is growing or not, in terms of employment during 1985-2000. They find that in the unconditional model, there is no significant relation with log of initial employment levels and manufacturing employment growth, with a very low adjusted R^2 of 0.06. They also apply spatial lag, spatial error and spatial cross-regressive

models to test spatial dependencies. In the spatial error model, they find that AIC and Schwartz criterions improve, and initial manufacturing employment has a negative and significant, and immediate neighbors' initial manufacturing employment has a positive and significant effect (R^2 here is 0.56)[3]. This points to importance of ommitted (spatially autocorrelated) covariates. Manufacturing industry employment seems to grow in the vicinity of former industrial centers, where initial employment was lower. In the conditional model, neither the OLS model (adjusted R^2 is 0.20) nor the spatial error (adjusted R^2 is 0.59), lag or cross-regressive models find any significant interaction between manufacturing employment growth and employment growth in other sectors. An unwanted outcome is that including these variables have removed significance of the effect of initial manufacturing employment in spatial models.

Divergence in employment growth rates in agriculture was found by Yıldırım and Öcal (2009) in the unconditional model (adjusted R^2 is 0.07). In the conditional model, they have found that initial services employment had a positive effect on agricultural employment growth during 1985-2000 (adjusted R^2 is 0.41), and manufacturing employment contributed in the years 1990 to 2000. In both the unconditional and conditional versions, spatial diagnostics suggested that a spatial error model should be used and otherwise the models are misspecified (R^2 is 0.48 for the unconditional model and 0.60 for the conditional model).

In the services sector, the unconditional model points to convergence (adjusted R^2 is 0.54), but the conditional model points to divergence in terms of employment growth (adjusted R^2 is 0.72). Again, a spatial error model had to be used to overcome issues related to spatial dependencies. In the unconditional version, the spatial error model shows that less developed regions grow faster, and there could be spatially autocorrelated ommitted variables (adjusted R^2 is 0.77). The spatial error model points that the base year agricultural level had a positive but base year manufacturing employment had a negative effect (adjusted R^2 is 0.81).

In the same study, Yıldırım and Öcal (2009) also apply a geographically weighted regression model. Their contribution here is that they detect structural differences in

[3] Note that the unconditional or conditional beta convergence models are run by OLS and the spatial error models are solved by Maximum Likelihood Methods. Therefore the R^2 here are not comparable.

the Eastern and Western Turkey, which is also pronounced in many other studies (Tansel and Güngör 1997; Temel et al., 1999; Gezici and Hewings, 2004, 2007).

As a conclusion, some important points could be addressed regarding empirical studies given above. First of all, it is evident that there are structural differences between Eastern and Western Turkey. We may classify provinces in the Mid-Interior, Mid-North, North-East, East, and South-East in general as belonging to the Eastern part. Most of these regions were characterised by dependence on agricultural activity.

Filiztekin (2002) and Kıymalıoğlu and Ayoğlu (2006) focused on manufacturing employment. The data set used in both these studies does not cover employment in small enterprises which have less than 10 employees. This is not a big problem for the mentioned studies because that is the only available data at the sub-industry level. At the aggregate level, this is a problem because the number of people counted in manufacturing workplaces at the General Census of Industries is much lower than number of people who reported themselves to be working as manufacturing employees in the General Census of Population. The post 1980 period is characterised by a growing number of small and medium sized enterprises but also by the growing size of the informal sector. Therefore, employment growth in manufacturing industries could be further assessed by using Population Census data[4].

Total employment growth and employment growth in services, manufacturing and agriculture are likely to exhibit different spatial patterns. Yıldırım and Öcal's (2009) study reveals that spatial dependencies related to the same sector is important in regional employment growth. It could be assumed this as an indicator of agglomeration of economic activities.

Considering the neighborhood structure Yıldırım and Öcal (2009) applies, it could be assumed that employment growth in first order neighbors is an important factor in growth of employment in manufacturing industries in a region. Manufacturing industries seem to grow in a decentralized fashion, in the neighborhood of traditional centers. This is inline with Filiztekin (2002) who found that proximity to urban

[4] One setback is that Population Census data informs us only about the number of workers that work on non-agricultural production, but doesn't provide information about the number of administrators or technical staff working in manufacturing industries. Since most of the office functions are being separated from manufacturing operations, this data is still valuable in understanding spatial development of manufacturing.

centers and forward and backward linkages are important. Kıymalıoğlu and Ayoğlu's (2006) finding that (manufacturing) diversity had a negative effect on manufacturing employment growth aslo seems to fit in, because diversity in manufacturing is higher in metropolitan areas in Turkey (Erkut and Baypınar, 2003).

Filiztekin (2002), and Kıymalıoğlu and Ayoğlu's (2006) findings contrast with Glaeser et al. (1992), but are inline with Acs and Armington (2004) and He (2004), indicating diversity and specialization are not important determinants of employment growth in manufacturing. Filiztekin (2002) found only that specialization first had a negative then a positive effect. One reason for insignificance of diversity could be due to indices used in these studies. As these studies measure diversity as diversity of manufacturing industries and do not take into account different services, the diversity indices used do not reflect the complete diversity in an urban environment.

4.2 An Evaluation of Spatial Growth of Employment

Density is likely to be an important factor after some level which creates negative externalities. It may have quite different effects on different sectors, and thus may not have a significant effect on aggregate employment growth.

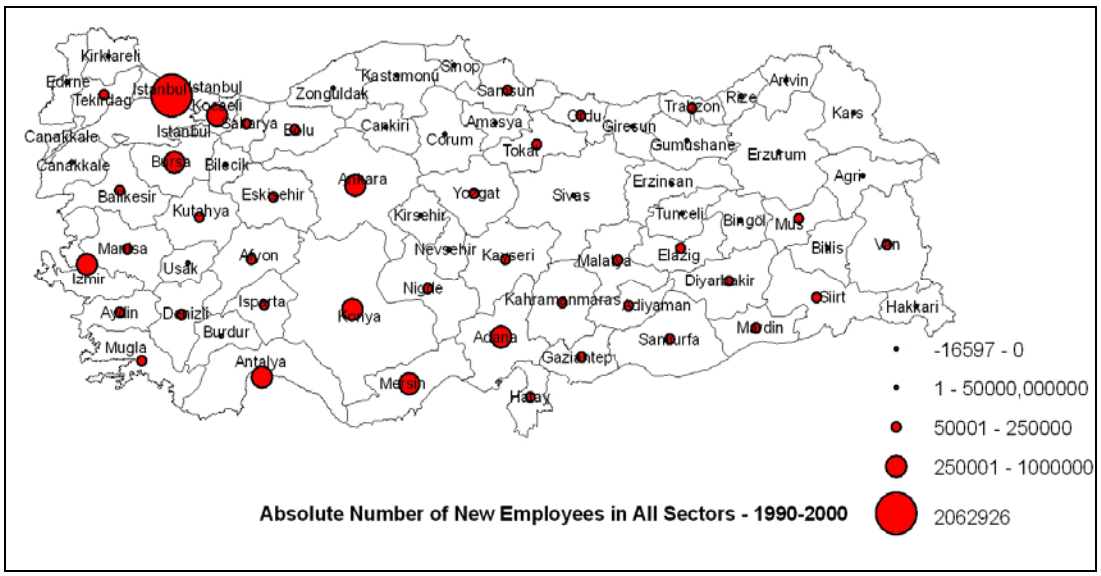


Figure 4.1 : Increase in the absolute number of workers in all sectors 1990-2000.

A look at the data on workforce from General Census of Population for 1990 and 2000 reveals that in absolute terms, growth in employment is strong in metropolitan core regions like Istanbul, Izmir, Ankara and Antalya (Figure 4.1). The same applies

to population growth (Figure 4.2). The initial look brings in the idea that most of the employment is created due to population growth.

In absolute terms, growth of population and workforce follows almost the same route. Istanbul, Bursa and Kocaeli act as a single region. Ankara, İzmir, Antalya are other strong centers of growth. Mersin, Adana and Konya are other centers where employment in general and manufacturing employment is increasing. The growth pattern is rather clustered, and despite the decentralization policies, Istanbul experienced the largest growth in absolute terms. This picture makes one think that static externalities play a key role in the growth of employment.

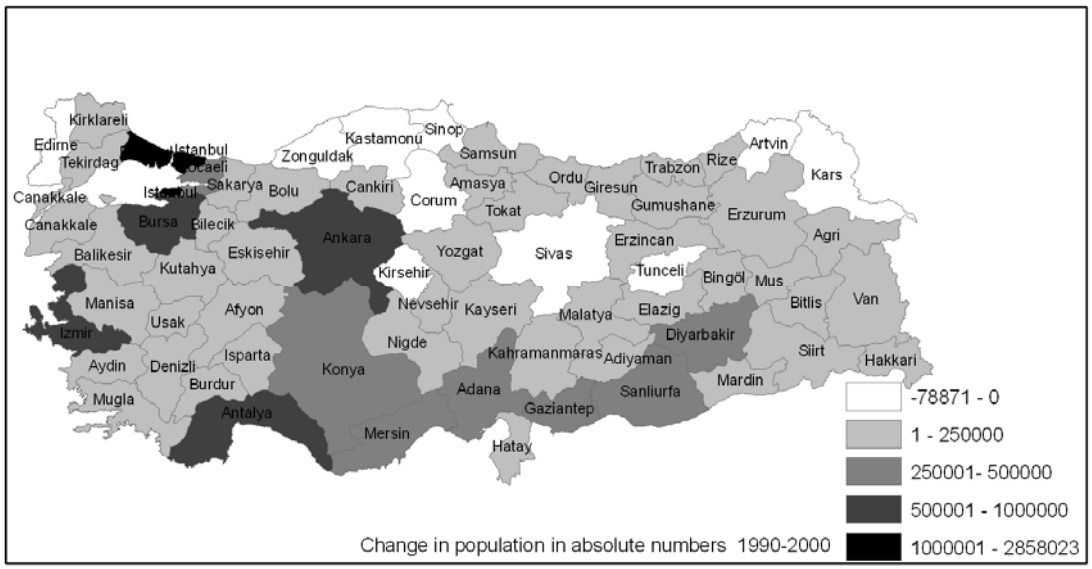


Figure 4.2 : Change in population in absolute numbers, 1990-2000.

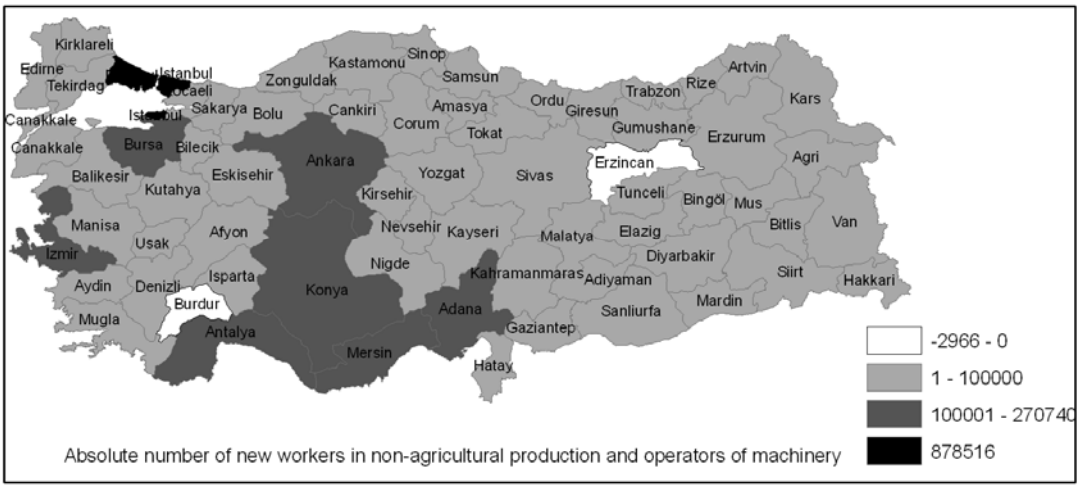


Figure 4.3 : Absolute number of new workers in non-agricultural production and operators of machinery.

Despite the large growth of manufacturing employment in Istanbul, the share of manufacturing workers in total employees decreased from 49% to 46% in the course, due to rapid growth in services. Similarly, its neighbor province Kocaeli experienced a decrease from 42% to 40%. Despite the change, Istanbul's share in the manufacturing employment in the country did not change. In 1990, it was 22.2% and in 2000 it was 22.4%. Share of other centers also remained about the same: Kocaeli had 2.6% and 2.5%, Bursa had 4.2% and 4.5%, İzmir had 6.7% and 6.8%, Ankara had 6.9% and 6.7%, and Adana had 3.2% and 3.6%. Therefore, the ranks of provinces did not change. Istanbul, Bursa, Kocaeli and Tekirdağ roughly accomodated 30% of manufacturing workers both in 1990 and 2000. Of a total of 3,877,613 new workers in Turkey, 1,213,610 new workers joined in manufacturing industries in these four provinces, which is about 31.2% of all new employees in manufacturing.

To evaluate growth of services through population census statistics, all non-agricultural and non-production professions could be assigned in a single group. Although this group would include office workers and managers in manufacturing or construction industries as well, still it provides us the information about the structure of regional economies. Regions which has a high share of such workers are mostly metropolitan regions with headquarters, offices, retail and wholesale centers, producer and personal services, financial institutions, etc. Istanbul, Bursa, Kocaeli and Tekirdağ's shares in workers that work in non agricultural and non production activities was 27.7 % in 1990 and increased to 30.7% in 2000. İstanbul's share alone was 22.1% and rose to 24.1%. İzmir's share was 6.7% and rose to 7.3%, Ankara remained at 11%, and Adana declined from 3.2% to 2.95%. Despite the growth of Adana, it is likely loosing its importance as a command and control center, after relocation of headquarters of local companies to Istanbul. Istanbul and Izmir, two advantageous locations have increased their importance. Due to growth of tourism, Antalya experienced a sharp rise in its national share, rising to 3.5% from 2.5% in ten years.

Thus, Istanbul-Kocaeli-Bursa-Tekirdağ cluster and Izmir increased their importance as economic centers of industry and trade, while Adana and Ankara remained in their positions despite absolute growth, Antalya emerges as a new center (figure 4.4.).

None of the studies discussed above evaluated importance of entrepreneurial activity on employment growth in Turkey, although both He (2004) and Acs and Armington (2004) find it to be an important factor in explaining employment growth. It should also be the case for Turkey, since transforming into a market economy should have increased the importance of entrepreneurs as a decision maker in the location of production. An initial look at the entrepreneurs in Turkey may be informative at this point. Below in figure (4.5) number of new entrepreneurs and administrators are mapped. The data is from General Census of Population for years 1990 and 2000, and covers those people who reported that they either were self-employed, entrepreneurs or were administrators in a company. A setback of this data set is that it doesn't inform us about the sector entrepreneurs and administrators are working or investing in. Another setback is that it does not reflect the real geography where an entrepreneur is active, because it only informs us where entrepreneurs and administrators are living in. As an example, it is common to find an entrepreneur in Antalya who is from Konya, Ankara or Kayseri, or an entrepreneur in Muğla who is from Istanbul or Izmir, but these people are counted in their hometown in Population Census. Still, it may be thought that entrepreneurs are likely to live in places where most of their business take place.

A striking feature in figure (4.5) is that in Istanbul and Ankara absolute number of entrepreneurs and administrators have sharply decreased. In large metropolitan areas, companies change to flexible forms of production and exercise vertical disintegration. Company mergers and acquisitions also are common. This in turn might have decreased the number of entrepreneurs and administrators. Another possibility is that entrepreneurs seeking cheaper inputs and escaping negative externalities of agglomeration might be relocating to peripheral areas. In total, Istanbul had 20,779 less entrepreneurs and administrators in year 2000, while Turkey overall had 10,480 new entrepreneurs and administrators. Ankara, Istanbul and Izmir experienced a sharp increase in entrepreneurial activity during the 1980'es. In the 1990'es, entrepreneurial activity decreased in Ankara and Istanbul, and almost halted in Izmir. One more possibility is that some of the companies could have gone informal. Another option is that some of the entrepreneurs moved to Muğla and Antalya, where international tourism industry was booming. Sharp increases in number of entrepreneurs in these two provinces are observed.

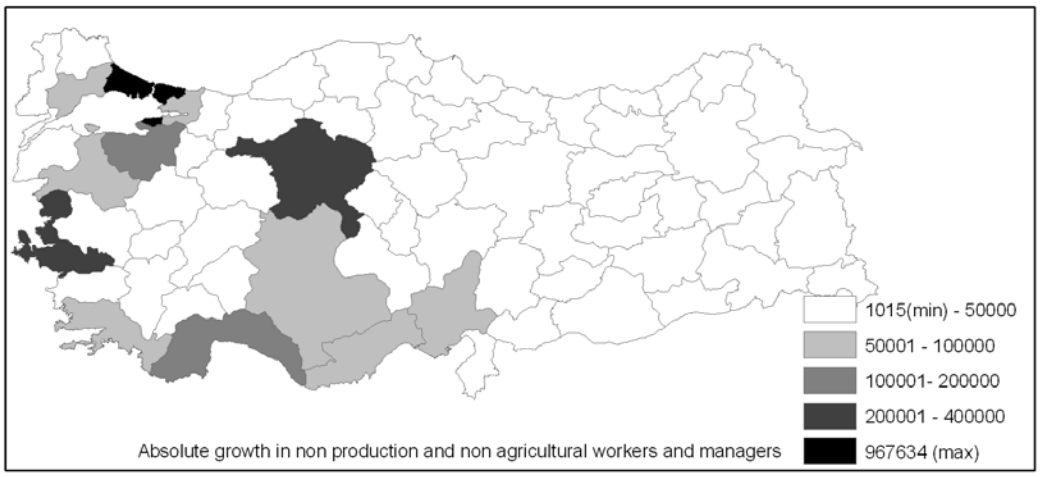


Figure 4.4 : Absolute growth in non production and non-agricultural workers and managers between 1990-2000.

Figure 4.5 : Number of new entrepreneurs or administrators between 1990-2000.

Table 4.1: Number of entrepreneurs and administrators in three most populated metropolitan areas.

Regions	***Years***		
	1980	**1990**	**2000**
Ankara	27,113	34,483	32,505
Istanbul	44,006	78,599	57,820
Izmir	11,977	16,018	16,134

As a conclusion, it may be claimed that role of entrepreneurs in growth of employment should be assessed. If absolute employment growth is considered, most of the growth in overall employment is likely to be connected with absolute population growth. On the other hand, both manufacturing industry employment and

services employment are growing in few clusters, which are also growing in population. Therefore, static externalities are likely to play a key role in the growth of employment. Distance to major metropolitan centers like Istanbul, Izmir, Ankara and Adana are likely important factors, but since NUTS III regions are usually large enough to accommodate such growth, most of the growth occurs within these regions. Except in Istanbul and its surrounding growth is large, and covers four NUTS III regions. One should note that still this area is not too different in size from that of Konya, but it accomodates about 30% of employment in both services and manufacturing, while Konya accomodates only 2.8% of manufacturing workers and 2.5% in services. Istanbul, Bursa, Tekirdağ and Kocaeli have increased their population share in the country from 18.3% to 20.9% only in 10 years. İzmir's share increased from 4.8% to 5% while Ankara's share was about the same, (6.4% to 6.5%) and Adana's share was almost stagnant at 3.4%. Therefore, it is possible to conclude that largest centers continued to grow. The sharp decline in number of entrepreneurs and administrators in Istanbul and increases in Bursa and Kocaeli still blurs the picture. It is possible that companies in Istanbul are reorganizing and despite the growth in employment, entrepreneurs and managers are likely to decrease. Ongoing internationalization of most of the services like banking, retailing, tourism and other services, mergers and acquisitions of FDI is likely to play a role in this phenomenon.

4.3 The Model and Results

4.3.1 Approach

The selected approach here is to focus on absolute employment growth. This is because absolute employment growth is more associated with size effects and associated externalities. Second, smaller settlements usually experience very high employment growth, while most of the jobs are usually created in largest cities. Proportionally, small settlements contribute very little to the absolute growth in employment in a country. For this study, it is more interesting at the moment to evaluate the factors that contribute to growth in employment. In this framework, the model used here is not a beta convergence model.

The conceptual model of employment growth is represented in figure 4.6. Initially advantaged metropolitan regions and their immediate vicinity are though to be major centers of employment growth.

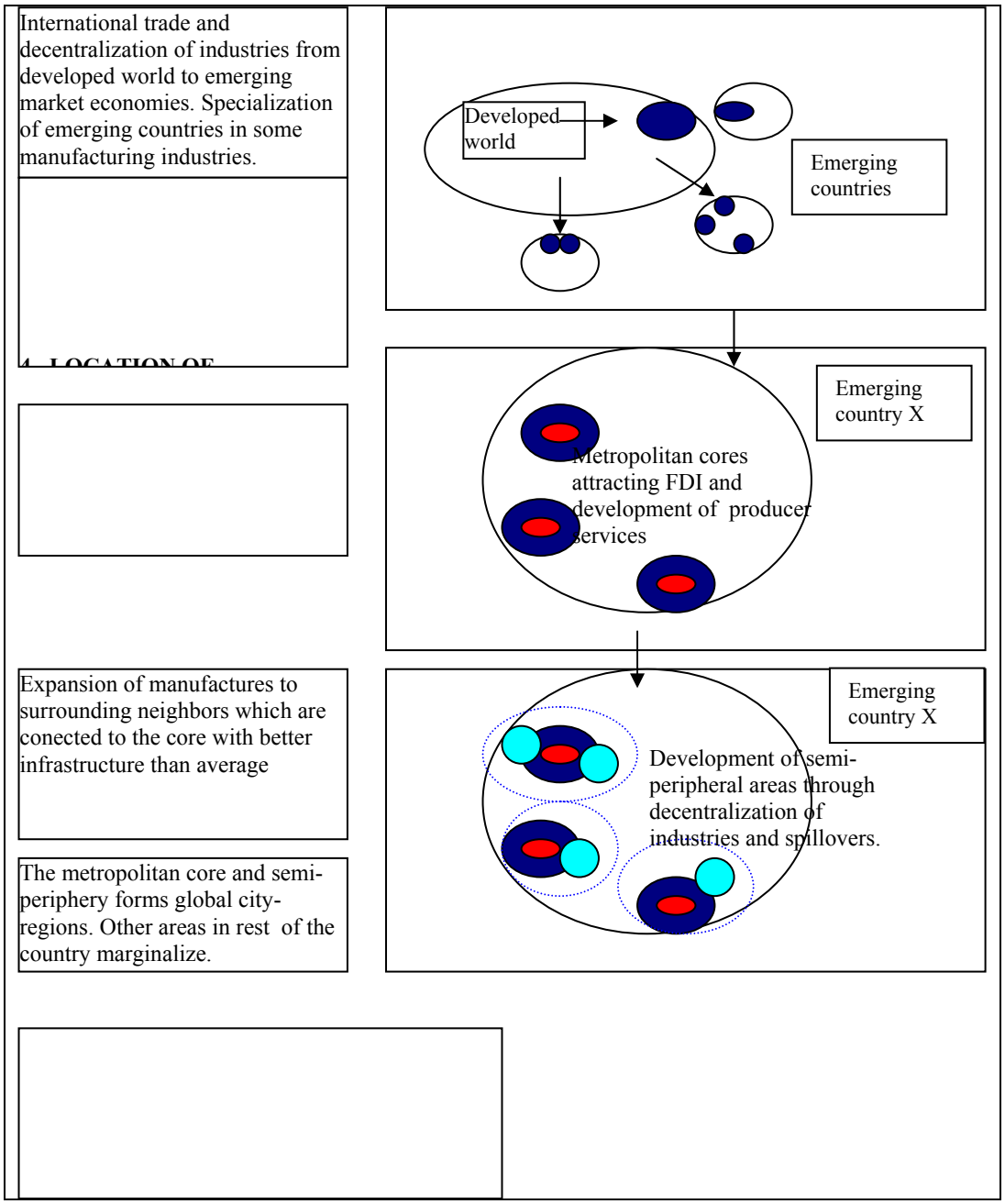


Figure 4.6 : The process of employment growth in an emerging market economy.

The unit of analysis will be 67 regions which are equivalent to NUTS III level. Currently number of NUTS III regions are 81, due to recent changes in political administrative borders. Since this causes inconsistency in the data set, the data is

converted to the old regional system of 67 regions,as is the usual custom in empirical studies reviewed in this study.

The analysis period covers the years between 1990 and 2000. Although the time span is only 10 years, it is believed that this is an adequate time span. Turkey has liberated its financial system at 1989 which enforced a concentration of financial institutions to Istanbul, the most populated province, and the most international airway connections. Population Census are held at 1990, 1997 and 2000. At year 2001, Turkey experienced a major economic crisis. Therefore, for the sake of data consistency, the selected period is thought to be suitable.

It was not intended to use a conditional convergence model here, because employment is an input to production and the main focus in the next sections will be on productivity growth. Following the empirical results of Yıldırım and Öcal (2009) above, there is no finding on unconditional beta convergence at the aggregate employment growth levels.

In the next section thestudy proceeds with an analysis of aggregate employment growth and agglomeration of employment in Turkey.

4.3.2 Hypotheses, variables and data

The variables are specified in a way to capture agglomeration rather than pure employment growth.

The dependent variable is an indicator that shows if the employment created in a region is above or belove the national average. It is named *difgremp*. It is calculated as in equation (4.1):

$$Difgremp = ((E_{ti+T}-E_{ti})/ E_{ti}) - ((E_{t+T})-E_t)/E_t \quad \textbf{(4.1)}$$

Where $_t$ is for the initial year 1990, $_T$ is 10 years, and $_i$ is the regional index. E_{ti} is the employment in region "i" in year 1990, E_{ti+T} is employment in region "i" in year 2000. E_t is the employment in the country in year 1990 and E_{t+T} is the employment in the country in year 2000. The purpose here is to capture if the growth rate of employment in a region is higher than the average growth rate in the country. The data is obtained from Population Census of 1990 and 2000, and implies that it covers

everybody who has worked in a job at the last week before the census was held. It excludes retirees, unemployed, students and those who live on other income sources.

The explanatory variables for each region are as follows:

- Distance from the nearest major metropolitan center at year 1990, following Falcıoğlu (2009). This variable is named as *dist.*
- Difference of growth in entrepreneurs and administrators in region "i" than the national average. This variable is named as *difent*.
- Difference of growth of population in region "i" than the national average. This variable is named as *difgrpop.*
- Cumulative amount of FDI in the geographical region. This variable is named as *lnfdi*.

Distance from the nearest major metropolitan center (*dist*) is measured in km and is obtained from the General Directorate of Highways. It reflects the current land route distances to nearest metropolitan region in year 1990. 4 major metropolitan centers are defined : İstanbul, Ankara, İzmir and Adana. As it was discussed in the second section, economic globalization entails further clustering of economic activities, due to increasing importance of distance and knowledge inputs. An initial look at the data points to existence of a spatial regime. The hypothesis proposed is that distance to major metropolitan centers may be an initial advantage for businesses, so growth of employment is likely to be higher in regions which were either metropolitan areas, or which were in close proximity to metropolitan areas. This variable is expected to have a significant and negative coefficient. It is likely that this variable may help in avoiding problems related to spatial autocorrelation.

The variable *difent* is used to capture if the growth rate of entrepreneurs and administrators in a region is higher than the average growth rate in the country. Number of entrepreneurs and administrators is from Population Census of 1990 and 2000. These are people who are either self-employed, or who have claimed to own companies, or having a post as an administrator in a company. An administrator in a company is more likely to conduct entrepreneurial activities. The impact of this variable is expected to be positive in the creation of excessive employment, as entrepreneurs start new businesses, or existing companies grow and thus

accommodate more administrators. This variable is calculated in the same way as the dependent variable :

$$Difent = ((Ent_{ti+T} - Ent_{ti}) / Ent_{ti}) - ((Ent_{t+T}) - Ent_t) / Ent_t \quad \textbf{(4.2)}$$

Where *Ent* is for number of entrepreneurs and administrators, and other notations hold as in formula (4.2) above. The data is obtained from Population Census of 1990 and 2000, and implies that it covers everybody who has worked in a job at the last week before the census was held. It excludes retirees, unemployed, students and those who live on other income sources. It is expected that this variable will have a positive impact on creation of excess employment.

The variable for assessing relative growth of population is *difgrpop*. It is calculated in the same way as variables *difgremp* and *difent*. The proposed hypothesis is that this variable has a positive and strong effect on agglomeration of employment, because where population concentrates, new jobs will be available. In larger cities, even new job categories will be available specific for metropolitan lifestyles and business environment. Although causality may be the other way around, here it is preferred to use relative growth of population as an explanatory variable. The formula for calculation of *difgrpop* is given in equation (4.3) below:

$$Difgrpop = ((Pop_{ti+T} - Pop_{ti}) / Pop_{ti}) - ((Pop_{t+T}) - Pop_t) / Pop_t \quad \textbf{(4.3)}$$

The variable *lnfdi* captures the cumulative amount of FDI in the 7 supra-regions. Although data was available from the Treasury of Turkey, the way it was provided was not very suitable for this analysis. The data is not publicly available at the NUTS III level, and thus it is preferred to use this data as given in Yavan and Kara (2003) for 7 geographical regions with different geographic and climatic features. They show the cumulative amount of foreign direct investment until year 2000 in these regions. This variable is used as a categorical variable. The proposed hypothesis is that FDI has a positive effect in creating employment. Since cumulative FDI data is a large number, natural logarithm of this data is used in order to avoid heteroskedasticity problems.

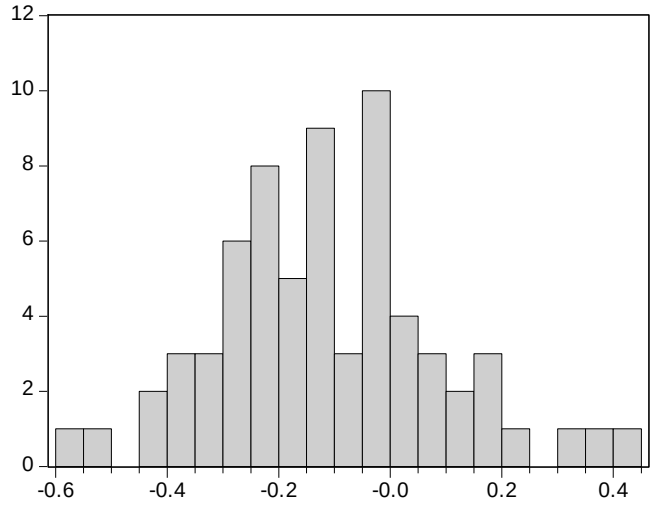
4.3.3 Exploratory conventional and spatial data analysis

Before the model is specified an exploratory data analysis (EDA) and exploratory spatial data analysis (ESDA) are run on the variables. Also, the change in the coefficient of variation is evaluated. These analyses were not executed on the variable *lnfdi*, since it covers only 7 supra-regions and is a categorical variable here.

Only 16 cases of the dependent variable *difgremp* has a positive value, and the remaining 51 cases has a negative value. Than, the distribution of the dependent variable *difgremp* is assessed, and it is found that it is normally distributed.

Table 4.2: Summary statistics.

	difgremp	***difgrpop***	***difent***	***dist***
Mean	-0.112060	-0.030712	0.262940	382.0896
Median	-0.126047	-0.043505	0.219746	311.0000
Maximum	0.443935	0.351819	1.040537	1008.000
Minimum	-0.569148	-0.466550	-0.308842	1.000000
Std. Dev.	0.201299	0.143942	0.269465	266.4188
Skewness	0.355442	-0.041614	0.334301	0.750448
Kurtosis	3.238191	3.675865	2.802507	2.612194
Jarque-Bera	1.569169	1.294553	1.356843	6.708600
Probability	0.456309	0.523470	0.507417	0.034934
Sum	-7.507996	-2.057696	17.61696	25600.00
Sum Sq. Dev.	2.674393	1.367467	4.792349	4684611.
Observations	67	67	67	67
Negative obs.	51	40	11	N/A
Positive obs.	16	27	56	67



Series:	Difgremp
Sample	1 67
Observations	67
Mean	-0.1120
Median	-0.1260
Maximum	0.4440
Minimum	-0.5691
Std. Dev.	0.2013
Skewness	0.3554
Kurtosis	3.2381
Jarque – Bera	1.5692
Probability	0.4563

Figure 4.7 : Properties of the dependent variable *difgremp*.

In table 4.3, distribution of cumulative amount of FDI in year 2000 in seven geographical regions is presented. Marmara Region had 81.3% of all FDI stock in Turkey, making it the most attractive place for FDI. Moreover, amount of FDI per company is highest in the Marmara Region.

Table 4.3: Cumulative amount of FDI.

	number of companies FDI	percentage in total	amount of cumulative FDI stock (in USD, 1 USD=1.5 TL)	percentage of cum. FDI stock	FDI/company (in USD)
Marmara Region	3,864	66.15	2,737,178,629	81.33	708,380
Aegean Region	665	11.38	260,187,083	7.73	391,259
Interior Anatolia Region	638	10.92	209,644,346	6.23	328,596
Mediterranean Region	536	9.17	93,229,554	2.77	173,936
Black Sea Region	79	1.35	50,577,782	1.50	640,225
Southeastern Anatolia Region	44	0.75	14,507,685	0.43	329,720
Eastern Anatolia Region	15	0.25	185,923	0,01	12,395
Source: Yavan and Kara, 2003					

The diagnostics show that all the variables are correlated with the dependent variable (table. 4.3). The weakest correlation is between *difent* and *difgremp*. The correlation coefficients have the expected signs. However, there is a strong correlation between *dist* and *lnfdi*, and weak correlation between *difent* and *difgrpop,* and weak correlation between *difent* and *dist*.

It is likely that FDI prefers to concentrate in large cities, so distance to major metropolitan centers is an important factor in the location of FDI. Following Eldem (1994) and Pamuk (1994), Yavan and Kara (2003) address that before the establishment of the Republic of Turkey, Istanbul was the major destination for FDI. Similarly, İzmir was another important region as an FDI destination. Thus, there is likely some path dependencies established before the establishment of the Republic. Cross correlation of the variable *lnfdi* and *dist* is very high and negative. It is probably because metropolitan regions are also attractive for FDI. Therefore, the variable lnfdi is removed from the model. Correlations between other explanatory variables are not very strong and thus they remain in this model.

Figure (4.8) indicates that economic activity continues to cluster. Of 6 growth centers represented by dark colors, 1 is the capital, Ankara, 3 are coastal regions and the two other are border regions. It is assumed that this is not a result of chance. To formally check whether if the clustering pattern is statistically significant, a Moran's I test for global spatial autocorrelation is done on the dependent variable *difgremp*. Details on Moran's I test is given in appendix (A.1). This exploratory spatial data analysis shows that employment growth is clustered. Global Moran's I Spatial Autocorrelation diagnostic is run for 1st order neighbors in ArcGIS Map. The Moran's I index is positive and significant (figure 4.4 and Table 4.4). The clustering is highly significant. It may be concluded that regions with a high rate of employment growth are surrounded by similar regions. Regions with high rates of employment loss are surrounded by similar regions.

Table 4.4: Cross-correlations of variables.

Variables	*difgremp*	*difgrpop*	*difent*	*dist*	*lnfdi*
difgremp	1.000000				
difgrpop	**0.875853**	1.000000			
difent	0.052560	**0.309410**	1.000000		
dist	**-0.341350**	**-0.127907**	**0.116871**	1.000000	
lnfdi	**0.203403**	0.062867	-0.039711	**-0.726604**	1.000000

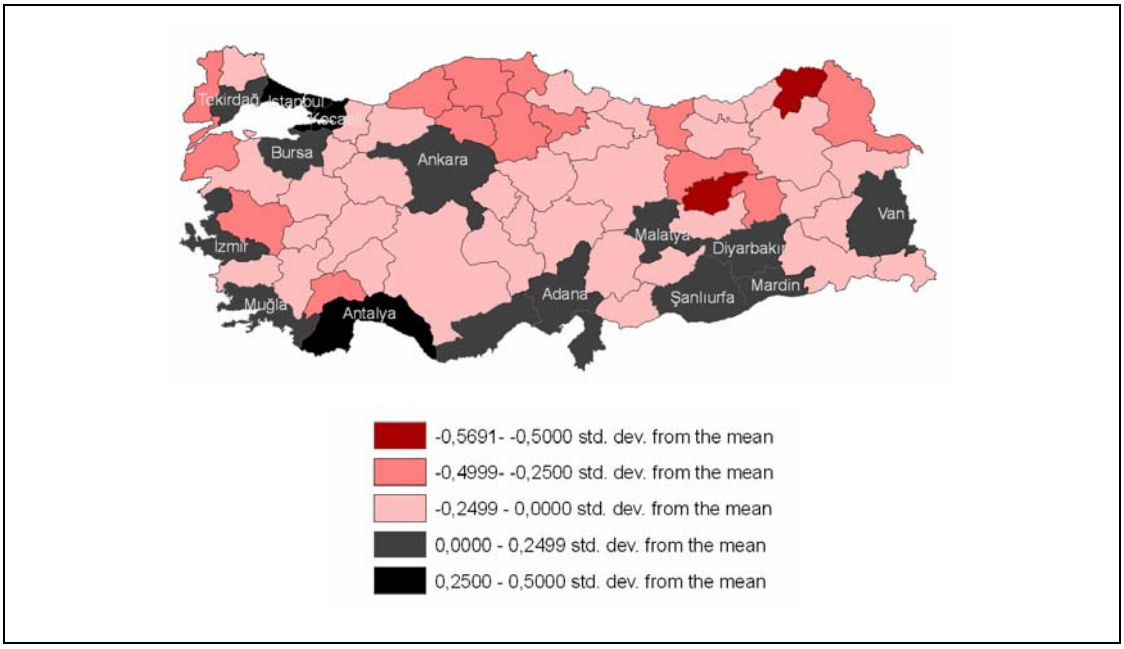


Figure 4.8 : Distribution of the dependent variable *difgremp* according to ¼ standard deviations.

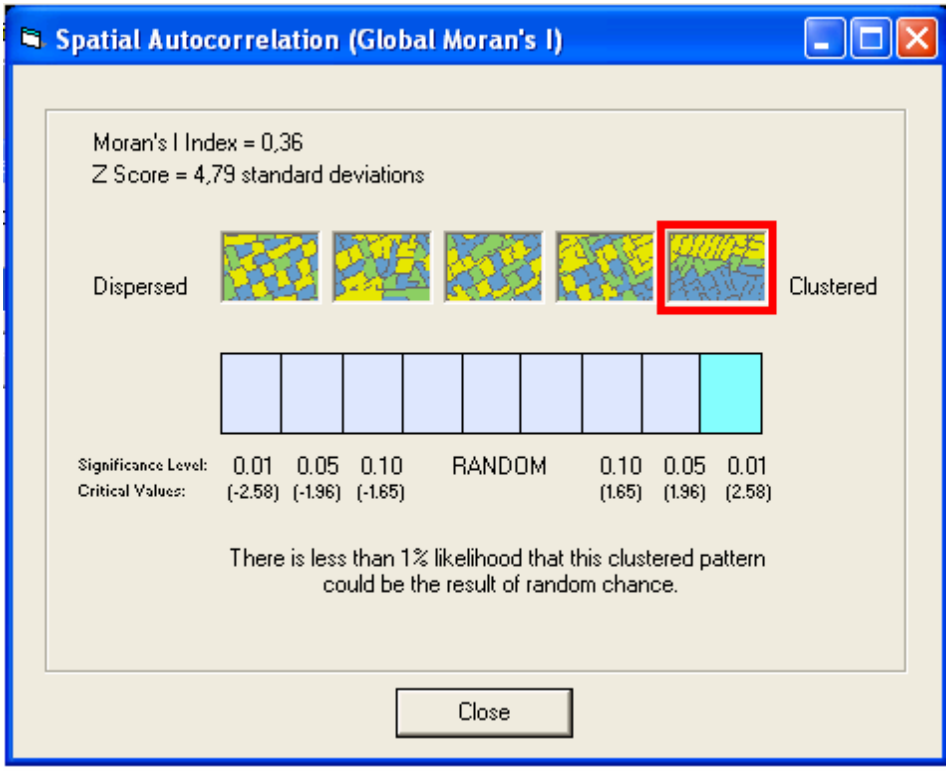


Figure 4.9 : Spatial autocorrelation diagnostics of the dependent variable *difgremp* – Moran's I index.

Table 4.5: Moran's I results for the dependent variable *difgremp*.

Global Moran's I Summary		
Moran's Index	:	0.358600
Expected Index:		-0.015152
Variance	:	0.006094
Z Score	:	4.787758
p-value	:	0.000002

4.3.4 Model

A linear model is specified to explain the variations in the differences in relative regional employment growth. The variable *lnfdi* is removed because of its high correlation with the variable dist, in order to avoid issues related to multicollinearity. The model is:

$$Difgremp = c + difgrpop + difent + dist + \varepsilon \qquad \textbf{(4.4)}$$

Where c is the constant and ε is the error term with the usual properties.

4.3.5 Results and diagnostics

The model is run first in EViews 6, by using least squares procedure. The results are given below in table (4.6).

The adjusted R^2 is 0.85, and all the variables are significant. The coefficients of the variables *difgrpop* and *dist* have the expected signs. However, the sign of the coefficient of variable *difent* is negative. The reason for this would be that in metropolitan cities, there are many advanced companies which are effectively working. This could be a reason for developing labor saving technologies and thus lower rates of employment growth. Moreover, company mergers and acquisitions could have played a role in low growth in the number of entrepreneurs. Despite the sign, the role of entrepreneurs should be evaluated cautiously. Baypınar (2003) showed that most of the new workplaces were opened in and around major metropolitan centers during 1991-1997.

As heteroskedasticity and multicollinearity problems are usually reported, a diagnostics for heteroskedasiticty for the model is run in EViews6 and multicollinearity is checked by running a backward procedure and using an OLS model in SPSS 16.0. The multicollinearity index is 3.846 and the smallest eigenvalue is 0.167, which are quite acceptable. A multicollinearity index above 30 is usually considered to be a problem. The variance inflation factors (VIF) of the variables is another indicator of multicollinearity. In ArcGIS MAP Spatial Statistics Tool Package, a VIF more than 7.5 is considered to be an indicator of multicollinearity, while in other references 5.0 is the benchmark (reference). In the model, the largest VIF value is 1.14. The results suggest that there is not an important multicollinearity problem.

A confirmatory data analysis is proceeded by heteroskedasiticity tests. First the Breusch-Pagan-Godfrey Test and then the White Test for heteroskedasticity are run. The results are in the table (4.7). The results suggest there is no significant heteroskedasticity in the model. Finally, the fit of the model is checked and find that the estimations fit well with the actual data (figure 4.10).

Table 4.6: Results of the test for Model 1.

Dependent Variable: DIFGREMP
Method: Least Squares
Sample: 1 67
Included observations: 67

	Coefficient	Std. Error	t-Statistic	Prob.
C	0.025657	0.018624	1.377646	0.1732
DIFGRPOP	1.278578	0.070840	18.04888	0.0000
DIFENT	-0.154578	0.037789	-4.090546	0.0001
DIST	-0.000151	3.66E-05	-4.128218	0.0001

R-squared	0.858234	Mean dependent var	-0.112060
Adjusted R-squared	0.851483	S.D. dependent var	0.201299
S.E. of regression	0.077576	Akaike info criterion	-2.217267
Sum squared resid	0.379138	Schwarz criterion	-2.085643
Log likelihood	78.27843	Hannan-Quinn criter.	-2.165183
F-statistic	127.1313	Durbin-Watson stat	2.164898
Prob(F-statistic)	0.000000		

Table 4.7: Heteroskedasiticity tests for Model 1.

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	1.034423	Prob. F(3,63)	0.3835
Obs*R-squared	3.145367	Prob. Chi-Square(3)	0.3698
Scaled explained SS	4.727870	Prob. Chi-Square(3)	0.1928
Heteroskedasticity Test: White			
F-statistic	1.221326	Prob. F(9,57)	0.3005
Obs*R-squared	10.83157	Prob. Chi-Square(9)	0.2874
Scaled explained SS	16.28117	Prob. Chi-Square(9)	0.0612

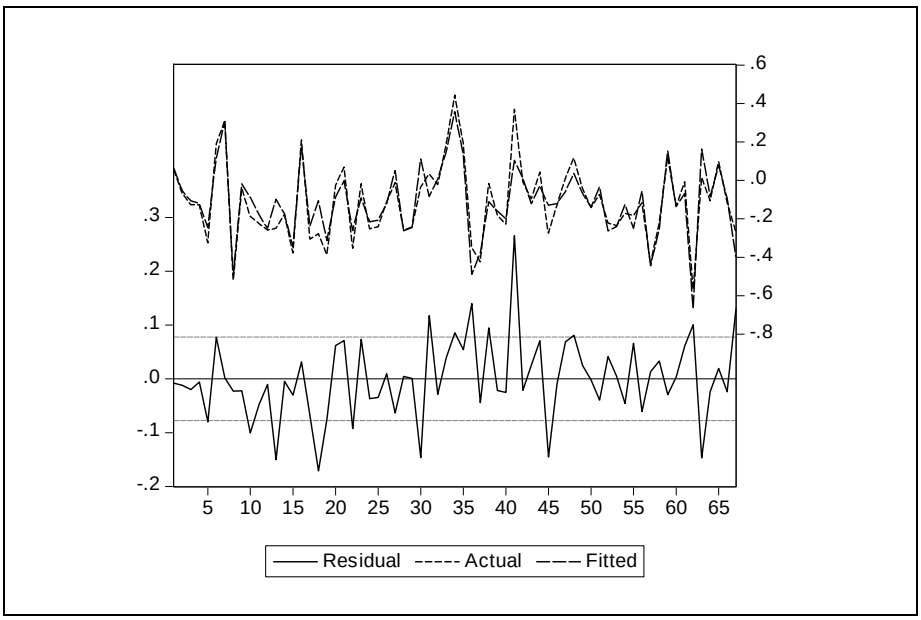


Figure 4.10 : Residual plots for Model 1.

Table 4.8: Results of the OLS test and spatial diagnostics for Model 1.

```
REGRESSION
SUMMARY OF OUTPUT: ORDINARY LEAST SQUARES ESTIMATION
Data set            : empgrowth
Dependent Variable  :  DIFGREMP  Number of Observations:   67
Mean dependent var  :    -0.11206  Number of Variables   :    4
S.D. dependent var  :    0.199791  Degrees of Freedom    :   63

R-squared           :    0.858234  F-statistic           :     127.131
Adjusted R-squared  :    0.851483  Prob(F-statistic)     :1.11983e-026
Sum squared residual:    0.379138  Log likelihood        :     78.2785
Sigma-square        :  0.00601806  Akaike info criterion :    -148.557
S.E. of regression  :   0.0775762  Schwarz criterion     :    -139.738
Sigma-square ML     :  0.00565878
S.E of regression ML:   0.0752248
------------------------------------------------------------------------
    Variable    Coefficient     Std.Error    t-Statistic   Probability
------------------------------------------------------------------------
    CONSTANT    0.02565697     0.01862367       1.377654    0.1731846
    DIFGRPOP      1.278578      0.0708397       18.04889    0.0000000
    DIFENT    -0.1545779     0.03778898      -4.090556    0.0001244
        DIST  -0.0001512847   3.66465e-005     -4.128218    0.0001094
------------------------------------------------------------------------
REGRESSION DIAGNOSTICS
MULTICOLLINEARITY CONDITION NUMBER   3.846265
TEST ON NORMALITY OF ERRORS
TEST                  DF          VALUE            PROB
Jarque-Bera            2           6.718785        0.0347564

DIAGNOSTICS FOR HETEROSKEDASTICITY
RANDOM COEFFICIENTS
TEST                  DF          VALUE            PROB
Breusch-Pagan test     3           4.314269        0.2294675
Koenker-Bassett test   3           2.537726        0.4685118
SPECIFICATION ROBUST TEST
TEST                  DF          VALUE            PROB
White                  9           10.83157        0.2874311

DIAGNOSTICS FOR SPATIAL DEPENDENCE
FOR WEIGHT MATRIX : w1modifiye.GAL  (row-standardized weights)
TEST                          MI/DF      VALUE          PROB
Moran's I (error)           -0.025257     N/A            N/A
Lagrange Multiplier (lag)       1        0.0276280      0.8679863
Robust LM (lag)                 1        0.0000279      0.9957857
Lagrange Multiplier (error)     1        0.0981429      0.7540697
Robust LM (error)               1        0.0705428      0.7905481
Lagrange Multiplier (SARMA)     2        0.0981708      0.9520998
========================= END OF REPORT ==============================
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Results suggest that employment is being highly concentrated in regions which had above the average population growth. Only 16 centers show positive growth in employment above the national average. It may be concluded that during 1990-2000, a clustered employment pattern has emerged.

Since ESDA provided that there is spatial autocorrelation in the dependent variable, the study proceeded with spatial diagnostics with the OLS model, using the program GeoDA. Despite spatial autocorrelation of the dependent variable is found in the ESDA analysis, spatial diagnostics with the OLS model assume there is no spatial autocorrelation (table 4.8). This is probably because the same effects are captured by

the variables in the model. Therefore, it is concluded that the model is thoroughly specified.

4.4 Conclusion

Findings suggest that employment growth is following a clustered pattern, and growing beyond the immediate vicinity of metropolitan areas. Employment is mostly growing in regions with excessive population growth. However, it should be noted that the study is executed by incorporating only two data points in time and therefore it was not possible to evaluate the causality processes. It is most likely that population growth fosters employment growth but employment growth also attracts immigrants and thus cause population growth, forming a cumulative causation mechanism. The growth pattern is not very different from that of the 1980'es (Tekeli, 1984). Agglomeration of economic activities continue, and metropolitan regions continue to grow.

Entrepreneurial activity, by surprise, had a negative effect on population growth. If entrepreneurs are avoiding negative externalities, and choosing other locations where inputs like land and labor is cheaper, then this should be no surprise. Further investigation on the role of entrepreneurs on creation of employment would be necessary. The role of entrepreneurs could be different than as suggested. If entrepreneurs are focused on productivity growth and investing in labor saving technologies, this may even hamper employment growth. The role of entrepreneurs on productivity growth is assessed in the next section.

It may be concluded that during integration to global markets, especially to the EU, growth of employment is strengthened in and around core metropolitan regions with locational advantages. The role of local and international immigration on population growth and associated public policy should of course not be neglected. It is likely that there is a possibility of increased in migration from surrounding countries and countries with similar cultural background to cities in Turkey like Istanbul, Antalya, Trabzon, Adana and others, due to increasing integration to global economy and decreasing barriers to migrants.

5. REGIONAL PRODUCTIVITY GROWTH, CONVERGENCE AND INEQUALITIES IN TURKEY

In the previous section, growth of employment was evaluated. The clustered pattern is similar to patterns observed in many other countries. Growth of productivity and the changes in regional inequalities will be discussed in this section.

First, an assessment of empirical studies on regional productivity and income convergence in Turkey is presented. It is seen that as in the international literature, there is some confusion and cross-referencing. Studies cover those which focus either on income convergence or labor productivity convergence.

Second, a discussion is made on the potentials of an empirical study on regional productivity convergence and some critical points are stressed.

Third, a sigma convergence analysis is done both for aggregate economic sectors and for each three major sectors separately. The analysis is held both for 67 NUTS III regions and for 7 geographical regions.

Fourth, an unconditional beta convergence model is used for estimation of the aggregate productivity growth and productivity growth in each three major sectors, by using the spatial econometrics toolbox. The convergence processes of three sectors; services, manufacturing and agriculture, are found to be different for the period of 1990 and 2000.

Fifth, a conditional beta convergence analysis is done only for the aggregate economy, to evaluate whether if overall inequality in labor productivity is decreasing, and to understand the role of economic globalization and local factors in the convergence/divergence processes. Finally the findings are evaluated briefly in the conclusion.

5.1 An Assessment of Empirical Studies in the Literature

Studies on regional convergence in Turkey in terms of growth in GDP per capita have either found or not found unconditional beta convergence. One point that

should be noted is that some of these studies focus on income while others focus on labor productivity, although usually these studies are cross referenced usually, without much attention on the dependent variable.

Tansel and Güngör (1997) studied unconditional convergence in labor productivity (GDP per labor force) and found absolute convergence for the 1980-1995 period, between NUTS III level regions. They found that convergence rates were even faster by studying Eastern and Western provinces separately. Taking into consideration the human capital, they found faster speed of conditional convergence as well.

Filiztekin (1997) in the same year, used GDP per population as income level, and found divergence for the 1975 -1990 period at NUTS III level. Temel et al. (1999) point that one of these studies focus on income convergence while the other on labor productivity. They comment on these different findings of Filiztekin (1997) and Tansel and Güngör(1997) as indicating an inverse relationship between population and labor force, and find both outcomes as reasonable due to high immigration from rural areas to three industrialized metropolitan areas (Istanbul-İzmit, İzmir and Adana).

Temel et al. (1999) applied a Markov chains approach and a non parametric regression to study spatial patterns of labor productivity in Turkey. Their findings support that two groups form convergence clubs. They found a persistent spatial pattern in productivity, indicating concentration around three highly industrialised metropolitan areas İstanbul, İzmir and Adana. To detect spatial patterns in productivity, they estimate productivity as a function of latitude and longitude, using a non-parametric regression technique. They find that İstanbul-İzmit became the highest, İzmir became the second and Adana became the third region where labor productivity peaked as early as 1985. They point that polarization started in 1975 and became stronger in 1990, and a persistent spatial pattern existed over the period 1975-1990.

Aldan and Gaygısız (2006) used a a spatial markov chains approach and unconditional beta convergence model to asses convergence in regional GDP per capita during 1987-2001. This study covers the year of 2001, in which a major economic crisis decimated much of the productivity and hence income, especially in metropolitan regions. Their dependent variable is income per capita, in terms of GDP per population, as in Filiztekin (1997). They found no strong evidence for

unconditional convergence at NUTS III level, in line with Temel et al. (1999). Even though after applying a spatial error model, still, the convergence rate is quite low. By applying a spatial markov chains model, they find that provinces surrounded by poor provinces are likely to remain poor. They show that the chance of a region to jump to a higher income class increases if its neighbors increase their incomes as well.

Another study by Doğruel and Doğruel (2003) was done for 1987-1999 period. Since the original source could not be reached, the comments of Gezici and Hewings (2004) is given below:

> Dogruel and Dogruel(2003) analyzed the period of 1987-1999 and put forward that s convergence is occurring only in developed-rich regions between 1987-1999. Moreover, they emphasize the spatial dualism and define developed regions as those west of the E-5 highway passing through the metropolitan regions and their surrounding regions which are, in a sense, most dependent on the more developed regions and growing the fastest.(Gezici and Hewings, 2004).

Karaca (2004), using GDP per capita income values as the dependent variable, found that there was unconditional income divergence between 1975-2000. In sub-period of 1975-1980, there was no significant divergence or convergence, 1980-1990 a significant divergence and 1990-2000 insignificant beta convergence was found in this study. Karaca claims that poor regions experienced slower growth rates during 1975-1990, and there was no significant difference between the growth rates of poor and rich regions during 1990-2000. His conclusions by using sigma convergence and coefficient of variation show that during 1975-2000, there was sigma divergence, in other words, increasing regional income inequalities. The rate of increase, seems to be slower during the 1990'es.

Gezici and Hewings have different studies focusing on both beta and sigma income convergence at different levels, dating from 2001 to 2007. Here two papers dated 2004 and 2007 are of major interest since they cover most of the previous works as well.

Gezici and Hewings (2004) studied both unconditional and conditional beta convergence in per capita income levels in Turkey, using different regional partitions. Gezici and Hewings (2004) report here an increasing spatial autocorrelation in terms of GDP per capita of regions during 1980 and 1997, but do

not provide information whether if there is spatial autocorrelation with the GDP per capita income growth rates. They find no convergence in the unconditional model, but after they conditioned the beta convergence model in order to capture regional effects they found that regional effects play a role in the per capita income growth rates.Although they introduce population growth, public investment to GDP ratio and net migration as conditioning variables, they find that these factors do not have significant effects on growth of regional per capita income. Therefore, they have found no conditional beta convergence.

Gezici and Hewings (2004) then progress by running a cross-regressive model where they include initial per capita income level of neighbor regions as an explanatory variable among other variables such as public investment ratio in the region and public investment ratio of neighbors. This model as well does not provide any significant conditional beta convergence.

Yıldırım et al. (2004) as well studied convergence in regional income per capita during 1990-2001 period at NUTS III level. By using a spatial lag model, they found that there is significant B convergence (with R^2= 0.25) and have found spillover effects; lower income regions which are neighbors of higher income regions grew faster. They also show that different regimes apply to different parts of the country. The models that take into account spatial dependence favor the spatial error models, and point to importance of spatial dependencies on regional per capita income growth. It should be mentioned that the economic crisis at year 2001 might have had significant negative effects on productivity, and thus income, so the results of this study may differ from others.

Yıldırım and Öcal (2006) study is another study that focus on regional income per capita. By using an unconditional beta convergence (OLS) model, found that there is very weak but statistically significant beta convergence at around 0.02 % per year, with an R^2 of 0.34 during 1979-2001 at NUTS III level. Then, using a spatial error model, they found that the convergence rate is 0.83% per year. The R^2 of the maximum likelihood model is 0.61 at this case.

Gezici and Hewings (2007) studied sigma convergence on regional income per capita at different geographical levels in Turkey. The striking finding was that although regional income inequalities were decreasing, the spatial dependencies at NUTS III level for first order neighbors increased during 1980-1997 period, indicating an

agglomeration of economic activity in the Western half of the country. This is probably mostly due to growth of urban economic activity in size, that expansion of manufacturing industries from metropolitan areas to nearby regions and associated growth of services played a key role in regional development in Turkey.

Kırdar and Saraçoğlu (2008) assessed the role of immigration on income convergence. Not surprisingly, they found that migration rate had a significant and negative effect on beta convergence in per capita income levels, during 1975-2000 for 67 NUTS III regions. In the unconditional beta convergence model, they found no income convergence as in other studies. However, since they divide the period into 5 sub-periods and pool the data to increase number of cases to 335, it becomes difficult to compare this study with others which find different results for sub-periods.

Önder et al. (2007) studied the effect of public capital investments on regional productivity per capita for NUTS I regions, by using a fixed effects spatial lag model. They found that public capital investments did not play a role in the spatial lag model. The initial productivity level and neighbor's productivity level played a role in the future productivity level of a region. Since the number of studied regions are only 12 in this study, spatial lag models are not likely to work well.

Later, Yıldırım et al. (2009) studied the conditional convergence in regional per capita income inequality in Turkey between 1987-2001. They have included explanatory variables which represent initial conditions of regions: average level of education, average fertility rate, average level of unemployment and regional per capita government expenditure in 1987. In the OLS, the R^2 is 0.42 and initial per capita income level has a negative and significant, initial average education level, initial unemployment rate and regional per capita government expenditure all have a positive and significant effect on per capita income growth. Fertility rate did not have a significant effect. Regarding Kırdar and Saraçoğlu(2008) it may be concluded that perhaps immigration is a more important factor than local fertility rates. Since spatial error and spatial lag models do not improve their model significantly, it may be accepted that their OLS model is conclusive enough. One contribution at this point could be introducing spatial dependencies of explanatory variables. Yıldırım et al. (2009) also use a geographically weighted regression model, which indicates that spatial location is also important in explaining differences. GWR model here

indicates a divergent trend for developed regions in the Western and central Turkey. An important contribution of their study is that they show high fertility rates in the East and high unemployment rates in the West play key roles in hindering income growth.

Falcıoğlu (2008)studied convergence in regional productivity in the manufacturing industries for the period between 1980 to 2000 with a cross section and a fixed effect panel data model, in a sample of 26 regions at NUTS II level. She used a form of GINI index for initial regional specialization, distance to nearest major metropolitan center (Istanbul, İzmir, Ankara and Adana) as a measure of geographical peripherality, average firm size (according to average number of employees) as an indicator of economies of scale, average wage, and fixed capital expenditures per worker. The logarithm of the variables are used in a log linear model. She has corrected her model by White's method for heteroskedasticity. She found that average firm size and regional specialization did not have a significant impact on the growth of productivity per capita in manufacturing industries. Average wage level had a positive and significant, distance to major metropolitan centers had a negative and significant, and fixed capital investment per worker had a significant effect on the growth of productivity. She reports an adjusted R^2 of 0.47 for her first model and 0.57 for her second model. The difference of the second model is that it also includes capital intensity per worker as another explanatory variable. Both of the model's have significant F values.

To sum up, it can be said that there is no or little income convergence in the post 1990 period until 2000. Only when the crisis year 2001 is included, there seems to be some evidence of weak convergence in income rates. Studies of Yıldırım et al. (2004) and Yıldırım and Öcal (2006), Yıldırım et al. (2009) are examples, where by adding data from year 2001 convergence is found. Other researchers have avoided using data of 2001 since it had major effects on metropolitan areas. The results support the idea of Petrakos and Saratsis (2000) that inequalities increase in times of economic expansion and decrease in times of recession.

If income inequality is left for a while and the attention is turned on to labor productivity, there seems to be beta convergence. Temel et al.'s (1999) study on general productivity level for 1975-1990 and Falcıoğlu (2008) study on labor productivity in manufacturing sector shows that productivity is highest around

metropolitan areas. The role of entrepreneurs, increase in skilled personnel such as engineers, economists, architects or creative professions, role of FDI, long distance spatial spillovers, Jacobs externalities are not studied for general labor productivity in the studies that could be reached and reviewed. Falcıoğlu (2008) found that initial specialization level did not have an important effect on manufacturing productivity growth.

Table 5.1: Summary of empirical studies on regional productivity growth and income growth in Turkey.

Productivity Convergence		
Authors	Unit	Results
Tansel and Güngör (1997)	NUTS III	Unconditional beta convergence in labor productivity for 1980-1995 period. Faster convergence within Eastern and Western regions. Human capital is important.
Temel et al. (1999)	NUTS III	Polarization started in 1975 and became persistent
Önder et al. (2007)	NUTS I	No effect of public capital investments. Initial productivity level of a region neighbors explain growth in productivity.
Falcıoğlu (2008)	NUTS II	1980-2000- Distance to major metropolitan center has a negative, average wage level and fixed capital investments per worker had positive effects on regional productivity growth in manufacturing industries.
Income Convergence		
Authors	Unit	Results
Filiztekin (1997)	NUTS III	Divergence for 1975-1990 period.
Doğruel & Doğruel (2003)		1987-1999 - Convergence only among developed regions West of the E-5 motorway.
Karaca (2004)	NUTS III	Unconditional income divergence between 1975-2000. 1990-2000 insignificant beta convergence (or in other words, no convergence).
Gezici and Hewings (2004)	NUTS III and other	Spatial autocorrelation in terms of GDP per capita increased from 1980 to 1997. No unconditional beta convergence. Regional effects important on regional income growth.
Yıldırım et al. (2004)	NUTS III	1990-2001 - Significant beta convergence in Spatial lag model. Low income regions that are neighbors of high income regions are growing faster. Different regimes apply to different parts of the country.
Aldan and Gaygısız (2006)	NUTS III	1987-2001 - Poor regions surrounded by poor regions are likely to remain poor. If a poor region's neighbors increase their incomes, then the subject region's chance to jump to a higher income class increases.
Yıldırım and Öcal (2006)	NUTS III	1979-2001 - Weak unconditional beta convergence. Spatial error model improves the results. Spatially autocorrelated ommited variables could be important.
Gezici and Hewings (2007)	NUTS III and other	1980-1997 - Spatial dependencies for first order neighbors increased. May be indicating more intense interaction with neighbor regions or agglomeration
Kırdar and Saraçoğlu (2008)	NUTS III	Migration rate had a significant negative effect on growth.
Yıldırım et al. (2009)	NUTS III	1980-2001 - Conditional Beta convergence. Initial average education level, initial unemployment rate and regional per capita government expenditure have positive effects on growth.

If income inequality is left aside and attention is paid to labor productivity, there seems to be beta convergence. Temel et al.'s (1999) study on general productivity level for 1975-1990 and Falcıoğlu (2008) study on labor productivity in manufacturing sector shows that productivity is highest around metropolitan areas. The role of entrepreneurs, increase in skilled personnel such as engineers, economists, architects or creative professions, role of FDI, long distance spatial spillovers, Jacobs externalities are not studied for general labor productivity in the studies that could be reached and reviewed. Falcıoğlu (2008) found that initial specialization level did not have an important effect on manufacturing productivity growth.

Therefore, there is some scope for research on productivity growth and convergence in Turkey for the post 1990 period.

5.2 An Empirical Study on Regional Productivity Growth in Turkey

First of all, it should be mentioned that the emphasis in this empirical study is the convergence in regional per capita productivity rather than convergence in income per capita. It is because the original theoretical approach focuses on regional productivity levels rather than income levels. Although in the neo-classical theory these two different things may be taken as the same thing due to assumptions of perfect competition, and full employment, in reality perfect competition is not common and there are different levels of unemployment in regions. Furthermore, post neo-classical theory focuses on issues related to diffusion of technology, the role of externalities and entrepreneurial activity on productivity growth, rather than income growth. Another important aspect is that in Turkey there is a minimum wage which is the same for all regions, despite differences in productivity levels.

To the best knowledge of the author of this study, dynamic developments in the organization of production have not been paid enough attention up to now in the convergence literature on Turkey. The role of entrepreneurs, increasing share of information workers in the economy, the role of FDI on technology transfer and the impact of growth of population on regional productivity and convergence are not studied within the same framework. Together with initial advantages such as proximity to international markets and proximity to developed areas, these dynamic changes in economy must have had significant impacts on the spatial pattern of

productivity. The post 1990 period, therefore, deserves a study on conditional beta convergence on labor productivity.

The changing organization of production and improvements in the transportation system could have far reaching effects on diffusion of technology and business culture between regions. Companies specialized in producer services could have become more important in upgrading productivity in other sectors in distant regions. Up to now, only first order neighbors at NUTS III level have been taken into account in convergence studies. As mentioned above, Lopez-Baso et al. (2004) found that in European Union, spillover effects on regional productivity growth are usually effective within 600 km and mostly within the same country. If similar forces are active in Turkey, it might have certain implications on the spatial pattern of productivity growth.

Another important issue is that different dynamics influence manufacturing employment and services. In many countries, manufacturing industries are likely to decentralize within and out of metropolitan areas, while especially producer services are concentrating to metropolitan areas (Frankel, 2001; Dekle, 2002; Sideri, 1997; Sassen, 2001). Together, these dynamics create large concentrations of economic activities within large regions, not only in Europe but also in countries like China and Brasil (Fujita and Hu, 2001; Azzoni, 2001). Yet, only few empirical studies on Turkey address these issues.

Since employment growth and productivity growth are usually assessed only at the aggregate level, the picture on the evolution of regional inequalities in productivity is blurred. The pattern of development in different industries may be a reason for this. If services are agglomerating in certain metropolitan areas and driving manufacturing industries out of the traditional manufacturing core, the overall productivity growth may not have changed. Infact, large cities are being dominated by highly productive producer services but also with low level services, as described in Sassen (2001). On the contrary, if manufacturing industries are dispersing to rural neighborhood of metropolitan areas, convergence in aggregate productivity rates may occur between metropolitan areas and their neighbors, since productivity rates in even labor intensive manufacturing activities will be higher than agricultural productivity rates. These regional groups may resemble the so-called global city-regions, or globalizing regions. On the other hand, divergence could be expected between the remaining

agrarian regions and the globalizing regions, even though there are improvements in agricultural productivity rates.

Another possible outcome of integration is that productivity rates on average could be falling. If a country is specializing in labor intensive manufacturing industries due to integration to global markets, this may lead to a stable or decreasing regional productivity. The spatial growth of employment thus implies strong effects on the changes in productivity levels and regional inequalities.

To assess the evolution of regional productivity inequalities in Turkey, two types of convergence analysis will be held in the following sections. Sigma convergence analysis will be used to understand the changes in the distribution of the inequalities in productivity levels. Then, following the post-neo-classical growth theories, unconditional and conditional beta convergence models will be used to assess whether if poorer regions are catching up, and which factors are influential in productivity growth.

The unit of analysis and time span is the same as described in section 4.2.1.

5.3 Sigma Convergence in Aggregate Productivity Growth

As a first step the sigma convergence on aggregate productivity growth is assessed in this section. Before proceeding to the sigma convergence analysis, an initial look at the geography of production in Turkey will be informative. Below presented are maps showing distribution of productivity at NUTS III levels for all economic sectors (figure 5.1), manufacturing and other industries (figure 5.2), services (figure 5.3) and agriculture (figure 5.4).

To evaluate distribution of productivity and sigma convergence, regional productivity per employee is calculated. Two datasets from TURKSTAT are used to calculate per capita productivity. Data set on GDP in 1987 fixed prices in Turkish Lira covers the years between 1987-2001. This data set is disaggregated at NUTS III level and is calculated in terms of producer prices. As mentioned, data for 1990 and 2000 are going to be used in the following. Data set of General Population Census 1990 and 2000 will be used for number of workers at NUTS III level, which is explained and used in the previous sections for assessment of employment growth.

Therefore, the variable for regional labor productivity is the division of GDP of the region to the working population.

As seen in figure (5.1), most of the Western half of the country was more productive in 1990 when all sectors are considered together. Istanbul-Ankara corridor and İzmir-Manisa cluster were the most productive clusters by year 2000. Productivity rates in the Eastern half were below the average at 1990 and remained so at year 2000. Mean productivity level increased during the period.

In manufacturing and other industries, Northwestern provinces remained strong but few Eastern provinces which had high productivity levels fell below the average by year 2000. Provinces nearby metropolitan provinces in the West – Northwest have improved their relative productivity to the mean. Attention should be paid to the drop in mean productivity level in manfuacturing and other industries.

Mean productivity also fell in services sector. The dominance of Western Provinces seems to be disappearing, and productivity rates of some provinces between Western and Eastern Turkey seems to have improved. Eastern provinces were still below the average at year 2000.

Agricultural productivity rates were also high in the West, during the whole period. Provinces like Istanbul, Bursa, Ankara experienced declining productivity rates, and their relative position changed. Almost all of the East were below the average at year 1990, but Şanlıurfa and Siirt's productivity levels rose above the country average by year 2000, probably due to GAP project. However, some Southeastern provinces fell below the average by year 2000. Mean productivity level has risen only in agricultural sector. Since share of employment in agriculture is still very high, this improvement had a positive effect in overall productivity levels.

The picture presented by these maps clearly addresses differences between the Eastern and Western Half of the country. At the aggregate level, differences are about up to 8 times between the least productive and the most productive region, while in manufacturing it is even higher. In services and agriculture, it is about 5 times.

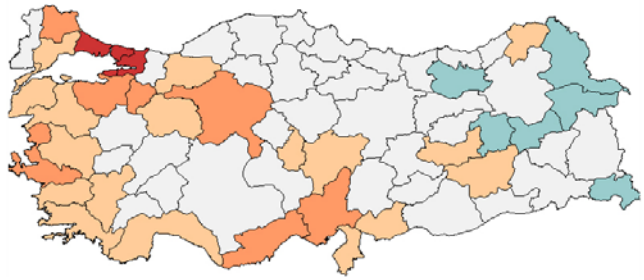
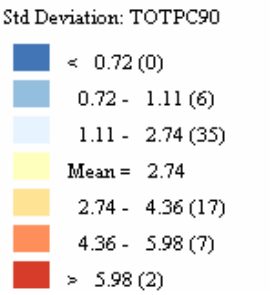
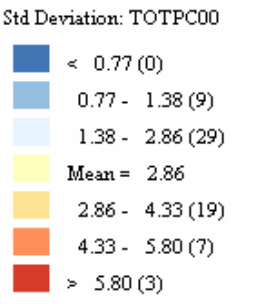
Total Productivity per employee, 1990	1987 fixed prices, in million old TL
	
Total Productivity per employee, 2000	1987 fixed prices, in million old TL
	
The numbers indicate standard deviations from the mean. The numbers in brackets indicate number of regions in that group in the legend.	

Figure 5.1 : Distribution of regional labor productivity in all sectors.

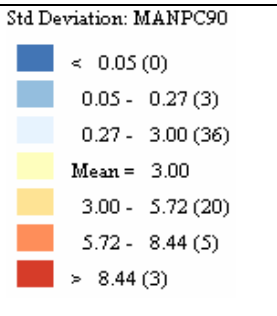
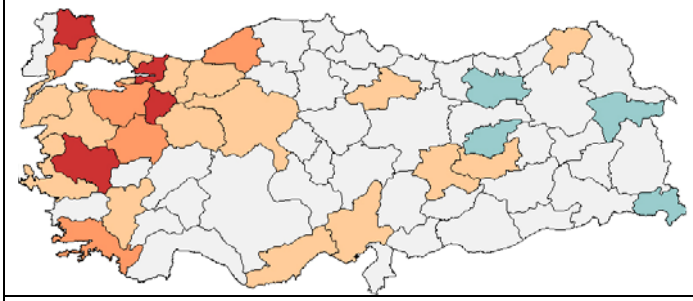
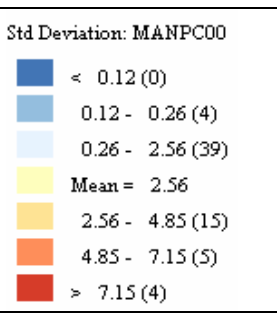
Productivity per employee in manufacturing and other ind., 1990	1987 fixed prices, in million old TL
	
Productivity per employee in manufacturing and other ind., 2000	1987 fixed prices, in million old TL
	
The numbers indicate standard deviations from the mean. The numbers in brackets indicate number of regions in that group in the legend.	

Figure 5.2 : Distribution of regional labor productivity in manufacturing and other industries.

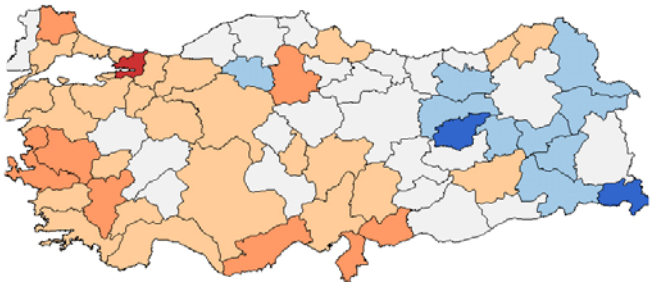
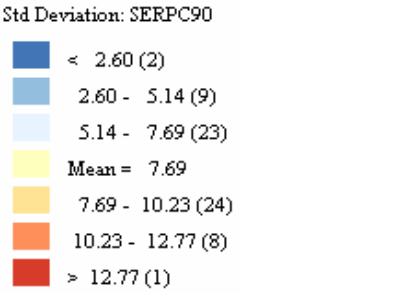
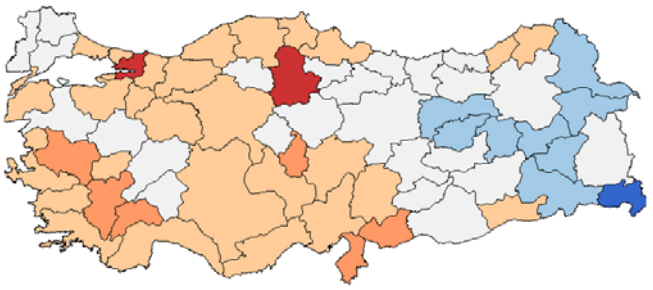
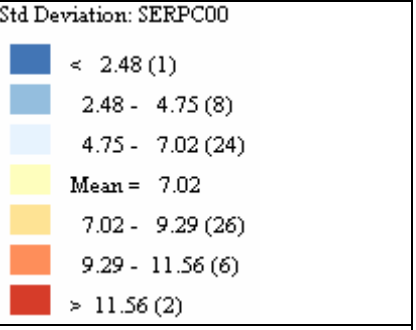
Productivity per employee in services, 1990	1987 fixed prices, in million old TL
	
Productivity per employee in services, 2000	1987 fixed prices, in million old TL
	
The numbers indicate standard deviations from the mean. The numbers in brackets indicate number of regions in that group in the legend.	

Figure 5.3 : Distribution of regional labor productivity in services.

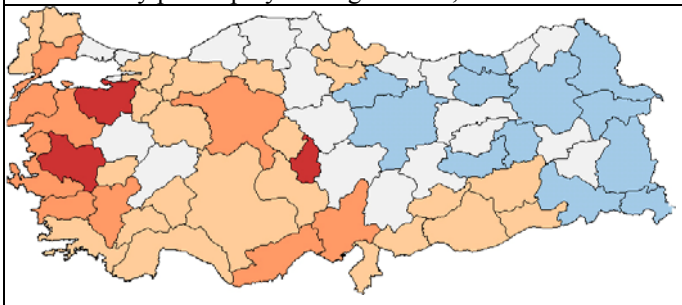
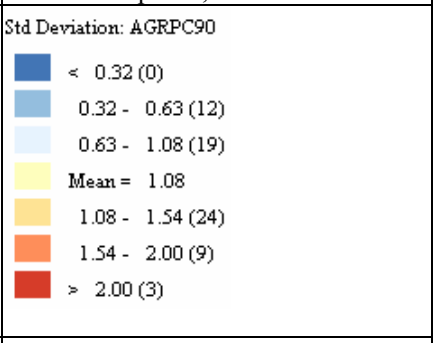
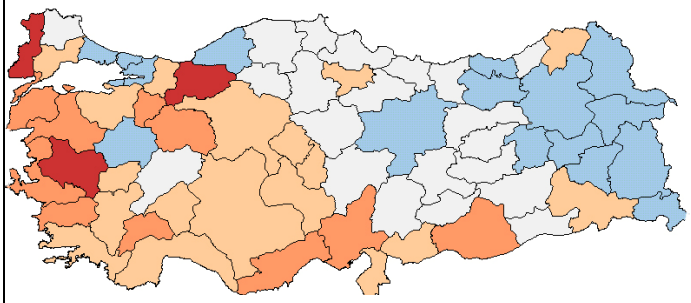
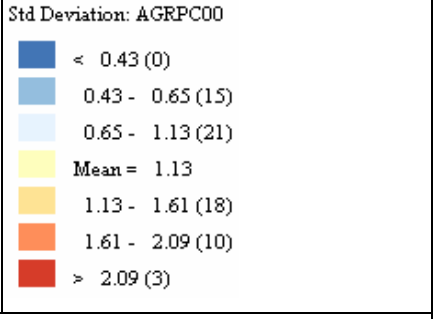
Productivity per employee in agriculture, 1990	1987 fixed prices, in million old TL
	
Productivity per employee in agriculture, 2000	1987 fixed prices, in million old TL
	
The numbers indicate standard deviations from the mean. The numbers in brackets indicate number of regions in that group in the legend.	

Figure 5.4 : Distribution of regional labor productivity in agriculture.

For analysis of sigma convergence, different methods may be used. To test existence of sigma convergence, a trend analysis could be used. However, since employment data used here is from the Population Census and is only available for 1990 and 2000, it is not possible to evaluate the time trend with a formal analysis.

One of the simplest methods is to have a look at the changes in standard deviations.This is not very informative, so usually other methods are used to evaluate the distribution of data which gives an idea about how the inequalities changed. One common method to evaluate the changes in the dispersion is to calculate coefficient of variation (CV) of the productivity per capita. CV is a normalized measure of dispersion of a probability distribution and is only defined for non-zero mean. It is dimensionless, which makes it suitable for assessing two different time periods. It is calculated as follows, where σ is the standard deviation and μ is the mean of the sample:

$$CV=\sigma / \mu \qquad \textbf{(5.1)}$$

Because it is the division of the standard deviation to the mean, CV is sensitive to small changes in the mean when mean is close to zero. Since, in the data set, the mean is not close to zero, CV could be used for an assessment of sigma convergence. If CV decreased from 1990 to 2000, then we may assume that there was sigma convergence in regional labor productivity levels.

Fujita and Hu (2001), following Williamson (1965) suggest the use of a weighted coefficient of variation (WCV) rather than the unweighted coefficient of variation, if per capita income (or, productivity) of a nation (or region) will be used to measure inequality. This is because the population of regions may differ widely. If CV is used to assess inequality, regions with a small population will have the same impact with regions with large populations. The formula to calculate WCV as in Petrakos et al. (2003) is as follows:

$$WCV=\sqrt{\sum\left[(x_{it}-\bar{x}_t)^2 * (p_{it}/p_t)\right]} \Big/ \bar{x}_t \qquad \textbf{(5.2)}$$

Where x_{it} is the productivity per employee in region i at year t. $\bar{x}_t$ is the arithmetic mean regional production at year t. The regions are weighted by working population. Thus, p_{it} is the number of workers in region i at year t, and p_t is the arithmetic mean of number of workers in a region in the country at year t.

Table 5.2: Coefficient of variation and weighted coefficient of variation – regional labor productivity – 67 NUTS III regions.

	Coefficient of Variation (CV)		**Weighted Coefficient of Variation (WCV)**		**Min/Max**		**Change in Average Productivity (%)**
Sector	**1990**	**2000**	**1990**	**2000**	**1990**	**2000**	**1990-2000**
Total	0.5937	0.5155	0.7810	0.6532	0.0683	0.0884	3.88
Manufacturing	0.9086	0.8981	0.8550	0.9026	0.0038	0.0113	-10.31
Services	0.3384	0.3311	0.3290	0.2729	0.1164	0.1341	-13.05
Agriculture	0.4294	0.4334	0.4612	0.4438	0.1428	0.1744	2.97

Values of CV, WCV and minimum to maximum ratios are given in table (5.2). In terms of general labor productivity, the regional inequality has decreased in Turkey. Minimum to maximum ratio has increased showing that the gap between the least productive and the most productive region has decreased. The most productive region was Kocaeli both at 1990 and 2000, but its productivity declined, similar to Istanbul, Izmir, Bursa, Ankara and Adana. Thus, all the metropolitan regions experienced declining labor productivity during the period. One could suspect that rise of informal economy could have played a role on this.

First intra-regional inequalities in productivity levels are evaluated. In table (5.3) below, sigma convergence and divergence in geographic regions can be followed. In general, productivity has grown very little in 10 years. At the regional level, both CV and WCV decreased. Decline is sharper when population (worker) weights are considered. Sharpest declines were in Marmara Region and Eastern Anatolia Region.

At 1990, productivity in services was 8 times higher than in agriculture and about 2.3 times higher than in manufacturing and other production. At 2000, productivity in services was 6.7 times higher than in agriculture and 2.2 times higher than in manufacturing and other production. Although the increases in productivity of the agricultural sector was a positive development for about 13 million workers, transformation to urban economies helped in increasing overall productivity despite falling productivity rates in urban sectors.

Aegean Region grew second fastest in total productivity, while inequalities in total productivity decreased. On the manufacturing side, inequalities were high and increased, but leading to growth. Services and agricultural inequalities decreased according to WCV, at the expense of shrinking productivity levels.

In the Black Sea Region except Trabzon all provinces' total productivity levels increased. Inequalities increased, but the region benefited the rapid growth in productivity. Manufacturing productivity decreased sharply, but inequality increased. In services, productivity did not change, and inequality did not change strongly. Productivity in agriculture increased sharply, while inequality increased.

In the Eastern Anatolia, inequality decreased, accompanied by a drop in total productivity. The highest inequality was in manufacturing and other industries, due to polarized economic structure of the region, where industries were concentrated in Elazığ and Malatya. This is because hydro-electric dams are located here and production of electricity is accounted in this category. Despite large drops in productivity of Elazığ and Malatya, WCV shows increasing inequality in manufacturing and other industries, as well as services. Only agricultural productivity increased, accompanied by decreasing inequalities.

Interior Anatolia experienced increasing total productivity with a decline in inequalities. Despite the growth in total productivity, average productivity in all sectors declined. This may be attributed to sharp increases in employment in services and manufacturing and slow growth in employment in agriculture.

Decline in Istanbul's productivity accompanied by Kocaeli's had a great impact on inequalities in the Marmara Region due to size of Istanbul, Bursa and Kocaeli. Except Istanbul, Kocaeli, Bursa and Kırklareli, all other provinces experienced increasing productivity levels. It should be noted that both at 1990 and 2000 Kocaeli, Istanbul and Bursa were still the most productive regions. Kocaeli, Bilecik, Kırklareli and Tekirdağ were the most productive regions in manufacturing in Turkey by 2000.

Table 5.3: Sigma convergence in all sectors within geographic regions- Turkey, 1990-2000.

Sector	Geographic Region	CV		WCV		Min/Max		Aver. Prod. per worker (in 1987 fixed prices. Old TL)		Change in average prod. (%)
		1990	2000	1990	2000	1990	2000	1990	2000	1990-2000
Total	Aegean	0.3827	0.3569	0.4768	0.3868	0.3084	0.3644	3,925,156	4,170,587	6.25
	Black Sea	0.2850	0.3090	0.2582	0.3050	0.3426	0.3450	2,123,668	2,495,296	17.50
	Eastern Anatolia	0.6040	0.4520	0.5888	0.4750	0.2004	0.2996	1,510,765	1,449,334	-4.07
	Interior Anatolia	0.4971	0.4463	0.6744	0.5732	0.2338	0.2793	3,494,771	3,610,581	3.31
	Marmara	0.5257	0.3399	0.4949	0.2910	0.2170	0.3748	5,662,356	5,421,952	-4.25
	Mediterranean	0.3061	0.2298	0.2880	0.2136	0.4727	0.5225	3,586,995	3,346,886	-6.69
	Southeastern Anatolia	0.4084	0.3172	0.4008	0.3072	0.2992	0.4842	2,509,132	2,485,558	-0.94
	Turkey	**0.5938**	**0.5155**	**0.7810**	**0.6532**	**0.0683**	**0.0884**	**3,574,495**	**3,713,051**	**3.88**
Manufacturing	Aegean	0.5750	0.6793	0.5704	0.5262	0.2005	0.1399	3,822,977	4,066,526	6.37
	Black Sea	0.6932	0.7112	0.5580	0.7889	0.0454	0.0274	3,125,102	2,494,766	-20.17
	Eastern Anatolia	1.8007	1.1317	1.8830	2.0909	0.0050	0.0432	2,146,059	1,094,327	-49.01
	Interior Anatolia	0.5602	0.5154	0.5067	0.4058	0.0599	0.1470	2,765105	2,463771	-10.90
	Marmara	0.7069	0.5403	0.6492	0.5613	0.1058	0.2124	5,249,256	5,191,309	-1.10
	Mediterranean	0.6463	0.4528	0.6021	0.4573	0.1380	0.3222	3,613,630	2,509,345	-30.56
	Southeastern Anatolia	0.9564	0.3541	0.6800	0.5077	0.0371	0.2659	3,150,724	1,807,532	-42.63
	Turkey	**0.9086**	**0.8981**	**0.8550**	**0.9026**	**0.0038**	**0.0113**	**3,952,313**	**3,545,010**	**-10.31**
Services	Aegean	0.1934	0.1994	0.3086	0.2578	0.6219	0.5371	10,005,740	8,731,471	-12.74
	Black Sea	0.2360	0.2332	0.2081	0.2278	0.4337	0.4470	7,454,260	7,403,191	-0.69
	Eastern Anatolia	0.3978	0.3697	0.5743	0.6927	0.2481	0.2919	5,516,245	4,586,891	-16.85
	Interior Anatolia	0.2093	0.1672	0.2022	0.1722	0.0203	0.0189	8,652,142	8,028,121	-7.21
	Marmara	0.2584	0.2852	0.2898	0.2396	0.4386	0.4334	9,873,702	8,071,250	-18.26
	Mediterranean	0.2116	0.2140	0.2776	0.2030	0.4852	0.4969	9,663,084	7,969,074	-17.53
	Southeastern Anatolia	0.3785	0.3299	0.4094	0.3399	0.2962	0.3594	8,169,284	7,088,221	-13.23
	Turkey	**0.3371**	**0.3293**	**0.3290**	**0.2729**	**0.1164**	**0.1341**	**9,022,488**	**7,844,976**	**-13.05**
Agriculture	Aegean	0.3467	0.3743	0.4910	0.4573	0.3006	0.2756	1,587,517	1,498,910	-5.58
	Black Sea	0.1042	0.1612	0.1390	0.1673	0.1877	0.2131	838,423	924,492	10.27
	Eastern Anatolia	0.3081	0.2580	0.7756	0.6918	0.4073	0.4557	597,927	643,978	7.70
	Interior Anatolia	0.3957	0.3334	0.3398	0.2881	0.2404	0.3065	1,152,803	1,106,711	-4.00
	Marmara	0.2569	0.4089	0.4233	0.4309	0.4354	0.1744	1,515,464	1,316,729	-13.11
	Mediterranean	0.2133	0.2092	0.3120	0.2971	0.5557	0.5277	1,357,657	1,421,902	4.73
	Southeastern Anatolia	0.3523	0.3430	0.3237	0.3759	0.2376	0.4053	1,009,787	1,295,920	28.34
	Turkey	**0.4294**	**0.4334**	**0.4612**	**0.4438**	**0.1428**	**0.1744**	**1,137,843**	**1,171,613**	**2.97**

In the Mediterranean Region, total productivity declined, accompanied by a decline in inequalities. Largest decline in productivity was in manufacturing inequalities. In services, CV did not decline much but WCV declined to a large extent. In agriculture, inequalities remained almost unchanged. Antalya, Adana, Hatay and İçel experienced rapid growth in employment in all sectors.

In the Southeastern Anatolia, inequalities increased in general, and particularly in manufacturing and services. On the other hand, inequality of productivity increased in agricultural sector, if WCV is taken into consideration. Despite very high declines in manufacturing productivity, especially due to losses in Adıyaman and Diyarbakır, rapid growth in agricultural productivity kept average productivity almost stable, only with a slight decline. As employment in agriculture is two times larger than manufacturing and three times larger than services, growth in agriculture has been a key issue in keeping average productivity level stable.

Marmara and Aegean regions had the highest average productivity at 1990 and 2000. The Black Sea Region, which enjoyed increasing integration between former Soviet countries, experienced high levels of productivity growth. Bolu and Zonguldak, which are highly accessible from the developed Marmara Region and the capital of Ankara experienced strong growth in total productivity. In Zonguldak manufacturing productivity grew, probably due to integration to global production chains for metal and machinery industries. In Bolu, productivity did not grow much in manufacturing, but the number of employees almost doubled, making manufacturing an important contributor to overall productivity. Zonguldak, strikingly, increased its productivity in services, while productivity in services decreased almost everywhere in Turkey.

In table (5.4), inequalities between seven geographic regions are demonstrated. At a first glance, inequality in total productivity seems to have slightly decreased. Inequality in manufacturing productivity on the other hand, rose sharply. The losses of the East and Southeast in terms of productivity and growth of employment in the Western half of the country should have contributed to the rapid increase in inequalities.

Inequalities in services between geographic regions, on the contrary have declined. Inequality in productivity in services has been the lowest among other sectors both in 1990 and 2000.

Inequalities at the provincial level in agricultural productivity increased according to CV and decreased according to WCV in Turkey during 1990 and 2000 (table 5.2). On the other hand, productivity disparities between geographical regions decreased both in terms of CV and WCV. Improvements in less developed regions contributed to decreases. The spectacular rise in productivity in the Southeasterna Anatolia could be attributed to the Southeastern Anatolia Project (GAP). Since more than half of the workforce in agriculture was in less developed regions, improvements had a significant impact on decreasing inequalities. Eastern Anatolia and the Black Sea Region's shares in workforce amounted to 32% in 1990 and 30% in 2000. Together with the Southeastern and Mediterranean Regions, it was 57% and 55% respectively. Another indicator of decreasing inequality is the rise in minimum to maximum ratio.

Table 5.4: Sigma convergence in all sectors between geographic regions- Turkey, 1990-2000.

Sector	CV		WCV		Min/Max		Aver. Prod. per worker (in 1987 fixed prices, old TL)		Change av. prod. (%)
	1990	2000	1990	2000	1990	2000	1990	2000	1990-2000
Total	0.4209	0.3951	0.4272	0.4018	0.2668	0.2673	3,574,495	3,713,051	3.88
Manufacturing and other	0.2872	0.4939	0.3505	0.5680	0.4088	0.2108	3,952,313	3,545,010	-10.31
Services	0.1904	0.1823	0.1574	0.1321	0.5513	0.5253	9,022,488	7,844,976	-13.05
Agriculture	0.3298	0.2582	0.3062	0.2340	0.3540	0.4296	1,137,843	1,171,613	2.97

The study of sigma convergence in this section showed that total productivity differences declined in Turkey. At the geographic regional level, inequalities decreased, except the Black Sea Region. This is even so when weights of workforce is taken into account. On the other hand, in all regions, minimum to maximum ratio has increased, indicating that regional productivity differences are increasing between the least productive and most productive regions (table 5.3). Overall inequalities seem to decrease because, as demonstrated in the 4th section; population and workforce are agglomerating in and around metropolitan areas where urban sectors are growing. As productivity in urban sectors has been much higher, overall regional productivity inequalities seem to decrease even when workforce is considered.

One important feature about aggregate productivity growth is that it has decreased in half of the geographic regions and increased in the other half, where it was almost

stagnant in Southeastern Anatolia, where industries declined and agricultural productivity rose. An empirical outcome is that both Eastern and Southeastern Anatolian regions' manufacturing productivity decreased sharply. Another region where manufacturing productivity dropped sharply is the Mediterranean Region; sharp declines in Adana, İçel, Kahramanmaraş and Hatay contributed to the decline heavily. On the contrary, manufacturing productivity growth in Şanlıurfa in Southeastern Anatolia was the highest.

In this framework, one can suggest that provinces in the West with better proximity to European markets and with good proximity to nearby large metropolitan areas benefited the integration process more. Provinces like Eskişehir, Bilecik, Zonguldak, Denizli, Manisa, Muğla, Sakarya, Tekirdağ, Edirne and Çanakkale experienced large growth in their manufacturing productivity levels. In the East, traditional manufacturing centers experienced losses while employment grew, and Şanlıurfa joined as a new manufacturing center.

In the services, the picture is more blurred, but large employment growth and large decreases in productivity growth were evident mostly in Istanbul, İzmir, Kocaeli, Bursa, Tekirdağ, Antalya and Muğla. Clearly, growth of services employment did not follow with productivity growth apparently, especially in and around large metropolitan centers where export oriented industries are located, and in provinces likeAntalya and Muğla where international tourism developed.

Under this picture, one can assume that manufacturing sector is developing in and around core regions in the Northwest, West, and East of Mediterranean and West of Southeastern Anatolia. Northwest and West are integrating to global markets, with enlargement of industries and services. Supposedly, low level services are growing as well as producer services, supressing productivity growth in services. Even though declining productivity per capita, immigration from agrarian provinces to these highly urbanized areas lead to transformation of the society and help in decreasing regional inequalities in productivity rates coupled by increasing productivity in agriculture in Southeast, East and Northern provinces. Despite the decline in total labor productivity inequalities at the provincial level, at the geographical regional level, inequality is highly persistent, mostly due to structural changes. CV, WCV dropped just slightly and min/max ratios did not change between geographical regions during 1990-2000, indicating that rapid growth in agricultural productivity

still was not strong enough to overcome large disparities in average productivity levels among regions (table 5.4).

5.4 An Assessment of Beta Convergence in Aggregate Productivity Growth in Turkey

The fourth section showed us how employment grew and the section above on sigma convergence showed how inequalities changed in Turkey during 1990-2000. Together with results derived from the empirical literature, the results suggest that income divergence or no convergence is accompanied by productivity convergence at the provincial level. Temel et al. (1999) have concluded that this was the result of migration from rural areas to metropolitan regions like Istanbul, Ankara and Izmir, at least for the period before 1995.

Immigration should have supplied large amounts of cheap labor to already developed metropolitan areas with good access to international markets, where export oriented industries were growing. Following theory and empirical works, immigration and rapid population growth are likely to have a negative effect on productivity growth, as well as income growth. First of all, rapid population growth may create negative externalities. Second, investors may be interested in exploiting cheaper labor, thus invest in labor intensive industries. In the early processes of integration, this may lead to specialization of a country in labor intensive industries. Third, population growth will lead to an increase in the needs for basic services and products, thus increasing scale of production rather than productivity may become a priority for producers.

The growth of manufacturing employment suggests that manufacturing industries experienced a process of spatial expansion during 1990-2000. This could have led to diffusion of technology through entrepreneurial activity, licencing, and support of producer services in nearby metropolitan regions. In the 1990'es, Istanbul attracted many producer services operated by TNC. It was also the region which attracted most of the FDI and most of the foreign skilled employees (Geniş, 2004). By 2000, Marmara Region attracted In this framework, Marmara Region attracted about 81.3%, Aegean Region attracted about 7.73% and Interior Anatolia Region attracted about 6,23% of FDI in monetary terms. FDI investments per company in the Marmara Region was around double that of in Aegean Region, indicating that

Marmara Region not only attracted most of the FDI, but also attracted most of the large companies, or control of companies were acquired by TNC. The resulting spatial pattern was the concentration of financial and producer services in few small areas in metropolitan provinces, and opening or relocation of manufacturing plants at the outskirts, or neighboring provinces. In this context new manufacturing plants at the closer vicinity of metropolitan areas are likely to increase their productivity, through technology transfers and spillovers via FDI investments, or imported technologies. This is especially so for higher technology manufacturing industries such as automotive and machinery, and less so for industries like textile and wearing apparel. However, as discussed, mostly labor intensive parts of the international product chain of higher technology industries, or completely labor intensive mature industries like textiles have concentrated in Turkey at the initial years of integration, thus productivity growth in general has decreased in most of the provinces. Still, The Marmara Region experienced only a neglectable drop in manufacturing productivity and the Aegean Region experienced an increase. Thus, it may be assumed that manufacturing industries in regions which rapidly integrated to international markets and attracted FDI could upgrade their productivity levels.

The role of entrepreneurs is not clearly assessed in the empirical literature on Turkey. An outlook to distribution of entrepreneurial activity points that entrepreneurial activity declined in major metropolitan cities (table 4.1) but increased in the surrounding areas. This could have played a role in diffusion of technology and hence increases in productivity. However, since few regions are subject to these effects, it could be hard to detect such effects through a formal analysis. Still, it is thought to be an important factor that requires attention. The role of entrepreneurs in making use of knowledge spillovers is often mentioned. At this point the choice of entrepreneurs is important. If entrepreneurs are not rent seeking but trying to introduce innovations, they are likely to help in improving productivity. Innovative and new industries are also likely to enjoy knowledge externalities more than mature industries. But, if entrepreneurs prefer to focus on labor intensive industries where production is simple and standardized, i.e. in basic textile industries, then they may not play an important role in upgrading productivity levels.

Another important development is the increase in the number of skilled workers. Skilled workers reside mostly in metropolitan regions, and continue on concentrating

in these regions. Turkey's number of skilled workers can be evaluated using Population Census Data. The category of scientific, technical and related professionals includes engineers, specialists in humanities and other technical professions, as well as artisans or those in creative industries. Number of such people increased from 1,281,899 in year 1990 to 3,276,829 in year 2000, which points to an increase of 2.55 times. A quarter of new professionals were living in Istanbul by 2000, exactly half of it in Ankara, and about 8% in İzmir. Including Bursa and Antalya, 54% of new professionals were only from these 5 provinces. This explains to an extent why in the Marmara Region and the Aegean Region overall productivity were stagnant or increasing while elsewhere in Turkey it was decreasing. An increase in the share of skilled workers in a region, implies that more knowledge intensive economic activities are growing and productivity should hence be growing. Here it may be asked: What are the effects of increases in the skilled workers on productivity per capita growth?

Indeed the concentration of scientific, technical and related professionals is a better proxy to study Jacobs externalities than the mix of industrial sectors. This is because most of the technical information is exchanged between these workers, and due to their professions they contain and share more technical information than unskilled workers. The use of indices like GINI, calculated by using employment data in each sector as a proxy of diversity is common, but this might lead to problems in running a formal model as same data is used also for calculating the dependent variable; per capita productivity. Therefore, it may be assumed that a concentration of scientific, technical and related professionals in a city does not only increase productivity within the sectors they are employed only, but also in other sectors.

The transformation into higher technology industries and services should have contributed to a productivity increase at the macro-regional level. In this context, the new division of labor in and around metropolitan areas imply that spatial externalities might be playing an important role in the development of productivity in neighboring areas. Lopez-Baso et al., (2004) found in Europe that spatial externalities could be influential on productivity growth even at distances about 600 km. This is approximately an acceptable distance for most of the producer services to conduct intensive face to face services within a day, if transportation network allows higher speeds. In regions where it does not, distance effects could be stronger.

Therefore, proximity to metropolitan areas and growth of number of scientific, technical and related professionals could be an important factor effecting regional productivity growth and convergence within a macro region.

There are no studies in the empirical literature on Turkey discussed above which employs higher order spatial externalities than first order neighborhood level. Therefore, among first order neighborhood effects, long distance effects on productivity growth should also be evaluated.

It was demonstrated that employment growth in urban sectors in Turkey is clustered in the previous section. Growth of employment, in turn, may lead to emergence of positive MAR externalities due to specialization and agglomeration of certain industries, and Jacobs externalities due to diversification in metropolitan areas. These effects may also be seen around metropolitan areas because employment growth is, as mentioned, clustered. The emergence of these externalities may lead to increases in productivity of labor in these regional clusters. So, one of the questions is: Do spatial externalities play a role in the productivity growth in Turkish regions?

All these factors are likely to have strong impacts on labor productivity growth as suggested in the post neo-classical literature. But before answers for these questions are discussed, an evaluation of unconditional beta convergence is provided below, to understand if initially less productive regions are catching up with other regions.

5.4.1 Unconditional beta convergence in Turkey

In order to evaluate unconditional beta convergence in labor productivity levels of regions in Turkey, the growth rate in labor productivity at the regional level during 1990 and 2000 has to be calculated. This is the dependent variable and is named as *prodemp* for aggregate productivity growh. For different sectors, subscripts $_{man}$, $_{ser}$, and $_{agr}$ will be used respectively for manufacturing, services and agricultural sectors.

This variable is specified as the annual average growth rate of gdp per employed person, and it is the growth rate of productivity per capita which is used in assessing sigma convergence in productivity levels in the section above. The way it is calculated is given in equation (5.3).

$$prodemp = (1/T) * \ln((y_{it+T}) / (y_{it})) \qquad \textbf{(5.3)}$$

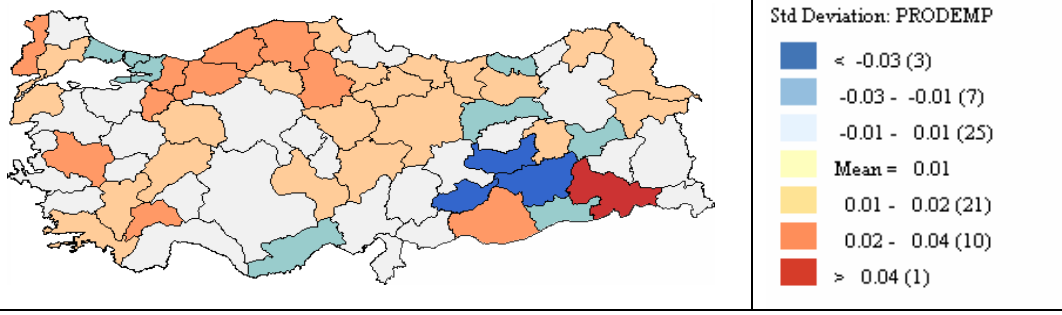
Where y_{it+T} is the GDP per capita of region i at year 2000 divided to total employed population of region *i* at year 2000, and y_{it} is the GDP per capita of region *i* at year 1990 divided to total employed population of region *i* at year 1990. *T* is the number of years, which is equal to 10 here.

The explanatory variable in the unconditional beta convergence model, as discussed in section 3, is the logarithm of initial productivity level of a region, and is indicated as *initgdp* for the aggregate productivity levels. In this study, it is equal to the logarithm of the productivity level per employee at year 1990 and is specified as in equation (5.4).

$$initgdp = \ln(y_{it}) \qquad \textbf{(5.4)}$$

5.4.1.1 Unconditional Beta Convergence at the Aggregate Level

It should be noted that among 67 regions, 25 regions experienced productivity decline instead of growth when all sectors are considered, during 1990-2000 period. All metropolitan regions and some of their neighbor regions experienced drops in productivity at the aggregate level. Productivity dropped about 2 to 1 % annualy in these regions during this period.



The numbers indicate standard deviations from the mean. The numbers in brackets indicate number of regions in that group in the legend.

Figure 5.5 : Distribution of average annual regional labor productivity growth levels, NUTS III regions

To evaluate unconditional beta convergence, an ordinary least squares (OLS) regression is run by using software EViews 6. The results below in table (5.5) show that there was slow unconditional beta convergence at the country level. The model does not experience problem of heteroskedasiticty according to Breusch Pagan and White tests, also run in EViews6. As evident in some other studies, the R^2 is only

0.085, and adjusted R^2 is 0.071 but the F test shows that model fit is not due to chance.

The coefficient of $initgdp_{tot}$ in unweighted model is -0.00936, which indicates an annual convergence rate of only 0. 9% annually. This means that it would take about 77 years to eliminate half of the initial gap of productivity per capita inequalities across regions.

Following Petrakos and Saratsis, (2000), a weighted least squares (WLS) model is run in EViews6 to assess the unconditional beta convergence at aggregate productivity levels (table 5.6). The working population at year 2000 is used for weights. The R^2 of the WLS model is 0.57, while the adjusted R^2 is 0.53. The coefficient of $initgdp_{tot}$ is much more higher now, and is 0.0195, and highly significant and negative. This equals to an annual convergence rate of 1.8 % which is still very low but about 2 times faster than in the unweighted model. Hence, half life is about 38.5 years.

As usual in the literature, spatial diagnostics are used to detect for spatial dependencies. To avoid complexities, spatial diagnostics are run only for the OLS model and ignored for the WLS model.

An OLS model is run with a spatial weight matrix for first order neighbors in the program GeoDA v.0.95, and its results are demonstrated at table (5.7). For first order neighbors, the results suggest the use of a spatial error model. This means the error term is spatially autocorrelated and the OLS model is misspecified. Details of such a model was given in section 3 before.

A maximum likelihood model is run with a weight matrix incorporating first order neighbors to evaluate the spatial error model. The results are given in table (5.8). It should be noted that the correlation coefficients of the OLS estimation and maximum likelihood estimation are not comparable. R^2 of the maximum likelihood model is 0.15, where both Akaike Information Criterion (AIC) and Schwarz criterion suggest that use of the spatial error model improves results. On the other hand, likelihood

Table 5.5: Unconditional beta convergence in Turkey, aggregate productivity growth, OLS estimation.

Dependent Variable: $PRODEMP_{tot}$
Method: Least Squares
Sample: 1 67
Included observations: 67

	Coefficient	Std. Error	t-Statistic	Prob.
C	0.143548	0.055863	2.569649	0.0125
$INITGDP_{tot}$	-0.009360	0.003804	-2.460246	0.0166

R-squared	0.085188	Mean dependent var	0.006206
Adjusted R-squared	0.071113	S.D. dependent var	0.017614
S.E. of regression	0.016976	Akaike info criterion	-5.284620
Sum squared resid	0.018732	Schwarz criterion	-5.218808
Log likelihood	179.0348	Hannan-Quinn criter.	-5.258578
F-statistic	6.052812	Durbin-Watson stat	2.124977
Prob(F-statistic)	0.016551		

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.052525	Prob. F(1,65)	0.8194
Obs*R-squared	0.054097	Prob. Chi-Square(1)	0.8161
Scaled explained SS	0.046414	Prob. Chi-Square(1)	0.8294

Heteroskedasticity Test: White

F-statistic	0.615674	Prob. F(2,64)	0.5434
Obs*R-squared	1.264733	Prob. Chi-Square(2)	0.5313
Scaled explained SS	1.085120	Prob. Chi-Square(2)	0.5813

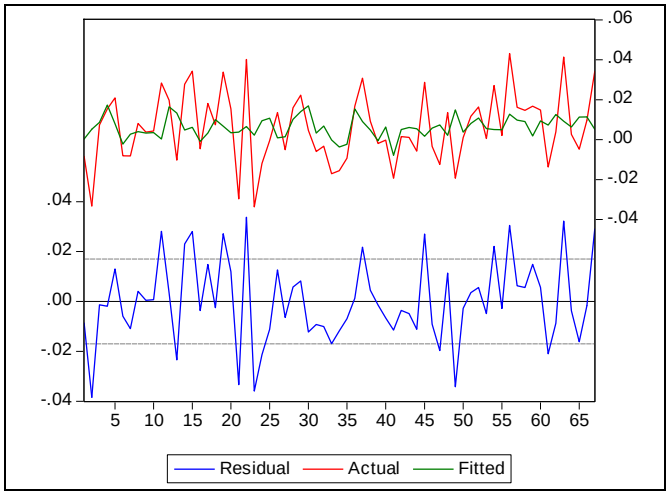


Figure 5.6 : Residuals of unconditional beta convergence – OLS model.

Table 5.6: Unconditional beta convergence in Turkey, aggregate productivity growth, WLS.

Dependent Variable: $PRODEMP_{tot}$
Method: Least Squares
Sample: 1 67
Included observations: 67
Weighting series: WORK2000

	Coefficient	Std. Error	t-Statistic	Prob.
C	0.292154	0.034722	8.414057	0.0000
$INITGDP_{tot}$	-0.019479	0.002245	-8.676230	0.0000

Weighted Statistics

R-squared	0.536631	Mean dependent var	0.000348
Adjusted R-squared	0.529502	S.D. dependent var	0.024105
S.E. of regression	0.013139	Akaike info criterion	-5.797118
Sum squared resid	0.011221	Schwarz criterion	-5.731306
Log likelihood	196.2034	Hannan-Quinn criter.	-5.771076
F-statistic	75.27696	Durbin-Watson stat	2.239254
Prob(F-statistic)	0.000000		

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.171227	Prob. F(1,65)	0.6804
Obs*R-squared	0.176032	Prob. Chi-Square(1)	0.6748
Scaled explained SS	0.275326	Prob. Chi-Square(1)	0.5998

Heteroskedasticity Test: White

F-statistic	0.751096	Prob. F(3,63)	0.5258
Obs*R-squared	2.313604	Prob. Chi-Square(3)	0.5099
Scaled explained SS	3.618622	Prob. Chi-Square(3)	0.3057

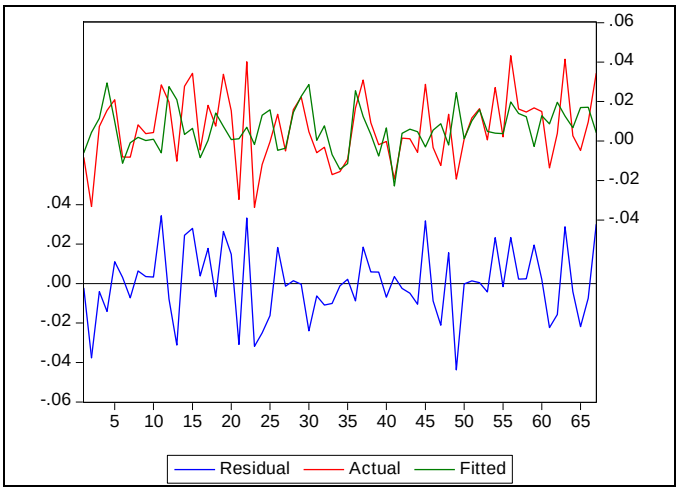


Figure 5.7 : Residuals of unconditional beta convergence - WLS model.

ratio test suggests that the results could be due to chance by 6%. The coefficient of lambda is significant and positive. This may be due to the fact that the data collected acording to NUTS III borders do not actually reflect the nature of the process generating sample data. Or, some ommitted variables are spatially correlated. It is likely that when other explanatory variables are added, the importance of the error term will be decreased or lost in the following sections.

Table 5.7: Spatial diagnostics for the unconditional beta convergence model for first order neighbor regions.

REGRESSION
SUMMARY OF OUTPUT: ORDINARY LEAST SQUARES ESTIMATION

Dependent Variable	**PRODEMP$_{tot}$**	Number of Observations:	67
Mean dependent var	0.0062063	Number of Variables	2
S.D. dependent var	0.017482	Degrees of Freedom	65
R-squared	0.085187	F-statistic	6.05276
Adjusted R-squared	0.071113	Prob(F-statistic)	0.0165518
Sum squared residual	0.0187322	Log likelihood	179.035
Sigma-square	0.000288188	Akaike info criterion	-354.07
S.E. of regression	0.0169761	Schwarz criterion	-349.661
Sigma-square ML	0.000279585		
S.E of regression ML:	0.0167208		

Variable	Coefficient	Std.Error	t-Statistic	Probability
CONSTANT	0.143547	0.05586275	2.569638	0.0124828
INITGDP$_{tot}$	-0.009359463	0.003804296	-2.460235	0.0165518

REGRESSION DIAGNOSTICS
MULTICOLLINEARITY CONDITION NUMBER 53.85206
(Extreme Multicollinearity)

TEST ON NORMALITY OF ERRORS

TEST	DF	VALUE	PROB
Jarque-Bera	2	0.1077024	0.9475731

DIAGNOSTICS FOR HETEROSKEDASTICITY
RANDOM COEFFICIENTS

TEST	DF	VALUE	PROB
Breusch-Pagan test	1	0.06225076	0.8029732
Koenker-Bassett test	1	0.06828695	0.7938475

SPECIFICATION ROBUST TEST

TEST	DF	VALUE	PROB
White	2	1.264694	0.5313433

DIAGNOSTICS FOR SPATIAL DEPENDENCE
FOR WEIGHT MATRIX : **w1modifiye.GAL** (row-standardized weights)

TEST	**MI/DF**	**VALUE**	**PROB**
Moran's I (error)	0.148281	N/A	N/A
Lagrange Multiplier (lag)	1	1.1059224	0.2929701
Robust LM (lag)	1	10.0914525	0.0014896
Lagrange Multiplier (error)	1	3.3828261	0.0658790
Robust LM (error)	1	12.3683562	0.0004367
Lagrange Multiplier (SARMA)	2	13.4742786	0.0011860

========== END OF REPORT ==========

Table 5.8: Spatial Error Model for first order neighbors.

REGRESSION
SUMMARY OF OUTPUT: SPATIAL ERROR MODEL - MAXIMUM LIKELIHOOD ESTIMATION
Spatial Weight : **w1modifiye.GAL**

Dependent Variable	:	**PRODEMP**$_{tot}$	Number of Observations:		67
Mean dependent var	:	0.006206	Number of Variables	:	2
S.D. dependent var	:	0.017482	Degree of Freedom	:	65
Lag coeff. (Lambda)	:	0.337396			
R-squared	:	0.154131	R-squared (BUSE)	:	-
Sq. Correlation	:	-	Log likelihood	:	180.793431
Sigma-square	:	0.000259	Akaike info criterion	:	-357.587
S.E of regression	:	0.0160784	Schwarz criterion	:	-353.177477

Variable	Coefficient	Std.Error	z-value	Probability
CONSTANT	0.2172504	0.06243786	3.479466	0.0005025
INITGDP$_{tot}$	-0.01440244	0.004249688	-3.389057	0.0007014
LAMBDA	0.3373961	0.1548652	2.178644	0.0293580

REGRESSION DIAGNOSTICS
DIAGNOSTICS FOR HETEROSKEDASTICITY
RANDOM COEFFICIENTS

TEST	**DF**	**VALUE**	**PROB**
Breusch-Pagan test	1	1.386369	0.2390193

DIAGNOSTICS FOR SPATIAL DEPENDENCE
SPATIAL ERROR DEPENDENCE FOR WEIGHT MATRIX : **w1modifiye.GAL**

TEST	**DF**	**VALUE**	**PROB**
Likelihood Ratio Test	1	3.516932	0.0607448

To asses longer distance effects, another set of diagnostics are run for the unconditional beta convergence model. This time, a weight matrix covering neighbors within 500 km is used (table 5.9). This is done because Baso et al. (2004) found that spatial dependencies could be effective in about 600 km at NUTS II level in Europe. The road infrastructure in Turkey is not as developed as in Europe, so a shorter distance is employed in the weight matrix.

The results suggest the use of a spatial autoregressive moving average model (SARMA), indicating that both errors and the dependent variable are spatially autocorrelated. Since in GeoDA v.0.95 it is only possible to run either the spatial lag model or the spatial error model, the SARMA model is not run. The results of the spatial lag and spatial error models are given separately in the tables (5.10) and (5.11) below. The results of the spatial lag model given in table (5.10) suggest that growth of other regions within 500 km distance plays a role in the growth of a region. This could be taken as an indicator of spatial spillovers. However, the AIC and Schwarz Criterion do not improve and the likelihood ratio is considerably low, showing that the results of the model could be 9% due to chance.

On the other hand, the results of the spatial error model at table (5.11). suggests that the spatially correlated ommited variables and/or measurement errors are more important. Both AIC and Schwarz Criterion have improved, and the likelihood ratio is higher than in the spatial lag model. The R^2 of the maximum likelihood estimation is 0.25, and the coefficient of lambda is highly significant. The rate of convergence is now about 1.82%, indicating a half-life of 38 years. Finally, it may be concluded that other variables are likely to be important in explaining aggregate regional productivity growth.

Table 5.9: Spatial diagnostics for the unconditional beta convergence model for neighbor regions within 500 km.

REGRESSION
SUMMARY OF OUTPUT: ORDINARY LEAST SQUARES ESTIMATION

Dependent Variable	: **PRODEMP**$_{tot}$	Number of Observations:	67
Mean dependent var	: 0.0062063	Number of Variables :	2
S.D. dependent var	: 0.017482	Degrees of Freedom :	65
R-squared	: 0.085187	F-statistic :	6.05276
Adjusted R-squared	: 0.071113	Prob(F-statistic) :	0.0165518
Sum squared residual	: 0.0187322	Log likelihood :	179.035
Sigma-square	: 0.000288188	Akaike info criterion :	-354.07
S.E. of regression	: 0.0169761	Schwarz criterion :	-349.661
Sigma-square ML	: 0.000279585		
S.E of regression ML	: 0.0167208		

Variable	Coefficient	Std.Error	t-Statistic	Probability
CONSTANT	0.143547	0.05586275	2.569638	0.0124828
INITGDP$_{tot}$	-0.009359463	0.003804296	-2.460235	0.0165518

REGRESSION DIAGNOSTICS
MULTICOLLINEARITY CONDITION NUMBER 53.85206(Extreme Multicollinearity)
TEST ON NORMALITY OF ERRORS

TEST	DF	VALUE	PROB
Jarque-Bera	2	0.1077024	0.9475731

DIAGNOSTICS FOR HETEROSKEDASTICITY
RANDOM COEFFICIENTS

TEST	DF	VALUE	PROB
Breusch-Pagan test	1	0.06225076	0.8029732
Koenker-Bassett test	1	0.06828695	0.7938475

SPECIFICATION ROBUST TEST

TEST	DF	VALUE	PROB
White	2	1.264694	0.5313433

DIAGNOSTICS FOR SPATIAL DEPENDENCE
FOR WEIGHT MATRIX : **x500.GWT** (row-standardized weights)

TEST	MI/DF	VALUE	PROB
Moran's I (error)	0.119982	N/A	N/A
Lagrange Multiplier (lag)	1	2.5870942	0.1077378
Robust LM (lag)	1	17.2595037	0.0000326
Lagrange Multiplier (error)	1	14.2486407	0.0001602
Robust LM (error)	1	28.9210501	0.0000001
Lagrange Multiplier (SARMA)	2	31.5081443	0.0000001

Table 5.10: Spatial Lag Model for neighbors within 500 km.

REGRESSION
SUMMARY OF OUTPUT: SPATIAL LAG MODEL - MAXIMUM LIKELIHOOD ESTIMATION
Spatial Weight : **x500.GWT**

Dependent Variable	: **PRODEMP$_{tot}$**	Number of Observations:	67
Mean dependent var	: 0.0062063	Number of Variables :	3
S.D. dependent var	: 0.017482	Degrees of Freedom :	64
Lag coeff. (Rho)	: 0.60831		
R-squared	: 0.138393	Log likelihood :	180.409
Sq. Correlation	: -	Akaike info criterion :	-354.818
Sigma-square	: 0.000263324	Schwarz criterion :	-348.204
S.E of regression	: 0.0162273		

Variable	Coefficient	Std.Error	z-value	Probability
W_PRODEMP$_{tot}$	0.60831	0.1921642	3.165575	0.0015479
CONSTANT	0.1747809	0.05787681	3.019878	0.0025289
INITGDP$_{tot}$	-0.01173559	0.003910716	-3.00088	0.0026921

REGRESSION DIAGNOSTICS
DIAGNOSTICS FOR HETEROSKEDASTICITY
RANDOM COEFFICIENTS

TEST	DF	VALUE	PROB
Breusch-Pagan test	1	0.2423545	0.6225107

DIAGNOSTICS FOR SPATIAL DEPENDENCE
SPATIAL LAG DEPENDENCE FOR WEIGHT MATRIX : **x500.GWT**

TEST	DF	VALUE	PROB
Likelihood Ratio Test	1	2.747995	0.0973765

Table 5.11: Spatial Error Model for neighbors within 500 km.

REGRESSION
SUMMARY OF OUTPUT: SPATIAL ERROR MODEL - MAXIMUM LIKELIHOOD ESTIMATION
Spatial Weight : **x500.GWT**

Dependent Variable	: **PRODEMP$_{tot}$**	Number of Observations:	67
Mean dependent var	: 0.006206	Number of Variables :	2
S.D. dependent var	: 0.017482	Degree of Freedom :	65
Lag coeff. (Lambda)	: 0.808610		
R-squared	: 0.259535	R-squared (BUSE) :	-
Sq. Correlation	: -	Log likelihood :	184.635843
Sigma-square	: 0.000226	Akaike info criterion :	-365.272
S.E of regression	: 0.0150433	Schwarz criterion :	-360.862301

Variable	Coefficient	Std.Error	z-value	Probability
CONSTANT	0.2998592	0.06106012	4.910884	0.0000009
INITGDP$_{tot}$	-0.0199923	0.004119165	-4.853483	0.0000012
LAMBDA	0.8086095	0.1198387	6.747484	0.0000000

REGRESSION DIAGNOSTICS
DIAGNOSTICS FOR HETEROSKEDASTICITY
RANDOM COEFFICIENTS

TEST	DF	VALUE	PROB
Breusch-Pagan test	1	1.541108	0.2144530

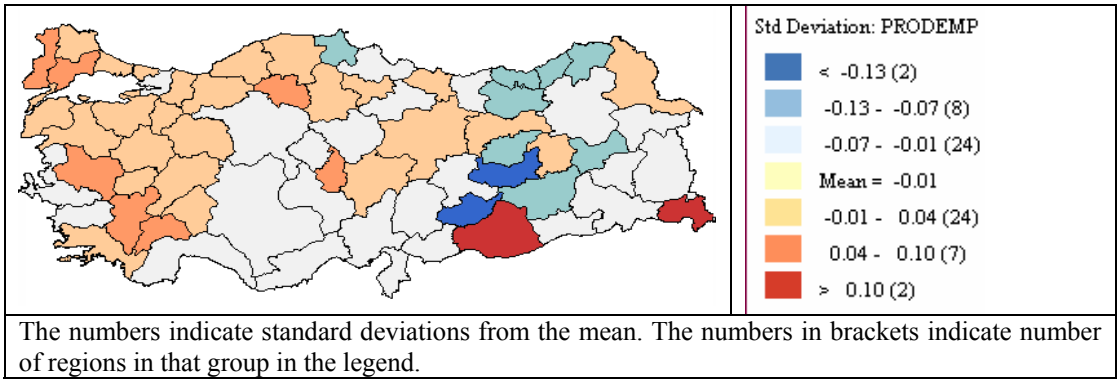
DIAGNOSTICS FOR SPATIAL DEPENDENCE
SPATIAL ERROR DEPENDENCE FOR WEIGHT MATRIX : **x500.GWT**

TEST	DF	VALUE	PROB
Likelihood Ratio Test	1	11.20176	0.0008172

5.4.1.2 Unconditional Beta Convergence in Manufacturing and Related Industries

An initial look at the regional productivity growth rates in manufacturing and other industries provides that productivity growth is mostly clustered in the West, but there are also regions where productivity growth sharply increased in the Southeastern Anatolia (the province of Şanlıurfa) and Eastern Anatolia (Hakkari). Though, the growth in Hakkari may be misleading, as Hakkari's workforce in manufacturing was only 5,363 although it was almost 10 folded. On the other hand, the spectacular growth in Şanlıurfa may be attributed to the GAP project and development of resource based industries. Of 67 regions, 43 regions experienced declining productivity rather than growth. Istanbul, İzmir, Ankara, Kocaeli, Bursa and Adana all experienced declining productivity rates.

The unconditional model suggests that there is convergence in manufacturing productivity rates (table 5.12). The annual rate of convergence is 1.84%. However the model suffers from heteroskedasticity. The reason for heteroskedasticity could be due to differences in size of manufacturing industries in regions, or, due to existence of different spatial regimes in different parts of the country. Studies on other countries have shown agglomeration of manufacturing industries in certain locations in emerging countries, as mentioned in section 2.3. The changing spatial structures of manufacturing in Turkey was discussed in section 2.4 and employment growth in Turkey was discussed in section 4. Therefore, rather than doing a WLS estimation for the whole country, the spatial regime is further investigated.



The numbers indicate standard deviations from the mean. The numbers in brackets indicate number of regions in that group in the legend.

Figure 5.8 : Distribution of average annual regional labor productivity growth levels in manufacturing and related industries, NUTS III regions.

Table 5.12: Unconditional beta convergence in Turkey, productivity growth in manufacturing and other industries, OLS estimation.

Dependent Variable: $PRODEMP_{man}$
Method: Least Squares
Sample: 1 67
Included observations: 67

	Coefficient	Std. Error	t-Statistic	Prob.
C	0.279730	0.092401	3.027338	0.0035
$INITGDP_{man}$	-0.020200	0.006363	-3.174510	0.0023

R-squared	0.134228	Mean dependent var	-0.012851
Adjusted R-squared	0.120909	S.D. dependent var	0.057561
S.E. of regression	0.053969	Akaike info criterion	-2.971401
Sum squared resid	0.189326	Schwarz criterion	-2.905589
Log likelihood	101.5419	Hannan-Quinn criter.	-2.945359
F-statistic	10.07752	Durbin-Watson stat	2.411372
Prob(F-statistic)	0.002294		

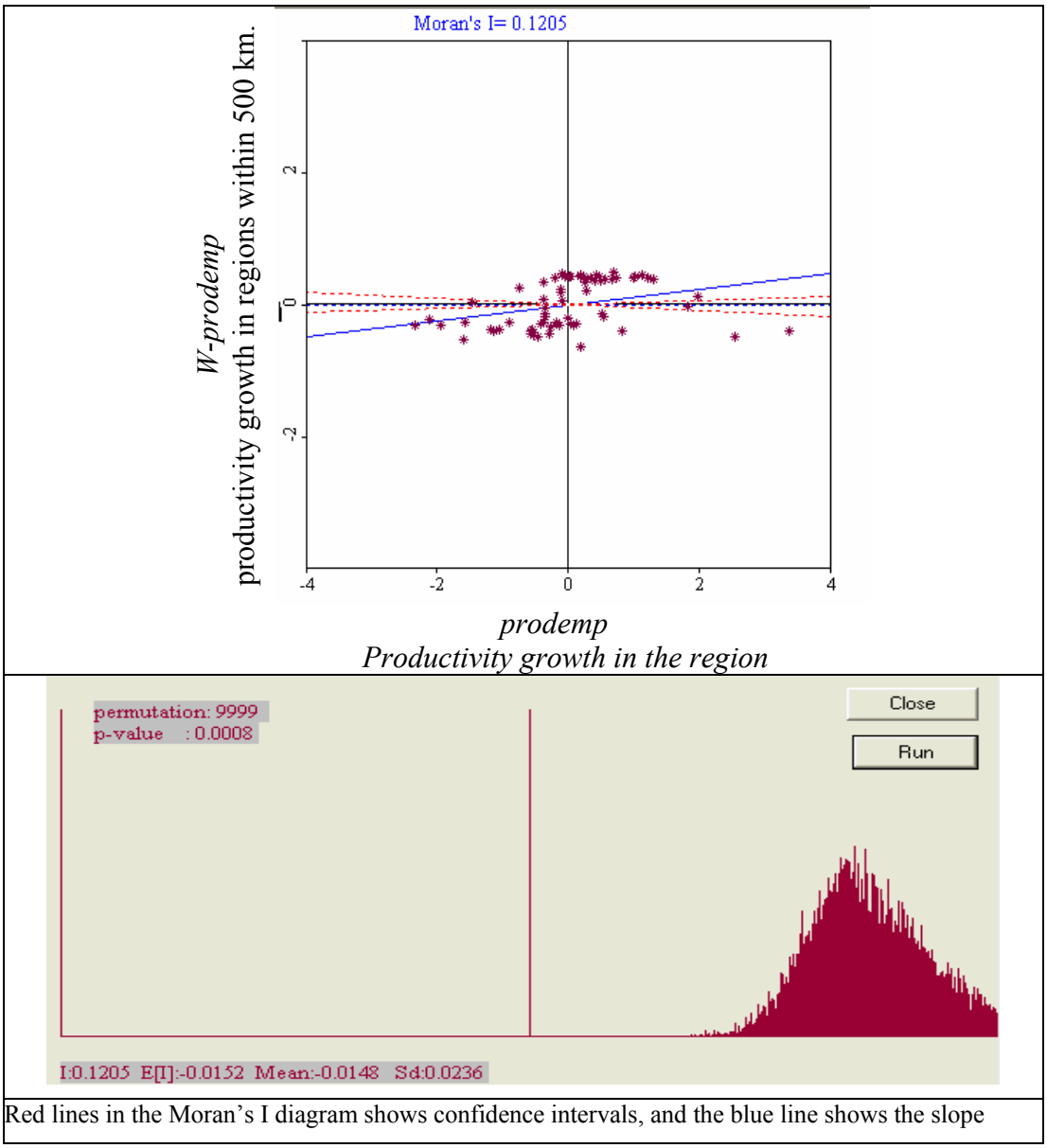
Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	5.156289	Prob. F(1,65)	0.0265
Obs*R-squared	4.924310	Prob. Chi-Square(1)	0.0265
Scaled explained SS	5.237146	Prob. Chi-Square(1)	0.0221

Heteroskedasticity Test: White

F-statistic	5.663534	Prob. F(2,64)	0.0054
Obs*R-squared	10.07491	Prob. Chi-Square(2)	0.0065
Scaled explained SS	10.71496	Prob. Chi-Square(2)	0.0047

Heteroskedasticity problem is thought to exist because of large differences in the sizes of the observations. In this case, it could be due to rapid growth of manufacturing productivity in some agrarian regions and accompanying stagnancy or even decline in other agrarian regions. In other words, there is a possibility that not all initially less productive regions have improved their productivity levels. Vice versa, it is also possible that not all initially more productive regions have slower productivity growth rates. Another probability is that there could be some spatial effects. If only agrarian regions nearby developed Western metropolitan areas experienced increasing productivity rates in manufacturing, but other regions in the East experienced different developments, its outcome would be heteroskedasticity.



Red lines in the Moran's I diagram shows confidence intervals, and the blue line shows the slope

Figure 5.9 : Moran's I Diagram and significance results for productivity growth in manufacturing for neighbor regions within 500 km.

An ESDA analysis run in GeoDA v.0.95 shows that there is significant spatial autocorrelation on the dependent variable $prodemp_{man}$ when neighbors within 500 km is considered. The results were slightly insignificant for first order neighbors, so are not reported in here. The Moran's I value is 0.12 and is highly significant after running 9,999 permutations (figure 5.9). The regions which are surrounded by regions with higher productivity growth rates also had high growth rates, pointing to the importance of spatial spillovers. Interpretation of these results is a bit ambitious, since most of the regions had declining productivity rates. It may be concluded that despite falling productivity rates in the aggregate manufacturing industries, most of the Western regions stayed above the average. In the section 4 it was discussed that

absolute employment growth in manufacturing industries were highly clustered in and around metropolitan regions. Both labor intensive and capital intensive labor could be growing in these regions, keeping average growth rates still above the average despite they are negative.

A further assessment of spatial autocorrelation is held by applying a local indicators of spatial autocorrelation analysis (LISA). It is used to evaluate statistically whether if regions are surrounded with other regions with similar or different values or not. It has 4 categories: High-High, High-Low, Low-High, and Low-Low. As an example, if a region is in High-High category in this case it means it has relatively higher productivity growth than other regions and is surrounded by regions which also have higher than average growth rates. Details about the LISA analysis are given in the appendix (A.2). LISA analysis shows that regions with high productivity growth are surrounded by regions with similar values (Figure 5.10), and there is only 0.1% probability that this is due to chance (Figure 5.11). One striking point is that there is clearly different spatial regimes existent in the Western and Eastern halves of the country. Therefore, the unconditional beta convergence is run to test for the Eastern and Western parts of the country.

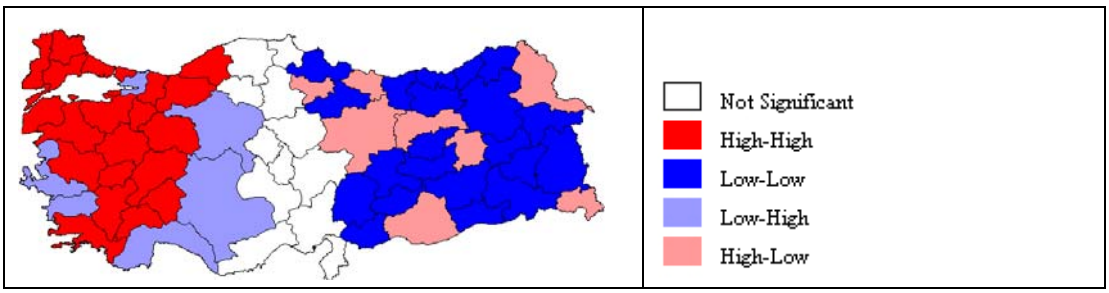


Figure 5.10 : LISA Cluster Map on productivity growth in manufacturing – neighbors within 500 km.

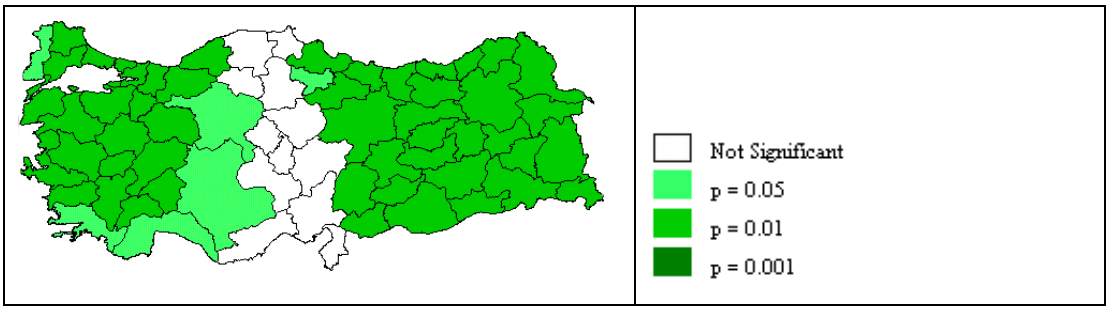


Figure 5.11 : LISA Significance Map on productivity growth in manufacturing – neighbors within 500 km.

When Southeastern Anatolian, Eastern Anatolian and Middle and East Black Sea Regions are excluded and the analysis is re-run for this Western Part, there is no more heteroskedasticity problem (table 5.13). But when it is run for the Eastern Part, there is still some small heteroskedasticity problems (table 5.14). Most of the problem arises due to sensitiveness of the growth rates in especially small regions like Hakkari. Only 4 regions out of 28 experienced growth in the Eastern Part of the country, while 20 regions out of 39 experienced growth in the West. In figure 5.5, it was shown that 33 regions experienced growth rates above the average which was -0.01, and most of these regions were in the West. The explanatory power of the model for the East is (R^2 0.37) , stronger than that for the West (R^2=0.13) (Table 5.13 and 5.12 respectively).

Table 5.13: Western Turkey – unconditional beta convergence in Turkey, productivity growth in manufacturing and other industries, OLS Estimation

Dependent Variable: $PRODEMP_{man}$
Method: Least Squares
Sample: 1 39
Included observations: 39

	Coefficient	Std. Error	t-Statistic	Prob.
C	0.281677	0.118086	2.385362	0.0223
$INITGDP_{man}$	-0.018873	0.007988	-2.362615	0.0235

R-squared	0.131087	Mean dependent var	0.003054
Adjusted R-squared	0.107603	S.D. dependent var	0.040061
S.E. of regression	0.037844	Akaike info criterion	-3.660771
Sum squared resid	0.052990	Schwarz criterion	-3.575461
Log likelihood	73.38504	Hannan-Quinn criter.	-3.630163
F-statistic	5.581948	Durbin-Watson stat	2.037618
Prob(F-statistic)	0.023516		

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.363115	Prob. F(1,37)	0.2505
Obs*R-squared	1.385745	Prob. Chi-Square(1)	0.2391
Scaled explained SS	1.472457	Prob. Chi-Square(1)	0.2250

Heteroskedasticity Test: White

F-statistic	0.663173	Prob. F(2,36)	0.5214
Obs*R-squared	1.385817	Prob. Chi-Square(2)	0.5001
Scaled explained SS	1.472534	Prob. Chi-Square(2)	0.4789

The picture for the West is more about regional integration and growth of productivity through diffusion of technology while for the East it is more like a

pattern where there are poles of productivity growth. This is probably mostly due to development of resource based industries in the Southeastern Anatolia, Eastern Anatolia and the Middle and Eastern Black Sea Regions. Provinces like Şanlıurfa and Rize are some examples for such developments. Western provinces do accommodate a variety of other industries, on the other hand, which are not completely natural resources oriented, but dependent on intermediate products and imported inputs. Many of the so-called footloose industries like automobile assembly plants, textiles and wearing apparel, machinery and similar industries are located in the Western Half. Despite the drops in productivity in metropolitan provinces in the West, they are still far more productive than many other provinces, and are large centers of manufacturing. While on the East, although employment increases in all provinces, productivity drops except few cases.

Table 5.14: Eastern Turkey – unconditional beta convergence in Turkey, productivity growth in manufacturing and other industries, OLS estimation.

Dependent Variable: $PRODEMP_{man}$
Method: Least Squares
Sample: 1 28
Included observations: 28

	Coefficient	Std. Error	t-Statistic	Prob.
C	0.446768	0.124305	3.594127	0.0013
$INITGDP_{man}$	-0.034178	0.008785	-3.890411	0.0006

R-squared	0.367939	Mean dependent var	-0.035004
Adjusted R-squared	0.343629	S.D. dependent var	0.070471
S.E. of regression	0.057093	Akaike info criterion	-2.819506
Sum squared resid	0.084751	Schwarz criterion	-2.724349
Log likelihood	41.47309	Hannan-Quinn criter.	-2.790416
F-statistic	15.13529	Durbin-Watson stat	2.812113
Prob(F-statistic)	0.000622		

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	4.536804	Prob. F(1,26)	0.0428
Obs*R-squared	4.159915	Prob. Chi-Square(1)	0.0414
Scaled explained SS	6.518655	Prob. Chi-Square(1)	0.0107

Heteroskedasticity Test: White

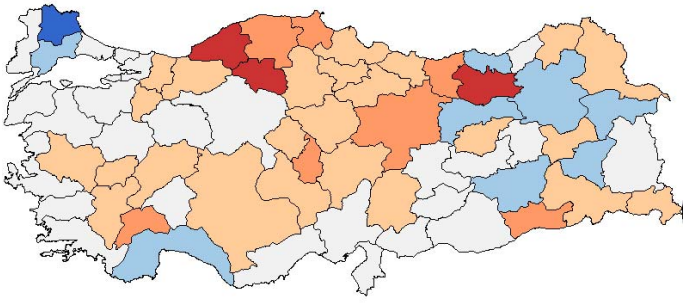
F-statistic	2.186332	Prob. F(2,25)	0.1333
Obs*R-squared	4.168317	Prob. Chi-Square(2)	0.1244
Scaled explained SS	6.531821	Prob. Chi-Square(2)	0.0382

5.4.1.3 Unconditional beta convergence in services

Services have grown rapidly in terms of employment and GDP in Turkey, during the 1990'es. Rapid urbanization, transformation to flexible production systems, changing lifestyles all contributed to this change. Growth of producer services and financial services are strongly clustered, as discussed in the 2nd. chapter. However, it was not possible to evaluate growth of productivity and convergence in sub-sectors due to both data limitations and the nature of its growth pattern. Since producer services cluster in very small and few areas, it is obvious that it is neither easy nor necessary to statistically assess differences in productivity levels. Producer services rather may act as a catalyser for diffusion of technology and increasing productivity rates in other sectors. Rather, an assessment of overall productivity in services sectors could be more useful to understand differences in per capita productivity and, in turn income levels of regions. Another problem is that average productivity rates fell most in services during 1990-2000 (table 5.2)

In this part same data set is used as in assessing sigma convergence in services above.

In figure (5.12), it is seen that productivity in the most developed and productive regions in the West fell. It seems as if productivity growth is diffusing from West to East, in the non metropolitan regions.



The numbers indicate standard deviations from the mean. The numbers in brackets indicate number of regions in that group in the legend.

Figure 5.12 : Distribution of average annual regional labor productivity growth levels in all services, NUTS III regions

To assess unconditional beta convergence in services sector, an OLS estimation is run in EViews6 (table 5.15). In line with sigma convergence results of CV given in the above sections, there is no significant relationship between initial productivity

levels and productivity growth. Therefore it can not be concluded that there is convergence. However, the WCV in the above sections showed that when size effects are taken into account, there is convergence in productivity rates in services (table 5.2).To assess the importance of size effects, a WLS model is run by using services employment in year 2000 as weights (Table 5.16). This time, convergence is found, and the model is highly significant.

Table 5.15: Unconditional beta convergence in Turkey, productivity growth in services, OLS estimation.

Dependent Variable: $PRODEMP_{ser}$
Method: Least Squares
Sample: 1 67
Included observations: 67

	Coefficient	Std. Error	t-Statistic	Prob.
C	0.130997	0.075987	1.723951	0.0895
$INITGDP_{ser}$	-0.008859	0.004810	-1.841638	0.0701

R-squared	0.049591	Mean dependent var	-0.008902
Adjusted R-squared	0.034970	S.D. dependent var	0.015187
S.E. of regression	0.014919	Akaike info criterion	-5.542997
Sum squared resid	0.014467	Schwarz criterion	-5.477185
Log likelihood	187.6904	Hannan-Quinn criter.	-5.516955
F-statistic	3.391631	Durbin-Watson stat	1.787026
Prob(F-statistic)	0.070091		

Table 5.16: Unconditional beta convergence in Turkey, productivity growth in services, WLS estimation

Dependent Variable: $PRODEMP_{ser}$
Method: Least Squares
Sample: 1 67
Included observations: 67
Weighting series: SER2000

	Coefficient	Std. Error	t-Statistic	Prob.
C	0.389326	0.118817	3.276683	0.0017
$INITGDP_{ser}$	-0.025414	0.007388	-3.439896	0.0010

Weighted Statistics

R-squared	0.154008	Mean dependent var	-0.015035
Adjusted R-squared	0.140993	S.D. dependent var	0.045520
S.E. of regression	0.011832	Akaike info criterion	-6.006629
Sum squared resid	0.009100	Schwarz criterion	-5.940817
Log likelihood	203.2221	Hannan-Quinn criter.	-5.980587
F-statistic	11.83288	Durbin-Watson stat	2.309092
Prob(F-statistic)	0.001021		

Despite the results of the WLS model, the pattern of productivity growth points to potential presence of spatial autocorrelation. Since the pattern of productivity growth seems to be clustered, an ESDA is run to assess spatial dependencies. Not surprisingly, Moran's I was 0.05 for neighbor provinces within 500km, and 0.25 for first order neighbors, and is highly significant (figure 5.13). A LISA analysis is executed to find significant clusters of growth.

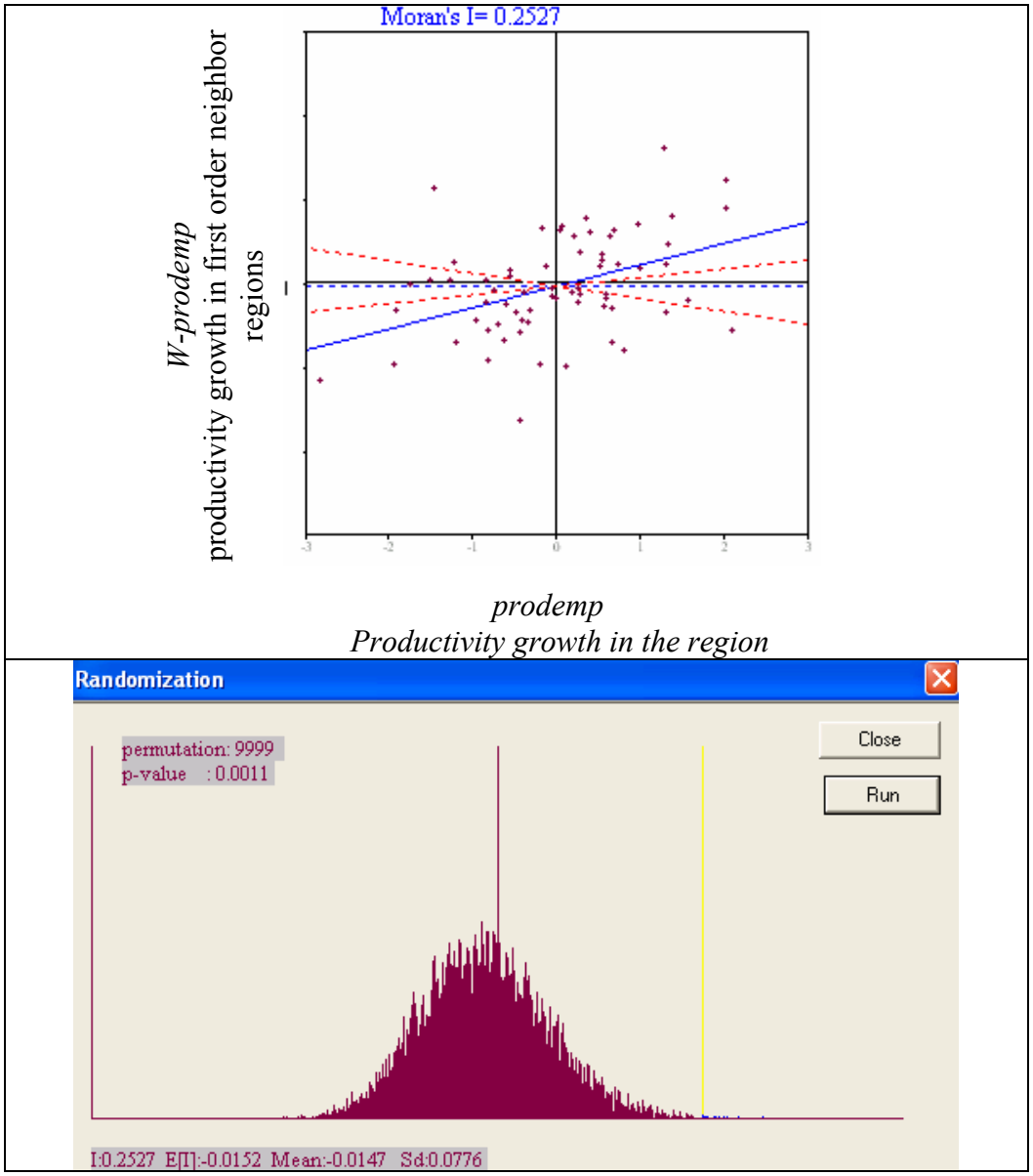


Figure 5.13 : Moran's I Diagram and significance of spatial autocorrelation between productivity growth in services for first order neighbor regions and the productivity growth rate in services of a region.

The LISA results are given in figures (5.14) and (5.15). Despite the clustered pattern in the distribution of productivity, the pattern of significant clusters is different. Istanbul and provinces on the West of Istanbul experienced lower productivity

growth in services during 1990-2000. Provinces on the North of Ankara, those in the Western Black Sea Region experienced high lewels of growth in productivity in services.

In order to take into account the spatial dependencies, a spatial diagnostics test is run in GeoDA v.0.95 for the unconditional beta convergence OLS model. Unlike in the previous section where productivity growth is assessed, here the data set is not divided because there is not evidence of a clear divide between East and West. Thus, all 67 regions are taken into consideration.

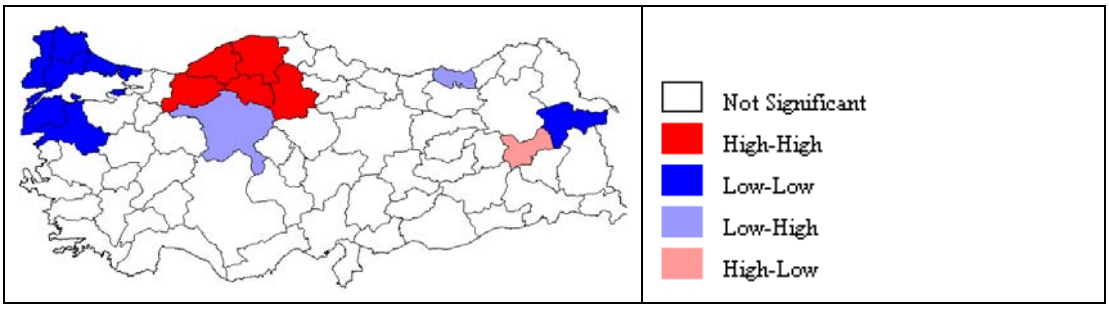


Figure 5.14 : LISA Cluster Map on spatial autocorrelation between productivity growth in services for first order neighbor regions and productivity growth rate in services of a region.

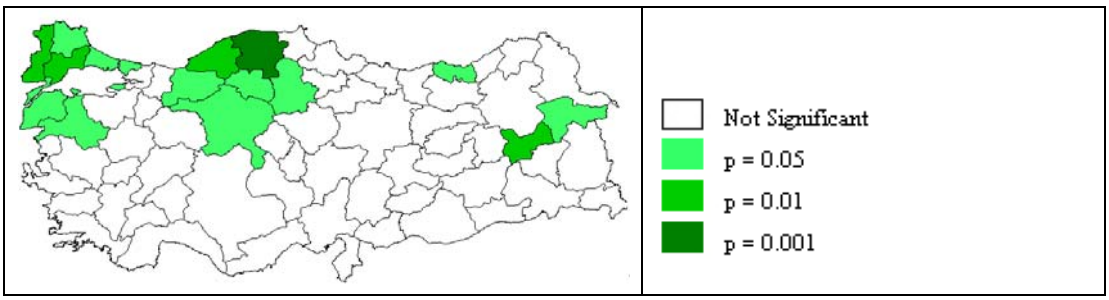


Figure 5.15 : LISA Significance Map on spatial autocorrelation between productivity growth in services for first order neighbor regions and productivity growth rate in services of a region.

The spatial diagnostics results in table (5.17) suggest the use of a SARMA model. However, most of the problem seems to be due to spatial error term. Thus, a spatial error model is run. The results are given in table (5.18).

The likelihood ratio test shows that the model is valid. The R^2 of the maximum likelihood model is 0.25, and AIC and Schwarz Criterion improved slightly. The convergence rate is higher as indicated by the coefficient of the variable $initgdp_{ser}$. The coefficient of lambda is also highly significant, pointing to potential importance of ommited and spatially autocorrelated variables.

Finally results suggest that both size of services employment and ommited and spatially autocorrelated variables could be important in the assessment of convergence in productivity in services. When CV and pure OLS results are considered, there is no convergence in productivity levels across provinces.

Development of manufacturing industries and producer services in large macro regions is likely an interactive process, and that is why East Turkey experiences a different pattern in productivity growth in urban sectors.

Table 5.17: Spatial Diagnostics for the unconditional beta convergence model for first order neighbor regions.

REGRESSION
SUMMARY OF OUTPUT: ORDINARY LEAST SQUARES ESTIMATION

Dependent Variable	**$PRODEMP_{ser}$**	Number of Observations:	67
Mean dependent var	-0.00890239	Number of Variables :	2
S.D. dependent var	0.0150729	Degrees of Freedom :	65
R-squared	0.049591	F-statistic :	3.39164
Adjusted R-squared	0.034970	Prob(F-statistic) :	0.0700911
Sum squared residual	0.0144671	Log likelihood :	187.69
Sigma-square	0.00022257	Akaike info criterion :	-371.381
S.E. of regression	0.0149188	Schwarz criterion :	-366.971
Sigma-square ML	0.000215927		
S.E of regression ML	0.0146944		

Variable	Coefficient	Std.Error	t-Statistic	Probability
CONSTANT	0.1309978	0.07598687	1.723953	0.0894698
$INITGDP_{ser}$	-0.008859119	0.004810453	-1.84164	0.0700911

REGRESSION DIAGNOSTICS
MULTICOLLINEARITY CONDITION NUMBER 83.36999
(Extreme Multicollinearity)

TEST ON NORMALITY OF ERRORS

TEST	DF	VALUE	PROB
Jarque-Bera	2	0.7916052	0.6731396

DIAGNOSTICS FOR HETEROSKEDASTICITY
RANDOM COEFFICIENTS

TEST	DF	VALUE	PROB
Breusch-Pagan test	1	0.5522134	0.4574147
Koenker-Bassett test	1	0.5599543	0.4542787

SPECIFICATION ROBUST TEST

TEST	DF	VALUE	PROB
White	2	1.812859	0.4039640

DIAGNOSTICS FOR SPATIAL DEPENDENCE
FOR WEIGHT MATRIX : **w1modifiye.GAL** (row-standardized weights)

TEST	**MI/DF**	**VALUE**	**PROB**
Moran's I (error)	0.298984	N/A	N/A
Lagrange Multiplier (lag)	1	11.3266460	0.0007640
Robust LM (lag)	1	2.8287206	0.0925921
Lagrange Multiplier (error)	1	13.7532398	0.0002085
Robust LM (error)	1	5.2553144	0.0218799
Lagrange Multiplier (SARMA)	2	16.5819604	0.0002508

========== END OF REPORT ==========

Table 5.18: Spatial Error Model for first order neighbors.

REGRESSION
SUMMARY OF OUTPUT: SPATIAL ERROR MODEL - MAXIMUM LIKELIHOOD ESTIMATION
Spatial Weight : **w1modifiye.GAL**

Dependent Variable	: **PRODEMP**$_{ser}$	Number of Observations:	67
Mean dependent var	: -0.008902	Number of Variables :	2
S.D. dependent var	: 0.015073	Degree of Freedom :	65
Lag coeff. (Lambda)	: 0.509501		
R-squared	: 0.250784	R-squared (BUSE)	: -
Sq. Correlation	: -	Log likelihood	: 193.515760
Sigma-square	: 0.000170	Akaike info criterion	: -383.032
S.E of regression	: 0.0130467	Schwarz criterion	: -378.622134

Variable	Coefficient	Std.Error	z-value	Probability
CONSTANT	0.2192191	0.08101091	2.706045	0.0068091
INITGDP$_{ser}$	-0.01441026	0.00513061	-2.808684	0.0049746
LAMBDA	0.5095009	0.1310181	3.888782	0.0001008

REGRESSION DIAGNOSTICS
DIAGNOSTICS FOR HETEROSKEDASTICITY
RANDOM COEFFICIENTS

TEST	**DF**	**VALUE**	**PROB**
Breusch-Pagan test	1	0.8864613	0.3464381

DIAGNOSTICS FOR SPATIAL DEPENDENCE
SPATIAL ERROR DEPENDENCE FOR WEIGHT MATRIX : **w1modifiye.GAL**

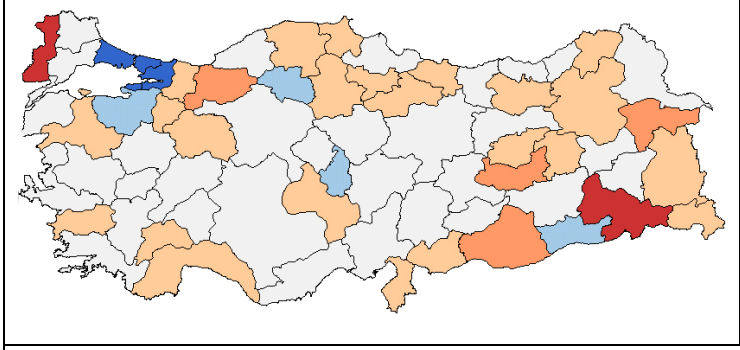
TEST	**DF**	**VALUE**	**PROB**
Likelihood Ratio Test	1	11.65093	0.0006417

========================= END OF REPORT ==============================

5.4.1.4 Unconditional beta convergence in agriculture

The same data is used for assessing productivity growth in agriculture, as used in the sigma convergence analysis above.

The agricultural sector was and is still highly productive in Western half of Turkey. However, all metropolian regions (except Antalya) in the West experienced decreasing productivity per capita in agriculture during 1990-2000. The sharpest decline in agricultural productivity is clustered in and around Istanbul (figure 5.16), where the largest manufacturing industry cluster is located. The pattern is like a patch-work, where there are clusters of mild productivity growth. Sharp growth is experienced in Edirne, probably due to irrigation works, and in Şanlıurfa and Siirt, where GAP project provided large scale infrastructure for irrigation, power and transportation. The mean rate of growth across regions is 0, where 29 out of 67 regions experienced growth (figure 5.16). If workforce is considered, the average productivity growth was 2.97% per annum (table 5.2).



The numbers indicate standard deviations from the mean. The numbers in brackets indicate number of regions in that group in the legend.

Figure 5.16 : Distribution of average annual regional labor productivity growth levels in agriculture, NUTS III regions.

The gap in agricultural productivity rates across regions increased slightly according to CV and decreased according to WCV (table .5.2). The Black Sea Region is where inequality increased both in terms of CV and WCV. The Eastern Anatolia Region experienced highest inequalities, but it decreased both in terms of CV and WCV. On the other hand, Marmara Region experienced a sharp increase in CV and slight increase in WCV.

To asses the speed of convergence, an unconditional beta convergence model is run. The results are presented in table (5.19). The coefficient of the variable $initgdp_{agr}$ is highly significant and negative, indicating presence of beta convergence. The speed of convergence is about 2.4% annually, where it implies that 29 years are necessary to eliminate half of inequalities. This is the fastest speed of convergence across other sectors.

The unconditional model does not suffer from heteroskedasticity problems. The distribution of the productivity growth in the map in figure (5.16) do not point to the presence of a general pattern of clustering, except that around Istanbul. Therefore, no spatial dependency problems are expected. A Moran's I test for spatial autocorrelation for first order neighbors and neighbors within 500 km. is run but no significant spatial autocorrelation is found. Therefore, the unconditional beta convergence model is not misspecified. It is not surprising since the role of spatial externalities should be only minor in the growth of productivity in agriculture.

Table 5.19: Unconditional beta convergence in Turkey, productivity growth in agriculture, OLS estimation.

Dependent Variable: $PRODEMP_{agr}$
Method: Least Squares
Sample: 1 67
Included observations: 67

	Coefficient	Std. Error	t-Statistic	Prob.
C	0.375351	0.108183	3.469584	0.0009
$INITGDP_{agr}$	-0.026892	0.007834	-3.432771	0.0010

R-squared	0.153469	Mean dependent var	0.004178
Adjusted R-squared	0.140445	S.D. dependent var	0.031015
S.E. of regression	0.028755	Akaike info criterion	-4.230614
Sum squared resid	0.053745	Schwarz criterion	-4.164803
Log likelihood	143.7256	Hannan-Quinn criter.	-4.204573
F-statistic	11.78392	Durbin-Watson stat	2.036766
Prob(F-statistic)	0.001044		

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.313931	Prob. F(1,65)	0.2559
Obs*R-squared	1.327525	Prob. Chi-Square(1)	0.2492
Scaled explained SS	2.754725	Prob. Chi-Square(1)	0.0970

Heteroskedasticity Test: White

F-statistic	1.291965	Prob. F(2,64)	0.2818
Obs*R-squared	2.600077	Prob. Chi-Square(2)	0.2725
Scaled explained SS	5.395377	Prob. Chi-Square(2)	0.0674

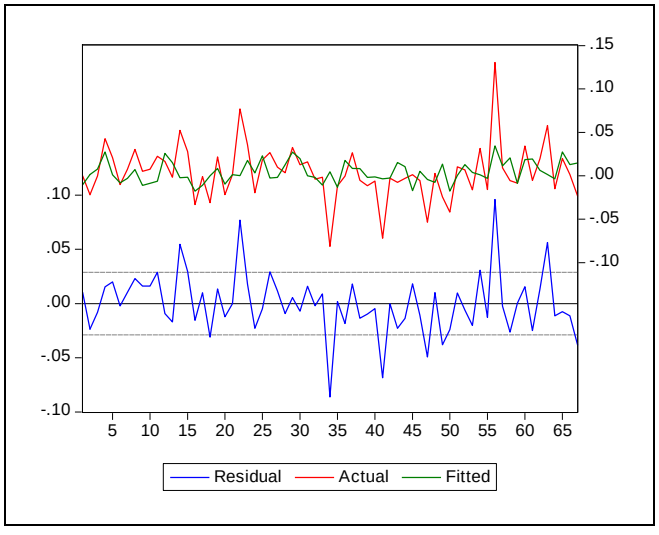


Figure 5.17 : Residuals of the unconditional beta convergence model (OLS).

5.4.1.5 Conclusions on unconditional beta convergence estimations

The role of large projects in changing the spatial structure of productivity in agriculture can not be neglected. Almost all of these projects are run according to state policy and target natural resources and underdeveloped regions. In the case of Turkey, rapid increases in productivity growth in initially less productive regions especially on the East plays a counter-acting role against agglomeration of industries and services on the West, promoting convergence in aggregate productivity levels.

Although unconditional beta convergence analyses point to convergence in the aggregate economic level, this picture is a different one than the neo-classical picture where convergence is automatically achieved within a free market mechanism. The role of government interventions and the role of geography can not be neglected in assessing the growth patterns of economic activities.

5.4.2 Conditional beta convergence in regional productivity in Turkey

In this final analysis, conditional beta convergence in total labor productivity in Turkey between 1990-2000 will be estimated. A cross-section approach will be used.

Previous analyses on sigma convergence in total productivity showed that inequalities have slightly decreased in Turkey during 1990-2000. Inequalities between geographic regions were also increasing, but the dynamics behind were not simple. While Western provinces experienced smaller drops in productivity in manufacturing, Eastern provinces experienced usually sharp drops, leading to increasing productivity differences in terms of manufacturing between geographic regions. Agricultural productivity was a counteracting force. It resembles of a picture where East is specializing in agriculture while West is specializing in manufacturing and other industries. Sharp productivity increases in agriculture helped in decreasing overall inequalities.

Not surprisingly, the unconditional beta convergence analysis on total productivity showed that there was beta convergence. In line with sigma convergence analysis, results showed that beta convergence was slow if only regional units are considered, and faster when size differences of working population is considered. The model explained only 8% of the variance, meaning that other conditions should be considered, and not all the initially poorer regions are growing faster. Following Le

Sage et al. (2007), the conditional beta model could include also other conditions which influence regional growth:

Spatial effects working through the dependent variable (productivity growth)

- Spatial effects working through the initial variable(s) (initial productivity levels).
- Spatial effects working through a set of conditioning variables (growth of human capital, etc).

The spatial error model given in table (5.8) suggested that spatially auto-correlated omitted variables or measurement errors could be important if first order neighbor regions are considered. The initial productivity level of neighbor regions, as an example, could be important in explaining productivity growth in a region. If this is so, the use of a cross-regressive model as in equation (3.9) given in section (3.2) may be suitable for a conditional beta convergence estimation. Another finding was that regions that are surrounded by fast growing regions within 500 km. are growing faster (table 5.10). This is likely because diffusion of knowledge is not very difficult in such a distance, due to daily trips made to other regions.

These two issues are not contradictory but rather complementary: Inequalities were established before the beginning of analysis. During integration to global economy, initially more productive, richer metropolitan regions with good proximity to international markets were more attractive for growth of economic sectors. The analysis of employment growth in the 4th section demonstrated this. The clustered growth of economic activities, especially manufacturing, also enables diffusion of technology and information, because it opens new channels and establishes new relations between regions. So, if inequalities were established before the study period, they were likely to be effective in the spatial pattern of growth: poorer regions near productive metropolitan regions with good access to international markets attract economic activities. Therefore, either a spatial lag model or a spatial cross-regressive model may be used for estimation of conditional beta convergence.

Therefore, three hypotheses could be tested:

- Hypothesis 1: Initially less productive (poorer) regions experience faster productivity growth

- Hypothesis 2: Regions surrounded by initially more productive (richer) regions experience faster growth.
- Hypothesis 3: Regions surrounded by regions with fast productivity growth also experience faster productivity growth rates, so catch up with more productive regions faster.

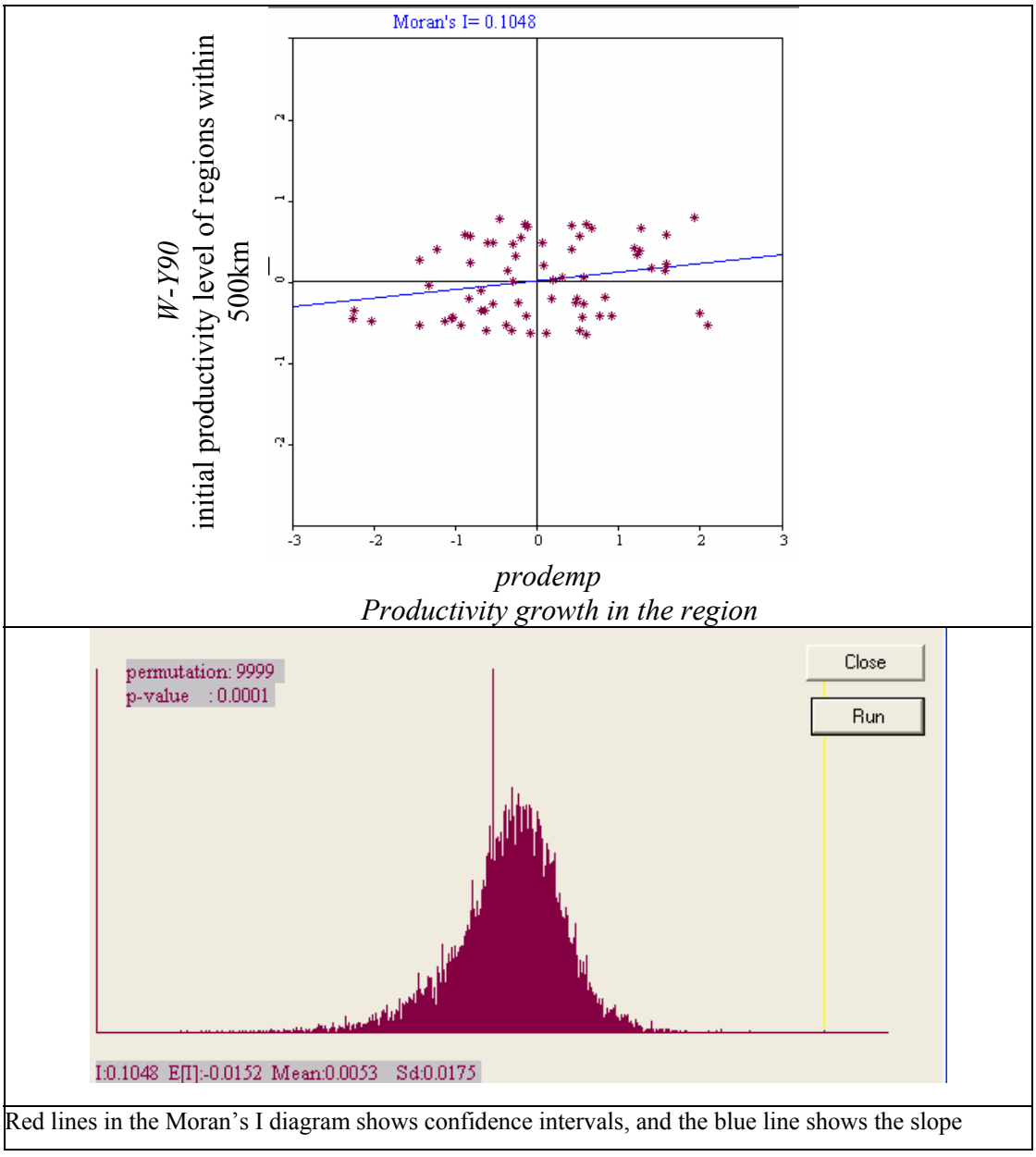
To test the first hypothesis, the initial per employee productivity level of regions will be used as an explanatory variable, as used in the unconditional beta convergence models above. This variable is called $initgdp_{tot}$. If the coefficient of this variable is negative, the hypothesis will be accepted. The calculation of this variable is was given in equation (5.4). Briefly it is the natural logarithm of the productivity per employee at year 1990, and is formally demonstrated as $ln(y_{it})$.

To test the second hypothesis, a new variable has to be defined and a spatial cross-regressive model has to be specified. This is the spatial lag of initial productivity levels of first order neighbor regions (equation 5.5).

$$lnW(y_{it}) \qquad \textbf{(5.5)}$$

Where W is the spatial weight matrix and it is row standardized. It includes information either on first order neighbor regions or neighbor regions within 500 km. A Moran's I test and a LISA was executed to statistically test if there is a significant relationship between the initial productivity level of a region and the dependent variable. Morans I test (figure 5.18) and LISA Analysis (figure 5.19 and 5.20) shows that there is significant spatial autocorrelation between the initial productivity levels and the productivity growth rates, indicating that hypothesis two may be valid.

The LISA cluster maps in figures 5.19 and 5.20 point to an interesting East-West differentiation of regional productivity growth in Turkey. While on the West the spatial structure represents growing peripheral areas around developed regions, in the East it seems that there were some growth poles developing, surrounded by poor regions. Therefore it is likely that regions in the East and West parts of the country were experiencing different episodes of development.



Red lines in the Moran's I diagram shows confidence intervals, and the blue line shows the slope

Figure 5.18 : Moran's I Diagram and significance for spatial autocorrelation between initial productivity levels of neighbor regions within 500 km. and the productivity growth rate of a region.

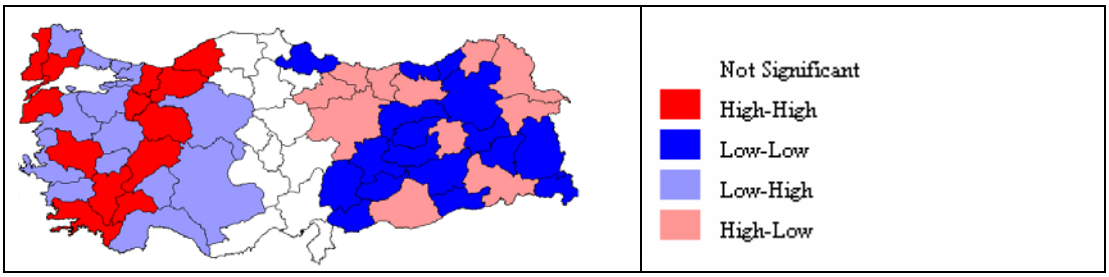


Figure 5.19 : LISA Cluster Map on spatial autocorrelation between initial productivity levels of neighbor regions within 500 km. and the productivity growth rate of a region.

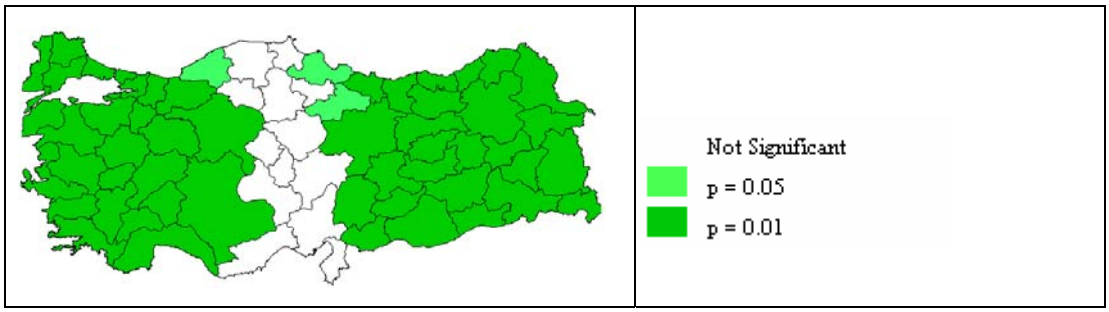


Figure 5.20 : LISA Significance spatial autocorrelation between initial productivity levels of neighbor regions within 500 km. and the productivity growth rate of a region.

If the coefficient of this variable is positive, hypothesis 2 will be accepted. To test this hypothesis, the model could be specified in a cross-regressive form similar to that in Lopez-Baso et al. (2004) in equation (3.9).

The third hypothesis is an alternative to hypothesis 2, because they represent similar issues. Another reason for this is because the way variables are calculated are similar, and if both of these hypotheses are tested in the same model, there could be significant problems of multicollinearity. To test this hypothesis, a spatial lag model has to be specified as in equation (3.6) . If the coefficient of this variable, ρ is positive, then it may be suggested that regions surrounded with fast growing regions also experience fast growth, and thus accept hypothesis 3.

Falcıoğlu (2008) found that average firm size and regional specialization did not have a significant impact on the growth of productivity per capita. As this section deals with aggregate productivity levels, it is hard to capture specialization effects. A region could be specialized in services but not in manufacturing, or it could be specialized in both. Therefore, specialization, or MAR effects, are not going to be added as a factor explaining total productivity growth.

NEG literature suggests that technology is not freely available everywhere. Knowledge spillovers play a key role in endogenous growth. On the other hand, there is a confusion about Jacobs externalities, which point to importance of diversity within a region for further growth. Often, these concepts are taken as separate things that have nothing in common. In reality, knowledge spillovers and innovations depend mostly on skilled employees, who personally involve in creation, dissemination and use of knowledge. Engineers, architects, technicians, statisticians designers, and other professionals play important roles in higher technology

industries, for acquisition, adoption, or development of technologies. They are also connected to each other through professional and social ties. Usually in the literature, percentage of students are taken as an indicator of human capital. However, there is no guarantee that these students will stay in that region and be more productive than others. Instead, number of scientific, technical and related professionals could be a better proxy of human capital. If there is a large amount of these kind of workers in a region, there is likely to be more diversity as well. They may be briefly called knowledge workers.

Some regions are distinguished as centers of innovation and culture. These are also regions which possess high concentrations of such knowledge workers. Most of the innovations are created in these regions. Thus, if a region may attract or raise such workforce, it is likely to benefit increasing productivity rates. In Turkey, although highest amount of scientific staff per capita were found in Ankara, Istanbul accommodated the largest number of such professionals. Furthermore, it has become the largest cluster for such professionals in the cross-border Balkan Region (Erkut and Baypınar, 2009). The growth of per capita number of scientific and technical professionals shows a clustered pattern, increasing mostly in the largest metropolitan areas. In this context, a fourth hypothesis may be tested:

- Hypothesis 4 : Regions with excessive knowledge workers experience higher productivity growth rates

To test the fourth hypothesis, a new variable is offered, which is not used in the empirical literature on Turkey before. This variable is named as *scientific*. The data comes from General Census of Population for 1990 and 2000. In this dataset, there is a group for scientific, technical and professional workers. This group includes engineers, economists, architects and planners, graphic designers, and artists. It is specified as in equation (5.6):

$$\text{Scientific} = G_{i\ \text{scientific}} - G_{\text{scientific}}$$

$$G_{i\ \text{scientific}} = (1/T)\ln(S_{i00}/S_{i90}) \qquad \textbf{(5.6)}$$

$$G_{\text{scientific}} = (1/T)\ln(S_{00}/S_{90})$$

Where $G_{i\ \text{scientific}}$ is the growth rate of scientific, technical and creative professionals per worker in region I, and $G_{\text{scientific}}$ is the growth rate for the whole country. S_{i00} is

the per capita scientific, technical professionals in year 2000 and S_{i90} for year 1990 in region i. S_{90} and S_{00} are the per capita numbers at the country level. So, this variable aims to measure the excessive growth in a region which distinguishes it as a creative center. If the coefficient of this variable will be positive, hypothesis 4 will be accepted.

The role of entrepreneurs in innovation are often mentioned in the NG. Following empirical literature, the role of entrepreneurs on productivity growth will be also assessed. It was seen that entrepreneurial activity was negatively associated with employment growth in section 4, but the results were not very conclusive. If this is not the case, in a market economy it may be expected that entrepreneurial activity is associated with productivity growth. Regions where share of entrepreneurs are increased are likely to be experiencing faster growth:

- Hypothesis 5: Growth of entrepreneurial activity is positively associated with labor productivity growth in a region.

To test this hypothesis, a new variable is offered, which is not before used in the empirical literature on Turkey, to the best of the knowledge of the author of this study. The variable measures the average annual growth rate of the share of entrepreneurs and administrators in total employed population during 1990-2000. The data source is again the respective population census and was used also in the 4th section. This variable is named as *ent* and calculated as in equation (5.7), where S_i is the share of entrepreneurs in total employed people in a region at a given year, $_t$ is the initial year and $_T$ is 10 years. If the coefficient of the variable *Ent* is positive, hypothesis 5 will be accepted.

$$Ent = (1/T) * \ln(S_{i(t+T)} / S_{i(t)}) \qquad \textbf{(5.7)}$$

S_i = number of entrepreneurs in year t / total number of employed people in year t

The role of foreign direct investments in diffusion of technology and business cultures, as well as introducing more flexible forms of production is well known. As employment growth is clustered in Turkey, so is foreign direct investments. Therefore, it is likely that productivity growth is higher where FDI concentration is higher. Rather than absolute concentration, the existence of large firms are thought to

be more important in bringing in technology and innovation. Another interpretation is that larger firms bring in more capital and thus embedded technology with them. Therefore, a variable is specified to incorporate effects of FDI in a region. This variable is the natural logarithm of the cumulative stock of FDI per company in a region. Unfortunately, FDI data is not publicly available at NUTS III level. Although there are some sources in the literature where data is classified in NUTS II regions, data demonstrated at Yavan and Kara's (2003) for 7 geographical regions is thought to be a more reliable form. They show the distribution of cumulative FDI stock at the year 2000 and the number of companies in which foreign direct investments were made for seven geographical regions. This variable is named as *fdiperco*. It is calculated as in equation (5.8). where FDI is the cumulative amount of FDI stock at the end year 2000, COMP is the number of companies at year 2000 and *i* is the usual subscript for regions.

$$fdiperco = \ln(FDI_{i,2000} / COMP_{i,2000}) \quad \textbf{(5.8)}$$

Thus, the 6th hypothesis is :

- Hypothesis 6: The higher the amount of FDI per company, the higher the productivity growth rate.

And therefore, if the coefficient of this variable will be positive, the hypothesis will be accepted.

Another factor that is thought to be influential on productivity growth is the growth of population. In the literature, this variable is thought to have a negative effect on the productivity growth rate, because it decreases the available public capital per capita. Rapid population growth, may lead to rapid deterioration of public infrastructure, increases in land prices and other negative effects like increasing crime rates and congestion. In Turkey, growth of population is clustered, just as growth of employment. Therefore, it may be expected that metropolitan regions and surrounding regions experienced negative effects on productivity levels due to rapid population growth. To measure effects of population growth, a variable named *avpopgr* is specified in equation (5.9). It is the average annual growth rate of total population of a region.

$$avpopgr = (1/T) * \ln(POP_{i,2000}/POP_{i,1990}) \quad \textbf{(5.9)}$$

In the equation (5.9) above, POP is the population at given year in the subscript and *i* is the usual subscript for regions.

Therefore, the last hypothesis is:

- Hypothesis 7: Higher rates of growth of population slows productivity growth rates.

This implies that the coefficient of the variable *avpopgr* should be negative.

In the empirical literature, initial agricultural employment level is often used as a proxy for initial structural differences between regions in a given country. As an example, Basile (2008) found that in the EU, in NUTS II level, initial agricultural employment levels had a negative effect on productivity growth. Similar results could be expected for Turkey. Even though, initial employment level in agriculture will not be used as a variable, because it has a strong correlation with initial gdp per capita levels, and because it is derived from population data, it may cause problems together with other variables which also use population data.

Another variable that could be influential on productivity growth is distance to the metropolitan cities, or to borders. Falcıoğlu (2008) used distance to nearest metropolitan center as a variable reflecting this issue. However, initial gdp per capita levels are correlated with distance to metropolitan areas. The effects of space is likely to be already captured by incorporating spatial cross-regressive or spatial lag models, and the variable on FDI already captures some of the space effects as a geographical categorical variable.

Capital investments are surely the most important factor in increasing labor productivity. Despite their importance, data on capital investments at NUTS III level have been only available by year 2003 in Turkey. Falcıoğlu (2008)used this data at NUTS I level and found that fixed capital investment per worker had a significant effect on the growth of productivity. Despite its importance, this variable will have to be omitted.

As the number of cases will be limited to 67 and there are already 6 (plus one) hypotheses to be tested, addition of other important variables are thought to be unsuitable for the method employed.

Two models can be specified to test these hypothesis. First model is to test hypotheses 1,2,4,5,6,7, and is specified as a spatial cross-regressive model. It may be stated briefly as in equation (5.10) and formally as in equation (5.11):

prodemp = c, initgdp$_{tot}$, spatial lag of per capita productivity$_{1990,}$ scientific, ent, fdiperco, avpopgr **(5.10)**

$$(1/T)*\ln(y_{it+T}/y_{it}) = c + \delta\ln(y_{it}) + \beta_2 W\ln(y_{it}) + \beta_4 scientific + \beta_5 ent + \beta_6\ln(fdicum/company) + \beta_7 avpopgr + u_{it+T} \quad \textbf{(5.11)}$$

Where c is the constant, δ is the coefficient for initgdptot ($\ln(y_{it})$), and $\beta_2, \beta_4, \beta_5, \beta_6, \beta_7$ are other coefficients associated with hypotheses 1,2,4,5,6,7. This model can be solved through an OLS estimation.

A second model may be specified if spatial dependence on the dependent variable, *prodemp* is detected. The model then may be re-specified as a spatial lag model. If spatial dependence on error term u is detected, then the model may be re-specified as a spatial error model. Details of these models were given in section (3.2). In this form, the model becomes a spatial Durbin model. The spatial lag model could be as in equation (5.12):

$$(1/T)*\ln(y_{it+T}/y_{it}) = c + \rho W((1/T)*\ln(y_{it+T}/y_{it})) + \delta\ln(y_{it}) + \beta_2 W\ln(y_{it}) + \beta_4 scientific + \beta_5 ent + \beta_6\ln(fdicum/company) + \beta_7 avpopgr + u_{it+T} \quad \textbf{(5.12)}$$

Where ρ is the coefficient for spatial lag effects. If it is positive, then it hypothesis 3 may be accepted, that growth rate of its neighbor regions effect the growth rate of a region. However, the results below suggested that use of a second model is not necessary. Therefore, only first model is estimated.

Before proceeding with the estimation, below an exploratory data analysis is presented. The dependent variable is normally distributed. The skewness is close to zero, kurtosis is less than 3, and Jarque – Bera statistic is not significant (figure 5.21).

In table (5.20) descriptive statistics are provided. The variables *scientific, fdiperco* and *avpopgr* are not normally distributed. Therefore some heteroskedasticity

problems can be expected. As *fdiperco* is a categorical variables for only 7 geographical regions, and as literature suggests concentration of large multinationals in certain regions in an emerging market economy, it is an expected issue that distribution of FDI per company is not normal.

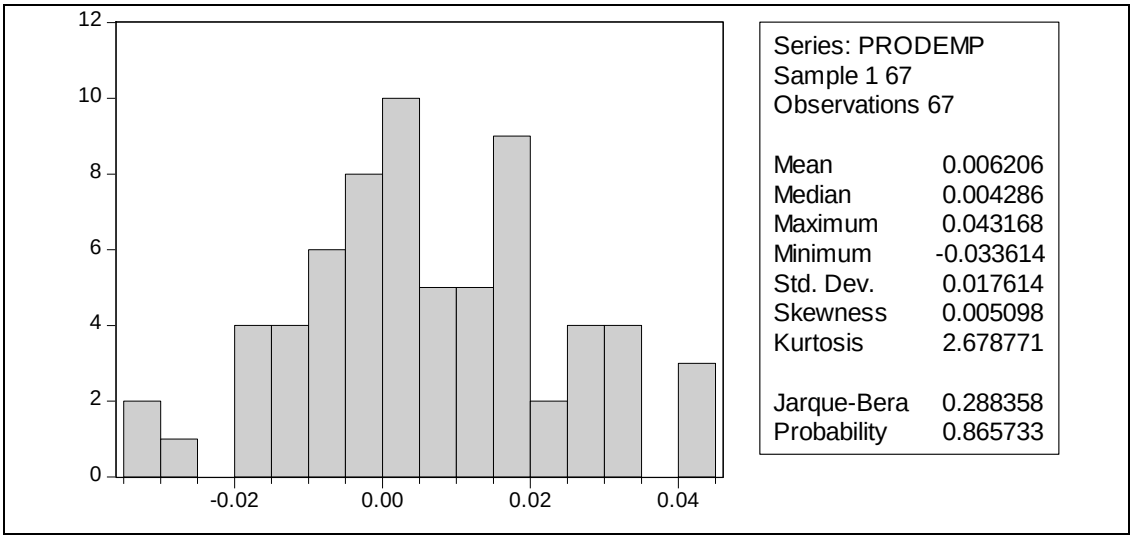


Figure 5.21 : Histogram and descriptive statistics for dependent variable *prodemp*.

Table 5.20: Descriptive statistics.

	INITGDP	SCIENTIFIC	ENT	FDIPERCO	AVPOPGR
Mean	14.6740	-0.0047	0.0115	12.3243	0.0120
Median	14.7162	-0.0059	0.0112	12.7060	0.0117
Maximum	16.1676	0.0319	0.0511	13.4707	0.04180
Minimum	13.4833	-0.0287	-0.0578	9.4250	-0.03559
Std. Dev.	0.5493	0.0110	0.0195	1.4277	0.01305
Skewness	-0.0340	0.5320	-0.5344	-1.3602	-0.6170
Kurtosis	2.9880	3.8689	4.0694	3.2689	4.6357
Jarque-Bera	0.0133	5.2686	6.3822	20.8604	11.7195
Probability	0.9934	0.0718	0.0411	0.0000	0.0029
Sum	983.1579	-0.3148	0.7737	825.7258	0.8019
Sum Sq. Dev.	19.9125	0.0080	0.0250	134.5237	0.0113
Observations	67	67	67	67	67

Table 5.21: Cross-correlations between explanatory variables.

	INITGDP	SCIENTIFIC	ENT	FDIPERCO	AVPOPGR
INITGDP	1.00				
SCIENTIFIC	0.11	1.00			
ENT	**-0.26**	**0.22**	1.00		
FDIPERCO	**0.52**	0.05	0.06	1.00	
AVPOPGR	**0.28**	0.04	**-0.35**	-0.03	1.00

In table (5.21) cross correlations between explanatory variables are presented. There is moderate correlation between the initial productivity levels and the FDI per company in geographic regions. Keeping in mind that *fdiperco* is a categorical variable, the result may be due to the fact that FDI prefers to locate to initially more developed regions. Historically, FDI was also concentrated in similar regions, and most of the industrial know-how diffused into the country via these gateway cities like Istanbul and İzmir. An explanation for Ankara is that as a capital it accommodated many economic activities of both public and private sector. The second highest correlation is between growth of share of entrepreneurs in the population and the growth of population. The relationship is negative, but this is probably due to heavy impact of decreasing number of entrepreneurs in Istanbul and Ankara. There could be a size effect that forces entrepreneurs to move out of large metropolitan cities. Or, entrepreneurs could be escaping these globalizing cities where FDI is concentrated and competition is tough. Other correlations are weaker, so are not discussed in here.

Below are the results of the estimation from the model 1, given in table (5.22).

Table 5.22: Conditional beta convergence – Model 1, OLS estimation.

Dependent Variable: PRODEMP
Method: Least Squares
Sample: 1 67
Included observations: 67

	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.084860	0.085535	-0.992115	0.3251
INITGDP	-0.020849	0.003538	-5.893058	0.0000
LNW5YIT	0.022888	0.006752	3.389835	0.0012
SCIENTIFIC	0.445048	0.132741	3.352749	0.0014
ENT	0.199368	0.081400	2.449233	0.0173
FDIPERCO	0.004896	0.001268	3.860806	0.0003
AVPOPGR	-0.168843	0.117516	-1.436772	0.1560

R-squared	0.633228	Mean dependent var	0.006206
Adjusted R-squared	0.596550	S.D. dependent var	0.017614
S.E. of regression	0.011188	Akaike info criterion	-6.049344
Sum squared resid	0.007510	Schwarz criterion	-5.819003
Log likelihood	209.6530	Hannan-Quinn criter.	-5.958198
F-statistic	17.26487	Durbin-Watson stat	2.358959
Prob(F-statistic)	0.000000		

The F statistic provides that the model fit is not due to chance. Except avpopgr, all the variables' coefficients are significant and have the expected signs. The coefficient of the avpopgr is negative, as expected, but it is not significant. Therefore, it may be concluded that population growth may have a negative effect on growth in productivity in general, but for some few regions it could have a positive effect on growth. This is most likely possible for few regions among less developed regions, where population growth creates new economies of scale.

Table 5.23: Conditional beta convergence – Model 1, OLS estimation.

Dependent Variable: PRODEMP
Method: Least Squares
Sample: 1 67
Included observations: 67

	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.084647	0.086278	-0.981104	0.3304
INITGDP	-0.022184	0.003443	-6.442686	0.0000
LNW5YIT	0.023873	0.006775	3.523585	0.0008
SCIENTIFIC	0.426194	0.133238	3.198732	0.0022
ENT	0.231906	0.078866	2.940526	0.0046
FDIPERCO	0.005084	0.001272	3.996077	0.0002

R-squared	0.620609	Mean dependent var	0.006206
Adjusted R-squared	0.589511	S.D. dependent var	0.017614
S.E. of regression	0.011285	Akaike info criterion	-6.045368
Sum squared resid	0.007769	Schwarz criterion	-5.847933
Log likelihood	208.5198	Hannan-Quinn criter.	-5.967243
F-statistic	19.95677	Durbin-Watson stat	2.270248
Prob(F-statistic)	0.000000		

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.268730	Prob. F(5,61)	0.2890
Obs*R-squared	6.311277	Prob. Chi-Square(5)	0.2771
Scaled explained SS	6.850583	Prob. Chi-Square(5)	0.2320

Heteroskedasticity Test: White			
F-statistic	1.121327	Prob. F(20,46)	0.3624
Obs*R-squared	21.95900	Prob. Chi-Square(20)	0.3427
Scaled explained SS	23.83542	Prob. Chi-Square(20)	0.2497

The model is run again by excluding the population growth factor. Above are results in table (5.23). The error terms are normally distributed (figure 5.22) and the model fit is good (figure 5.23). Only few cases exhibit large residuals: Adıyaman, Şanlıurfa, Trabzon, Mardin and Antalya. Adıyaman experienced sharp losses in manufacturing

productivity. Şanlıurfa experiences high growth in manufacturing productivity. Trabzon is likely influenced by increased international trade within the Black Sea Region. There is not much that could be said for Mardin, but since growth in the Southeastern and Eastern Anatolia is concentrated in only few regions, it is perhaps a loser. Antalya has grown as an international tourism center with international significance and today attracts the most number of tourists in Turkey. Despite these outliers, the model fit is good.

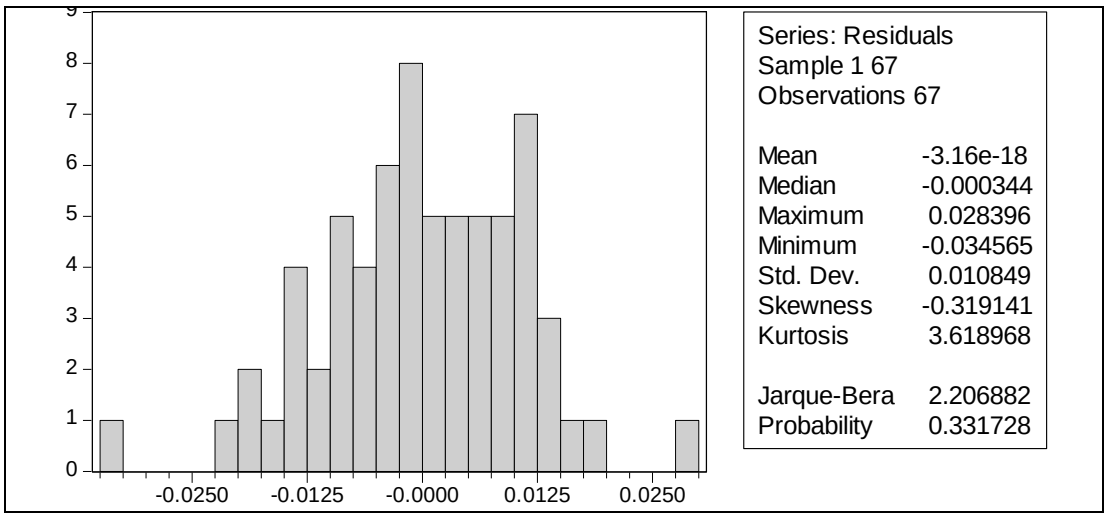


Figure 5.22 : Distribution of the residuals for Model 1.

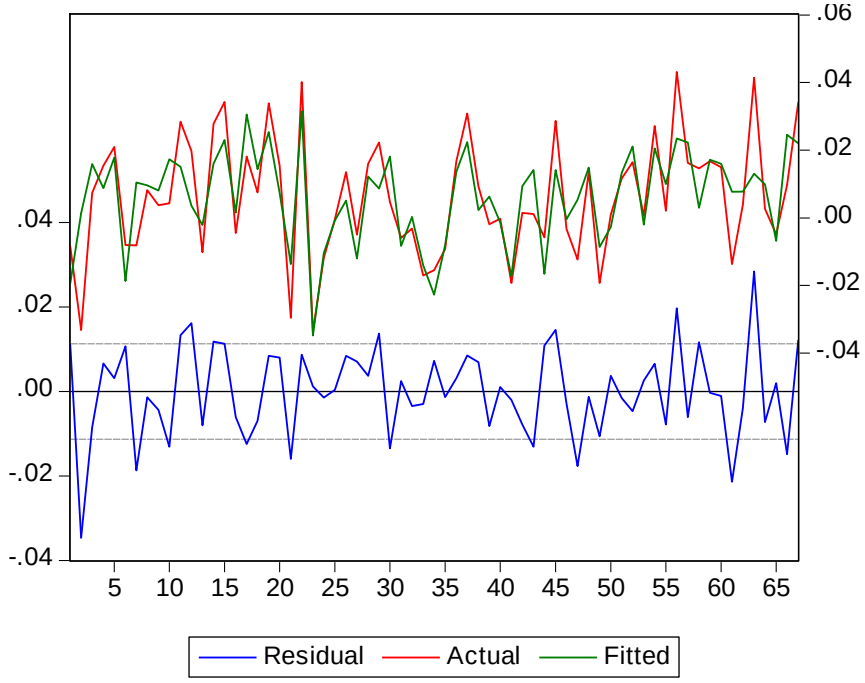


Figure 5.23 : Fit of the residuals for Model 1.

Finally the model is checked for spatial dependencies on the dependent variable and the error term, by running spatial diagnostics in GeoDA 0.95. First, spatial dependencies for first order neighbor regions are diagnosed. Results show that there isn't any significant spatial autocorrelation of the dependent variable, or the error term (table 5.24).

Table 5.24: Conditional beta convergence – Model 1, OLS estimation, first order neighbors.

REGRESSION - SUMMARY OF OUTPUT: ORDINARY LEAST SQUARES ESTIMATION

Dependent Variable	**PRODEMP**	Number of Observations:	67
Mean dependent var	0.0062063	Number of Variables	6
S.D. dependent var	0.017482	Degrees of Freedom	61
R-squared	0.620610	F-statistic	19.9568
Adjusted R-squared	0.589512	Prob(F-statistic)	9.83755e-012
Sum squared residual	0.0077686	Log likelihood	208.52
Sigma-square	0.000127354	Akaike info criterion	-405.04
S.E. of regression	0.0112851	Schwarz criterion	-391.812
Sigma-square ML	0.000115949		
S.E of regression ML:	0.010768		

Variable	Coefficient	Std.Error	t-Statistic	Probability
CONSTANT	-0.08464746	0.08627734	-0.9811088	0.3304146
INITGDP	-0.02218388	0.003443263	-6.442691	0.0000000
LNW5YIT	0.02387316	0.006775218	3.5236	0.0008134
SCIENTIFIC	0.4261995	0.1332384	3.198775	0.0021900
ENT	0.2319049	0.07886568	2.940504	0.0046242
FDIPERCO	0.005084368	0.001272345	3.99606	0.0001761

REGRESSION DIAGNOSTICS

MULTICOLLINEARITY CONDITION NUMBER 197.5353

TEST ON NORMALITY OF ERRORS

TEST	DF	VALUE	PROB
Jarque-Bera	2	2.206664	0.3317638

DIAGNOSTICS FOR HETEROSKEDASTICITY

RANDOM COEFFICIENTS

TEST	DF	VALUE	PROB
Breusch-Pagan test	5	6.57845	0.2539256
Koenker-Bassett test	5	5.023721	0.4129922

SPECIFICATION ROBUST TEST

TEST	DF	VALUE	PROB
White	20	21.95879	0.3427513

DIAGNOSTICS FOR SPATIAL DEPENDENCE

FOR WEIGHT MATRIX : **w1modifiye.GAL** (row-standardized weights)

TEST	**MI/DF**	**VALUE**	**PROB**
Moran's I (error)	-0.229583	N/A	N/A
Lagrange Multiplier (lag)	1	6.9856434	0.0082166
Robust LM (lag)	1	0.6970710	0.4037696
Lagrange Multiplier (error)	1	8.1093890	0.0044037
Robust LM (error)	1	1.8208166	0.1772161
Lagrange Multiplier (SARMA)	2	8.8064600	0.0122377

Table 5.25: Conditional beta convergence – Model 1, OLS estimation, neighbors within 500 km.

REGRESSION
SUMMARY OF OUTPUT: ORDINARY LEAST SQUARES ESTIMATION

Dependent Variable	**PRODEMP**	Number of Observations:	67
Mean dependent var	0.0062063	Number of Variables	6
S.D. dependent var	0.017482	Degrees of Freedom	61
R-squared	0.620610	F-statistic	19.9568
Adjusted R-squared	0.589512	Prob(F-statistic)	9.83755e-012
Sum squared residual	0.0077686	Log likelihood	208.52
Sigma-square	0.000127354	Akaike info criterion	-405.04
S.E. of regression	0.0112851	Schwarz criterion	-391.812
Sigma-square ML	0.000115949		
S.E of regression ML	0.010768		

Variable	Coefficient	Std.Error	t-Statistic	Probability
CONSTANT	-0.08464746	0.08627734	-0.9811088	0.3304146
INITGDP	-0.02218388	0.003443263	-6.442691	0.0000000
LNW5YIT	0.02387316	0.006775218	3.5236	0.0008134
SCIENTIFIC	0.4261995	0.1332384	3.198775	0.0021900
ENT	0.2319049	0.07886568	2.940504	0.0046242
FDIPERCO	0.005084368	0.001272345	3.99606	0.0001761

REGRESSION DIAGNOSTICS
MULTICOLLINEARITY CONDITION NUMBER 197.5353
TEST ON NORMALITY OF ERRORS

TEST	DF	VALUE	PROB
Jarque-Bera	2	2.206664	0.3317638

DIAGNOSTICS FOR HETEROSKEDASTICITY
RANDOM COEFFICIENTS

TEST	DF	VALUE	PROB
Breusch-Pagan test	5	6.57845	0.2539256
Koenker-Bassett test	5	5.023721	0.4129922

SPECIFICATION ROBUST TEST

TEST	DF	VALUE	PROB
White	20	21.95879	0.3427513

DIAGNOSTICS FOR SPATIAL DEPENDENCE
FOR WEIGHT MATRIX : **x500.GWT** (row-standardized weights)

TEST	**MI/DF**	**VALUE**	**PROB**
Moran's I (error)	-0.041382	N/A	N/A
Lagrange Multiplier (lag)	1	0.6560949	0.4179420
Robust LM (lag)	1	0.4365279	0.5088031
Lagrange Multiplier (error)	1	1.6949559	0.1929490
Robust LM (error)	1	1.4753889	0.2244974
Lagrange Multiplier (SARMA)	2	2.1314838	0.3444722

A second test is done for neighbors within 500 km distance. The results are given in table (5.25). Regression diagnostics in GeoDA 0.95 suggest a multicollinearity condition number which is higher than 20 (table 5.25). Multicollinearity in cross-section models is a common problem. The correlations between initial GDP levels and FDI as well as correlations between other variables are likely to create multicollinearity. To be sure that multicollinearity is not a major problem, the OLS estimations are run once again, this time by using the software ArcGIS 9.3 Spatial Analyst Toolbox. The results given in table (5.26) suggest that multicollinearity is not a problem, since none of the variance inflation factors (VIF) are higher than 7.5.

Therefore, establishing a second model is not found to be necessary. The results of the first model can be interpreted as follows. In terms of productivity per employee;

- Initially less productive regions grew faster, but
- Regions whose neighbors were more productive at the beginning of the period grew faster.
- Regions which had an excessive growth of scientific, technical and related professionals experienced faster growth,
- Regions which experienced an increasing share of entrepreneurs grew faster,

And regions which were accommodated in geographical regions where large transnational companies are located in grew faster.

5.5 Summary of Results

Some important findings of the empirical study in this section should be addressed. First of all, the influence of FDI through large companies on productivity growth is not very high. This could be due to the fact that some of the FDI companies have transferred only labor intensive sections of their production chain. Some others are established only for importing consumer products and almost all these companies' headquarters are located in Istanbul. Third, some FDI companies compete with local producers, and thus protect themselves with patents and copyrights. Therefore, there is little scope for transfer of technology and knowledge diffusion.

Table 5.26: Conditional beta convergence – Model 1, OLS estimation in ArcGIS 9.3.

```
Running script OrdinaryLeastSquares...
                                Summary of OLS Results
Variable   Coefficient StdError t-Statistic Probability Robust_SE Robust_t  Robust_Pr VIF [1]
Intercept  -0.084647   0.086277 -0.981109   0.330411    0.089046  -0.950607 0,345551  --------
INITGDP    -0.022184   0.003443 -6.442691   0.000000*   0.002988  -7.424914 0,000000* 1.853763
ENT        0.231905    0.078866 2.940504    0.004625*   0.077349  2.998172  0,003927* 1.222752
SCIENTIFIC 0.426199    0.133238 3.198775    0.002192*   0.136044  3.132808  0,002662* 1.120770
FDIPERCO   0.005084    0.001272 3.996060    0.000178*   0.001112  4.572541  0,000025* 1.709999
LNW5YIT    0.023873    0.006775 3.523600    0.000816*   0.006804  3.508851  0,000855* 1.834611

                                    OLS Diagnostics
Number of Observations:      67          Number of Variables:                          6
Degrees of Freedom:          61          Akaike's Information Criterion (AIC) [2]:     -405.040241
Multiple R-Squared [2]:      0.620610    Adjusted R-Squared [2]:                       0.589512
Joint F-Statistic [3]:       19.956841   Prob(>F), (5,61) degrees of freedom:          0.000000*
Joint Wald Statistic [4]:    156.638542  Prob(>chi-squared), (5) degrees of freedom:   0.000000*
Koenker (BP) Statistic [5]:  6.311137    Prob(>chi-squared), (5) degrees of freedom:   0.277110
Jarque-Bera Statistic [6]:   2.206664    Prob(>chi-squared), (2) degrees of freedom:   0.331764


                          Notes on Interpretation
 *  Statistically significant at the 0.05 level.
[1] Large VIF (> 7.5, for example) indicates explanatory variable redundancy.
[2] Measure of model fit/performance.
[3] Significant p-value indicates overall model significance.
[4] Significant p-value indicates robust overall model significance.
[5] Significant p-value indicates biased standard errors; use robust estimates.
[6] Significant p-value indicates residuals deviate from a normal distribution.
```

On the other hand, the role of scientific, technical and related professionals is important. Although this model is too simple to conclude on the role of such professionals in creating knowledge, implementing innovations and diffusion of technology, it may be suggested that an excessive growth in the number of such professionals in a region is an indicator that shows R&D activities and technology adoption activities are higher. Further studies could be done in investigating the role of such knowledge workers on productivity growth.

The role of entrepreneurs also require much attention. The sharp drop in the number of entrepreneurs in Istanbul and Ankara do not match the sharp rise in number of new companies given in Baypınar and Erkut (2003). It is likely that large companies in large globalizing metropolitan regions is a harsh environment for local entrepreneurs. Their place is probably filled in with foreign entrepreneurs or administrators. In the post 2000 period, around over 5,000 work permits are provided to foreigners to work in FDI companies. About 90% of these are administrators, and almost all of the applications are for Istanbul. Ankara and Izmir's share is much less, but still much higher than the rest of the country (Geniş, 2004).

Population growth likely has negative effects if the region can not invest in public infrastructure, housing and other pressing needs adequately. On the other hand, population growth may induce start of new industries, and may even induce growth, but usually this is not the case.

Regions surrounded by more productive regions grew faster. This could be an important indicator of agglomeration for economic activities. Regions that are more productive are likely to have employed higher technologies and are more innovative. Thus, diffusion of technology to neighbor regions could be higher. The diffusion does not only effect immediate regions, but can be influential in distances as high as 500 km. This kind of effects were not studied in Turkey before, but findings are in line with that of Lopez-Baso et al. (2004).

It is most likely that the effects of spatial diffusion of technology is stronger for manufacturing industries which continue on concentrating in and around core metropolitan areas. Especially the concentration in the Northwest and around Izmir is quite significant. Despite drops in average productivity and concentration of labor intensive industries, still, these regions are the most productive regions and create most of the manufacturing output.

Study of aggregate labor productivity is not very easy. Different spatial growth dynamics in different sectors make it difficult to interpret the results. One important aspect is that the real geography is much more different than the neo-classical one. Export oriented industries led by the private sector grow in agglomerations. Services employment is growing due to urbanization and other factors, but producer services are concentrating in certain gateway cities. Agricultural productivity is highly influenced by public investments. It is evident that productivity differences in general drop because of growth of productivity in Eastern provinces in agriculture balances drops in manufacturing productivity overall.

This study has contributed to the literature on productivity growth and convergence in Turkey in a few ways. First of all, it supports other findings that there is conditional convergence in aggregate productivity levels. Second, it promotes the assumptions of Post Neo-Classical Theories on spatial spillovers, initial advantages and role of human capital on productivity growth. Third, it implies that spatial spillovers may have effects even on distant regions. Last, it demonstrates that different regimes apply to different sectors, and this has significant impacts on the aggregate productivity growth in a region.

6. CONCLUSION AND RECOMMENDATIONS

In this study regional employment growth and regional productivity convergence in Turkey for the 1990-2000 period is evaluated with respect to post neo-classical growth theory. Despite the presence of other valuable theories, this literature is distinguished because of the wide availability of empirical works as well as a wide range of methodology available. This study is distinguished from many other empirical works in Turkey, because while most other studies focus on income convergence, this study focuses on productivity convergence with its different dimensions.

6.1 Literature Survey and Empirical Findings

In this study, spatial structural changes experienced in the world economic system, were evaluated first. Special emphasis is given on emerging market economies. Economic globalization has been a powerful process in reshaping or re-inforcing clustered growth of economic sectors in these countries. Only few regions seem to enjoy agglomeration of economic activities in every country. On the contrary, the phenomenon is common across countries.

Second, in the third section, the post-neo-classical growth theory, its assumptions, methodological approaches and empirical studies are discussed. The discussion revealed that although the original theory focuses on convergence in per capita productivity rates, the literature is often cross referenced. Empirical studies are thus studied under different titles: employment growth, distribution of per capita productivity, and convergence in per capita productivity rates. Studies that focus on convergence between different countries were not the main focus here, so, studies that focus on regional integration are discussed mostly. Different approaches to measurement of productivity inequalities are also discussed.

These discussions on post neo-classical literature revealed that certain factors are thought to be influential on regional per capita productivity growth and convergence. Among these are specialization or so called MAR externalities, diversity or so called

Jacobs externalities, spatial spillovers between regions, human capital, population growth, competition and entrepreneurial activity.

The discussion on growth of employment revealed that employment growth is more associated with static externalities and in many emerging market economies, employment growth is clustered. This gives hints about regional productivity convergence as well, but these two different things should not be confused.

In the fourth section, employment growth in Turkey is studied for the 1990-2000 period. Following a survey on empirical literature, it is found that similar factors as elsewhere in emerging market economies could be influential in employment growth. An empirical study made for employment growth in urban sectors, manufacturing and services. It is found that distance to major metropolitan centers that are gateways to international markets and excessive population growth played a positive role in the growth of employment, while entrepreneurial activity seems to have played a negative role in employment growth.

In the fifth section, convergence in regional productivity rates in Turkey is evaluated. Both sigma and beta convergence analyses are held. Most of the analyses showed that there was convergence and this is inline with empirical findings that purely focus on productivity convergence, and not income convergence. Following Temel et al. (1999) it could be concluded that population growth could be hampering income convergence stronger. While people move to urban areas, they work in more productive jobs, but participation in the workforce drops. Thus, there can be productivity convergence but no income convergence in a given region. Productivity convergence does not guarantee income convergence in a country where participation to labor force is low and wages are suppressed.

On the side of productivity growth, inequalities were established long ago and are likely to persist for a long time, despite productivity convergence. Although metropolitan regions did not experience growth but experienced rather declining productivity in most urban sectors, they still remained powerful. Growth in agricultural productivity in some regions on the other hand contributed to a decrease in inequalities. Still, an important finding is that inequalities in productivity in manufacturing industries grew between geographical regions. The Northwest and Western parts have reinforced their position as industrial centers.

A conditional beta convergence analysis and supporting ESDA showed that important factors contributing to overall convergence in productivity per capita in the aggregate economy were, excessive growth in knowledge workers, growth in share of entrepreneurs and administrators, presence of large FDI companies and presence of spatial spillovers. This study provides unique findings on Turkey in this sense: the role of FDI is found to be not so strong. The role of entrepreneurial activity is found to be very important. The spatial spillovers may extend as far as 500 km, resembling the dual economy between East and West.

As a result, it could be concluded that especially manufacturing industries continue to concentrate around globalizing city regions and benefit positive spatial spillovers. On the other hand, the country has specialized more in labor intensive manufacturing industries and services. Development of infrastructure in Southeast and Eastern Anatolia is likely to have significant effects in improving productivity in agriculture, but in few centers. Also, some manufacturing centers are emerging in the East.

The picture on the West is more about regional integration and dispersion of manufacturing activities, while in the East it is more about growth of agriculture and resource based manufacturing industries in few core locations. It may be concluded that these two parts of the country still experience different episodes of development.

Increasing trade with non-EU countries are likely to have had significant effects in the post 2000 period. Thus, further studies should be done to assess both regional growth and evolution of regional inequalities.

Excessive growth of population is probably not beneficiary for regional productivity growth, but the statistical results were not significant. Still, saying that in most of the cases, excessive population growth has likely a detrimental effect to productivity growth should not be seriously objected, following empirical literature.

This may be the reason why greater metropolitan cities do not perform well, and a reason that contributes to decreases in productivity levels. Therefore, populist and rent seeking policies to boost metropolitan populations should not be supported with closed eyes.

Due to data constraints, it was not possible to fully capture the influence of FDI on regional productivity levels. The model used in this study suggests that there is some positive and significant influence, but very small. It is likely that FDI investments

could have diverse effects in different industries. In metropolitan areas FDI investments are more services oriented, while on the close vicinity, they are more manufacturing oriented. In rural regions, they are more agricultural oriented. The impact of FDI should be higher in the post 2000 period than before, because until 2000 FDI inflow to Turkey were not very high compared to other emerging market economies. In fact, the amount of FDI inflows to Turkey during 1991-2003 was only a third of the amount during 2003-2004. Thus, further studies are necessary to evaluate the role of FDI.

It should be noted that this empirical study did not take into account many factors that may have great influences in the way regional production systems evolve. These include regional and national policies addressing firms, individuals, or target regions. Institutional developments in state organizations and better spatial management, decentralization of governance power to regional or local authorities should be new factors in the post 2000 period that requires attention. Furthermore, due to geo-political conditions in Turkey, investor's perception of risk and return should be taken as an important factor influential on regional production systems.

It is also likely that in the post 2000's Turkey the migration issue will still continue to play a key role in regional development. However, unlike in the pre-1990 period, now in-migration to Turkey from other countries and concentration of migrants in gateway cities like Istanbul has become an important phenomenon that requires more attention. Such types of migration is likely to have significant effects on productivity growth especially in sectors like tourism, construction, retailing and personal services, but it is hard to detect these effects due to rise of the informal sector and lack of data. On the other hand, it is a challenge that should be faced, because such phenomena can not be detached from the process of globalization.

6.2 Data and Methodological Constraints

The study was limited by both data constraints and methodological constraints. Data constraints are common. One of the constraints is about the availability of time series, and the other is about he availability of spatially disaggregated data. The country size and number of regions have created also methodological constraints. These are well known constraints for such cross-sectional methods. However, the

results were still adequate to answer some hypothetical questions. Existence of empirical studies, on the other hand, was an advantage.

One major omitted variable was the fixed capital investments at the regional level. This data is now available beginning from year 2003. Future studies will likely benefit presence of spatial-temporal data series and convergence-integration issues will be better investigated.

6.3 Policy Recommendations

Turkey has been following an export oriented industrialization policy in the post 1980 period. Empirical analysis results suggest that manufacturing industries are growing, while productivity in manufacturing industries are falling in most regions. The role of FDI is ambiguous on productivity growth. Furthermore, while until 1990 entrepreneurial activity increased in large metropolitan cities, during 1990-2000 it fell sharply.

One policy recommendation could be about policies for FDI. Attracting FDI and bare privatizations should not be the only concern. Potential impacts of FDI and privatizatons on local economy and entrepreneurial activities should be carefully evaluated. Second, rather than specializing in labor intensive sectors, higher technology sectors are necessary, and thus, FDI policies should be selective. Following Porter (1990) local competition should be kept alive and supporting industries should be targeted for enabling a competitive and productive production environment.

Another policy recommendation is for development of human capital and diversity. It is common that in many countries few cities are locations for large concentrations of knowledge workers. Development of such centers in the East could be a good policy to boost endogenous technological growth. Local transportation and communication infrastructures could be developed selectively to maximize spatial spillovers in the East, by improving connections between peripheral areas and metropolitan centers in this area. Creating such concentrations of knowledge workers would not be easy and require many interventions, spanning from establishment of good institutions to increasing quality of urban life. In this context, it is surely not easy to select a region as a development core while not choosing the others. Still, it is

believed that there could be only few candidates. In this framework, growth of services is a key factor. Growth of services are found to be very weak in the Eastern Half and this could be a major obstacle to improving quality of life and quality of business environment.

One important outcome is that inequalities are highly persistent. Large infrastructure projects targeting rural development in the East have proved to be useful tools, counter weighting agglomeration of economic activities in the global gateway areas. Therefore, ongoing policies targeting less developed regions in the country have an important influence on decreasing regional inequalities. Studies could be done to assess impact of similar projects in the Eastern Anatolia and Black Sea Regions. However, over emphasis on resource based industries could be risky in the longer run, and development of other industries should be further assessed.

Although not evaluated in this study, income inequalities are found to be persistent in Turkey, in the empirical literature. Therefore, growth of productivity should be supported by improving re-distribution of wealth in the country. Instead of supporting rapid population growth in metropolitan cities through populist policies, creation of better paid jobs and better re-distribution of wealth across and within regions should be key priorities. These might in turn work as an incentive for people to invest in their education and further contribute to economic growth through creation of a more productive and creative labor force.

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APPENDICES

APPENDIX A.1 : Moran's I Test
APPENDIX A.2 : Local Analysis of Spatial Autocorrelation – LISA Test
APPENDIX A.3 : Glossary

APPENDIX A.1 : Moran's I Test

Moran's I Test is one of the tests available for assessing spatial autocorrelation. Spatial autocorrelation refers to the coincidence of value similarity with locational similarity. A positive spatial autocorrelation means that high or low values for a variable tend to cluster in space. A negative spatial autocorrelation means that locations tend to be surrounded by neighbors with dissimilar values.

Spatial autocorrelation is formally expressed as follows:

$Cov\ [YiYj] \neq 0$ for $i \neq j$ **A.1.1**

Where i and j refers to spatial units, and *Y* is any variable representing data collected at the level of the spatial unit.

To calculate Moran's I, a weight matrix is used to represent spatial relations which are multidirectional, unlike time –lags. The weight matrix operates as a spatial lag operator, and is often represented by Wy, which is the weighted average of the values at neighboring regions. It is an N times N positive and symmetric matrix, where:

$W_{ij} = 1$ when i and j are neighbor spatial units

$W_{ij} = 0$ otherwise

The matrix is sometimes row standardized, where, sum of each row adds to 1. This makes it possible that spatial parameters are comparable between models. In this study all weight matrices used are row-standardized. Global Moran's I is then calculated as follows (Moran, 1950) :

$$I = \frac{N}{\sum_i \sum_j W_{ij}} \frac{\sum_i \sum_j W_{ij}(X_i - \bar{X})(X_j - \bar{X})}{\sum_{i=1}^{N} (X_i - \bar{X})^2} \quad i \neq j \qquad \textbf{A.1.2}$$

Where x is a variable, N is the number of spatial units. If *I* is positive, it means positive spatial autocorrelation, where similar values cluster. In other words, regions with high values are likely to be closer to regions with high values, and regions with low values are likely to be closer to regions with low values.

If I is negative, it means dissimilar values are clustered, e.g. regions with high values are likely to be surrounded by regions with low values.

APPENDIX A.2 : Local Analysis of Spatial Autocorrelation – LISA Test

Lisa test indicates significance of spatial clustering for each location. Sum of LISA is proportional to a global indicator of spatial association, like local Moran's I. LISA analysis is used to identify significant local clusters (hot spots) in the absence of global autocorrelation, but introduces complications in the presence of global autocorrelation. It also provides information on significant local outliers where dissimilar values are clustered.

Local Moran's I is calculated for each spatial unit, and then visualized by two maps, LISA Cluster Map and LISA Significance Map. GeoDA 0.95 is used in this study for producing these maps. The first one shows the hot spots and local outliers qualitatively in four categories : high-high, low-low are the hotspots and low-high and high-low are the spatial outliers. The second map shows the significance of the local spatial autocorrelation. Local Moran's I is calculated as follows:

$$I_i = \frac{(X_i - \bar{X})}{m_2} \sum_j W_{ij}(X_j - \bar{X}) \qquad \textbf{A.2.1.}$$

Where

$$m_2 = \frac{\sum_i (X_i - \bar{X})^2}{N} \qquad \textbf{A.2.2.}$$

then

$$I = \sum_i \frac{I_i}{N} \qquad \textbf{A.2.3.}$$

N here is the number of observations (Anselin, 1995).

APPENDIX A.3 : Glossary

Heteroskedasticity : As described in Maddala (1992) One of the assumptions made in a regression model is that the errors in the model (represented by ε_i or υ_i) have a common variance, σ^2. This is known as homoskedasticity assumption. If the variance of the errors are not constant, this violates the assumption and it is said that they are heteroskedastic. This may point to large differences in the size of the dependent variable, depending on measurement errors, or other independent variables that are not taken into account. In the case of heteroskedasticity, the least squares estimators will still be unbiased but they will be inefficient and/or, the estimated variances themselves will be biased.Therefore, the inferences from the results of a regression equation may be incorrect. Heteroskedasticity is tested formally by methods like White's Heteroskedasiticty Test, or Breusch-Pagan Test.

Multicollinearity : If two or more variables in a multiple regression model are highly correlated, this is called multicollinearity. This makes it difficult to distinguish the separate effects of each factor on the dependent variable (Maddala, 1992).

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