Institutions and economic growth: A panel data analysis of selected European countries

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بسم الله الرحمن الرحيم

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A Dissertation
Submitted in the Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
IN
STATISTICS

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Certificate

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A DISSERTATION SUBMITTED IN THE PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF THE MASTER OF SCIENCE IN STATISTICS

We accept this dissertation as conforming to the required standard.

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Dedication

To my Parents,
For the endless support and patience.

To my Teachers,
For the constant source of Knowledge and Inspiration.

To my friends,
The ones that are close and the ones that are far.

Forwarding Sheet by Research Supervisor

The thesis entitled **"Institutions and economic growth: A panel data analysis of selected European countries"** submitted by **Zain ul Abdeen** (Registration # 75-FBAS/MSST/F15) in partial fulfillment of M.S degree in Statistics has been completed under my guidance and supervision. I am satisfied with the quality of his research work and allow him to submit this thesis for further process to graduate with Master of Science degree from Department of Mathematics and Statistics, as per IIU Islamabad rules and regulations.

Dated: _____

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My sincere thanks goes to my parents for their love and support throughout my life. I owe my loving thanks to my brother and sister. Without their support and encouragement it would have been impossible for me to complete this work.

Zain ul Abdeen

DECLARATION

I hereby declare that this thesis, neither as a whole nor a part of it, has been copied out from any source. It is further declared that I have prepared this dissertation entirely on the basis of my personal efforts made under the supervision of my supervisor **Dr.Muhammad Akbar**. No portion of the work, presented in this dissertation, has been submitted in the support of any application for any degree or qualification of this or any other learning institute.

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List of Abbreviations

CEM	Common Effect Model
FEM	Fixed Effect Model
REM	Random Effect Model
ECM	Error Component Model
GDP	Gross Domestic Product
ECB	Economic bulletin
GVAFC	Gross value added at factor cost
IV	Institutional variables
LF	Labor force
GFCF	Gross fixed capital formation
GMM	Generalized Method of Moments
CLRM	Classical Linear Regression Model
GLRM	General Linear Regression Model
WDI	World Development Indicator
ICRG	International Country Risk Guide
PRS	Political Risk Services
LSDV	Least Square Dummy Variable

Abstract

This study attempts to examine the impact of various institutions on economic growth using panel data for 17 countries over the period 1990–2015. This sample is representative of European countries. We can estimate common effect model, fixed effect model, random effect model and dynamic effect model for panel data. First three models are not valid models due to many reasons. Common effect model is not selected as a valid model because the estimate of institutional indicators is insignificant and shows that institutional indicator has no impact on economic growth. Fixed effect model and random effect model are also not selected because their estimate shows inverse relationship between economic growth and institutional indicators whereas fixed effect model shows significant effect of institutional indicators on economic growth means there is a negative impact of institutional indicators on economic growth and random effect model shows insignificant effect of institutional indicators on economic growth means institutional indicators have no impact on economic growth.

Dynamic Random effect model is the valid model because it shows that economic growth and institutional indicator have significant and positive relationship which is according to the economic theory. Our other explanatory variables such as labor force and gross fixed capital formation also show significant and positive impact on our response variable. Lag term of dependent variable also show significant effect, it means economic growth depends upon its own lag value. J-test statistic and adjusted R-square is also in favor of this model. So their estimates are reliable and we can use these estimates for policy making in the case of selected European countries.

Chapter 1

Introduction

For the period of the last twenty five years, European countries have faced very unusual growth performances. Differences among different countries are not justified due to difference in the starting levels of GDP per capita. According to economic bulletin ECB (2015) the worth of domestic and political institutions and governance of government has a significant and positive effect on income growth per capita and deficiency of actual convergence is "related to several factors, notably weak institutions, structural rigidities, weak productivity growth and insufficient policies to address asset price booms".

The basic aim of the topic under study is to determine either the institutions play a major role as growth determinant or not in case of European countries and to figure out the link between economic growth and institutions. There are very important questions arises in the social sciences is about the variation in the cross country income i.e. the question about the fact that some countries are rich than the others. Why the economical growth of one country is greater than others? Or why the productions of some countries are better than the others.

The economic institutions, they play a "key" role in this variation of development & growth between different nations. Besides it also influences the use of new technologies in the process of production. Economic institutions are vital as they have impact on the economical structure of an economy. Also they help out in the allocation of resources through production factor (Acemoglu & Robinson; 2004).

In describing the economic growth process, institutions play very important role by disturbing the structure for investment in human and physical capital as well

as technological advancement and innovations. It is assumed that security of property rights play a noteworthy role for estimation the long term economic increase or growth. It is believed that insecurity of property rights play inverse relationship with economic growth. Mauro (1995) studied the association between economic growth and institutions. He concluded that corruption has strong negative effect on economic growth.

The differences in infrastructure are caused by human capital, education and productivity and the cross country difference is due to the difference in the institutional indicators among countries. Institutions and trade have statistically significant and positive effect on per capita growth while remittances hold back the economic growth in the case of sample countries. The country specific institutions are positively and strongly affected to the growth rate of regional productivity.

Political & economic growth also depends upon the institutions. Neoclassical assumption describes the fact that where there will be the availability of beneficial opportunities, growth will occur. Violence hinders the process of growth & development. It is the one of those evils which our societies are facing today & this is especially aggravated in the countries which is developing as people spread/promote violence for sake of wealth & other purposes. Institutions help to resolve the conflict between the social economic and political factors.

Institutions are the significant determinants of the economical status & development of a country. Recently a lot of work has been done on it. The reduction of transformation cost & insecurity is also dependent upon it. The involvement of the institutions in the process of growth has been studied & documented in various studies by shaping the human phenomena. There are wonderful differences in the organization of economical & political set up/life among the countries.

Institutions are essential for any economy. Major role in the determination of differences in the cross country income is played by its institutions have effect on developmental & growth processes through numerous/various indicators. However the conflict is there in the literature of economy among researchers. Some are the supporters of this view according to which economic growth depends upon the quality of the institutions while the researchers who oppose these views, they say that analysis of the institution is in initial stage. Therefore, more work is required in this aspect. This study will focus on the investigation that either the institutions, help in the explanation of European countries through panel data analysis.

1.1 Objectives of the Study

On the basis of above discussion, the following objectives are specified in this study.

- Testing the impact of institutions upon economic growth in European developed countries.
- Estimation of common effect, fixed effect and random effect model and selection of the best model to analyze the phenomenon under consideration.
- Give policy implications.

To achieve these targets, outlines of the present study are as follow. Chapter 2 contains four sections. In section 2.1, we can give an overview of the chapter. In section 2.2, we discuss basic concepts of economic growth and institutions. We can also see that there is a relation between economic growth and institutions. Economic growth also depends upon labor force, physical capital and advanced technologies etc. Economic growth is very sensitive in relation with institutions. In section 2.3, we present different studies related to effect of institutions on economic growth. The entire study, establish a direct and positive relation between economic growth and

institutions. Statistical analysis of these studies through different econometric models shows a positive and significant relationship among economic growth and institutional indicators. The effect of institutional indicators is positive in low income countries as compared to high income countries. Investment profile effect is less effective in developed countries as compared to developing countries for growth process. Analysis also shows that for the long term economic increase institutions are very important. Institutions play key role for development in developed countries as compared to developing countries. The results of these studies also reveals that institutional structure indicators such as the trade barriers, integrity of the law system, restriction of foreign investments have a significant and positive effect on the economic growth of the developing countries. On the other hand, according to the analysis results, variables as civil freedoms, government expenditures, collective bargaining, the black market exchange rate and military support have negative effect on the macro-economic conditions of developing countries. Institutions are essential for any economy. Major role in the determination of differences in the cross country income is played by its institutions, have effect on developmental & growth processes through various indicators. However the conflict is there in the literature of economy among researchers. Some are the supporters of this view according to which economic growth depends upon the quality of the institutions while the researchers who oppose these views, they say that analysis of the institution is in initial stage. Therefore, more work is required in this aspect. This study will focus on the investigation that either the institutions, help in the explanation of European countries through panel data analysis.

In chapter 3, we can explain the specification of the model in section 3.2. In section (3.3) we can write about data and construction of variable through principal

component method. Section (3.4) cover methodology of study in which we discuss about time series data, cross sectional data and pool data for better understanding of panel data. After that we also present different panel data regression models such as common, fixed, random and dynamic random effect model. In sections (3.4.5) we can briefly explain the estimation method for panel data models, the "generalized method of moments". Section (3.5) is about diagnostic tests such as F-test statistic, Hausman test statistic and J test statistic for panel data models.

Chapter 4 contains results and discussion while the last chapter contains summary and conclusion of the whole study.

Chapter # 2

Literature Review

2.1 Introduction

In the chapter "Literature Review", we can discuss various studies linked with economic growth as well as institutions and their relation with each other. We can divide this chapter into subsections. Section (2.1) is introduction of the chapter "literature review". Second section contains basic concepts of institutions and economic growth. Section three contains previous studies related to impact of institutions on economic growth. Fourth and last section we can give the summary of conclusions based on their verified results from the review of studies.

2.2. Basic Concepts of Economic Growth and Institutions

2.2.1. Economic Growth

The persistent increase in output of an economy is known as economic growth. Simply it is an increase in market value of services and goods produced within a country. Only final goods are selected to calculate the money value of goods. As for services e.g those of doctors, professors, advocates etc are concerned, they are always performed in their final form. Thus, their money value is straight away added with money value of final goods in the measurement of economic growth. It is also measured through increase in real GDP (Gross Domestic product) in terms of per capita.

2.2.2. Institutions

The term institution means those organizations which can create policies, enforce their orders and apply their laws. We can use six institutional indicators variables in our study. These all variables have their own points, on the basis of these

points we can decide whether the economy face high risk or low risk. So we can discuss in detail about these indicators for better understanding of our topic.

2.3 Review of Studies

North and Thomas (1973), North (1981) studied the function of institutions describing the difference on economic increase between different countries. These studies show that while calculating the performance of different countries, institutions play an extensive role. In describing the economic growth process, "institutions plays very important role by disturbing the structure for investment in human and physical capital as well as technological advancement and innovations. It is assumed that security of property rights play a noteworthy role for estimation the long term economic increase or growth".

Knaack and Kefer (1995) explore the relationship between property rights and the growth process and the data used in this study is collected by IBO (international business organizations). It is believed that insecurity of property rights play inverse relationship with economic growth. Mauro (1995) studied the association between economic growth and institutions. He concluded that corruption has strong negative effect on economic growth.

Baarro (1998) took panel data of hundred countries observed from 1960 to 1995 and analyze determinants of investment and economic growth. He concluded that by holding institutions, fixed government policies and national population character, the initial level of GDP per capita is inversely proportional to growth rate of GDP per capita.

Hall and Jones (1999) took data of institutions from international country risk guide dataset for one hundred twenty-seven countries. They examined that the differences in infrastructure are caused by human capital, education and productivity.

They also concluded that cross country difference is due to the difference in the institutional indicators among countries.

Acemoglu *et al.,* (2006) also determine the effect of institutions on the economic growth. They use "constraint on executive" as a substitute for property institutions and show that the property institutions have a great influence on the financial development, long run economic growth, macroeconomic stability and investment.

Drury *et al.*, (2006) used panel data for more than hundred countries from 1982 to 1997(taking data from ICRG). They study the relation of corruption with democracies and non-democracies and found that the corruption has insignificant effect on economic growth in the case of democracies while in the case of non-democracies corruption has significant effect and this significant effect is harmful for economy.

Lee and Kim (2009) have studied the relationship between economic growth and institutions with the other control variables such as R and D and education. For both, developed and under developed countries panel data was used. They used fixed effect model for their study and apply GMM for estimation. They come to the conclusion that the institutions and R and D has significant effect on economic growth in the case of developed countries while in the case of under-developed or developing countries they found weak relationship of economic growth with R and D. They also find that primary education can effect positive and significant on economic growth in the case of developing countries.

Le (2009) took panel data of seventy-six developing countries over the period from 1970 to 2000 to explore the affect of remittances, trade and institutions on economic growth. He used pooled ordinary least square and GMM for empirical

analysis. He comes to the conclusion that the institutions and trade have statistically significant and positive effect on per capita growth while remittances hold back the economic growth in the case of sample countries.

Arbia *at al.*, (2010) took panel data of European regions over the period from 1991 to 2004 for the statistical analysis of growth experiences. They examined the effects of country specific institutions and regional productivity growth rate. By means of control charts and using spatial weight matrix these effects have been designed. The study reveals that the country specific institutions are positively and strongly affected to the growth rate of regional productivity.

Acemoglu and Robinson (2010) studied that why some countries grow slower than the others. They concluded that beside physical capital, human capital and technology are the determinant of economic growth, fundamental causes can also effect growth. Institutions play key role in influencing the economic growth process by affecting physical and human capital. In general it is believed that the institutions especially property rights security play a significant role on economic increase or growth.

Valeriani and Peluso (2011) employing a panel data from 1950 to 2009 for one hundred eighty-one countries by using common effect model (CEM) and fixed effect model (FEM) to investigate the affect of institution's quality on the economic growth at various stages of development. They tell that institutions and quality of government have positive impact on economic growth. They also examined that institutions are more helpful for describing features of economic growth in developed countries instead of developing countries.

Chauffour (2011), use panel data for more than hundred countries from 1975 to 2007 and find that "institutions play an extensive role in calculating the growth

performance of countries". Institutions play key role in influencing the economic growth process by affecting physical and human capital. In general it is believed that the institutions especially property rights security play a significant role on economic increase or growth.

Massa (2011) takes sample of one hundred one countries to examine the connection between financial institutions and economic growth. She uses panel data for the time period from 1986 to 2009. Data is collected from PRS (ICRG). She examines significant and positive impact of investment on economic growth. She also found that investment has strong effect on economic growth in the case of low income countries. His results show that eleven percent increase in the investment can cause one point twenty nine percent increase in economic growth in the case of low income countries while eleven percent increase in the investment can cause point eight nine percent increase in economic growth in the case of high income countries. Similarly Betancourt at al., (2010) examines "the effect of institutions on economic growth process". The data which is used for analysis is taken from Freedom House. They come to the conclusion that property right institutions can cause significantly in the long run economic growth.

Vieira *at al.*, (2012) used cross-sectional and panel data analysis for a set of developed and under-developed countries to investigate the role of institutions on per capita income and economic growth. Data was collected from PRS (ICRG).They used GMM for statistical analysis. Their economic growth models show that institutions like investment profile and law and order can effect significantly on growth process.

Dias and Tebaldi (2012) can use panel data for cross countries from 1965 to 2005 and studied the relation between human capital, institutions, and economic growth. They find that, political institutions are not correlated with long term

economic growth and productivity. They also show that human capital and physical capital determines economic growth in long run.

Siddiqui and Ahmed (2012) studied that how institutions affect economic increase. Institutional indicators each covering eighty four countries with a time period of five years has been used to obtain factors depend upon PCA. Factors depend upon on these indicators are divided as political rents, policy rents and institutional and risk-decreasing technology. These factors are used in the model by employing generalized method of moments based estimation and panel ordinary least square estimation. They find that economic growth is positively affected by institutions. This study also finds that in under developed countries the policy rent and institutional is more important than other 2 indices.

Saima Nawaz (2014) used panel data over the time period from 1981 to 2010 for fifty six countries to study the effect of different institutions on economic increase. Data is collected from PRS (international country risk guide). She calculates fixed effect model and dynamic random effect model using system GMM. Statistical analysis of this study shows a positive relationship among economic growth and institutions. The effect of institutional indicators is positive in low income countries as compared to high income countries. Investment profile effect is less effective in developed countries as compared to developing countries for growth process. Analysis shows that for the long term economic increase institutions are very important. Institutions play key role for development in developed countries as compared to developing countries.

Yildirim and Gokalp (2015) analyze the relationship between institutions and macro-economic performance in terms of developing countries. For this purpose, for a period covering the years 2000-2011 through the use of 23 institutional structure

variables in the study, the relationship between the institutional structure and macro-economic performance is investigated in sampling countries where 38 developing countries take place by using the 'Panel Data Analysis' method. The results of the analysis reveals that institutional structure indicators such as the trade barriers, integrity of the law system, restriction of foreign investments have a significant and positive effect on the economic growth of the developing countries. On the other hand, according to the analysis results, variables as civil freedoms, government expenditures, collective bargaining, the black market exchange rate and military support have negative effect on the macro-economic conditions of developing countries.

Carlos Goes (2015) took panel data of one hundred nineteen countries to construct a panel of "structural vector auto regressive model" over ten years. When he controls fixed effects then institutional indicator shows positive and statistically significant results on GDP per capita. One percent shock in the institutional indicator can cause one point seven percent increase in GDP per capita after six years. Robust results can be made by using different substitute for institutional indicators.

Dutta and Williamson (2016) using a panel of 108 countries from 1971 to 2010. Their main focus of the study is the aid effect on economic freedom conditional on quality of political institutions. By investigating aid influence on economic freedom conditional on the quality of political institutions, they find that in the case of democracies aid can pick up economic freedom while in the case of autocracies aid can decrease economic freedom. Their results are used for making policies. They also conclude that those countries who need aid from others countries do not enjoy healthy political institutions.

2.4 Summary

The review of literature chapter contains four sections. In section 2.1, we can give an overview of the chapter. In section 2.2, we discuss basic concepts of economic growth and institutions. We can also see that there exist relationship between economic growth and institutions. Economic growth also depends upon labor force, physical capital and advanced technologies etc. Economic growth is very sensitive in relation with institutions. In section 2.3, we present different studies related to effect of institutions on economic growth. The entire study discussed above, establish a direct and positive relation between economic growth and institutions. Statistical analysis of these studies through different econometric models shows a positive and significant relationship among economic growth and institutional indicators. The effect of institutional indicators is positive in low income countries as compared to high income countries. Investment profile effect is less effective in developed countries as compared to developing countries for growth process. Analysis shows that for the long term economic increase institutions are very important. Institutions play key role for development in developed countries as compared to developing countries. The results of these studies also reveals that institutional structure indicators such as the trade barriers, integrity of the law system, restriction of foreign investments have a significant and positive effect on the economic growth of the developing countries. On the other hand, according to the analysis results, variables as civil freedoms, government expenditures, collective bargaining, the black market exchange rate and military support have negative effect on the macro-economic conditions of developing countries.

So we can conclude that institutions are essential for any economy. Major role in the determination of differences in the cross country income is played by its

institutions that have effect on developmental & growth processes through numerous/various indicators. However the conflict is there in the literature of economy among researchers. Some are the supporters of this view according to which economic growth depends upon the quality of the institutions while the researchers who oppose these views, they say that its initial stage is the analysis of the institution. Therefore, more work is required in this aspect. This study will focus on the investigation that either the institutions, help in the explanation of economic growth of European countries through panel data analysis.

Chapter 3

Material and Methodology

3.1. Introduction

In this chapter, first we explain the specification of the model in section 3.2. In section (3.3) we can write about data and construction of variable through principal component method. Section (3.4) cover methodology of study in which we discuss about time series data, cross sectional data and pool data for better understanding of panel data. After that we also present different panel data regression models such as common, fixed, random and dynamic random effect model. In sections 3.4.5 we can briefly explain the estimation method for panel data models, the "generalized method of moments". Section (3.5) is about diagnostic tests such as F-test statistic, Hausman test statistic and J test statistic for panel data models.

3.2. Specification of the Model

Follow "Romer and Weil (1992) and Hall and Jones (1999)", we can estimate the impact of institutions on economic growth using the following statistical model. In this model we can use gross fixed capital formation, labor force as control variables. Hence, the model may be written as follows.

$$Y_{it} = f(Institutions, Control\ Variables)$$

Or

$$Y_{it} = \beta_1 + \beta_2 X_{1it} + \beta_3 X_{3it} + \beta_4 X_{4it} + \mu_{it} \ldots\ldots\ldots\ldots\ldots\ldots (3.1)$$

Where

$i = 1, 2, \ldots\ldots\ldots\ldots\ldots J$ (countries)

$t = 1, 2, \ldots\ldots\ldots\ldots\ldots K$ (time periods)

Y = Gross value added at factor cost

X_1=Institutional variables

X_2=Labor force

X_3= Gross fixed capital formation

3.3 Data and Construction of Variable

Data of all above economic variables are taken from 1990 to 2014 from WDI and PRS (ICRG). In the present study we have taken seventeen most important European countries including countries of European Union. The list of these countries is as follow "Austria ,Belgium ,Bulgaria ,Cyprus, Denmark ,Finland ,France ,Greece ,Iceland , Italy , Netherlands ,Norway ,Portugal ,Spain ,Sweden ,Switzerland ,united kingdom". Yearly data of these countries are taken from world development indicators (WDI) and political risk service (international country risk guide) from 1990 to 2015. Data of gross fixed capital formation, labor force, gross value added at factor cost is used directly but we can use principal component of institutional indicators because if we can use these institutional indicators separately then problem of multi co linearity occurs.

- Gross income of the country after settlement of indirect taxes and subsides is known as "Gross value added at factor cost or gross domestic product".
- The term "labor force" implies to all those people who have ability to do work in an area or country.
- "Gross fixed capital formation" is the net expansion in the physical assets of a country during a specific period.

We can use principal component of six institutional indicators, their names and description are as follows

- "Government stability
- Control over Corruption
- Military in politics
- Law and order
- Democratic accountability
- Bureaucracy quality", respectively.

According to ICRG "Government stability is an assessment both of the government's ability to carry out its declared program(s), and its ability to stay in office. The risk rating assigned is the sum of three subcomponents, each with a maximum score of four points and a minimum score of 0 points. A score of 4 points equates to Very Low Risk and a score of 0 points to Very High Risk. The subcomponents are, Government Unity, Legislative Strength and Popular Support".

When an individual compromises the national interests for sake of accomplishment of his personal needs and benefits leads to phenomena referred as corruption. As it is a common saying "power corrupts and absolute power corrupts absolutely". This becomes very dangerous for the foreign investment due to various reasons : it damages the financial and economical atmosphere; the functioning of the Government and business greatly reduces because of the fact that the people are given higher positions on the basis of relationships not on the basis of their abilities and potentials. There are various types of corruption based upon different things like financial corruption associated with trade licenses which may be in the form of bribes, police protection, exchange controls & tax assessments etc. Such corruption endangers the integrity & the fair conduction of the business & may cause the

withdrawal of investments. This indicator has six points, zero means high risk and six indicate low risk and on the basis of these points we can decide whether the economy face high risk or low risk.

The objective of Military is to protect and maintain the integrity of the country therefore its involvement in the political affairs even at lower level may cause a great risk to the democracy. Normally the military is not criticized by the people but it is political criticized as its involvement towards the political issues increases. This indicator also has six points, zero means high risk and six indicate low risk and on the basis of these points we can decide whether the economy face high risk or low risk.

The components of law and order are usually dealt separately; law refers to the strengthening of the legal system whereas the order is the implementation of the law. This indicator has also six points, zero means high risk and six indicate low risk and on the basis of these points we can decide whether the economy face high risk or low risk.

"Democratic accountability is a measure of how responsive government is to its people, on the basis that the less responsive it is, the more likely it is that the government will fall, peacefully in a democratic society, but possibly violently in a non-democratic one. The points in this component are awarded on the basis of the type of governance enjoyed by the country in question. In general, the highest number of risk points (lowest risk) is assigned to Alternating Democracies, while the lowest number of risk points (highest risk) is assigned to Autarchies".

.Whenever a Government changes revisions in the previous policies are always made but the degree of the alteration greatly depends upon the quality of the bureaucracy therefore when the bureaucracy takes no external pressures & remains unbiased and fair; minimum is the risk of the destabilization of the Government as it

changes. This indicator has four points, zero means high risk and four indicate low risk and on the basis of these points we can decide whether the economy face high risk or low risk.

Principal component is a technique to reduce the variables in that form in which we can study only those linear combinations which have large variance while those which have small variance may be discarded. We may be interested in linear combination which shows considerable variation.

In other words principal component analysis is the transformation of original variables into new variables which are uncorrelated with each other. In PCA first principal component captures maximum variation present in the original data; second principal component captures second highest variation and so on. If first PC captures 70 percent or more than 70 present variation in the data we can use only one PC and if not than we can use second PC along first PC and vice versa.

It is quite common to calculate the principal components after they have been standardized to have unit variance. This means that one is effectively finding the principal components from the correlation matrix ρ rather than from the covariance matrix sigma. However it is important to realize that the eigen values and eigen vectors of ρ will generally not be the same as that of sigma. Choosing to analyze ρ rather than sigma involves a definite but arbitrary decision to make the variables equally important.

After calculating the eigen values and principal components of sigma (co variance matrix) or ρ (correlation matrix),the usual procedure is to look at the first few components which hopefully accounts for a large proportion of total variation. In order to do this it is necessary to decide which eigen values are large and which are small, so that the component corresponding to the latter may be discarded.

If all the variables are positively correlated, then the first principal component is the weighted average of the variables and can be regarded as measure of size. When correlation matrix contains both negative and positive elements, the usual procedure is to look at the corresponding eigen vector and pick out the variables for which the co-efficients in the eigen vector relatively large, either positive or negative.

There are some situations in which some variables are uncorrelated from the others. If this sort of situation occurs then it can easily be shown that the uncorrelated variables themselves are mutually uncorrelated and all the co variances are zero then there is no need to carry out the principal component analysis. Wold *et al.,* (1987), Bro and Smilde (2014), Richardson (2009) also use PCA (data reduction technique) to remove multi collinearity. We can calculate principal components of institutional indicators of our selected European countries for further analysis.

The requirement of principal components analysis is that the value of KMO lies between 0 and 1. A value close to zero signifies that the partial correlation sums are as large as compared to the pair wise correlations sum. This indicates that the correlations are prevalent and therefore cannot take together **as** a few variables. This is an indication that principal component analysis is not suitable here, On the other hand, a value of KMO close to 1 signifies that principal component analysis is a good fit and the some of the pair correlation between the variables are greater than 0.3. The KMO, measure of sampling adequacy (MSA) for each variable and overall set of variables should be at least 0.50 to perform the PCA and the Bartlett's test of sphericity is statistically significant. Indices of institutions for different countries developed on the basis of PCA are given in Table 3.1.

Table 3.1.Computation of Principal Components of Sample Countries

Years	PC-Aus	PC-Bel	PC-Bul	PC-Cyp	PC-Den	PC-Fin
1990	20.57775	20.48708	14.83775	18.84708	18.55319	18.03817
1991	20.89725	20.22725	15.2565	18.875	18.53259	18.01757
1992	21.316	20.03183	14.754	17.79125	18.51199	17.99697
1993	21.12058	19.94808	15.13625	17.55696	18.49139	17.97637
1994	20.56225	19.66892	16.98892	17.69679	18.47079	17.95577
1995	19.57442	19.99524	16.5315	17.97308	18.45019	17.93517
1996	20.75767	19.97464	16.43483	18.358	18.42959	17.91457
1997	20.61783	19.95404	16.39758	18.43092	18.40899	17.89397
1998	20.44625	19.93344	16.35108	18.86363	18.38839	17.87337
1999	20.195	19.91284	15.75088	18.84967	18.36779	17.85277
2000	20.16708	19.89224	15.8765	18.93342	18.34718	17.83217
2001	20.195	19.87164	15.56942	18.62633	18.32658	17.81157
2002	19.73438	19.85104	15.10879	18.01217	18.30598	17.79096
2003	20.11125	19.83044	15.738	18.15175	18.28538	17.77036
2004	19.92979	19.80984	15.87225	17.76092	18.26478	17.74976
2005	19.70646	19.78924	15.11321	17.48175	18.24418	17.72916
2006	19.67479	19.76864	14.70842	15.30533	18.22358	17.70856
2007	20.16925	19.74804	14.45717	15.33275	18.20298	17.68796
2008	20.16979	19.72743	14.62467	16.33675	18.18238	17.66736
2009	21.1485	19.70683	14.12217	16.55958	18.16178	17.64676
2010	20.96704	19.68623	14.30363	18.837	18.14118	17.62616
2011	20.49246	19.66563	14.20592	18.97033	18.12058	17.60556
2012	20.18538	19.64503	13.9036	18.19017	18.09998	17.58496
2013	20.1435	19.62443	15.9195	17.22867	18.07938	17.56436
2014	20.21385	19.60383	16.49533	17.38233	18.05877	17.54376

Table 3.2.Computation of Principal Components of Sample Countries

Years	PC-Fra	PC-Gre	PC-Ice	PC-Ita	PC-Net	PC-Nor
1990	20.311	19.09167	16.49312	19.09167	19.73438	20.311
1991	20.56225	19.16146	16.47252	19.16146	20.11125	20.56225
1992	20.03183	19.13354	16.45192	19.13354	19.92979	20.03183
1993	20.1435	19.17542	16.43132	19.17542	19.70646	20.1435
1994	20.95308	19.06375	16.41071	19.06375	19.67479	20.95308
1995	21.4835	18.53333	16.39011	18.53333	20.16925	21.4835
1996	21.651	18.31	16.36951	18.31	20.16979	21.651
1997	21.26017	18.08021	16.34891	18.08021	21.1485	21.26017
1998	21.34392	17.69367	16.32831	17.69367	20.96704	21.34392
1999	21.53933	17.9304	16.30771	17.9304	20.49246	21.53933
2000	20.95308	18.58333	16.28711	18.58333	20.18538	20.95308
2001	20.54829	18.16458	16.26651	18.16458	20.1435	20.54829
2002	20.8135	18.025	16.24591	18.025	20.21385	20.8135
2003	20.65996	17.15492	16.22531	17.15492	20.03183	20.65996
2004	20.19933	19.30033	16.20471	19.30033	19.94808	20.19933
2005	20.19933	19.19858	16.18411	19.19858	19.66892	20.19933
2006	20.50642	17.8275	16.16351	17.8275	19.47133	20.50642
2007	20.50642	17.85542	16.14291	17.85542	20.45108	20.50642
2008	20.43663	18.54958	16.1223	18.54958	19.901	20.43663
2009	20.26913	18.85292	16.1017	18.85292	19.694	20.26913
2010	20.08767	18.90133	16.0811	18.90133	19.58233	20.08767
2011	20.17142	18.82746	16.0605	18.82746	19.63817	20.17142
2012	20.4785	18.13742	16.0399	18.13742	19.55442	20.4785
2013	19.44933	18.18892	16.0193	18.18892	20.15896	19.44933
2014	19.33767	18.28663	15.9987	18.28663	20.145	19.33767

Table 3.3.Computation of Principal Components of Sample Countries

Years	PC-Pur	PC-Spa	PC-Swe	PC-Swi	PC-Uk
1990	18.84708	19.09167	19.09167	19.73438	20.311
1991	18.875	19.16146	19.16146	20.11125	20.56225
1992	17.79125	19.13354	19.13354	19.92979	20.03183
1993	17.55696	19.17542	19.17542	19.70646	20.1435
1994	17.69679	19.06375	19.06375	19.67479	20.95308
1995	17.97308	18.53333	18.53333	20.16925	21.4835
1996	18.358	18.31	18.31	20.16979	21.651
1997	18.43092	18.08021	18.08021	21.1485	21.26017
1998	18.86363	17.69367	17.69367	20.96704	21.34392
1999	18.84967	17.9304	17.9304	20.49246	21.53933
2000	18.93342	18.58333	18.58333	20.18538	20.95308
2001	18.62633	18.16458	18.16458	20.1435	20.54829
2002	18.01217	18.025	18.025	20.21385	20.8135
2003	18.15175	17.15492	17.15492	20.03183	20.65996
2004	17.76092	19.30033	19.30033	19.94808	20.19933
2005	17.48175	19.19858	19.19858	19.66892	20.19933
2006	15.30533	17.8275	17.8275	19.47133	20.50642
2007	15.33275	17.85542	17.85542	20.45108	20.50642
2008	16.33675	18.54958	18.54958	19.901	20.43663
2009	16.55958	18.85292	18.85292	19.694	20.26913
2010	18.837	18.90133	18.90133	19.58233	20.08767
2011	18.97033	18.82746	18.82746	19.63817	20.17142
2012	18.19017	18.13742	18.13742	19.55442	20.4785
2013	17.22867	18.18892	18.18892	20.15896	19.44933
2014	17.38233	18.28663	18.28663	20.145	19.33767

An important benefit of principal component (PC) analysis is that no distributional assumption need to be made to do this and does not need to interpret the principal component.

3.4. Methodology of Analysis

3.4.1 Panel Data Regression Models

There are 3 main types of data with respect to time periods and cross-section units. These types are as follows:

Data with respect to time is known as time series data i.e observations varying with respect to time period represent time series data. Time period may be a second, a minute, an hour, day, week or years etc. Data of institutional indicator of finland from 1992 to 2015.

Data of particular variable collected from different units at the same point of time is known as cross-sectional data. e.g Data of institutional indicator of five European countries for the year 2015.

Data of particular variable collected from different units for more than one time period is called pool data i.e observations vary with respect to time period as well as with respect to cross-sectional unit's e.g Data of institutional indicator of 10 European for 2011-2015.

Panel data is a particular type of pool data where same units are surveyed over different time points. Simply we can say that panel data have two dimensions "space as well as time". Other names of panel data are cohort analysis, event history analysis and longitudinal data.

As compared to cross sectional and time series data, panel data can measure better effects. General form of panel data regression model may be written as follow

$$Y_{it} = f(X_{it}) + \mu_{it}$$

Estimation of the above model depends on the basis of assumptions. On the basis of these assumptions, there are different models for panel data are formed such as "common effect model", "fixed effect model", "random effect model" and "dynamic random effect model".

If we assume that the parameters of the model represent common effect with respect to time period as well as cross sectional units and error term follows all assumptions of CNLRM, it is called common effect model. Greenland and Robins (1985) use "estimation of a common effect parameter from sparse follow-up data". We can write common effect model as follows

$$Y_{it} = \beta_1 + \beta_2 X_{1it} + \beta_3 X_{2it} + \beta_4 X_{3it} + \mu_{it} \ldots\ldots\ldots\ldots\ldots\ldots (3.2)$$

Least square method is used for the estimation of above model. If there is the problem of endogeneity then we can also apply any instrumental variable technique such as 2SLS or GMM.

If we assume that at least one parameter of the model varies w. r. t time periods or w. r. t cross sectional units then such a model is called fixed effect model. Fixed effect (LSDV) model allocate intercept value to all its candidate entities for allowing heterogeneity.

Consider the following model

$$Y_{it} = \beta_{oi} + \beta_1 X_{1it} + \beta_2 X_{2it} + \beta_3 X_{3it} + \mu_{it} \ldots\ldots\ldots\ldots\ldots\ldots (3.3)$$

In the above equation the subscript "i" means we can allow intercepts to vary or differ across countries because all countries have their own characteristics. These characteristics are, such as political conditions, law and order situation and economic ups and downs etc

The above model is known as fixed effect model in the sense that every country has its own intercept value and does not vary over time means time invariant.

If varies with respect to time than we can also introduce time dummies in the model for all time periods.

How we can allow fixed effect intercept to differ among the countries? We can handle simply by using the dummy variable method. Now we can write as follows

$$Y_{it} = \alpha_1 + \alpha_2 D_2 + \alpha_3 D_3 + \alpha_4 D_4 + \alpha_5 D_5 \ldots\ldots\ldots + \alpha_{17} D_{17} + \beta_1 X_{1it} + \beta_2 X_{2it} + \beta_3 X_{3it} + \mu_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.4)$$

Where

D_2=1 for country 2,

Otherwise 0;

D_3=2 for country 3,

Otherwise zero and so on.

We have 17 countries and we can launch 16 dummies. Kaushik at al., (1984) use "this model for analysis of combining ability for seed oil content in cotton".

Al through LSDV or fixed effects model can be expensive with respect to degree of freedom if several cross sectional units are surveyed. Supporters of the ECM (error component model) or random effect model gave the idea that if dummy variable show limited information about the model, we can introduce error term in the model to express this limited information.

Easily we can define the REM as if parameters of the model are suppose to vary randomly w.r.t units or time periods and hence that random variations of the parameters may be considered by the introduction of random error term. Such a panel data model is called random effect model

$$Y_{it} = \beta_{oi} + \beta_1 X_{1it} + \beta_2 X_{2it} + \beta_3 X_{3it} + \mu_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.5)$$

We can assume that β_{1i} is fixed, instead of treating β_{1i} as random variable with a mean value of β_1 and the intercept value for an individual. This can be expressed as

$$\boldsymbol{\beta_{oi} = \beta_o + e_i}$$

Where

$$i = 1, 2, 3, 4, \ldots\ldots\ldots\ldots, N$$

Where ϵ_i is a random error term with a mean value of zero and variance σ^2_ϵ.

$$\boldsymbol{Y_{it} = \beta_o + \beta_1 X_{1it} + \beta_2 X_{2it} + \beta_3 X_{3it} + e_i + \mu_{it}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots \mathbf{(3.6)}$$

Where

$$\boldsymbol{w_{it} = e_i + \mu_{it}}$$

The composite error term consist of two components, "the cross-sectional or individual specific error component and the combined time series and cross sectional error component". The usual assumptions made by ECM are

- The individual error terms are uncorrelated with each other.
- The individual error term not auto correlated with both units and time periods.

If we can estimate this model by using OLS and the above assumptions are not taken into account, their resultant estimates will not efficient. The most valid method in this case we can apply is the GLS method. When regressors are correlated with error term then we can apply instrumental variable technique such as 2SLS or GMM. Abrahamson and Youngs (1992) studied "a stable algorithm for regression analyses using the random effects model".

When we include lag term of the response variable as an explanatory variable then the random effect model is called "dynamic random effect model". Dynamic random effect model when we can incorporate lag term of the dependent variable is written in equation form as follow

$$Y_{it} = \beta_o + \beta_1 X_{1it} + \beta_2 X_{2it} + \beta_3 X_{3it} + \beta_4 Y_{it-1} + e_i + \mu_{it} \ldots\ldots\ldots\ldots\ldots\ldots (3.7)$$

Now we have to face a specific problem in the above model. This problem is due to the violation of the assumption of CLRM. The assumption of CLRM is that the regressors are exogenous to error term, if this assumption does not fulfill then there will be a problem of endogeneity. In such a situation least square method cannot be applied. There are two methods for endogeneity problem. First is instrumental variable least square method and 2nd is generalized methods of moments. These two methods are very popular to encounter the problem of endogeneity. Bhargava and Sargan (1983) estimate dynamic random effect model from longitudinal data using short time periods. .

3.5 Estimation Method for Panel Data Models

3.5.1 Generalized Method of Moments (GMM)

GMM is a popular method to account the problem of endogeneity and extension of Instrumental Variable (IV) technique. GMM is generalization of method of moments, moment conditions are constructed on the basis of available instruments. Three cases may arises

- No of moment conditions is less than no of parameters to be estimated and hence model is unidentified.

- No of moment conditions is equal to the no of parameters to be estimated, then model is exactly identified and hence we may apply the method of moments.
- No of moments conditions is more than no of estimated parameters then the model is over identified. Then estimates have no unique solution. In such a situation GMM provides us a unique solution. The procedure of this technique is as follows.

Consider simple linear regression model

$$Y = \alpha + \beta X + \mu$$

Then we will find valid instruments of X (instrumental variable should have correlation of high degree with the actual variable and no or low correlation with dependent variable). Suppose z_1 and z_2 are the valid instruments. Now, we have three options

- $E(\mu) = 0$
- $E(z_1\mu) = 0$
- $E(z_2\mu) = 0$

Here we have three moment conditions to estimate two parameters of the model. Replacing population moments by the corresponding samples moments, we get three equations and name these sample moments as m_1, m_2 and m_3. If we solve the above three equations simultaneously we would be unable to get unique estimates of two parameters.

In such a situation GMM technique can be applied to get unique estimates as following.

Now

$$W = Minimization\ (m_{12} + m_{22} + m_{32})$$

Differentiate the above function W w.r.t "α" and equate it to zero, it will provide us normal equation of α. Again differentiate W with respect to β, it will give us second normal equation of β. Solve the two equations simultaneously to get unique solution of regression co efficient α and β.

There are certain assumptions regarding GMM technique. First assumption is convergence of the empirical moments i.e the sample moments converges in probability to its counter parts. Second assumption is order condition (no of equation is greater than no of parameters to be estimated) and rank condition (moment conditions are not redundant). These assumptions establish that generalized method of moments give us unique estimates of parameters besides these assumptions one most important assumption regarding error term is also taken into account that random error term follow normal distribution. This normal distribution has zero mean and constant variance.

There are certain advantages regarding GMM estimation technique

- Model does not need to be serially independent and homoskedastic.
- Moment restrictions on error term, that lagged regressor and error term is zero.
- Accounts non-observable country related effects, time series effect and consider all independent variables are endogenous (Caseelli et al., 1996 ; Bondd et al., 2001)

Bondd et al., 2001 apply GMM introduced by Blundell and Bond (1998) and Arellano and Bover (1995) to growth equations and reduces the small sample bias that is used by Caselli et al. (1996).

3.6 Diagnostic tests

3.6.1 F-test Statistic:

We can provide formal test for choice between common effect model and fixed effect model. In relation to model (3.3), model (3.2) is restricted model in that sense; it imposes a same intercept for all the countries. In that case the restricted F test is used. Simply we can say that under null hypothesis common effect model is accepted and under alternative hypothesis fixed effect model is accepted. The formula for F test is as follows

$$F = \frac{\frac{\left(R^2ur - R^2r\right)}{p}}{\frac{(1-R^2ur)}{(l-m)}}$$

Where

R^2_{ur} = Unrestricted model's coefficient of determination

R^2_r = Restricted model's coefficient of determination

p = no of linear restrictions

m = no of parameters in the unrestricted model

l = no of observations

If F test statistic shows significant result then we can reject h_o and say fixed effect model is appropriate but if F test statistic shows insignificant result then we can accept h_o and say that common effect model is appropriate.

3.6.2 Hausman Test Statistic

In the comparison of fixed effect model and random effect model, we can see many differences among the two models. The important question is now: which results are reliable? Or which should be the choice between the 2 models? We know that in random effect model w_{it} is not correlated with any of the independent variables

and we also know that ϵ_i is the component of $w_{it,}$ it is possible that explanatory variables correlated with that error term. If it happens the ECM or random effect model will result in incompatible estimates. We can use Hausman test to moniter this assumption. The null and alternative hypothesis under Hausman test is as follow.

H_o= REM is appropriate or best one OR

Random effect model is selected

H_a= FEM is appropriate or best one OR

Fixed effect model is selected

Hausman test statistic follows chi-square distribution. If our H_o is rejected then we can conclude that fixed effect model is valid instead of random effect model but if we do not reject our H_o then we can say that random effect model is best one.

3.6.3 J Test Statistic

Advantages of GMM estimation lies over-identified models. Model is over identified if no of valid instruments are more than the no of variables to be replaced. To check over identification of the model, validity of "moment conditions" is tested. Formally we can consider the following hypothesis

H_o; All moment conditions are valid

H_1; All moment conditions are not valid

The j-statistic is applied to test the above hypothesis. J-test statistic follows chi-square dist with (k-l) degree of freedom where k is the no of estimated parameters and l is the number of valid moment conditions. If p-value is less than 0.05, we can reject over null hypothesis at five percent level of significance and conclude that moment conditions are not valid and if p-value is greater than 0.05, we can accept

over null hypothesis at five percent level of significance and conclude that moment conditions are valid.

3.7 Summary

In this chapter we have presented specification of our econometric model, discussed source of data and construction of institutional indicator variable through principal component method. In section (3.4) we have also studied different panel data models such as "Common effect model", "Fixed effect model", "Random effect model" and "dynamic random effect model" along with their concepts. We have also discussed method of estimation of these models; the "generalized method of moments" Dynamic random effect model which is very important model of our study is calculated through only GMM method. At the end of this chapter we have elaborated diagnostic tests for panel data models such as F-test statistic, Hausman test statistic and J-test statistic.

Chapter 4

Results and Discussions

4.1. Introduction

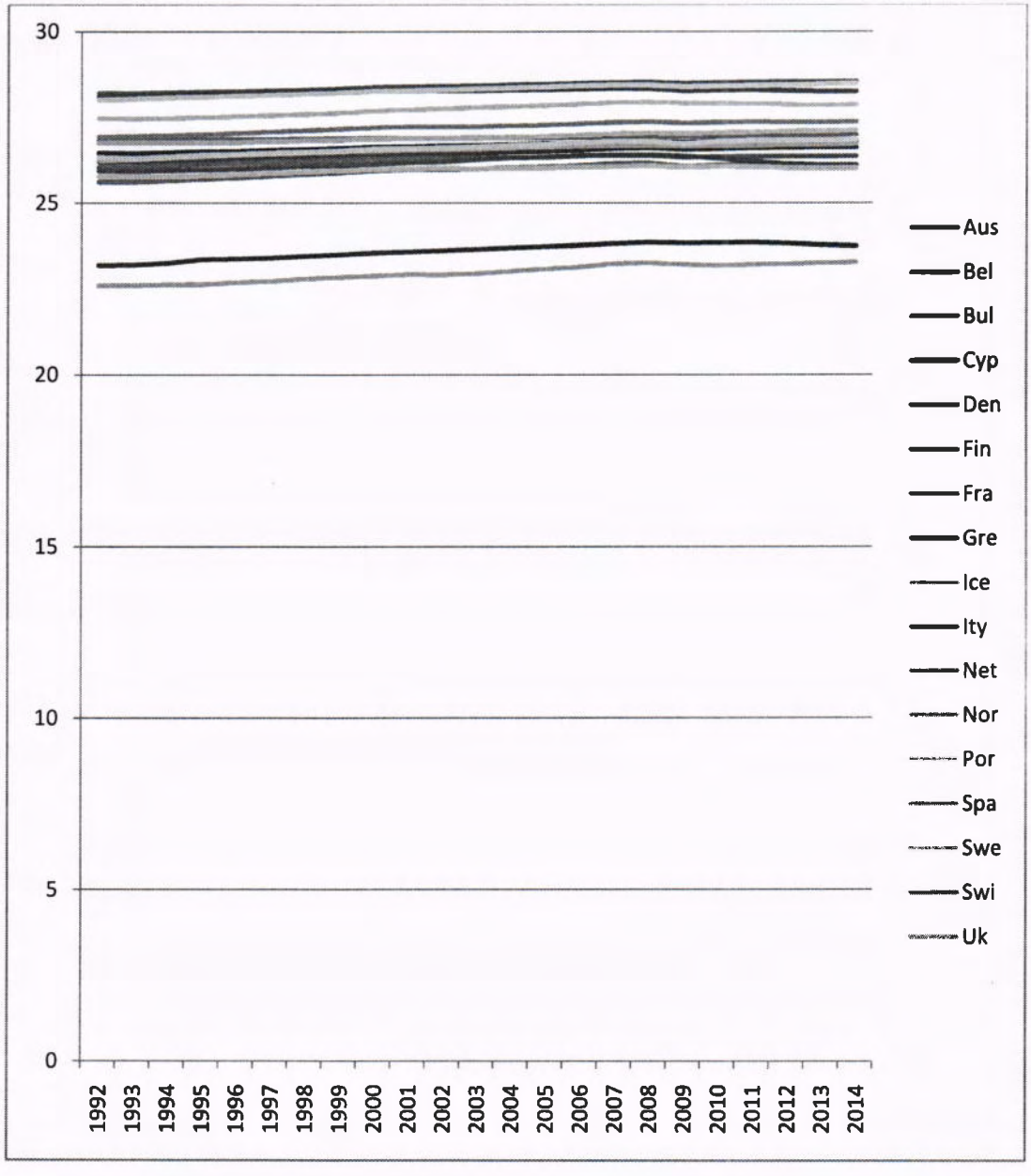
Chapter "Results and Discussions" contains four subsections. Section one includes the introduction. Section two is about the descriptive analysis of our response variable and explanatory variables. First Sub section of section two is the estimation of common effect model, second sub section contains estimation of fixed effect model and third sub section four covers the estimation of random effect model while sub section four elaborates the estimation of dynamic effect model. Section four summarizes the whole chapter.

4.2. Descriptive Analysis

4.2.1. Graphical Presentation of Response and Explanatory Variables

By using graphs we can brief our response variable "Gross Domestic Product" and explanatory variables "Gross Fixed Capital Formation and Institutional Indicators". We will see that these variables show approximately same type of pattern in case of our sample countries.

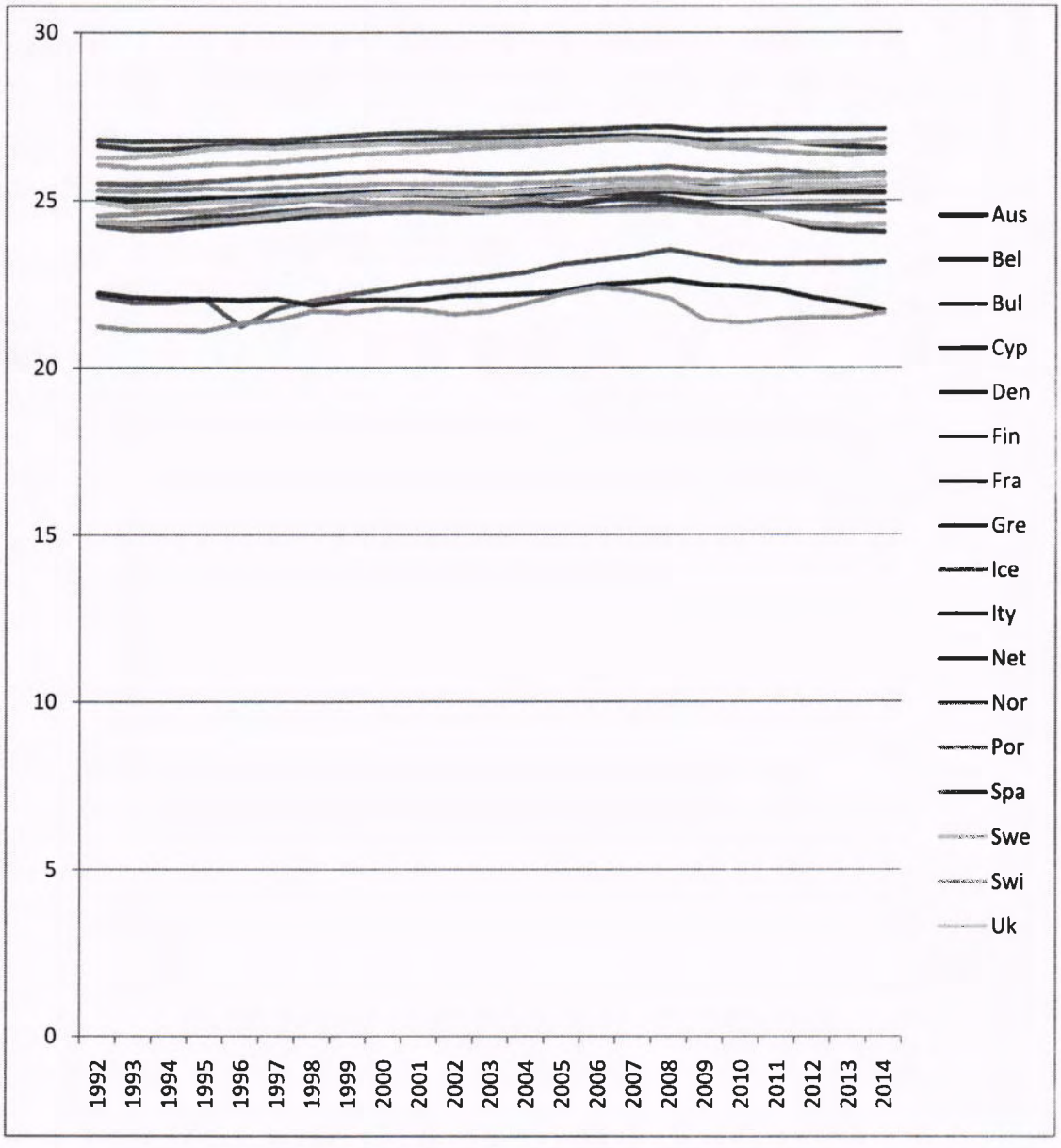
Figure 4.1 Graph of Gross Domestic Product



- Years on X-axis
- Gross domestic product on Y axis (log value of gdp)

On above graph we can see that gross domestic product of all selected countries show same pattern and the range is between 25 to 30 interval except two countries (Cyprus, Bulgaria) show same pattern but range is between 20 to 25.

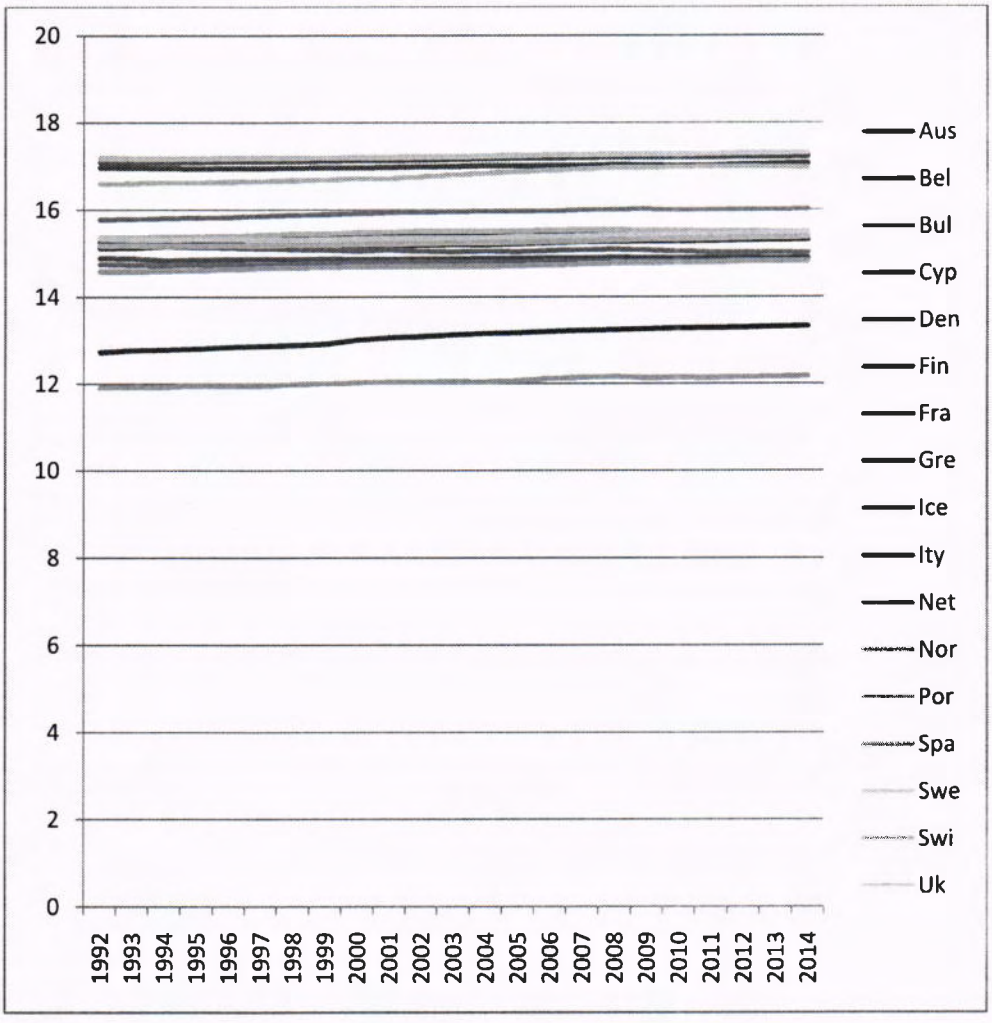
Figure 4.2. Graph of Gross Fixed Capital Formation



- Years on X-axis
- Gross Fixed Capital Formation data on Y axis

On above graph we can see that gross fixed capital formation of all selected countries show same pattern and the range is between 24 to 27 intervals except three countries (Cyprus, Bulgaria, Iceland) show same pattern but range is between 21 to 23.

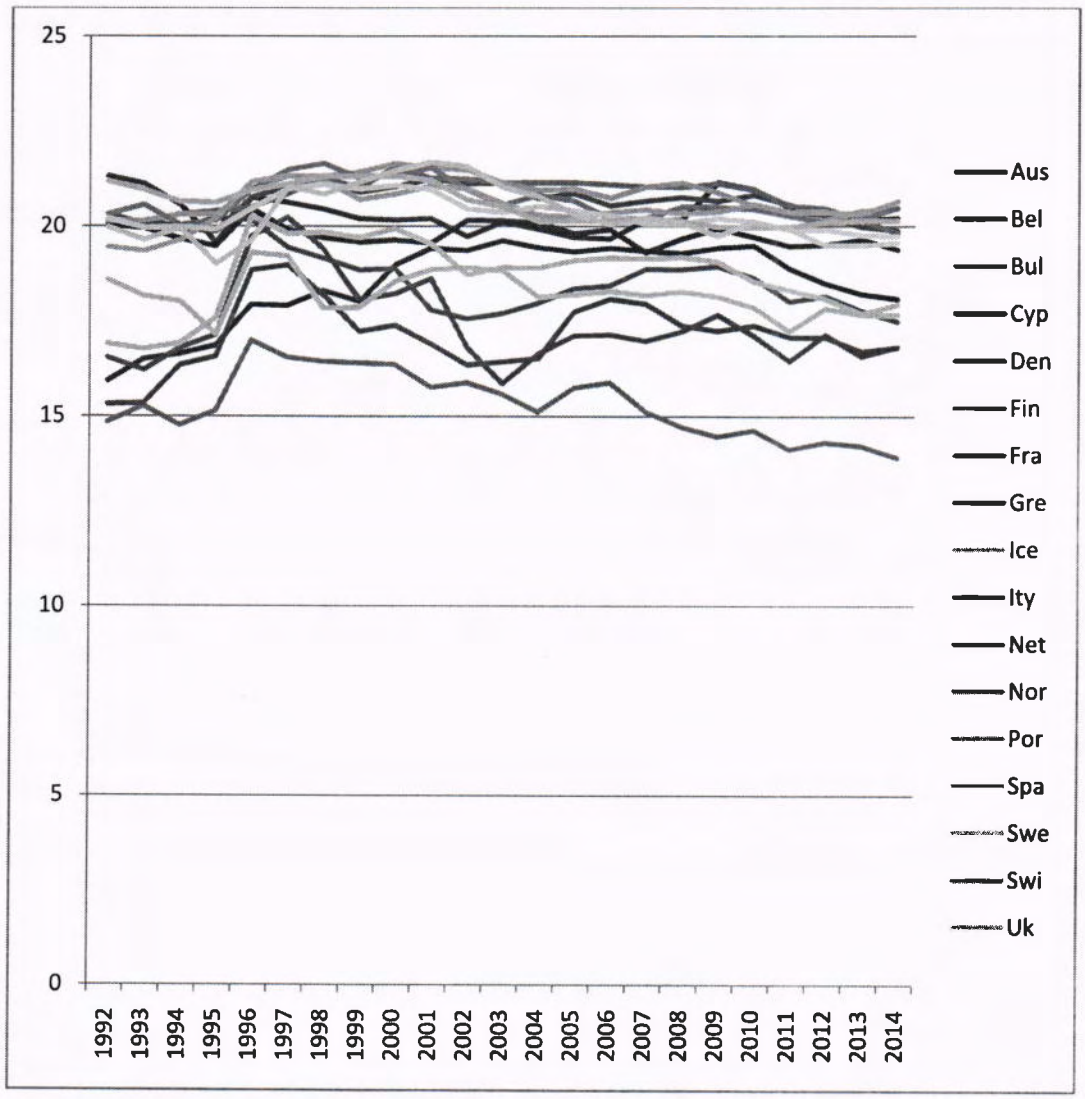
Figure 4.3. Graph of Labor Force



- Years on X-axis
- Labor force data on Y axis

Above graph show the labor force of our selected European countries. The term "labor force" implies to all those people who have ability to do work in an area or country. This labor force mainly depends upon total population of the country, that country which has larger population has greater labor force and vice versa. In further analysis we will see that labor force has a significant and positive impact on grossdomestic product or economic growth.

Figure 4.4.Graph of Institutional Indicators



- Years on X-axis
- Institutional indicators data on Y axis

Above figure show the graphical presentation of "Principal Component of Institutional Indicator". Mostly European countries are developed countries, so they show approximately same type of pattern and there points are between14 to 22. These points are given on the basis of institutional quality that they have enjoyed.

4.3. Results and Discussion

4.3.1 Estimation of Common Effect Model Through GMM

Parameters of the model represent common effect with respect to time period as well as cross sectional units and error term follows all assumptions of CNLRM, it is called common effect model. We can also estimate this model through ordinary least square method but according to theory we know that economic growth and institutions have causal relationship. In growth models common problem with institutional indicator variable is, they are endogenous in nature. So in this situation we have faced a specific problem, the problem of endogeneity in the model. In the case of endogeneity we can only use instrumental variable technique and the best technique in the family of instrumental variable technique is GMM due to its assumptions. The result of this model is presented in Table-4.1

Table 4.1 Results of Common Effect Model Through GMM

Variable	Co efficient	Standard Error	t-test statistic	p-value
Constant	2.229	0.281	8.003	0.0000
Lnx1	0.845	0.024	34.21	0.0000
Lnl1	0.183	0.028	6.36	0.0000
Icrg6	0.268	0.182	1.471	0.1419

Table 4.1(a) Goodness of fit and Diagnostic Test

Co efficient of determination(R-square)	(0.9882)
Adjusted R-square	(0.9881)
J –Test Statistic	(0.1335)
P-value(J- Test Statistic)	(0.714)

- Where dependent variable is gross value added at factor constant 2010 US dollar.
- Lnx1 (Gross fixed capital formation)
- Lnl1 (Labor force)
- Icrg6 (principal component of institutional indicators)

On the basis of probability value we can decide about significance and non significance of the parameters. We can take 5 percent level of significance, if probability value is less than 0.05 then the parameter estimate is significant, but if probability value is more than 0.05 then the parameter estimate is insignificant.

One unit change in gross fixed capital formation causes 0.845 percent increase in gross value added with standard error 0.024 and shows significant effect on dependent variable while one unit increase in labor force causes 0.183 percent increase in gross value added with standard error 0.028 and shows significant effect on dependent variable moreover one unit increase in institutional indicator causes 0.268 percent increase in gross value added with standard error 0.182 and shows insignificant effect on dependent variable. J-test statistic shows that instruments used

are valid instruments and adjusted R-square show that model can capture 98 percent variations of our model.

Overall common effect model is not valid model in our case because the model shows that economic growth and institutional indicator are insignificant but according to economic growth theory, economic growth (gross value added) and institutional indicators always have positive and significant effect. Therefore we can switch over fixed effect model.

4.3.2 Estimation of Fixed Effect Model Through GMM

At least one parameter of the model varies w. r. t time periods or w. r. t cross sectional units then such a model is called fixed effect model. Fixed effect (LSDV) model allocate intercept value to all its candidate entities for allowing heterogeneity. We can apply "generalized method of moment" for the estimation of "fixed effect model". The result of this model is presented in Table-4.2

Table 4.2 Results of Fixed Effect Model Through GMM

Variable	Co efficient	Standard Error	t-test statistic	p-value
Constant	2.742	1.09	2.514	0.0124
Lnx1	0.337	0.027	12.157	0.0000
Lnl1	1.017	0.035	28.892	0.0000
Icrg6	-0.461	0.142	-3.243	0.0013

Table 4.2(a) Goodness of fit and Diagnostic Test

Co efficient of determination(R-square)	(0.9986)
Adjusted R-square	(0.9976)
J –Test Statistic	(2.608)
P-value(J- Test Statistic)	(0.156)

One unit change in gross fixed capital formation causes 0.337 percent increase in gross value added with standard error 0.027 and shows significant effect on dependent variable while one unit increase in labor force causes 1.017 percent increase in gross value added with standard error 0.035 and shows significant effect on dependent variable moreover one unit increase in institutional indicator causes 0.268 percent decrease in gross value added with standard error 0.142 and shows significant effect on dependent variable. J-test statistic shows that instruments used are valid instruments and adjusted R-square show that model can capture 99 percent variations of our model.

Overall fixed effect model is not valid model in our case because the model shows that economic growth and institutional indicator have negative or inverse relationship, but according to economic growth theory, economic growth (gross value added) and institutional indicators always have positive and significant effect. Therefore we can switch over Random effect model.

4.3.3 Estimation of Random Effect Model Through GMM

We can define the REM as if parameters of the model are suppose to vary randomly w.r.t units or time periods and hence that random variations of the parameters may be considered by the introduction of random error term. Such a panel data model is called random effect. Such a panel data model is called random effect model. The composite error term of REM consists of two components, "the cross-sectional or individual specific error component and the combined time series and cross sectional error component". The usual assumptions made by ECM are

- The individual error terms are uncorrelated with each other.
- The individual error term not auto correlated with both units and time periods.

If we can estimate this model by using OLS and the above assumptions are not taken into account, their resultant estimates will not efficient. The most valid method in this case we can apply is the GLS method. In growth models common problem with institutional indicator variable is, they are endogenous in nature. When regressors are correlated with error term and have causal relationship then we can apply instrumental variable technique such as GMM. The result of this model is presented in Table-4.3

Table 4.3 Results of Random Effect Model Through GMM

Variable	Co efficient	Standard Error	t-test statistic	p-value
Constant	5.85	0.632	9.249	0.0000
Lnx1	0.430	0.032	13.24	0.0000
Lnl1	0.6569	0.031	21.123	0.0000
Icrg6	-0.3274	0.188	-1.735	0.0836

Table 4.3(a) Goodness of fit and Diagnostic Test

Co efficient of determination(R-square)	(0.8986)
Adjusted R-square	(0.8977)
J –Test Statistic	(0.00163)
P-value(J- Test Statistic)	(0.96775)

One unit change in gross fixed capital formation causes 0.43 percent increase in gross value added with standard error 0.0324 and shows significant effect on dependent variable while one unit increase in labor force causes 0.6569 percent increase in gross value added with standard error 0.031 and shows significant effect on dependent variable moreover one unit increase in institutional indicator causes 0.3274 percent decrease in gross value added with standard error 0.142 and shows insignificant effect on dependent variable. J-test statistic shows that instruments used are valid instruments and adjusted R-square show that model can capture 89 percent variations of our model.

Overall random effect model is not valid model in our case because the model shows that economic growth and institutional indicator have insignificant and negative or inverse relationship, but according to the economic growth theory, economic growth (gross value added) and institutional indicators always have positive and significant effect. According to F-test statistic (P-value less than 0.05) and hausamn test statistic (P-value less than 0.05), fixed effect model is appropriate model but the estimate of institutional indicator show insignificant impact on economic

growth, so there is a problem in this model. Therefore we can switch over to the most important model "Dynamic Random effect model".

4.3.4 Estimation of Dynamic Random Effect Model Through GMM

When we include lag term of the response variable as an explanatory variable then the random effect model is called dynamic random effect model. Now we have to face a specific problem in the above model. This problem is due to the violation of the assumption of CLRM. The assumption of CLRM is that the regressors are exogenous to error term, if this assumption does not fulfill then there will be a problem of endogeneity. In this model endogeneity arises in two ways. Firstly economic growth and institutional indicators have causal relationship. In growth models common problem with institutional indicator variable is, they are endogenous in nature. Secondly lag term and error term are also correlated due to inclusion of dependent lag term in the model. So we can apply instrumental variable technique that is GMM. The result of this model is presented in Table-4.4

Table 4.4 Results of Fixed Effect Model Through GMM

Variable	Co efficient	Standard Error	t-test statistic	P-value
Constant	0.1557	0.035	4.44	0.0000
Lnx1	0.033	0.013	2.55	0.0011
Lnl1	0.016	0.003	4.09	0.0001
Icrg6	0.103	0.034	2.98	0.0030
Lny1(-1)	0.9506	0.011	80.06	0.0000

Table 4.4(a) Goodness of fit and Diagnostic Test

Co efficient of determination(R-square)	(0.9997)
Adjusted R-square	(0.9997)
J –Test Statistic	(0.00149)
P-value(J- Test Statistic)	(0.9692)

One unit change in gross fixed capital formation causes 0.033 percent increase in gross value added with standard error 0.013 and shows significant effect on dependent variable while one unit increase in labor force causes 0.016 percent increase in gross value added with standard error 0.003 and shows significant effect on dependent variable moreover one unit increase in institutional indicator causes 0.103 percent decrease in gross value added with standard error 0.034 and shows significant effect on dependent variable. Lag term of dependent variable also shows significant effect. J-test statistic shows that instruments used are valid instruments and adjusted R-square show that model can capture 99.99 percent variations of our model.

Dynamic Random effect model is the valid model because it shows that economic growth and institutional indicator have significant and positive relationship which is according to the economic theory. Our other explanatory variables such as labor force and gross fixed capital formation also show significant impact on our response variable. One unit change in labor force can positively and significantly affect 0.016 percent increase in GDP while one unit change in gross fixed capital formation can also positively and significantly affect 0.033 percent increase in GDP. Lag term of dependent variable also show significant effect, it means economic

growth depends upon its own lag value. J-test statistic and adjusted R-square is also in favor of this model. So their estimates are reliable and we can use these estimates for policy making in the case of selected European countries.

4.4. Summary

In this chapter we can estimate "common effect model, fixed effect model, random effect model and dynamic effect model". First three models are not valid models due to many reasons. Common effect model is not selected as a valid model because the estimate of institutional indicators is insignificant. Fixed effect model and random effect model are also not selected because their estimate shows inverse relationship between economic growth and institutional indicators whereas fixed effect model shows significant effect of institutional indicators on economic growth and random effect model shows insignificant effect of institutional indicators on economic growth. According to F-test statistic (P-value less than 0.05) and hausamn test statistic (P-value less than 0.05), fixed effect model is appropriate model but the estimate of institutional indicator show insignificant impact on economic growth, so there is a problem in this model.

Dynamic Random effect model is the valid model because it shows that economic growth and institutional indicator have significant and positive relationship which is according to the economic theory. Our other explanatory variables such as labor force and gross fixed capital formation also show significant impact on our response variable. One unit change in labor force can positively and significantly affect 0.016 percent increase in GDP while one unit change in gross fixed capital formation can also positively and significantly affect 0.033 percent increase in GDP. Lag term of dependent variable also show significant effect, it means economic growth depends upon its own lag value. J-test statistic and adjusted R-square is also in

favor of this model. So their estimates are reliable and we can use these estimates for policy making in the case of selected European countries.

Chapter 5

Summary, Conclusion and Recommendations

This thesis comprises five chapters. Chapter 1 contains the explanation of our topic and objectives of our study. The core objective of our study is to determine the factors that represents institutions of the economics, to construct theoretical framework that represent the effect of institutions on the economic growth and to test the effect of institutions on the economic growth in the case of selected European countries using panel data models and select the best model.

Chapter 2 "review of literature" contains four sections. In this chapter we can give an overview of the chapter and discuss basic concepts of economic growth and institutions. We can also see that there is a relationship among economic growth and institutions. Economic growth also depends upon labor force, physical capital and advanced technologies etc. Economic growth is very sensitive in relation with institutions. We can present different studies related to effect of institutions on economic growth. The entire study, establish a direct and positive relation between economic growth and institutions. Statistical analysis of these studies through different econometric models shows a positive and significant relationship among economic growth and institutional indicators. The effect of institutional indicators is positive in low income countries as compared to high income countries. Investment profile effect is less effective in developed countries as compared to developing countries for growth process. Analysis shows that for the long term economic increase institutions are very important. Institutions play key role for development in developed countries as compared to developing countries. The results of these studies also reveals that institutional structure indicators such as the trade barriers, integrity of the law system, restriction of foreign investments have a significant and positive

effect on the economic growth of the developing countries. On the other hand, according to the analysis results, variables as civil freedoms, government expenditures, collective bargaining, the black market exchange rate and military support have negative effect on the macro-economic conditions of developing countries.

In chapter 3 we have presented specification of our econometric model, discussed source of data and construction of institutional indicator variable through principal component method. We have also studied different panel models such as common, fixed, random and dynamic effect model along with their concepts. We have also discussed "generalized method of moments" for the estimation of these models. Dynamic random effect model which is very important model of our study is calculated through only GMM method. At the end of this chapter we have elaborated different diagnostic tests for panel data models such as F-test statistic, Hausman test statistic and J-test statistic.

In chapter 4 we can estimate common, fixed, random and dynamic effect model. First three models are not valid models due to many reasons. Common effect model is not selected as a valid model because the estimate of institutional indicators is insignificant. Fixed and random effect model are also not selected because their estimate shows inverse relationship between economic growth and institutional indicators whereas fixed effect model shows significant effect of institutional indicators on economic growth and random effect model shows insignificant effect of institutional indicators on economic growth.

Dynamic Random effect model is the valid model because it shows that economic growth and institutional indicator have significant and positive relationship which is according to the economic theory. Our other explanatory variables such as

labor force and gross fixed capital formation also show significant impact on our response variable. One unit change in labor force can positively and significantly affect 0.016 percent increase in GDP while one unit change in gross fixed capital formation can also positively and significantly affect 0.033 percent increase in GDP. Lag term of dependent variable also show significant effect, it means economic growth depends upon its own lag value. J-test statistic and adjusted R-square is also in favor of this model. So their estimates are reliable and we can use these estimates for policy making in the case of selected European countries.

Recommendations

- Institutions are the basic determinant of the economic growth, if we want to reach high and consistent increase, institution's quality should be strengthened.
- The effect of different institutions is different among countries or regions. While preparing and implementing institutional reforms we should consider their local requirements such as "development stage of an economy".
- For the long term economic expansion, different regions need different institutional indicators and also the quality of institutions. Especially "The house environment" plays a fundamental role in making appropriate institutions.

For further research, this work can be extended to Bayesian panel econometrics (estimating through OLS, 2SLS and GMM estimation techniques) and Bayesian spatial econometrics, is my next goal.

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