"LUCIAN BLAGA" UNIVERSITY OF SIBIU

FACULTY OF ECONOMICS

DOCTORAL STUDIES

THESIS SUMMARY:

THE INFLUENCE OF PRIVATE AND PUBLIC SECTORS ON ECONOMIC GROWTH IN THE EUROPEAN UNION

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Sibiu, 2017

TABLE OF CONTENTS

KEY WORDS

➢ economic growth, public and private determinants, regional growth, metropolitan growth, European Union, dynamic panel data models, panel data techniques

INTRODUCTION

The motivation for choosing the theme and the importance of the subject

The Ph.D thesis entitled *"The influence of private and public sectors on economic growth in the European Union"* addresses a very important topic for macroeconomists, which is to determine the most important factors of economic growth. Researchers, Nobel Prize winners and public institutions tried to find the proper definition for the concept of economic growth. Why should we focus on this dry statistical issue? This is because economic growth is a key factor in the well-being of billions. From the advantages brought by the industrial revolution, advanced countries that experience constant growth help their citizens to live well and longer. The recent economic crisis of 2008 showed that certain events can also pay a significant role in determining the variation of gross domestic product. Better understanding the mechanism behind what influences the economy will help us in mitigating or eliminating the negative outcomes that affect economic development.

Economic growth is the pinnacle of the twentieth century. Entire nations continue to see it as an extremely important objective economically and politically, the only factor that ensures the economic success of a nation in the long term.

The theme proposed for this scientific research aims at showing how private and public variables have had an influence on economic growth in the European Union at different territorial levels, more specifically at country, regional – NUTS areas and metropolitan level.

The link between government investment and economic development is a widely explored topic. Research studies that targeted the public sector are important for policy-makers from different countries, who are interested in allocating government funds more efficiently. The analysis of the influence of the private sector on economic growth is a less

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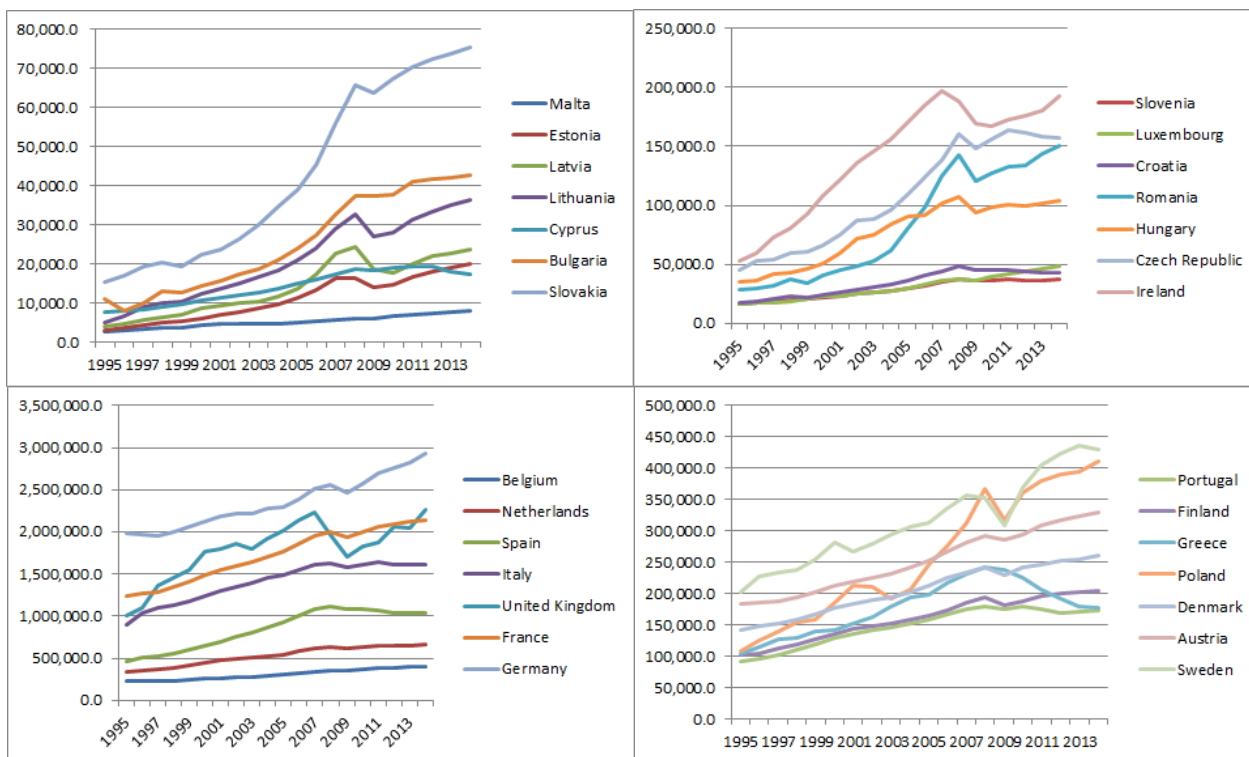
Figure 1: The evolution of GDP for the 28 EU countries from 1995 to 2014

Source: own contribution

investigated theme in the literature. Very often in research papers that focused on the public sector, there were also some private variables that were included (gross capital formation, public investment, FDI, exports, etc.).

Gross domestic product in the EU has risen considerably. Figure 1 shows that between 1995 and 2014 many states saw improvements regarding economic development. For most of the Eastern European countries, the European integration was an advantage because of the new capital investments and the benefits of open trade. GDP is an aggregate indicator and it is important to quantify the exact factors that determined the rise in EU economic growth. This thesis investigates what factors have determined economic growth in the EU for different territorial levels and tries to quantify and to make a comparison with other studies. This study will be important for policy makers in better determining the exact factors that foster economic development.

Placing the thesis in the scientific context

The shifts that are taking place in the economy in the recent years have seen many developing states play a more important role in the world. Migration, globalization and the opening of new trade markets helped states like China, India or Brazil to have each year a sustained economic growth rate.

Emerging markets account for more than 50% of the world's total output and China has already outpaced the US as the top economy. What were the other factors that determined this economic advancement? Regarding the European Union, the 2008 economic crisis impacted negatively many nations. Greece lost more than a third of its GDP since the onset of the economic crisis and Western European countries have each year a below 1% GDP growth rate. Are these outcomes a direct consequence of the austerity measures? What were the determinants of economic growth for the European Union states? These factors can be measured using economic variables, but some of them like trust, uncertainty, panic, political instability are non-economic factors.

The literature makes a clear distinction between economic and non-economic factors. For example "proximate" or economic sources refer to factors like capital accumulation, technological progress and labour and "ultimate" or non-economic sources refer to factors like government efficiency, institutions, terrorism, political and administrative systems, cultural and social factors, geography and demography.

Europe is in the middle of a changing economic and political landscape. The developing nations of the EU are seeing improved economic growth with the industrialized countries facing more political and social problems than economic ones. The 2016 vote for the Brexit may impact Europe in a negative way if policy makers will not come with concise measures. The huge wave of migrants and terrorism will have serious consequences on the economy and on human trust.

Are the economic growth models still viable in this ever changing world economy? More and more people are involved in creating virtual goods which are produced with smaller costs and distributed much easier. All you need for this is access to the internet and an

innovative idea. We should not ignore the Space industry, which generates 300 billion each year. This industry could have a decisive effect for the economy in the future.

Knowledge stage

Economic growth theories and econometric models highlight the various ways in which the present economic activity can influence the future and identify sources that may lead to continuous growth. These theories have evolved over time, depending on the dynamics of the economic reality and the evolution of economic analysis tools. The interest in this subject was and is very high. From the classical economists to the present new economic growth theory, this topic is very debated and researched.

There are a large number of scientific investigations in this field proved by the considerable number of articles, books, journals and other such works. Many theoretical and empirical works helped improve the knowledge regarding the determinants of economic growth. There are a large number of economists that have devoted an important part of their life to study the concept of economic growth and what influences this difficult concept. I will only name a few of them, such as: A. Smith, D. Ricardo, T. Malthus, J. M. Keynes, R.J. Barro, R. Solow, Sala-I-Martin.

Research studies investigated the impact on economic growth of such determinants like investment, human capital, economic and fiscal policies, trade openness, foreign direct investment, research and development, institutional and political framework, socio-cultural factors, geography and demography. These studies were conducted mostly on country samples, but in the recent decades, there is a surge of empirical analysis done for regional, metropolitan or city samples.

Many authors have dealt with the relationship between public expenditure, foreign direct investment, openness, public or private investment, non-economic variables, among others and economic growth at country level. Some of them focused on a single field of study like for example the role of health and education on economic growth, or the role of public and private investment.

The empirical research in the field of regional economic growth has tried to determine what variables have an influence on growth and to come to a consensus on the relevant sign of the variation. There are a number of research studies that determined a significant link between innovation (research and development expenditures, patent application, population employed in research), transportation (airport infrastructure, roads, highways), population growth, capital formation, energy consumption, public investments and economic growth at EU regional level (Bottazzi and Peri, 2002; Parent and LeSage 2012; Rodriguez-Pose et al. 2012, 2015). Like in the case of economic growth at country level, there is still not a consensus on the effects of some variable. Also, contradictions in results may appear from studies done for different regions like South America, China, North America or Russia (Golubchikov 2007; Spiezia and Weiler 2007; Hartono et al. 2007).

The notion that cities and metropolitan regions are a source of economic growth is gaining more and more focus in the recent period. Cities and urban zones are considered to be the fundamental sites for the concentration of economic activity. This is in part because of the new research done by many scholars in the field of new economic geography (agglomeration economies) or the ones involved in the "new growth theory" (Glaeser et al. 1992; Combes 2000; Melo et al. 2009).

Urban areas are human centres that allow for the exchange of goods, ideas and people and in turn the society reaps the benefits from trade and specialization. They facilitate all these factors to come together to allow for more production and labour specialization. Towns and cities rose to become market places in which goods and services are transferred faster and more efficiently.

These concepts and findings will represent the theoretical and methodological framework for this thesis. Also, this investigation will use the latest research regarding the concept of economic growth, published in top journals. The study will identify the possibilities to extend the investigation in this field and to provide comprehensive comparisons with the findings captured by previous studies. All of these literature works will be presented at the end of the thesis in a separate section entitled References.

The main objectives of the thesis

The most important objective of this thesis is *to determine the main factors that influence economic growth in the European Union*. This objective is researched in the three empirical chapters of this study.

The first empirical chapter entitled **„Investigating the most important factors that determine economic growth in the European Union: An analysis of EU 28 countries"** has as its main objective to establish the *most important factors that impacted economic growth for the 28 European Union countries*. The other goals of this chapter, that stem from this main objective, are to provide comprehensive knowledge regarding what public or private variables have a more important role on economic growth. Furthermore, the division of education into primary, secondary and tertiary levels demonstrated which type of schooling is more significant. By using a dynamic panel data model, the lag dependent variable also highlighted meaningful knowledge related to the economic convergence hypothesis.

The second empirical chapter entitled „**Territorial economic growth in the EU:An analysis of NUTS 1 and NUTS 2 regions between 2000-2013**" has as a main objective to provide conclusive information regarding th*e most relevant determinants at regional/territorial level in the European Union for 98 NUTS 1 and 273 NUTS 2 areas*. Another objective is to establish if the convergence hypothesis holds for the above mentioned regions.

The objective of the last empirical chapter entitled „**Are European metropolitan regions still relevant and what are the driving forces of urban economic growth?"** is to determine the most important factors that influenced economic growth at EU metropolitan level. The secondary objective that stems from this initial one is to find out which economic sectors are significant in fostering economic development. Another goal is to see if population measured by density, size and growth and net migration had a relevant effect for the variation of per capita gross domestic product at metropolitan level. Furthermore, an essential goal of this chapter is to present conclusive information regarding the difference between Western and Central and Eastern European metropolitan regions.

Thesis methodology

The methodology of this thesis is an empirical one in the sense that it is using econometric models by which the influence of the main important factors of economic growth in the European Union (at country, regional and metropolitan level) was evaluated. The data for this empirical investigation is collected from renowned international organizations. It is collected from credible sources like the World Bank's Statistical Database, the European Commission's statistical database (Eurostat), the Annual Macroeconomic database of the European Commission (AMECO), which process the information gathered from state and private institution.

The main goal of this thesis is to determine the factors that influenced economic growth in the EU after the 1990's for the country analysis and after the 2000's for the regional and metropolitan analysis. This investigation involves the use of certain research methods and techniques, as follows:

The documentation and literature review involves the use of references, of theoretical documentation by consulting journals, books, national or international papers. Also, this documentation comprises of further processing and a complex interpretation of the findings.

The mathematical and the statistical methods requires the use of classification, static and dynamic analysis, the correlation between variables, econometric modelling and the use of panel data techniques suited for the models created, graphical representations to show the trend of the variables used in the models, the representation of the minimum, maximum, mean and standard deviation.

The interdisciplinary methods are based on economic (use of economic variables like GDP, FDI, etc. or of economic ratios), econometrics (using certain specification tests for determining the proper models to be used like the Hausman, Fisher, Parm, In-Pesaran-Shin,Breusch-Pagan), mathematics and informatics (the use of the STATA program).

To accomplish the aim of the thesis and to empirically investigate it, the study demonstrated which determinants are the most important in fostering economic growth in the

European Union at different territorial levels, namely at country, regional and metropolitan division. A secondary objective of this thesis was to determine if the convergence hypothesis still holds for the EU. The thesis has three empirical chapter, namely Chapter Three, Four and Five and these chapters have the following methodology:

Chapter 3 entitled „*Investigating the most important factors that determine economic growth in the European Union: An analysis of EU 28 countries***"** provided conclusive information regarding the variables that determine economic growth for the 28 European Union[1] countries from 1990 to 2014. It empirically investigated the relationship between:

- the dependent variable, real gross domestic product per capita
- the independent variables life expectancy, final energy consumption, financial sector leverage, general government debt, total general government expenditure, government deficit, employment rate, exports, imports, trade openness, private sector debt, real labour productivity per hour worked, gross fixed capital formation, foreign direct investment, inflation, population size, primary, secondary and tertiary education.

The investigation used several dummy variables to measure if the governance indicators (control of corruption, absence of violence of terrorism, government effectiveness, rule of law, etc.) used by the World Bank had an influence on economic growth and also if there is any difference between Western, Eastern, Northern, Southern or Western Asian regions. The study used a dynamic panel data model and the variables were logarithmized using the neglog transformation which doesn't drop observation form the panel. The chapter highlighted a summary statistics table for the variables (mean, std.dev, observations, etc.) and the correlation matrix. Some preliminary tests were conducted to determine what kind of econometric model will be properly used for this investigation, like the Fisher and Im-Pesaran-Shin unit root tests, Hausman, Breush- Pagan/Cook-Weisberg, LR for panel-level heteroskedasticity, Wooldridge tests. The Pesaran, Frees and Friedman test were also computed to determine the cross section independence. To offer more robustness of the

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[1]The 28 EU countries are Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and United Kingdom

results, several panel date techniques were used, namely the pooled OLS, REM, FGLS and FMOLS regressions. The investigation used also the GMM and system GMM estimations. These two methods are popular for dynamic panel investigation. They increase efficiency of estimation, are suited for autocorrelation and heteroskedasticity and try to fix endogeneity biases. Finally the methodology showed if the model is properly fitted by conducting some normality tests – Ramsey, Shapiro Wilk W and by plotting the residual.

Chapter 4 entitled „*Territorial economic growth in the EU:An analysis of NUTS 1 and NUTS 2 regions between 2000-2013*" continued the investigation by empirically analysing the factors that determine economic growth for 98 NUTS 1 and 273 NUTS 2 regions from 2000 to 2013, regions that are in the same 28 European Union countries as in the previous chapter. The study empirically investigated the relationship between:

- two dependent variables used to measure economic growth, namely real GDP/capita and real GDP per inhabitant in purchasing power standard.
- independent variables are population size, fertility rate, life expectancy, early leavers from education and training, persons with tertiary education, average hours of usual weekly hours of work at main job (male and female), employment rate (total, male and female), R&D expenditures, infrastructure (motorways and other roads), total nights spend by residents and non-residents in tourist accommodations, the stock of vehicles, population density and net migration.

This study also used a dynamic panel data model and the neglog transformation. Some preliminary tests were conducted to determine what kind of econometric model will be properly fitted, like the Fisher unit root test, Hausman (to decide between a fixed or random effects model) and Parm tests. To offer robustness the GMM, system GMM and QML methods were used. The quasi-maximum likelihood method does not use any instruments like the GMM or system GMM methods. Also the weak instruments that may be used in the GMM and SysGMM are avoided in QML estimation. By graphically illustrating the variation of GDP/ capita between 2000 and 2013 the chapter also highlighted if the convergence hypothesis holds. Because of the 2008 crisis, many regions saw a drop in output and this in turn affected GDP.

Chapter 5 entitled „*Are European metropolitan regions still relevant and what are the driving forces of urban economic growth?"* analysed the variables which played an important role at the metropolitan level in the European Union. The investigation is carried out for 14 years (2000-2013). The chapter will empirically investigate the relationship between

- two dependent variables used to measure growth, namely metropolitan real GDP/capita and real GDP per inhabitant in purchasing power standard.
- the explanatory variables that measured the impact of certain economic branches on economic growth were the share of metropolitan gross value added of agriculture, forestry and fishery, industry, manufacturing, construction, wholesale and retail trade, transport, accommodation and food service activities and finally, information and communication in total metropolitan gross value added.
- other independent variables were the number of employees, population size, density and growth, economically active population, net migration and a dummy variable that controls for the effects of European enlargement.

This study also used a dynamic panel data model and neglog transformation. The Hausman test was used to determine if the model is a random or fixed effects one. The Parm test was used to show if the model needs time fixed effects. Like in the previous chapter the GMM, system GMM and QML methods were used. To further improve efficiency and offer more robustness the study opted to split the time period in two (2000-2008 and 2008-2013) and also to divide the panel sample so as to measure the difference between Western and Central and Eastern metropolitan areas.

Research limitations

The concept of economic growth has some inherent limitations and we should not avoid underlining these facts because they may have serious economic and social repercussions. For this thesis a first limitation can be the problem of measurement or the occurrence of systematic errors which can have a negative effect on the outcomes of any empirical analysis and can bias the results.

Another problem regarding economic growth analysis is the fact that missingness has been always a common occurrence, especially for large panel data. For regional and metropolitan data missing values can affect the empirical results of the analysis. The study tries to overcome this problem by using several panel data techniques and by applying the quasi-maximum likelihood which is better suited to overcome this bias.

An important topic for future analysis of the models constructed in this thesis is the necessity to include spillovers which measure positive or negative externalities. For example, knowledge spillovers which are created by companies or institutions can affect other firms or institutions and can lead to more economic growth. In the category of spillovers we can find other types like industry, environmental or spatial spillovers.

The structure of the thesis

The Ph.D thesis has the following structure: Introduction, two theoretical chapters of the theories and main determinants of economic growth and the most important contributions econometric modelling, three empirical chapters, conclusions, appendices and references.

Chapter 1 entitled **„The literature review concerning economic growth . The main determinants"** showed that economic growth theory is a very complex process that involved many researchers and decades and centuries to refine. From the beginning of the classical theory of Adam Smith in the 18th century to the present days of the new growth theory, models have evolved constantly to take into account the changes in the economy.

Economic growth is determined by direct factors such as human resources (the increase of the active population, education - investing in human capital), natural resources (underground resources, soil, climate conditions), the increase in capital employed or technological changes/advancements and indirect factors such as institutions (private administrations, financial institutions, etc.), the size of the aggregate demand (the absorption capacity of the internal market), the efficiency of the banking system, investment rates and saving rates, the migration of labour and capital, fiscal and budgetary policies of the state and the efficiency of the government.

Economic growth in the long term has two major sources:

- Quantitative growth of production factors (the number of people, the amount of fixed or working capital used). It is also called extensive growth;
- Qualitative growth factors, i.e. the factors of production efficiency (productivity thereof). It is the result of intensive economic growth.

Economic growth measured by gross domestic product signifies the increase of the growth rate of GDP, but what influences the rise of each component is very different. Public and private factors have different outcomes on economic growth. Public spending, inflation, capital formation, private investment, employment rates, etc. have different consequences on economic growth and we should take into account that these factors have different implications if the countries are developed or not. There are also socio-political factors and events that have a major influence on the economic advancement of a nation (Boldeanu and Constantinescu 2015).

The chapter has highlighted the main determinants of economic growth ranging from public expenditure, foreign direct investment, openness, export, imports, private and public investment or "ultimate" (non-economic) causes. There are many more determinants that are being refined and disaggregated to be used into new and advanced models of economic growth. Also, as new mathematical and statistical models and tests are being produced, the old assumptions have to be retested and if differences occur the theory has to be modified.

For a well-balanced economic growth model we have to take into account the proximate causes (economic determinants) and also the ultimate causes or the fundamental causes (Acemoglu 2009). Also, as new statistical data are being published, the research has to focus not only on country analysis, but on regional analysis as well, like for example in the European Union the Nomenclature of Territorial Units for Statistics.

Moral-Benito (2007) affirmed that: *"in the search for a satisfactory statistical model of growth, the main area of effort has been the selection of appropriate variables to include in linear growth regressions. The cross-country regression literature concerned with this task is enormous: a huge number of papers have claimed to have found one or more variables correlated with the growth rate, resulting in a total of more than 140 variables proposed as growth determinants."*

Chapter 2 entitled **„Economic growth models"** focused on the main economic growth models and how they were used for determining the main influences on growth. Economic growth models are an important part of the growth theory. The evolution in time of these models was used for capturing the main characteristics of the most important macroeconomic indicators that influence the development of the contemporary economy.

Economic growth models have been a key interest for researchers since the classical period. Economists like Adam Smith (1776) or David Ricardo (1817) tackled with the problems of determining the appropriate factors that influenced economic growth. Keynesian models and the ones that followed (the Neo-Keynesians) argued that to have a stable economy requires the use of macroeconomic policies and direct state intervention in reaching equilibrium and stimulating economic growth. At the other extreme we have the neoclassical models who claim that the economy is stable and that it will return to a steady-state if different shocks will occur.

The chapter presented five important economic growth models developed mostly after the first and second world wars. For example the Harrod model has at its centre the correlation between economic growth rates and the accumulation rate, which depends on the investment rate. The basic elements of the model are three equations, by which you can calculate three possible rates of economic growth: the actual rate of economic growth, the warranted growth rate and natural growth rate.

The Domar model of economic growth doesn't differ much from that of Harrod. However, he highlighted some rather interesting particular issues. Domar starts from the observation that the Keynesian model, while containing a detailed analysis of demand and the impact of investments on it, completely ignores the effects that the same investments have on the supply component. For Domar (1946) the investments that appear in Keynes's model have a multiplying effect on demand, but no multiplying effect on the productive capacity, considered to be constant in time.

A fundamental point of economic growth for Domar is the fact that the act of investment always produces a double effect: on one hand, it increases global demand and, on the other hand, it leads to increasing production capacity, of real supply. A balanced growth is

only possible when the two effects are quantitatively equal, so only when demand growth is equal with the real supply.

Next, I continued by presenting the Solow model, which is an exogenous growth model. It shows us how increasing savings rate, population growth and technological progress affect economic growth and the production level over a certain period. Before this model the most used one was the model developed by Harrod and Domar (Harrod 1939, Domar 1946).

Solow's (1956) neoclassical model represents a fundamental landmark in the analysis of the process of economic growth. Aghion and Howitt (2009) said about the Solow model that it shows how economic policy can stimulate economic growth rate by stimulating citizens to save. Also the model predicts this kind of increase in economic growth cannot last indefinitely. In the long-run, the country's growth rate will return to the rate of technological progress.

Following the Solow model, Romer's economic growth model initiated the endogenous growth literature and resurrected the interest in economic growth theory within the community of researchers and economists. Romer (1986) has formulated his model of endogenous growth taking into account the knowledge externalities. The higher the average knowledge stock of other companies the higher is the production of a given company. His first model of endogenous growth was improved over the following years (it has to be mentioned the important contribution of the 1990 model (Romer 1990)).

Lastly, I presented the Schumpeterian model that centres on quality improving innovations that makes old products obsolete and thus involves the so called "creative destruction" force.

Chapter 3 entitled **„Investigating the most important factors that determine economic growth in the European Union: An analysis of EU 28 countries between 1990 and 2014"** is the first empirical chapter of the thesis. The purpose of this chapter is to establish the main determinants of economic growth in the European Union (EU28) from 1990 to 2014 taking into account private and public influences. In order to investigate what determinants are important for economic growth, this chapter utilizes a statistical model (a

growth equation) in which there are a total of 30 variables. It uses as dependent variable the real annual GDP/capita of the 28 countries that are member states of the European Union. The study employs time series data in a dynamic panel data model.

The economic growth equation used in this chapter has the following formula:

$$LY_{it} = \beta_0 + \beta_1 Ly_{i,t-1} + \beta_2 LLE_{it} + \beta_3 LFEC_{it} + \beta_4 LFSL_{it} + \beta_5 LGDEBT_{it} + \beta_6 LEXP_{it} + \beta_7 LDEFICIT_{it} + \beta_8 LEMPL_{it} + \beta_9 LEXPORT_{it} + \beta_{10} LIMP_{it} + \beta_{11} LOPEN_{it} + \beta_{12} LPDEBT_{it} + \beta_{13} LPROD_{it} + \beta_{14} LGFCF_{it} + \beta_{15} LFDI_{it} + \beta_{16} LINF_{it} + \beta_{17} LPOP_{it} + \beta_{18} LEDUC1_{it} + \beta_{19} LEDUC2_{it} + \beta_{20} LEDUC3_{it} + \alpha_j D_{it} + \eta_i + \varepsilon_{it}, \text{j}=\overline{21,30} \quad\quad (1)$$

where:

LY: the neglog of real GDP per capita; this variable represents the negative logarithm of per capita real gross domestic product, expressed in euros.

Ly_{t-1}: the neglog of one lag real GDP per capita;

LLE: the neglog of total life expectancy (years); the literature considers that life expectancy has a primary effect on population growth. Improving life expectancy can slow down population growth and can also encourage human capital accumulation. These improvements in life expectancy can also have an important effect on income per capita (Bloom and Sachs 1998; Cervelatti and Sunde 2009; Acemoglu 2009).

LFEC: the neglog of Final Energy Consumption (1000 tonnes of oil equivalent); this variable represents the total sum of the energy which is provided to the final. This sum represents the total final energy that is consumed in agriculture, industry, transportation, households, services, etc.

LFSL: the neglog of financial sector leverage (debt to equity), non-consolidated (%); this ratio of debt-to-equity illustrates the relative proportion of debt used to finance assets to shareholders' equity. This determinant will measure if financial over-indebtedness has a negative outcome on economic development.

LGDEBT: the neglog of General government gross debt (EDP concept), consolidated - annual data (% GDP); this indicator measures the total gross debt at nominal value outstanding at the end of the year and consolidated between and within the sectors of general government.

LEXP: the neglog of Total general government expenditure (% GDP); according to the COFOG classification, total government expenditure is comprised of the total sum of the 10 categories of public spending, namely general public services, defence, public order and safety, economic affairs, environmental protection, housing and community amenities, health, recreation, culture and religion, education and social protection.

LDEFICIT: the neglog of Deficit - Net lending (+) / net borrowing (-) (% GDP); the difference between general government total revenue and total expenses is known as general government net lending (+) / net borrowing (-) and is usually referred to as government deficit (or surplus). This figure is an important indicator of the overall situation of government finances. It is usually expressed as a percentage of GDP.

LEMPL: the neglog of Employment rates by sex, age and degree of urbanisation (% Total); this indicator represents the number of employed persons as a percentage of the working age population between 15 and 64 of years.

LEXPORT: the neglog of Exports of goods and services (% GDP); this indicator represents the exports of goods and services from residents to non-residents.

LIMP: the neglog of Imports of goods and services (% GDP); this variable represents the imports of goods and services from non-residents to residents.

LOPEN: the neglog of Trade Openness (% GDP); the sum between exports and imports proportional to GDP. Because the data for exports and imports is already divided by GDP, openness is L(Exports + Imports).

LPDEBT: the neglog of Private sector debt, consolidated (% of GDP); this indicator represents the total sum of liabilities in the hands of non-financial corporations, non-profit institutions and *households*. This variable does not consider the transactions within the same sector.

LPROD: the neglog of Real labour productivity per hour worked (Euro/hour/worked);

LGFCF: the neglog of Gross fixed capital formation (Direct investment) (% GDP); this indicator represents the resident producers' investments, deducting disposals, in fixed assets during a given period.

LFDI: the neglog of FDI - Direct investment in the reporting economy (flows) - annual data (% GDP); this indicator is the international foreign investment of a resident entity that acquires at least 10% of the equity of an enterprise in another country than of the investment.

LINF: the neglog of Inflation, consumer prices (annual %); this indicator is conventionally measured as the variation of the consumer price index in one year.

LPOP: the neglog of population (inhabitants); the total number of persons inhabiting a country measured in a year.

LEDUC1: the neglog of Less than primary, primary and lower secondary education (levels 0-2) (% total);

LEDUC2: the neglog of Upper secondary and post-secondary non-tertiary education (levels 3 and 4) (% total);

LEDUC3: the neglog of Tertiary education (levels 5-8) (% total);

D: is a vector of 10 dummy variables. It contains six dummy variables with which the analysis will want to measure the governance impact on economic growth. It employs the 6 governance indicators established by Kuafmann, Kraay and Mastruzzi (2010) - Voice and Accountability, Political Stability and Absence of Violence/Terrorism, Government Effectiveness, Regulatory Quality, Rule of Law and Control of Corruption. The dummy variables have two values, one and zero. One is given if the rank of a specific governance indicator of a certain country is above 50 and zero if the rank is below 50. The authors rank the indicator from 0 (lowest) to 100 (highest). Also, to observe if there are differences between countries regarding their location in Europe, the chapter uses regional dummies. The World Bank's "composition of macro geographical (continental) regions" divides each country in separate regions. The 28 EU countries will be separated into 5 regions: Eastern Europe (Bulgaria, Czech Republic, Hungary, Poland, Romania and Slovakia), Northern Europe (Denmark, Estonia, Finland,

Ireland, Latvia, Lithuania, Sweden and UK), Southern Europe (Croatia, Greece, Italy, Malta, Portugal, Slovenia and Spain), Western Europe (Austria, Belgium, France, Germany, Luxembourg and Netherlands) and Western Asia (Cyprus). The dummy variable will take the value 1 if the country is in the correct region and 0 if it is not in that specific region. It is expected that a positive or a big influence on economic growth will be observed for the countries in the North or Western Europe and negative or smaller influence for countries in the South and Eastern Europe or Western Asia. The analysis will use only 4 regional dummies, Western Asia being excluded to avoid multicollinearity.

η: is the unobserved country-specific effect;

ε: is the disturbance term;

i is the individual country dimension and t is the time period dimension.

Data are taken from the Annual Macroeconomic database of the European Commission (AMECO), from the World Bank's Statistical Database and from Eurostat database. All monetary data are expressed in constant prices and denominated in a common currency (ECU). Nominal GDP is deflated using the Eurostat country deflator, with the base year being 2010.

To empirically estimate the relation between the independent variables and the neglog of real GDP/capita this chapter of the thesis will use several panel data estimation techniques. It will employ the pooled ordinary leased square, random effects model, the feasible generalized least squares estimator, the fully modified OLS, the first difference GMM estimator and the system GMM estimator. This will also offer robustness of the estimation results.

Table 1: The results of the OLS, REM, FGLS, FM-OLS, GMM and sysGMM methods

	OLS	REM	FGLS	FM-OLS	GMM	sysGMM
LD.real LGDP/cap.	0.110***	0.110***	0.192*	0.194*		
	(0.0590)	(0.0590)	(0.0364)	(0.0271)		
L. real LGDP/cap.					0.490*	0.884*
					(0.0622)	(0.0314)
D.LLE	0.643	0.643	0.0462	0.919**		
	(0.651)	(0.651)	(0.354)	(0.370)		
LLE					0.253	0.358
					(0.734)	(0.234)
D.LFEC	0.168*	0.168*	0.141*	0.197*		

	(0.0582)	(0.0582)	(0.0316)	(0.0359)		
LFEC					0.147**	0.0556***
					(0.0617)	(0.0300)
D.LFSL	0.00632	0.00632	0.00232	0.000746		
	(0.0107)	(0.0107)	(0.00593)	(0.00602)		
LFSL					-0.0172	-0.0158**
					(0.0129)	(0.00724)
D.LGDEBT	-0.0824**	-0.0824**	-0.0820*	-0.0744*		
	(0.0326)	(0.0326)	(0.0143)	(0.0154)		
LGDEBT					-0.0644**	-0.0119
					(0.0302)	(0.0104)
D. LEXP	-0.000622	-0.000622	0.0230	-0.0121		
	(0.0360)	(0.0360)	(0.0316)	(0.0346)		
LEXP					-0.0575	-0.162*
					(0.0775)	(0.0445)
D. LDEFICIT	0.00274	0.00274	0.000999	0.00327		
	(0.00375)	(0.00375)	(0.00223)	(0.00241)		
LDEFICIT					-0.00219	0.00893**
					(0.00546)	(0.00388)
D. LEMPL	0.591*	0.591*	0.455*	0.503*		
	(0.158)	(0.158)	(0.0875)	(0.0856)		
LEMPL					0.271***	0.0547
					(0.144)	(0.0760)
D. LPDEBT	-0.000726	-0.000726	-0.0257	-0.0181		
	(0.0353)	(0.0353)	(0.0267)	(0.0214)		
LPDEBT					0.00549	-0.0453**
					(0.0405)	(0.0215)
D. LPROD	0.896*	0.896*	0.812*	0.957*		
	(0.125)	(0.125)	(0.0753)	(0.0662)		
LPROD					1.023*	0.101*
					(0.159)	(0.0284)
D. LEXPORT	-1.050	-1.050	-0.462	-0.944**		
	(1.263)	(1.263)	(0.447)	(0.451)		
LEXPORT					-2.158***	-1.897***
					(1.177)	(0.925)
D. LIMP	-0.669	-0.669	-0.362	-0.488		
	(1.332)	(1.332)	(0.470)	(0.501)		
LIMP					-1.981	-1.547
					(1.209)	(0.929)
D. LOPEN	1.584	1.584	0.761	1.291		
	(2.571)	(2.571)	(0.903)	(0.940)		
LOPEN					4.108***	3.453***
					(2.367)	(1.832)
D. LGFCF	0.0629	0.0629	0.118*	0.0329		
	(0.0488)	(0.0488)	(0.0352)	(0.0330)		
LGFCF					-0.0574	-0.0632***
					(0.0582)	(0.0346)
D. LFDI	0.00193	0.00193	0.000217	0.00234***		
	(0.00182)	(0.00182)	(0.000926)	(0.00129)		
LFDI					0.00570**	0.00459
					(0.00256)	(0.00377)
D.LEDUC1	0.106	0.106	0.0558	0.0839		
	(0.0696)	(0.0696)	(0.0434)	(0.0511)		
LEDUC1					0.0245	0.0125
					(0.0737)	(0.0422)
D. LEDUC2	0.122	0.122	0.102***	0.116***		
	(0.108)	(0.108)	(0.0558)	(0.0625)		
LEDUC2					0.120	0.0207
					(0.125)	(0.0281)
D. LEDUC3	0.127**	0.127**	0.0514**	0.131*		
	(0.0549)	(0.0549)	(0.0217)	(0.0329)		
LEDUC3					0.164**	-0.00780

	(1)	(2)	(3)	(4)	(5)	(6)
					(0.0772)	(0.0218)
D. LPOP	-1.146*	-1.146*	-0.666*	-1.265*		
	(0.285)	(0.285)	(0.197)	(0.211)		
LPOP					-0.624**	-0.0522***
					(0.247)	(0.0293)
D. LINF	0.0187*	0.0187*	0.0156*	0.0187*		
	(0.00417)	(0.00417)	(0.00274)	(0.00282)		
LINF					0.0221*	0.00981
					(0.00616)	(0.00730)
D. Voice and Accountability	0.29^{1}	0.29^{1}	0.15921			
	(0.287)	(0.287)	(0.07191)			
Voice and Accountability					^{2}	-2.015
						(1.781)
D. Political Stability and Absence of Violence/Terrorism	-0.00209	-0.00209	0.00548	-0.00127		
	(0.0122)	(0.0122)	(0.00577)	(0.00578)		
Political Stability and Absence of Violence/Terrorism					-0.0126	0.0123
					(0.0202)	(0.0113)
D. Government Effectiveness	-0.0773*	-0.0773*	-0.0694	-0.0842*		
	(0.00637)	(0.00637)	(0.0442)	(0.0174)		
Government Effectiveness					-0.0578***	0.00381
					(0.0330)	(0.0155)
D. Regulatory Quality	-0.0670*	-0.0670*	-0.0699	-0.0754*		
	(0.00768)	(0.00768)	(0.0443)	(0.0177)		
Regulatory Quality					-0.101*	-0.0835*
					(0.0197)	(0.0199)
D. Rule of Law	0.0406***	0.0406**	0.0251	0.0438**		
	(0.0198)	(0.0198)	(0.0286)	(0.0201)		
Rule of Law					0.0810***	0.0799*
					(0.0465)	(0.0233)
D. Control of Corruption	0.00490	0.00490	0.00793	0.00250		
	(0.00550)	(0.00550)	(0.0139)	(0.0118)		
Control of Corruption					0.00277	0.0181***
					(0.0113)	(0.00942)
Eastern Europe	0.00651	0.00651	0.0111	0.00667		
	(0.00774)	(0.00774)	(0.00926)	(0.00855)		
Northern Europe	-0.00937**	-0.00937**	-0.00368	-0.00970		
	(0.00388)	(0.00388)	(0.00729)	(0.00813)		
Southern Europe	-0.0119***	-0.0119**	-0.00618	-0.00890		
	(0.00598)	(0.00598)	(0.00779)	(0.00831)		
Western Europe	-0.0211*	-0.0211*	-0.0157**	-0.0185**		
	(0.00547)	(0.00547)	(0.00726)	(0.00814)		
linear				-0.0000127		
				(0.0000136)		
Constant	0.0360*	0.0360*	0.0305*	0.0310*		
	(0.00600)	(0.00600)	(0.00777)	(0.00858)		
Observations	346	346	346	345	346	374
R^2	0.714			0.316		
Adjusted R^2	0.688			0.250		
Root MSE	0.0381	0.0381		0.0813		
Hansen J-test					1.000	1.000

20

		1.000	1.000
Diff-in Hansen test			
AR(1)		0.00200	0.00316
AR(2)		0.397	0.0173
Instruments		210	224

Notes: Standard errors in parentheses. *** $p < 0.10$, ** $p < 0.05$, * $p < 0.01$

1. Voice and Accountability was omitted because of collinearity. By regressing the depended variable and the dummy variables we could determine the coef and p-value for Voice and Accountability.

2. X61 was omitted because of collinearity.

3. "GMM estimator" is the first difference GMM "system GMM estimator" is the system GMM.

4. The Hansen J-test and the Diff-in-Hansen test are the p-values for the null hypothesis of instrument validity and the p-values for the validity of the additional moment restriction necessary for system GMM, respectively. AR(1), AR(2) and AR(3) are the p-values for first, second and third order auto-correlated disturbances in the first difference equations.

Source: Stata v12

Summary of the findings of chapter 3 - The results of the third chapter, based on panel data analysis, have shown that among EU countries there was still regional divergence. The results of the pooled OLS and REM methods provided evidence that final energy consumption, employment rate, real labour productivity per hour worked, tertiary education and inflation had a positive effect on economic growth in the EU 28. Real labour productivity had the biggest influence on real GDP/capita. The variables that had a negative impact on growth were general government gross debt and population. For example a rise in population by 1% determines a drop in real GDP/capita growth of -1.15%. Also rule of law had an important effect on economic growth in EU28, with a negative effect from government effectiveness and regulatory quality. The regional dummies also offered interesting results. Western European countries grew the slowest compared with the ones in the rest of the EU 28. Also Southern and Northern Europe did not perform as expected.

The FGLS estimation determined that final energy consumption, the employment rate, real labour productivity per hour worked, gross fixed capital formation, upper secondary and post-secondary non-tertiary education, tertiary education and inflation had a positive effect on growth. The explanatory variables which had a negative impact were general government gross debt and population size. The FMOLS regression confirmed the above results and also showed that life expectancy, FDI and rule of law had a positive effect on economic growth. The interesting fact was that exports, government effectiveness and regulatory quality did not offer the expected outcomes.

The results of the GMM estimator provided evidence of the positive influence of final energy consumption, employment rate, trade openness, real labour productivity per hour worked, FDI, tertiary education and inflation. Trade openness and real labour productivity were the factors that had the most influence on real GDP/capita in the EU28. The negative coefficients were for government debt, exports and population. The dummy variables that were significant were government effectiveness, regulatory quality, control of corruption and the rule of law.

The results of the system GMM confirmed that final energy consumption, deficit, trade openness, real labour productivity per hour worked had a positive and significant influence on economic growth. Trade openness was the factor that had the most influence on real GDP/capita in the EU28. Trade openness can have an influence on economic growth through a multitude of different channels like technological transfers, the increase in economies of scale, competitive advantage (Chang et al. 2009). The variables that had a negative and significant influence on growth were financial sector leverage, total general government expenditure, exports, private debt, gross fixed capital formation and population.

Academic contributions of chapter 3 - Chapter Three has shown that economic growth theory is very complex and a unified model is difficult to be constructed because of the inherent estimation and data collection problems. This chapter used several panel data techniques which offered more comprehensive information regarding the main determinants of economic growth in the European Union at country level and also increased efficiency in estimation. The investigation also included public and private economic variables so as to demonstrate if one is more beneficial than the other. The results showed that debt in general, private or public, has a negative effect on economic growth. Public investment measured as total government investment hinders growth, but FDI is positively linked with it. The study opted also for decomposing education into 3 components. This has shown the positive role of tertiary education in fostering economic growth compared with primary and secondary education. As mentioned in the literature, non-economic variables can play an important role, albeit an indirect one, in the economic growth process. The results showed that the rule of law is an important determinant of economic development. Control of corruption is also an important non-economic variable. As there are more than 145 determinants that were

demonstrated by the literature to have contributed to economic growth in at least one article, creating the framework to include all of them into a single model will yield more comprehensive knowledge on a much debated subject.

Policy implications of chapter 3 - The finding of Chapter Three showed that employment and productivity have a big contribution to economic growth. This means that in the EU, the state and private companies should concentrate on stimulating employment and productivity. The unidirectional link from energy consumption to economic growth suggests that energy has a meaningful role in shaping growth and that the state has to use energy policies wisely as not to harm the economy. This concept was hardly debated and confirmed by many research papers. Yu and Choi (1985), Masih and Masih (1996), Lee (2005), Narayan and Prasad (2008), Bhattacharya and Bhattacharya (2014), Mahalik and Mallick (2014) showed that for developing countries (India, China, Pakistan, Turkey, Brazil, Indonesia, etc.) and also for developed countries (France, Australia, Italy, Korea, Japan, etc.) energy consumption plays an important role in shaping economic growth. The chapter suggests that a rise in population by 1% determines a drop in real GDP/capita growth of -1.15%. Population growth could have a negative influence on economic development by impacting the investment and savings behaviours of citizens, the dependency ratio and the quality of human capital.

Rule of law had a significant contribution to economic growth in Chapter Three. The EU authorities have to concentrate on safeguarding the justice system as to not hinder economic development. Better measures in controlling corruption will have a beneficial effect on the rule of law. Control of corruption is also a variable that had a positive effect on real GDP/capita. Trade openness was a determinant with a significant positive effect on economic growth. Better access to markets for developing countries in the EU can facilitate economic development. Trade openness can have an influence on economic growth through a multitude of different channels like technological transfers, the increase in economies of scale, competitive advantage (Chang et al. 2009). Tertiary education is the most important type of schooling education that had a significant and positive effect on growth. Education policies should concentrate on stimulating higher education and innovative research. The negative impact of government debt has to determine EU states to lower or better manage their

borrowing and debt service. Also policy makers should take into account that the over-indebtedness of the financial sector has a negative consequence for the economy.

Chapter 4 entitled „**Territorial economic growth in the EU: An analysis of NUTS 1 and NUTS 2 regions between 2000-2013"** contributes to the regional growth literature by testing and updating the importance of several determinants (variables). The study uses a number of different methods to quantify and statistically demonstrate the link between these different variables and regional economic growth. The growth analysis will be measured for two different territorial levels in the EU 28. Firstly, the investigation will test an economic model on the 98 NUTS 1 regions between 2000 and 2013. NUTS1 areas represent the major socioeconomic regions in the European Union with administrative functions. After that the study will go in depth and analyse a growth model for 273 NUTS 2 regions in the EU also between 2000 and 2013. NUTS 2 regions represent medium-sized regions with a population that varies from 100 000 to 10 million inhabitants. This part of the thesis also investigates if the regions of the EU 28 are converging or not, by analysing the time frame between 2000 and 2013.

Because the case study of this chapter of the thesis investigated two different territorial levels, it employed two separate growth equations.

The regional economic growth equation for the NUTS 1 level has the following formula:

$$LY_{it} = \beta_0 + \beta_1 Ly_{i,t-1} + \beta_2 LPOP_{it} + \beta_3 LFERT_{it} + \beta_4 LLIFE_{it} + \beta_5 LELET_{it} + \beta_6 LTERT_{it} + \beta_7 LWHOURm_{it} + \beta_8 LWHOURf_{it} + \beta_9 LEMPL_{it} + \beta_{10} LR\&Dexp_{it} + \beta_{11} LMOTORWAY_{it} + \beta_{12} LROADS_{it} + \beta_{13} LTOURISMint_{it} + \beta_{14} LTOURISMext_{it} + \beta_{15} LVEHICLES_{it} + \eta_i + \varepsilon_{it} \tag{1}$$

The regional economic growth equation for the NUTS 2 level has the following formula:

$$LY_{it} = \beta_0 + \beta_1 Ly_{i,t-1} + \beta_2 LPOP_{it} + \beta_3 LFERT_{it} + \beta_4 LLIFE_{it} + \beta_5 LELET_{it} + \beta_6 LTERT_{it} + \beta_7 LWHOURm_{it} + \beta_8 LWHOURf_{it} + \beta_9 LEMPL_{it} + \beta_{10} LR\&Dexp_{it} +$$

$$\beta_{11}LMOTORWAY_{it} + \beta_{12}LROADS_{it} + \beta_{13}LTOURISMint_{it} + \beta_{14}LTOURISMext_{it} +$$
$$\beta_{15}LVEHICLES_{it} + \beta_{16}LDENSITY_{it} + \beta_{17}LMIGRATION_{it} + \eta_i + \varepsilon_{it} \qquad (2)$$

where:

LY: the neglog of regional real GDP per capita. This variable will be expressed also as the regional real GDP in PPS standard per inhabitant to see it there are differences between the two indicators of growth. According to Eurostat expressing gross domestic product in purchasing power standards cancels the differences in price levels between countries. By calculating GDP per inhabitant makes it easier to compare different countries and regions in comparison with a calculation in absolute size. Also the eligibility of the structural programs of the European Union for the NUTS 2 are offered by determining and comparing the GDP per inhabitant in purchasing power standards.

$Ly_{i,t-1}$: represents the neglog of one lag regional real GDP per capita or one lag regional real GDP in PPS standard per inhabitant. It is usually introduced in the growth equation to measure the convergence or divergence hypothesis. If the coefficient of this variable is negative then we can state that the EU regions are converging or the less developed ones are catching-up to the most developed ones. This indicator is very important for this type of regional analysis.

LPOP: the neglog of regional population (inhabitants);

LFERT: the neglog of regional fertility rate. It is the average number of children that would be born to a woman over her lifetime. Micheli and Zuanna (Micheli and Zuanna 2005, p.80) see fertility rate as a proxy for the *spread of a full motherhood experience*;

LLIFE: the neglog of regional life expectancy measured in years. In the research literature, it is an important indicator and proxy for measuring the *health of the inhabitants*.

LELET: the neglog of early leavers from education and training. Flisi et al. (Flisi, Goglio, Meroni, and Vera-Toscano 2015) consider it to be a proxy of *the size of the group of individuals most at risk on the labour market;*

LTERT: the neglog of regional persons with tertiary education (percentage of total). It is a measure for human capital and for skilled labour. Some debate if persons which have finished tertiary educations are more skilled and find jobs faster than less educated persons.

LWHOURf: the neglog of regional average number of usual weekly hours of work in main job for female. The LWHOURm is the neglog of regional average number of usual weekly hours of work in main job for male. With this variable, this case study will want to determine if the number of hours worked has an impact on growth. Because of regulations and other socioeconomic factors, the average number of hours worked has declined in the developed world.

LEMPL: the neglog of regional employment rate. This indicator represents the number of employed persons as a percentage of the working age population between 15 and 64 of years. This indicator will be also divided into male and female employment to investigate if there are differences between genders.

LR&Dexp: the neglog of regional total intramural research and expenditure for all sectors (% of GDP). Intramural expenditures are expenditures for research and development during a specific period, whatever the source of funds. Both current and capital expenditures are included.

LMOTORWAY and LROADS: the neglog of regional motorway and roads (other roads besides highways) measured in kilometres. These two indicators are proxies for *regional infrastructure development*. Infrastructure is seen as a key investment for regional development and also for the convergence hypothesis.

LTOURISMint and LTOURISMext: the neglog of regional total nights spent by residents and non-residents in tourist accommodations (% of total). According to the United Nations World Tourism Organization, a 'tourist' is defined as a person who spends at least one night in official tourist accommodation establishments. These indicators are measured as percentage of total population.

LVEHICLES: the neglog of regional vehicles (except trailers and motorcycles). It is a *proxy for stock of vehicles*.

LDENSITY: the neglog of regional population density (persons per km^2). Population density is the ratio between the annual average population and the land area of the region. It is a *proxy for regional agglomeration*. Usually large and densely populated regions should have a positive effect on regional economic growth.

LMIGRATION: the neglog of regional net migration (%). The rate of net migration is the ratio of net migration plus adjustment during the year to the average population in that year.

η: is the unobserved regional-specific effect;

ε: is the disturbance term;

i is the individual regional dimension and t is the time period dimension.

Data are taken from the Eurostat database. All monetary data are expressed at constant market prices and denominated in a common currency (ECU). Regional nominal GDP is deflated using the Eurostat country deflator, with the base year being 2010.

The chapter uses several panel data estimation techniques to obtain the economic growth results and to offer some robustness. It employed the first difference GMM estimator and the system GMM estimator and the cross-section time-series dynamic panel data estimation by quasi-maximum likelihood. The last estimation has been developed by Kripfganz (2016). The ML (maximum likelihood) approach was pioneered by Bhargava and Sargan (1983), further developed by Hsiao, Pesaran and Tahmiscioglu (2002) and is suited also for panel data with missing values. Missingness can be solved by implementing a ML estimation or a multiple imputation technique.

Summary of the findings of chapter 4 - The results of Chapter Four provided compelling information regarding the main determinants at regional level in the EU. The chapter proved that for the 98 NUTS 1 and 273 NUTS 2 areas analysed there was regional divergence. There was a steady state of convergence between EU regions before 2008. Figure 2 shows that between 2001 and 2008 regional convergence was present, even if the correlation was small and relatively weak.
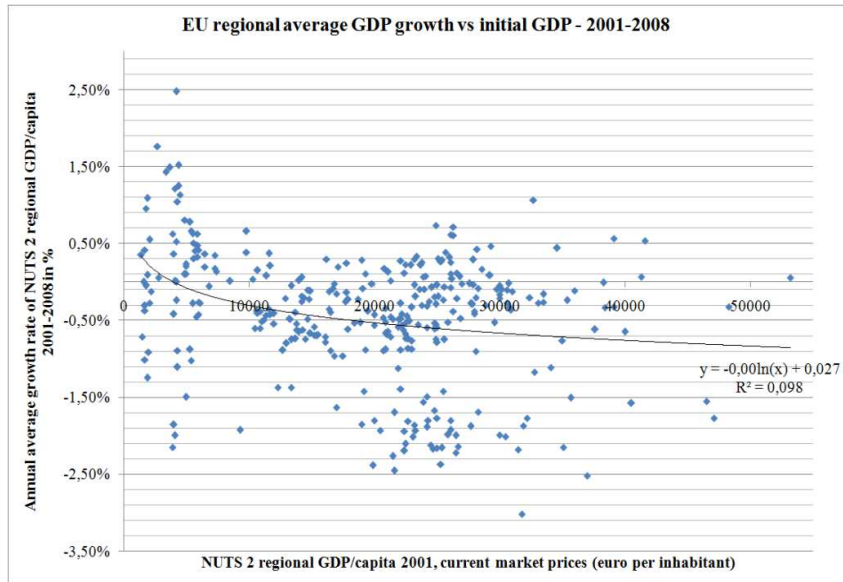
Figure 2: EU regional average GDP growth vs. initial GDP – 2001-2008

Source: own calculations

From 2007 onwards the divergence between EU regions has accelerated. The financial crisis may have had a big influence, even if it is not well proven by empirical research. The coefficient of determination in Figure 3 is higher, meaning a stronger correlation between the two variables.
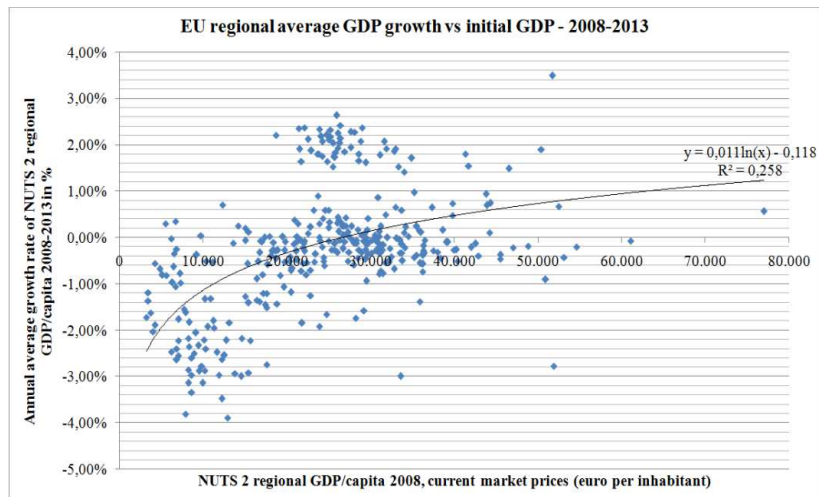

Figure 3: EU regional average GDP growth vs. initial GDP – 2008-2013

Source: own calculations

From the results of the QML estimation for NUTS 2 regions, population size appeared to be influencing regional growth. The ones for NUTS 1 were not significant at 10%. The outcome for fertility rate offered mixed results. It increased economic growth when the dependent variable was real GDP/capita and had a negative influence when real GDP in PPS/inhab was used. The results provided evidence of the importance of life expectancy. It is used as a proxy for the health level of the population. It makes sense that a healthier and longer life positively impacts the economy. Early leavers from education and training had a negative influence on regional economic growth. Tertiary education appeared to contribute to regional economic growth, but the coefficients were small and not statistically significant in most of the results. Average weekly hours worked by male hindered economic development and the variable for average weekly hours worked by female was negative but mostly not statistically significant. The investigation into the effects of employment rates offered the following conclusion: total employments and male employment were beneficiary for the economy and female employment decreased economic growth. Research and development had a negative impact on regional development in almost all of the regressions, even if some of the coefficients were not significant. Also infrastructure development appeared to not have a defining role in shaping regional economic growth. For total nights spent by residents and non-residents in tourist accommodations the results were not conclusive to say that these indicators had a major impact on regional growth. In general, from this case study, the stock of vehicles at the regional level was a variable that was positively correlated with growth. Furthermore the results obtained for population density contradict the agglomeration economies theory. It seems that regional agglomeration is not an important factor. This outcome can be attributed to Europe's high number of small and medium size cities and the negative externalities of living in a big city like congestion cost, labour competitiveness, pollution and high rental costs (Dijkstra et al. 2013). Finally the chapter suggests that migration was not contributing very much too regional development.

Academic contributions of chapter 4 - Chapter Four continued the previous investigation by applying panel data techniques for two separate growth equations for a panel of 98 NUTS 1 and 273 NUTS 2 regions. This chapter contributed to the existing regional economic literature by helping to better understand the role of the main factors that determine growth. This investigation used the GMM and system GMM techniques which are widely used in growth

analysis and also utilized a recently new method, namely the quasi-maximum likelihood. It was used to improve the estimations for the panel data which had missing values for some specific regions. Many empirical studies that dealt with regional investigation used variables like population, infrastructure, innovation, employment, migration. This study also used these variables simultaneously and disaggregated some of them. For example, it used average weekly hours at the main work place for male and female. Also employment was used as female and male employment and as a total. The results showed that the main factors that improve regional economic growth are employment, specifically male employment, life expectancy, tertiary education. Furthermore this chapter, like the other two empirical ones of this thesis, used the lag dependent variable to demonstrate or infirm the convergence hypothesis. In this chapter the regional divergence was furthermore confirmed by graphically illustrating the fact that after the 2008 crisis the EU areas are drifting more apart from each other, especially the ones from the former communist states.

Policy implications of chapter 4 - Chapter Four suggests that early leavers from education and training are a negative influence on regional economic growth. This social category is at risk economically and policy makers have to adopt measures for the better integration of this group in the society and on the labour market. Infrastructure development appears to not have a defining role in shaping regional economic growth. Infrastructure endowment is poorly linked to economic growth and the exact returns and implications of this type of investment is not so clear (Crescenzi and Rodríguez-Pose 2012; Rodriguez-Pose, Psycharis and Tselios 2012). The results obtained for population density contradict the agglomeration economies theory. It seems that regional agglomeration is not an important factor.

Chapter 5 entitled **„Are European metropolitan regions still relevant and what are the driving forces of urban economic growth?"** aimes to contribute to the metropolitan economic growth literature by implementing an analysis for 271 areas located in the European Union. For this endeavour the study uses several empirical methods (GMM, System GMM and QML) to quantify and statistically demonstrate the link between the independent variables and real GDP measured in per capita and in PPS per inhabitant.

To investigate the robustness of the results, the empirical model is also estimated by dividing the time period in two parts (post and ante economic crisis) and by splitting the sample of metropolitan regions in two components – the Western more developed regions and the Central and Eastern (the formal communist states, except for Cyprus) metropolitan areas.

The key questions that this study wanted to answer are:

1. What are the most important economic sectors for metropolitan growth?
2. Does population size, population density or population growth have an effect on metropolitan regions?
3. Is migration a positive influence on development?
4. Are metropolitan regions diverging and did the European enlargement substantially influenced growth in these areas?

The economic growth equation has the following form:

$$LY_{it} = \beta_0 + \beta_1 Ly_{i,t-1} + \beta_2 \, LGVAagr_{it} + \beta_3 \, LGVAind_{it} + \beta_4 \, LGVAmauf_{it} +$$

$$\beta_5 \, LGVAconst_{it} + \beta_6 \, LGVAserv_{it} + \beta_7 \, LGVAitc_{it} + \beta_8 \, LEMPL_{it} + \beta_9 \, LDENSITY_{it} +$$
$$\beta_{10} \, LEAP_{it} + \beta_{11} LPOP_{it} + \beta_{12} LPOPgr_{it} + \beta_{13} LMIGRATION_{it} + \beta_{14} D_{it} + \eta_i + \varepsilon_{it} \quad (1)$$

where:

LY: the neglog of metropolitan real GDP per capita or GDP in PPS standard per inhabitant to see if there are differences between the two indicators of growth. The metropolitan gross domestic product is defined as the market value of all final goods and services produced within a metropolitan area in a given period of time. According to Eurostat expressing gross domestic product in purchasing power standards cancels the differences in price levels between countries. By calculating GDP per inhabitant makes it easier to compare different regions in comparison with a calculation in absolute size.

$Ly_{i,t-1}$: represents the neglog of one lag metropolitan real GDP per capita or one lag metropolitan real GDP in PPS standard per inhabitant. It is usually introduced in the growth equation to measure the convergence or divergence hypothesis. If the coefficient of this variable is negative then we can state that the EU metropolitan regions are converging or the

less developed ones are catching-up to the most developed ones. This indicator is very important for this type of urban analysis.

LGVAagr: represents the neglog of the share of metropolitan gross value added of agriculture, forestry and fishing in total metropolitan gross value added. It represents the contribution that this specific economic activity/sector has on metropolitan economic output.

LGVAind: represents the neglog of the share of metropolitan gross value added of industry in total metropolitan gross value added. It represents the contribution that this specific economic activity/sector has on metropolitan economic output.

LGVAmanuf: represents the neglog of the share of metropolitan gross value added of manufacturing in total metropolitan gross value added. It represents the contribution that this specific economic activity/sector has on metropolitan economic output.

LGVAconst: represents the neglog of the share of metropolitan gross value added of construction in total metropolitan gross value added. It represents the contribution that this specific economic activity/sector has on metropolitan economic output.

LGVAserv: represents the neglog of the share of metropolitan gross value added of wholesale and retail trade, transport, accommodation and food service activities in total metropolitan gross value added. It represents the contribution that this specific economic activity/sector has on metropolitan economic output.

LGVAitc: represents the neglog of the share of metropolitan gross value added of information and communication in total metropolitan gross value added. It represents the contribution that this specific economic activity/sector has on metropolitan economic output.

LEMPL: the neglog of the total number of employees at metropolitan level. This indicator will measure the impact of employed persons on metropolitan economic growth.

LDENSITY: the neglog of metropolitan population density (persons per km^2). Population density is the ratio between the annual average population and the land area of the region. This variable is a *proxy for regional agglomeration*. Usually large and densely populated urban area should have a positive effect on regional economic growth.

LEAP: the neglog of economically active population (inhabitants).

LPOP: the neglog of metropolitan population (inhabitants). It measures the impact of population size on metropolitan economic output;

LPOPgr: the neglog of metropolitan population (inhabitants) growth. It measures the impact of population growth on metropolitan economic output. The study uses the crude rate of population change.

LMIGRATION: the neglog of metropolitan net migration (%). The study uses the crude rate of net migration plus statistical adjustment.

D: represents the dummy variable for European enlargement. This dummy variable will assess if EU enlargement had an impact on the economic growth of metropolitan areas. Because the study analyses all the 28 EU metropolitan areas between 2000 and 2013, some of them were not part of the EU before 2004, 2007 or 2013. The variable will take the value 1 if the metropolitan area was part of the EU and 0 if the metropolitan area was not part of the EU.

η: is the unobserved regional-specific effect;

ε: is the disturbance term;

i is the individual regional dimension and t is the time period dimension.

Data are taken from the Eurostat database, more specifically from the metropolitan regions database. All monetary data are expressed at constant market prices and denominated in a common currency (ECU).

Summary of the findings of chapter 5 - The main results of Chapter Five demonstrated that agriculture, forestry and fishing had a negative impact for the 271 EU metropolitan areas studied. Industry, construction and wholesale and retail trade, transport, accommodation and food service activities were positively related to metropolitan growth. The manufacturing and information and communication sectors were, in general, statistically insignificant and didn't contribute to economic growth. The number of employees was positively linked with EU metropolitan growth. European enlargement appeared to have contributed to metropolitan

development, but the coefficients were small. The results of this chapter demonstrated that population density had a small influence on metropolitan development. The results obtained were in contrast with the agglomeration economies theory that sees the increase in urban population as a stimulus of economic growth (Rosenthal and Strange 2004; van Oort, de Geus and Dogaru 2015). Population size measured by the number of inhabitants had a significant negative effect on metropolitan growth and the coefficients for population growth were positive, but the overall impact was very small which implied that density and size was more important that the growth of the population. Net migration was negatively influencing metropolitan economic growth for the System GMM method and was not statistically significant for the other two techniques.

Academic contributions of chapter 5 - Chapter Five provides a comprehensive glance regarding the main determinants of economic growth at metropolitan level. Compared with studies done at country or regional level, there are not too many empirical investigations for metropolitan areas. This chapter will try to fill in the gaps in the literature. An interesting fact was that it used all the economic metropolitan sectors (industry, agriculture, construction, wholesale and retail trade, transport, accommodation and food services, manufacturing and ITC) to investigate which branch has a positive or negative influence. To offer robustness it used three panel data techniques, namely GMM, system GMM and QML. The main results showed that agriculture, forestry and fishing had a negative impact for the 271 EU metropolitan areas studied. Industry, construction and wholesale and retail trade, transport, accommodation and food service activities were positively related to metropolitan growth. The manufacturing and information and communication sectors were, in general, statistically insignificant and didn't contribute to economic growth. The number of employees was positively linked with EU metropolitan growth. Population size had a significant negative effect on metropolitan growth and the coefficients for population growth were positive, but the overall impact was very small which implied that density and size was more important that the growth of the population. To further improve efficiency and offer robustness, the investigation opted to split the time period in two (2000-2008 and 2008-2013) and also dividend the panel sample to measure the difference between Western and Central and Eastern metropolitan areas.

Policy implications of chapter 5 - The results of Chapter Five clearly show that metropolitan regions are not converging to the steady state of growth. There are considerable differences in development among metropolitan areas and there is a visible gap between Western regions and Eastern regions. For example the only metropolitan region from Central-Eastern Europe that is in the top ten list regarding GDP in purchasing power per inhabitant in the year 2012 is Bratislava. In this regard underperforming urban areas are located in Romania, Bulgaria, Hungary, Poland and Croatia. Regional policy makers have to take this into account and try to limit the gaps between these regions by providing better cohesion funds. The main findings of this chapter regarding the influences of economic sectors on metropolitan growth are that agriculture, forestry and fishing can have a negative impact on economic growth. A considerable portion of EU funds is employed for stimulating investment in agricultural production and the big countries are also subsidizing this sector so as to be more competitive. The results of this chapter suggest that these allocations appear to not be efficient for metropolitan growth. Industry, construction and wholesale and retail trade, transport, accommodation and food service activities are positively related to metropolitan growth. The manufacturing and information and communication sectors were, in general, statistically insignificant. These findings have considerable policy implications for policymakers in the sense that EU funds must stimulate mostly the economic branches with the most value added for the economy.

The results also show that population density has a small influence on metropolitan development. Population density is used as a proxy for agglomeration. According to Puga (2002) high agglomeration in capital cities and large urban areas can have an influence on growth increasing labour specialization and productivity. van Oort, de Geus and Dogaru (2015) showed that agglomeration plays an important role for 15 EU countries at regional level, specifically for 205 EU NUTS2 regions. The results obtained by the system GMM estimator are in contrast with the agglomeration economies theory that sees the increase in urban population as a stimulus of economic growth (Rosenthal and Strange 2004; van Oort, de Geus and Dogaru 2015). Population size measured by the number of inhabitants has a significant negative effect on metropolitan growth and the coefficients for population growth were positive, but the overall impact is very small which implies that density and size is more important that the growth of the population.

List of publications

- Articles published in international Journals Thomson ISI rated or B+/BDI

1) **Boldeanu Florin Teodor**, Ialomițianu Răzvan – *Does government spending boost economic growth in Europe?*, Bulletin of Transilvania University of Brasov, Series V: Economic Sciences, vol. 9(58), no.1-2016, pp. 213-228, ISSN 2065-2194 (Print), ISSN 2065-2208 (CD-ROM). B+journal: **DOAJ, CABI, EBSCO**.

2) **Boldeanu Florin Teodor**, Ion Mădălin Sebastian – *The impact of fiscal policy on economic growth in the founding countries of the European Union,* Revista economică (Economic Review), 67:Supplement(2015), pp. 207-217, ISSN: 1582-6260. B+/BDI journal: **RePEc, EBSCO, DOAJ, ULRICHSWEB.**

3) **Boldeanu Florin Teodor**, Tache Ileana, Ion Mădălin Sebastian – *The impact of fiscal policy on economic growth in the countries of Eastern Europe,* Revista economică (Economic Review), vol. 67(5) -2015, pp. 16-32, ISSN: 1582-6260. B+/BDI journal: **RePEc, EBSCO, DOAJ, ULRICHSWEB.**

4) Tache Ileana, **Boldeanu Florin Teodor** – *Provocări ale politicii europene de vecinătate,* Buletinul științific al Universității Creștine Dimitrie Cantemir, Facultatea de Științe Economice, Centrul de cercetări economice Brașov, Editura INFOMARKET, ISSN 1841-298X, Nr.16-2015, pp.89-97.

5) **Boldeanu Florin Teodor**, Ion Mădălin Sebastian – *The influence of public and private sector investment on economic growth in the European Union*, Annals of the University of Craiova, Economic Sciences Series, vol. I, pp. 1-10, ISSN 1223-365X. B+/BDI journal: **RePEc, EBSCO, CEEOL, IDEAS, ECONPAPERS.**

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7) **Boldeanu Florin Teodor**, Tache Ileana – *Sub-division Expenditures and Economic Growth in Europe Based on United Nation's Classification of the Functions of Government,* International Journal of Economic Practices and Theories, Vol. 5(5), 2015 (October), Special issue on Trends in Sustainable Business and Consumption, pp. 435-446, ISSN 2247 – 7225 (online). B+/BDI journal: **Index Copernicus, Open J-Gate, DOAJ (pending), WorldCat, RePEc, EconPapers, Journal TOCs, New Jour, IDEAS, Cabells's, Google Scholar, Open Archives, Science Central, OCLC. BASE, PDF Cast, Scribd, ISeek Microsoft Academic Search, Academic Index, PKP Open Archives Harvester**.

8) **Boldeanu Florin Teodor**, Constantinescu Liliana – *The main determinants affecting economic growth*, Bulletin of Transilvania University of Brasov, Series V: Economic Sciences, vol. 8(57), no.2-2015, pp. 329-338, ISSN 2065-2194 (Print), ISSN 2065-2208 (CD-ROM). B+ journal: DOAJ, CABI, EBSCO.

9) **Boldeanu Florin Teodor**, Tache Ileana – *A regional approach to the metropolitan economic growth: Evidence from the European Union*, Journal of Smart Economic Growth, vol 1(1), pp.29-72, ISSN: 2537-141X. B+/BDI journal: **AcademicKeys, Google Scholar, Econpapers, SCIPIO, RePEc, IDEAS**.

10) Tache Ileana**, Boldeanu Florin Teodor –** *Politica externă a Uniunii Europene Răspunsul la recentele provocări de securitate,* Buletinul științific al Universității Creștine Dimitrie Cantemir, Facultatea de Științe Economice, Centrul de cercetări economice Brașov, Editura INFOMARKET, ISSN 1841-298X, Nr.17-2016, pp.119-125.

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12) **Boldeanu Florin Teodor**, Tache Ileana **–** *Examining the most important factors that determine economic growth in the European Union: An analysis of EU 28 countries between 1990 and 2014,* in the process of peer review for Romanian Journal of Economic Forecasting, ISSN 1582-6163, E-ISSN: 2537-6071. ISI journal: Social Sciences Citation Index, Social Scisearch, Journal Citation Reports/ Social Sciences Edition, EconLit, Scopus, RePEc.

- Articles/studies published in volumes of scientific conferences in Romania and internationally Thomson ISI rated or B+/BDI

13) **Boldeanu Florin Teodor**, Tache Ileana – *Public expenditures by sub-division and economic growth in Europe,* in BASIQ 2015 International Conference: New Trends in Sustainable Business and Consumption, edited by Rodica Pamfilie, VasileDinu, Laurențiu Tăchiciu, Proceedings of BASIQ Vol. 01, Article 16, pp. 114-121, ISSN 2457-483X, ISSN-L 2457-483X.

14) **Boldeanu Florin Teodor**, Ion Mădălin Sebastian – *The macro-regional framework and diversity in Europe,* EURINT proceedings 2015 Regional Development and Integration, volume 2, pp.52-63, ISSN 2393-2384, ISSN-L 2392-8867, ISBN 978-606-714-160-3. ISI proceedings: **Thomson Web of Science, RePEc, DOAJ, CC**.

15) **Boldeanu Florin Teodor**, Tache Ileana **–** *Are European metropolitan regions still relevant and what are the driving forces of urban economic growth? A comparison between Western and Central and South-Eastern regions in the EU*, ABSRC 2016 conference proceedings, Milan, Italy, October 20-21, ISBN 978-961-6347-60-0.

- Papers presented at national and international scientific events:

1) **Boldeanu Florin Teodor**, Ion Mădălin Sebastian – *The influence of public and private sector investment on economic growth in the European Union*, presented at the ICONEC conference, edition 7 (2015) – Competitiveness and stability in the

knowledge based economy, held at the University of Craiova, Faculty of Economics and Business Administration, Craiova, 20-21 March 2015.

2) **Boldeanu Florin Teodor**, Tache Ileana, Ion Mădălin Sebastian – *The impact of fiscal policy on economic growth in the countries of Eastern Europe,* presented at the 22nd International Economic Conference – IECS 2015 - "Economic prospects in the context of growing global and regional interdependencies", 15-16 May 2016, Sibiu.

3) **Boldeanu Florin Teodor**, Ion Mădălin Sebastian – *The macro-regional framework and diversity in Europe,* presented at the EURINT 2015 conference Regional Development and Integration. New challenges for the EU, Iasi, 21-23 May 2015

4) **Boldeanu Florin Teodor**, Ion Mădălin Sebastian – *The impact of fiscal policy on economic growth in the founding countries of the European Union,* presented at the 2nd International Conference for Doctoral Students – IPC 2015, Sibiu, 5-6 June 2015

5) **Boldeanu Florin Teodor**, Tache Ileana – *Public expenditures by sub-division and economic growth in Europe,* presented at BASIQ 2015 International Conference: New Trends in Sustainable Business and Consumption, organized by Business and Tourism Faculty, Amfitreatrul Economic Journal and The Association for Innovation and Quality in Susteinable Business, Bucharest, 18-19 June 2015

6) Ileana Tache**, Boldeanu Florin Teodor –** *A comprehensive analysis of the most important factors determining economic growth in the European Union,* presented at the 81st International Atlantic Economic Conference, Lisbon, 16-19 March 2016.

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8) **Boldeanu Florin Teodor**, Tache Ileana **–** *Are European metropolitan regions still relevant and what are the driving forces of urban economic growth? A comparison between Western and Central and South-Eastern regions in the EU*, presented at the ABSRC 2016 conference, Milan, Italy, October 20-21 2016. **The best paper award was received for this paper. Participation at the conference was financed by a doctoral scholarship - Jean Monnet Centre of Excellence – Challenges and Prospects of EU Integration in South Eastern Europe (Project Number 2015-2403)**

- Erasmus+ mobility at Vives University College in Kortrijk during September 2015 - July 2016

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