GDP GROWTH AND ITS DETERMINANTS IN THE EUROPEAN UNION

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ABSTRACT

The aim of this paper is to determine the variables that affect Gross Domestic Product (GDP) per capita growth. We analyze the main theoretical approaches that provide alternative factors to explain GDP growth and study these determinants for a group of EU countries. Using data for 22 countries and employing Ordinary Least Square model (OLS) find that openness, population growth and the crisis are significant determinants, but an important degree of heterogeneity may be present.

Keywords: GDP per capita, growth, European Union, OLS data, Heterogeneity.

JEL classification: B30, C01, F43

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SECTION 1. INTRODUCTION

Economic growth is one of the indicators that are commonly used to measure the wealth or well-being of a society. Strictly speaking, it measures intertemporal variations in the value of aggregate output in an economy over a period of time.

The objective of the work that follows is to analyze the growth of the countries of the Euro Zone and the factors that influence it. After the economic crisis of 2007, the maintenance of economic stability and knowledge about the factors that determine growth for the area Euro seem to gain importance. And nowadays, in the context of moderate growth that has been achieved after huge economic shocks, there are hidden risks and external impacts that are not quantified because of the difficulty to do so, so it is worth to investigate this variable more while dealing with the obstacles that it imposes.

After a bibliographical review on the variables that influence the economic growth rate, we use the variables proposed by Solow and Swan in 1956 and add successive variables as described in more complex models in the literature.

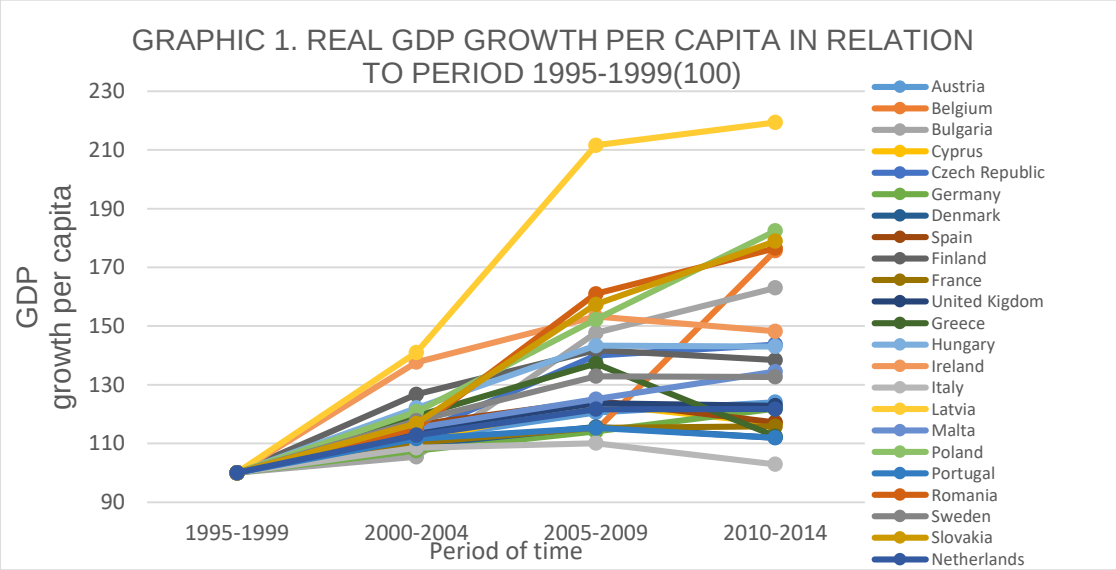
In the context of globalization where competitiveness is key to macroeconomic growth and stability, both, structural reforms and the international context play an undeniable role. But, as Lhuissier (2015) has shown, following a financial shock, the periods of economic stability and growth moderation do not exclude the possibility of reoccurring great crises and world-recessions as in the pre-crisis years. Although low volatility in GDP growth boosts new investment projects and domestic demand and improves the effectiveness of fiscal and monetary policies.

The conventional growth theories of the 1960s focus on the role of capital, human capital, and productivity, but much has been expanded and modified since then. For example, the models of the typologies of public goods by Sala-i-Martin (1992) have been included, as well as more recent analyses like the one of Sinn (2014) who analyzes the problem of competitiveness.

Although it seems a much studied subject as we will develop in the literature review, each one of these studies is done under assumptions so diverse that the final conclusions also differ. Therefore, under the hypotheses studied and based on one of

the studies and realizations as a reference, we will analyze the effect of a group of variables.

As can be seen in figure 1, attached below, the growth in the first period and the second period is much stronger than the subsequent ones, due to the effect of the recession previously mentioned. We will treat the growth of countries in two groups: The EU-15 group and the CEECS countries (countries of Central and Eastern Europe), incorporated later, in 2004 and 2007, whose predominant sector was the agriculture and which had relatively low initial income per capita levels.



Source: Author's Calculations

Throughout this academic work, we will analyze the factors that determine economic growth of some of the countries that belong to the European Union, the main objectives being stability and financial unity, through processes such as a the Single Market. Through econometric regressions, we will carry out an empirical analysis and present the results. The time period we have is limited to the years 1995 to 2014 due to the difficulty of finding data to extend this time horizon.

By including additional variables our aim is to measure the factors that affect economic growth of the nations between 1995 and 2014.

This work is organized as follows: After the introduction, the second section revises the main theories about the determination of economic growth. In section 3, previous empirical literature will be reviewed showing some of the recent empirical contributions and describing the different conclusions reached by the authors. In section 4 we present our results and analyze them. Finally, in section 5, we summarize the conclusions.

SECTION 2.THEORETICAL MODEL

Many researchers have tried to analyse the factors that affect the natural rate of economic growth, a variable with a great variety of definitions, as the model of growth of the Keynesians Harrod (1939) Domar (1946) shows. In the 1940's, these authors analysed the factors which influence the dependent variable defined as the speed of growth in the relation of capital and labor.

The theories have evolved since then, starting with neoclassical models of optimization followed by several contributions.

Solow and Swan (1956), authors who developed the neoclassical theory of growth, suggested what we nowadays understand as the neoclassical theory. They defined growth in a closed economy with a production function that considered both the exogenous[1] factors and the endogenous ones[2].

$$\text{Función de producción:} \quad Y_t = F(K_t, L_t, A_t) \quad [1.1]$$

Considering three production factors: Capital (K), Labor (L) and Technology (A), there are three assumptions under which the elaborated model Works:

1. Doubling the amount of the productive factors labor and capital produces constant returns to scale; as a result, the production also increases to an arbitrary constant, for example defined by λ. It is explained mathematically as:

$$F(\lambda K, \lambda L, A) = \lambda F(K, L, A) \qquad [1.2]$$

   We can observe that technology does not follow this homogeneity of degree 1 given that with the same level of technology, named A, the level of production will not increase by a constant factor.

2. The marginal productivity of the factors above is positive and decreasing. In mathematical language, we can define marginal productivity as the partial derivatives of the used factor according to the obtained output. Although there will be a time when investing more in capital and labor will not increase total output that is to say, the investment will not produce more growth.

[1] Exogenous: Variable that affected the model but it is not determined by them.
[2] Endogenous: Variable generated by a statistical model that is explained by the relationships between functions within the model

3. Inada's conditions, published by this Japanese economist in 1955, guarantee stability in economic growth and when one of the factors is used to its maximum, the marginal productivity has a trend towards zero and when its use is zero the marginal productivity has a trend towards infinity. This prevents the model from having a stochastic behavior and implies that the production function will have the form of a Cobb-Douglas production function.

Under this principles, the Cobb-Douglas function from which the law of accumulation of capital in the first stage is derived is:

$$Y_t = A_T \, K_T^{\propto} L_T^{1-\propto}. \qquad [1.3]$$

In this equation [1.3] the α exponents represent the proportion in which every productive factor contributes. Using this function reflects the division of the participation of the factors land and capital in the aggregate product, since over the years there was not observed any variation in this aspect.

Therefore, according to these authors' theory, all that is produced in an economy is distributed between consumption and investment, where both of them depend on national income.

$$\text{F } (K_t, L_t, A_t) = C_t + I_t \qquad [1.4]$$

Now, after developing all the principles of Solow and Swan, we are going to deal with the main equation of growth which shows us how the stock of capital per capita evolves over time.

$$\dot{k_t} = sA_t^{\propto}(\partial + n)k_t \qquad [1.5]$$

The variables used for the definition of the main equation are:

- Endogenous variables: capital per capita ($\dot{k}$) and saving(s). Next, we are going to define these variables.
    - The capital per capita is the national income according to the population which regarding to the model coincides with the number of workers.
    - The savings that are considered to be constant, are the fraction of income that the consumers do not spend. On the other hand, consumers choose between consuming and saving; in other words, all that is saved is considered investment in a closed economy. Therefore sY_t =I_t
- Exogenous variables: Technological progress, depreciation, and population.
    - Technological progress is a source of potential growth. It is supposed not to increase but to be constant.

- Depreciation rate, is equal to ∂K_t, where we suppose that for each "t" defined as time, a constant fraction of investment is deteriorating. It is important to study the movements of capital (K) because it is the variable that together with savings influences many of the changes in the output product (Y).
- And with respect to the population, one of the less realistic assumptions is that it is equivalent to the number of workers.

The reason of taking into account these exogenous factors is to consider that the factors that determine economic growth are external, come from outside the model.

This theory was questioned by Cass and Koopmans in 1965. Explaining that the assumptions of the Solow model prevent the introduction of technological progress as an endogenous variable. Given that capital and labor follow the principle of homogeneity of degree 1, relative to the variable of quantity of product, and A in [1.3] equation that it is not a 'rival good'[3] it is said could be used for so much production as desired, also follow this same principle.

To solve this problem of exogeneity of the variables that have been included in the last model but have that are not explained in the model the Solow model hypotheses were modified. Even after these changes, the model was not frequently applied due to its complexity and, later, in the seventies, was abandoned after the oil crisis.

In the 1980s the belief of that Neoclassical Model being theoretically unsatisfactory became clear. The integration of Ramsey's analysis (1965) in consumer optimization in economic growth provided endogenous saving rates. Although to include technological change is difficult, because it is a variable that does not have an isolated effect on GDP because it has aspects of a public good. Ramsey's contribution to the model by Cass and Koopmans which consists of an intertemporal consumption theory in which the time of consumption is infinite and where the individual obtains a given utility for each period was supposed to be a step forward in comparison to previous theory.

After the mid-1980s, research into economic growth experienced a rise through the work of Romer (1986) and Lucas (1988) which also recognized the relevance of long-term factors. It was observed that the weight of the determinants of growth in the equation was much larger than that of monetary and fiscal policies. But to go further it was

[3] Term used to define when a factor has a limited capacity to produce an amount of a good.

necessary to move away from the constraints that the model of Solow dragged, that is to deal with the variable of technological progress.
Years later in 1987-1990, Romer introduced theories of Research and Development (R & D) and imperfect competition by adding significant contributions where monopolies were shown to have a positive influence on technological advances, noting that due to market distortions Pareto efficiency cannot be reached. In addition, it is necessary to take into account the role of the state, diffusion models of technology and other factors of convergence. The production function is:

$$\dot{Y}_t = A k_t^{\propto} L_T^{1-\propto} k_t^n \qquad [1.6]$$

In this equation [1.6] "k_t^n" represents the role of the externality and the exponent “n” its importance. The aggregate capital of the economy is the new variable that is defined. Romer (1986) supposed that knowledge was obtained from the investment in physical capital, which allowed eliminating the assumption of decreasing returns to capital by applying the concepts of learning by doing and knowledge spillovers.

Jumping temporary to the latest contributions, simple growth models postulate linear relationships in terms of capital and receive a production function with constant scale and economic returns. The relevant contributions of recent years have been made by economists such as Romer (1986), Lucas (1988), (1986), Barro (1990) and Sala-i-Martin (1995) and simplify the production function by assuming technology as an exogenous constant and capital as a linear factor.

For Barro (1990), public spending provided by the government is desirable because it contributes to production along with private capital, K. The nature of the public good will depend on whether it is a rival and excludable good or not, following the criteria of Samuelson (1954), therefore the contributions surrounded these theories depend on the type of good in question. The production function that Barro identifies for a pure public good is:

$$Y_t = A K_T^{\propto} G_T^{1-\propto} \qquad [1.7]$$

In this equation [1.7] “K” it is defined as private capital and “G” as the flow of public goods supplied by the state with a proportional tax and a constant tax rate. Sala-i-Martin (1992c) modeled goods subject to social congestion and various functions for the types of public goods established by Samuelson.

Thus, having a parameter considered exogenous like the rate of population growth it is important to know that high rates trigger a decrease in the rate of growth. In addition, the standard model that we are considering does not take into account the wages per capita, resources used and the other factors that influence the population rate highlighted by authors like Thomas Malthus in their theories.

TABLE 1. LITERATURE REVIEW

Author	**Year of publication**	**Main contribution**	**Critiques**	**Variables**
Barro	(1991)	Adds public spending. Use of government budget constraints	It has a proportional tax and a constant tax rate	-K (Private Capital) -G (Public spending)
Cass and Abramowitz Koopmans	(1965) (1965)	Growth model with consumer Optimization The integration of Ramsey analysis	A very complex model, difficult to implement	The endogenous character of this variables in addition with an efficient Pareto outcome.
Harrod-Domar	(1939) (1946)	Model of Endogenous Growth. Attempted to combine two characteristics of the Keynesian economy, the multiplier and the accelerator	They do not consider labor in their specifications.	-Labor productivity - The rate of growth of capital -The productivity of capital.
Romer and Lucas	(1986) (1988)	Model of Endogenous growth Includes Human Capital	The distortions related to technical progress can affect the rate of growth; non-Pareto efficiency	Adds the role of the state diffusion of the use of technology, R&D, and imperfect competition
Solow and Swan	(1956)	Cobb- Douglass	This model considered that technological progress is exogenous	-Saving rate -Technological progress -Depreciation -Population
Sala-i-Martin	(1992)	Extends the contribution of Barro.		Modeling of different disturbances in public goods.

Source: Author's Elaboration

SECTION 3. PREVIOUS EMPIRICAL LITERATURE

After having analyzed the main theoretical contributions in this field, we now revise the main empirical contributions focused on the analysis of the role that competitiveness, productivity, education and economical openness have on economic growth. There are numerous academic works studying these effects that test the different hypotheses through various econometric techniques.

We are going to analyze empirical contributions by groups of empirical approaches.

In the first group of works, the focus is on the importance of human capital, as a factor that collects schooling and formation years, the productivity in growth and competitiveness. The second group gathers the effect of economic openness. And in the third group the inequality of growth within countries and the effects of the economic crisis on growth, as well as the volatility that influences on our interest variable are investigated.

On the one hand, considering the paper of human capital in economic growth Delgado *et.al* (2014) examine the statistical significance of the years of schooling in the growth model. The econometric regression model used is a non-parametric model based on the contribution of Mankiw *et al.* (1992) where human capital is given as a stock instead of a flow. Variables considered are the worker GDP growth, initial income, investment rate, and working-age population growth. Moreover, the model adds categorical variables to provide a geographical division of heterogeneity along the non-OCDE nations. They elaborated data collected from 1950-2005. The conclusion, despite what previous literature suggested is that they cannot find a significant effect of a proxy of education on economic growth. An important finding is that educational achievement shows relevance and significance, while the educational level cannot adequately represent human capital in a regression of growth.

According to Barro (1991) and other studies using as a variable the primary and secondary enrollment rates, human capital has a significant positive effect on economic growth. But in contrast with the later contributions such as Sala-i-Martin, Doppelhoper, and Miller (2004) the results are not so clear, there is a significant relationship between growth and primary education in contrast to a non-significant growth and higher education.

In addition, the results of the paper by Delgado *et. al* (2014) we have described are not isolated, Henderson (2010), shows the non-significance of the relation between human capital and economic growth.

Concerning the role of productivity, the European Commission (2007), provides an analysis of microeconomic reforms that focuses on increasing the productivity and attempts to explain the weakness of European industries with regard to competitiveness. It uses indicators of growth, productivity, profitability, international trade and foreign direct investment, limiting research to the period 1995 to 2004.

The main finding is that the performance of European industries in terms of competitiveness is heterogeneous over time and between industries, noting a trend towards convergence in productivity. Comparing the growth rates of the United States and the European Union and knowing the importance of competition for competitiveness, it has been found that the main differences are due to the gap in total factor productivity and the quality of human capital. The countries that start from initial levels of low labor productivity, tend to achieve the highest growth levels, although this does not occur in all industries.

In this way, some studies investigate technological progress, innovation capacity, and research & development expecting convergence of skills between economies. They highlight the importance of the European manufacturing business to adapt to new realities to continue improving competitiveness.

Bajo-Rubio *et al.* (2016) estimate the trade balance equations for the Southern European members of the Euro Area: Greece Italy, Portugal, and Spain. The objective of this paper is to assess if the Real Effective Exchange Rate (REER) used as a proxy of external competitiveness affects the trade balance understood as a ratio of real exports to real imports. Using quarterly data covering the years from 1994 until 2014, they did several tests; one for the total trade balance and the other for the euro area. The method used is Dynamic Ordinary Least Squares (DOLS). The relevant variable is REER measured using not only GDP deflators but also Consumer Price Index (CPIs)[4], export prices and unit labor costs (ULC). The conclusion of this study is that demand seems more relevant than relative prices to explain the evolution of trade flows.

In the second group of papers that study the effect of external openness, Bayoumi *et al.* (2011) examine the relationship between export trends and the lack of competitiveness among Eurozone countries, a key issue for export growth.

The paper uses two regressions, a quarterly set of competitiveness indicators covering the years 1995-2009 and an annual panel database to estimate the equations of external

[4] As an economic Index for compare between periods of time the evolution of prices of a representative familiar consumption basket.

demand. As a result, export equations suggest that trade in the European Union is much more sensitive to changes in relative prices (REER) than outside the European Union.

On the other hand, Harrison (1996) looks at the relation between openness and GDP growth. New theories say that trade policies affect long-term growth through their impact on technological change. Using a 1960-1988 database available through cross-section and panel regressions between the 1960s and 1987 results suggest that openness is significant with open trade policies associated with high growth. Although there is some causality in both directions, greater openness leads to high growth ratios but high growth ratios also lead to openness.

Billmeier and Nannicini (2007) also study the impact of trade openness. They use two regressions, one cross-section, and another that controls the heterogeneity between countries, covering the periods, 1950-1970, 1970-1909 and 1990-1998. The findings conveyed some interesting information to improve the results but the regression should be restricted to the observations that show a common support since there are unobservable characteristics that distort the result producing heterogeneity which is an endogenous selection that may violate the assumption of conditional independence.

In the same way, the European Commission (2017) evaluates the components of competitiveness to determine the growth in export market shares (EMS). The variable to be studied is the external competitiveness, within the period 2001-2015 on three sub-periods.

EMS, defined as the quotient of the country's exports, where g^* means global exports, g^e is the country´s export growth rate and g meaning an increase or decrease in the global market share.

$$g = \frac{g^e - g^*}{1 + g^*}$$

Three components influence the exports of the countries: REER country price, the dynamism and the non-price factors. Foreign demand is important but is considered exogenous in the short term.

So according to the author, the relationship between REER and EMS growth is weak and negative, there are country-specific factors to consider, due to heterogeneity. It is a challenge to measure competitiveness in terms of price and cost.

A good export strategy has to take into account both, price and cost competitiveness but despite that, a competition in prices is more adequate for countries with little diversification in their exports through devaluations and cost competition is more appropriate for countries with a low price elasticity of exports.

In the third group, Pichelmann (2015) evaluates the relationship between growth and inequality in income and wealth based on previous research and the evolution of inequality. The author uses inequality variables such as the Gini index, poverty index among age groups, educational integration, etc. The prospect of stagflation and inequality is a threat and strategies should be taken to eliminate these trends. To conclude, it is best to combine monetary and fiscal policies on the supply side as well as on the demand side, eliminate structural obstacles and use migratory flows to eliminate unfavorable demographic trends.

On the other hand, Sinn (2014) compares pre-crisis price inflation with the current prices. The problem of the competitiveness of the Southern Eurozone countries and France remains unsolved despite the policies of the European Central Bank (ECB). In South Europe, there is a need for austerity, and in the Northern European Countries an inflation growth through demand is needed to improve competitiveness and financial imbalances. The Eurozone needs to redirect capital flows.

In relation to the macroeconomics, the European Commission (2008) assesses the role of economic policies in volatility. The explained variable that is considered, is GDP growth volatility in the period 1973-2007 that is divided into 7 sub-periods and is estimated trough a Panel method with 20 OECD countries.

In the last thirty years, the economies of the OECD experienced reductions in output volatility and inflation to which economic policies have contributed. This lead to a GREAT MODERATION of GDP. The decline in volatility has varied according to the respective member country, it is said that the reduction of common shocks has reduced volatility. But there are two reasons that can be the source of GREAT MODERATION in general terms, improvements in the macroeconomic framework and the liberalization of labor and financial markets. The panel results show the relevance of the first factor considered. Further studies point that the volatility on growth will affect negatively our estimate as well as the correlation between the considered variables as said Brueckner and Cameiro (2016).

Durlauf *et al*. (2008) also evaluate the relation between untested and tested models. Along the paper, the method applied is based on the contribution of Fernandez *et al* (2001) and Sala-i-Martin *et al*. (2004). This is a Model Averaging method. The nature of growth theories makes their evaluation difficult, for their openness, and unlimited possibilities of interpretation. The key variable is Total Factor Productivity (TFP) and they emphasize the heterogeneity of this variable. Also, physical and human capital accumulation are included. The type of estimation Model Averaging (MA) shows that classical results for TFP growth produce important externalities by the link between this variable and human capital. It has not been possible to demonstrate that the variables added to produce a determinant effect on aggregate growth. To sum up, we have to work harder to discover the heterogeneities and put limits on the information that can be extracted from the regressions. The regressions have a fundamental growth aspect which is common to all regressions, but the macroeconomic policies affect regional heterogeneity.

TABLE 2. SUMMARY OF EMPIRICAL LITERATURE ON THE FACTORS EXPLAINING GDP GROWTH

Author	Year	Technique	Variable	Results
Bajo-Rubio. (2016)	1994-2014	Dynamic Ordinary Least Squares	REER	Demand plays a major role in capital flows than REER.
Bayoumi (2011)	1995-2009	Panel Dataset	Economic Openness	EU zone countries are more sensitive to changes in REER.
Barro(1991)	1960-1985	Cross section	Human Capital	The more human capital less fecundity and more physical investment.
Billmeier & Nannicini (2007)	1950-1998	Cross Section	Trade Openness	Heterogeneity distorts the results; it is important to control it.
Brueckner & Cameiro (2016)	1980-2010	Non-overlapping panel data	Trade volatility	The effect of trade is sensitive to the fixed effect of the country but is not statistically significant if government spending is not added.
Delgado *et.al* (2014).	1950-2005	Non-parametric	Human Capital level	No significant effect on growth.
Durlauf (2008)	1965-1994	Model Averaging	Total Factor Productivity	No significant effect on growth due to externalities.
European Commission (2007)	1995-2004	Panel and ANOVA	Productivity	Countries departing from low productivity levels grow more rapidly.
European Commission (2008)	1973-2007	Panel	GDP growth Volatility	Macroeconomic performance has contributed to reduction of volatility.
European Commission (2017)	2001-2015	Shift-share decomposition Of EMS	EMS	An export growth strategy has to take into account the real exchange rate based on costs and prices.
Sinn(2014)	1995-2008	Analysis of the situation	Competitiveness	Need to redirect capital flows.
Harrison (1996)	1960-1987	Cross Section and Panel	Output GDP	Causality in both directions between economic growth and open trading regimes.
Henderson (2010)	1965-1995	Nonparametric regression	Test multimodality	In relation to the Human capital, the majority of partial effects are insignificant.
Mankiw (1992)	1960-1985	OLS	Standard of living	The variables Solow and Swan are consistent explaining the differences (1956).
Pichelmann (2015)	Evolution in time of different variables	Analysis of the situation	Inequality distribution	Apply strategies to eliminate unfavorable trends like Stagflation.
Sala-i-Martin, Doppelhoper ,and Miller (2004)	1960-1996	Bayesian Averaging of classical estimates (BACE)	Variables of economic growth regressions	The dependent variable shows a robust partial correlation with the dependent variable. .

Source: Author's Elaboration

SECCION 4. EMPIRICAL RESULTS: DATA ANALYSIS AND ECONOMETRIC RESULTS

In this section, we try to study the role of the previously discussed variables to determine the evolution of real GDP growth per capita. The aim of this paper is to identify the variables that usually have an influence in the European countries, due to the relation between GDP growth and citizens' well-being.

In the previous section, we already gasped the difficulty inherent to estimating a model for GDP growth. Some authors found, despite the theory, that human capital may not be significant for its specification as well as the total productivity of the factors and there may be bidirectional causality between openness and growth, as we will show in the following sections.

To elaborate this empirical study most of variables have been obtained from the World Penn Table (WPT). The variables obtained from this source are, in addition to the dependent variable, human capital, investment, and productivity.

The definitions and transformations of the variables are also proposed by Durlauf et. al (2008), as well as the variables that are going to be explained now:

- **GDP growth (Dependent variable).** Per capita GDP growth is the dependent variable, defined as GDP at constant prices of 2011 in millions of US dollars (US $), calculated using the market prices.
- **The logarithm of GDP per capita in the initial year (LOG_GDP)** of each term, has been taken as the variable that measures the potential of growth towards the convergence of the countries. The countries that come from a lower level of growth are expected to grow faster on average than the countries that came from a high level, that is to say, that they converge (see European Commission (2007). The variable is the logarithm of the first year of each period considered in mil. 2011US$.
- **Human capital (HC)** is defined as an index base on years of schooling, calculated as the logarithm of the average of each term. This variable is included expecting the effect of the skills and the workers' capacity to be significant on the growth of GDP.
- **Capital Stock (CK)** is understood as the stock of capital at constant prices in millions of dollars ($) with 2011 being the base year; transformed into per capita terms and the logarithm of the average. We include this variable because the

reinvestment of capital plays a main role in accumulation of productive capital according to the neoclassical theories of growth.

- **Productivity (RTFPA)** is the total productivity of the factors of production at constant prices, prices of the year 2011, indexed to 1. The transformation of this variable consisted in changing the scale to 100 and calculate the average of each period and apply logarithms.

In addition to the above variables that form part of the baseline model, other explanatory variables are included in the specified model. Population, exports, and imports, as well as the Real Effective Exchange Rate, have been obtained from the World Bank

- **Exports and imports of goods and services (Openness**) as a percentage of GDP, excluding investment income, bank transfers, and workers' compensation are the variables used to calculate the economic opening of the countries. The transformation has consisted of taking the sum of both variables and the mean of each period and then calculate the logarithm. We expect a positive relationship with economic growth, but as Bayoumi *et al*. (2011) said t seems to be somewhat linked to competitiveness, so in times of crisis its effect can be weakened.
- **The real effective exchange rate (REER)** is an index based on 2010. And its transformation consisted in applying logarithms to the averages of each period contemplated. Although this information has been found in the World Bank, it has been extracted by them from the data of the International Monetary Fund.
- **Population growth rate (population growth).**The population growth rate in percentage terms is calculated as the average growth rate of the population in each period. It includes all residents of a country regardless of their legal status.

In the table of the annex, you can see information in table format for all the variables used as well as the transformation of the variables.

Therefore, based on Henderson *et al*. (2011) we can classify the variables that we have described according to the theory which they are studied in as we have evaluated in previous sections.

Variables of Solow's growth theory: GDP at the beginning of the period, human capital, investment and population growth. We add to Solow's contribution, as many other authors have already done, productivity, real exchange rate, and economic openness, as well as time dummies.

The Benchmark equation 1 estimated is as follows:

$$\Delta \text{ Growth GDP}_{it} = \beta_0 + \beta_1 \text{ Openness}_{it} + \beta_2 REER_{it} + \beta_3 \text{Initial income}_{it} + \beta_4 HC_{it} + \beta_5 CK_{it} + \beta_6 population\ growth_{it} + \beta_7 RTFPA_{it} + \delta_{2000-2004} d2000_{it} + \delta_{2005-2009} d2005_{it} + \delta_{2010-2014} d2010_{it} + \varepsilon_{it}$$

As we can see in the Benchmark equation, we want to explain the endogenous dependent variable through the set of explanatory variables.

The sample period is 1995 - 2014, given that due to data limitations we cannot use a longer sample. With this time range, we establish 4 time periods from 1995-1999, 2000-2004, 2005-2009, and 2010-2014, with a sample of 22 individuals, heterogeneous countries and the European Union members during the sample period.

Continuing with our goal of finding the determinants of economic growth, the results of the previous studies suggest the following foreseeable results:

- We expect that economic openness, human capital, physical capital and total factor productivity affect positively on economic growth. This could be due to the provided workers' skills to production and the necessary tools to achieve economic competitiveness, favoring productive performance. Although it could be that as Delgado and (2014) and Durlauf (2008) have shown, human capital and total factor productivity do not result to be significant.

- On the other hand, we expect the real effective exchange rate, initial income of countries and population growth affect negatively on economic growth. Furthermore, the following is expected respectively: The rate of economic activity will fall in the presence of appreciations; low-income countries will grow faster due to the possibilities of growth starting from a lower level being better and with larger population growth each period the increase in income will be lower, due to a larger number of citizens.

- Regarding the time dummies, from the first period, 1995-1999, to the second period, we expect a fall in the growth rate. Thus in the first period, a sustained growth process, as well as an increase in exports of consumption goods, are still taking place. From there the economies move to a stage with lower growth due

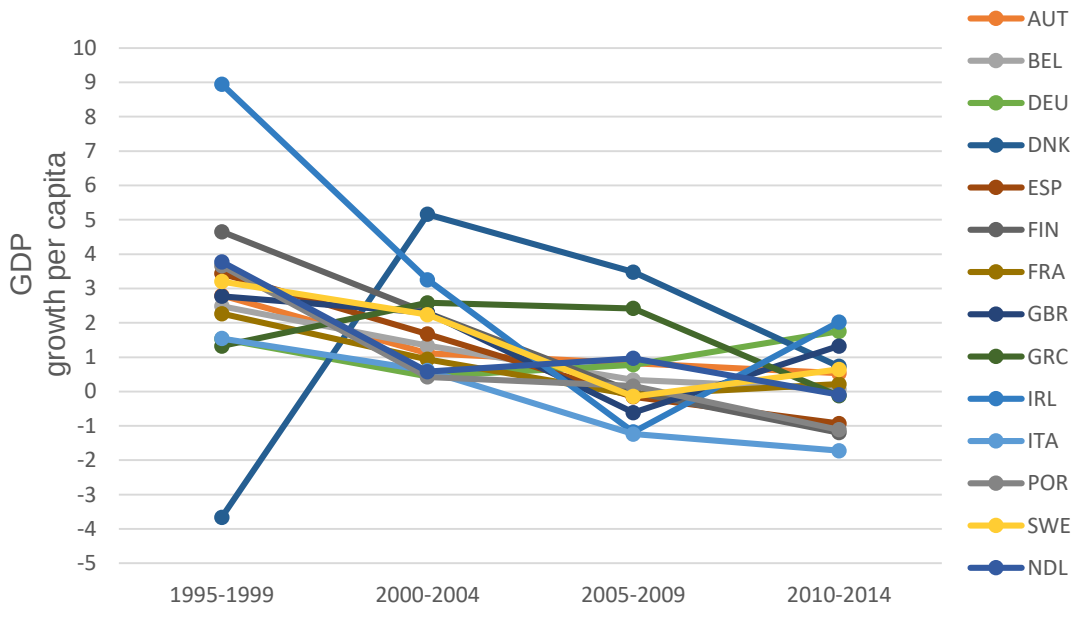
to profound changes at the global level, where a tendency towards emerging new powers increases their GDP weight in the world. In the third period, 2005-2009, which is the moment at which the global economic crisis is considered, we expect a negative temporal role. And for the last of the dummies of those considered, we expect a gradual increase from the previous phase.

These sub-periods cover a very heterogeneous sample due to the macroeconomic shocks experienced, first a period of growth, slight growth after the economic crisis and finally the beginning of the economic recovery.

Next, we will present a graph, which illustrates the evolution of average inter-temporal rates of change per capita in the period comprised for each of the individuals.

The European Union had at the beginning of the sample 15 Member States (in 1995) and increased up to the current 28 members. We present 2 graphs: the first one includes the EU-15: Austria, Belgium, Denmark, France, Germany, Spain, Italy, Ireland, Sweden, Finland, United Kingdom, Greece, Portugal and the Netherlands, excluding Luxembourg. The second one consists of the newer EU members, mostly Central and Eastern European countries.

GRAPH 2: GDP GROWTH EU-15



Source: Author's calculations

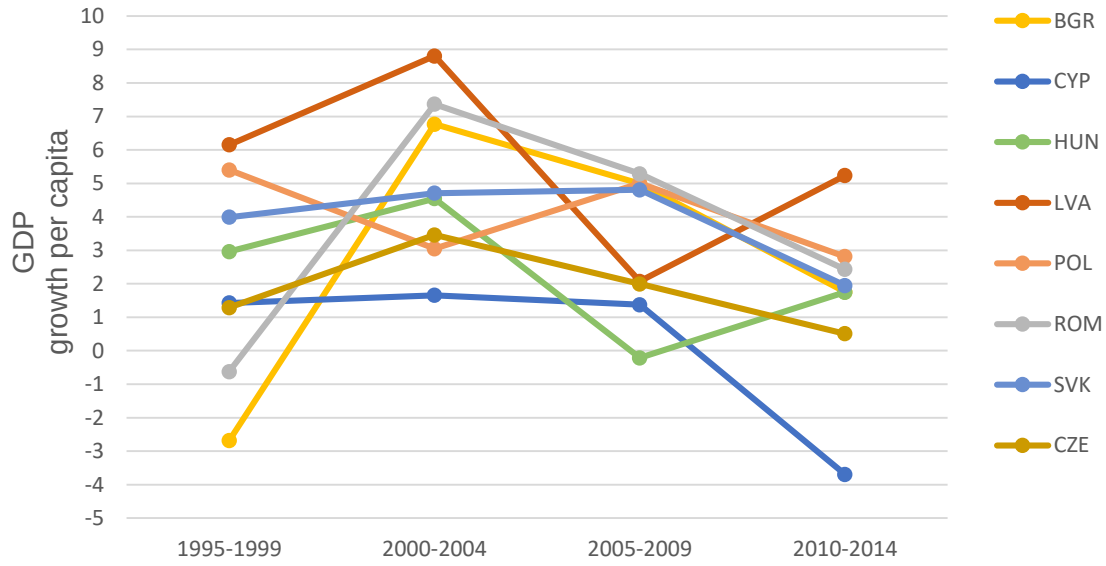
Through the variable GDP growth observed over time in an orderly way from 1995 to 2014, we obtain an average of the inter-annual variation rate of each set period. The rate of variation gives us a relative measure that allows comparisons between the treated series.

As we can see in graph 2 attached above, the countries follow similar trends, with the exception of Denmark which showed an average of real economic growth between 1995-1999 and 2000- 2004 higher than the other countries considered. Afterwards, it suffered a downward trend in growth in the following periods.

Economies in the 1995-1999 period start with growth rates varying between 1 and 5%, with the exception of Denmark and Ireland, and continue in the next period 2000-2004 with falls or relative stability in some economies. The period 2005-2009 includes the beginning of the international financial crisis of 2007. As we can see, some countries are more affected than others, as is the case in Italy, Ireland, Great Britain, Spain, and Sweden.

These countries experience a weak economic recovery in general terms in the following period. In the last period, 2010-, many other things continue to show the effects of the crisis, countries like Greece suffer a substantial fall in GDP during this period. The crisis has several repercussions among the economies considered, as reflected in the variables we discuss below.

GRAPH 3: GDP GROWTH OF CEECS



Source: Author's calculations

Regarding the more recent EU members, we can observe the following real growth rates per capita in Figure 2. The countries considered under the acronym CEECS are Cyprus, Hungary, Latvia, Poland, Slovakia, and the Czech Republic. On the other hand, of the countries incorporated in 2007, Romania and Bulgaria follow the same trend, although Romania has more marked rates of variation.

As we see in the CEECS countries, there is much more variability than in the previous analysis, the growth rates of the first period considered are higher than those of the last period, a characteristic that is shared with the group of countries of the EU-15. We can observe two tendencies, one group of countries that is most affected by the crisis in the last period, as we observed in its decreasing rate, and another one that includes other countries, Latvia and Hungary, with the same trajectory. Cyprus, in the first group of countries, also decreases more than 3%.

SECTION 4.1. SUMMARY AND MAIN DESCRIPTIVE STATISTICS

In Table 3 as we can see below we present a description of the variables.

TABLE 3. DESCRIPTION OF THE VARIABLES.

Variable	Transformation for each period	Countries	Periods of time
GDP growth (GGDP)	Average GDP per capita growth	22	4
Openness	Logarithm of average imports and exports in relation to GDP	22	4
REER	Logarithm of the average REER	22	4
LOG.GDP	Logarithm of GDP at the beginning of each period sample	22	4
HC	Logarithm of the average of a human capital index.	22	4
CK	Logarithm of the average capital stock.	22	4
Gppopulation	Average population growth	22	4
RTFPA	Logarithm of average Total Factor Productivity.	22	4

Source: Author's calculations

TABLE 4. CORRELATION MATRIX MODEL (1) FULL SPECIFICATION. OBSERVATIONS 88

	Dependent	Openness	REER	LOGGDP	HC	CK	GPOPULATION	RTFPA
Dependent	1.000	-------	----	------	-----	-----	-----	-----
Openness	0.062	1.000	-----	------	-----	-----	-----	-----
REER	-0.245	-0.105	1.000	------	------	-----	-----	-----
LOGGDP	-0.2805	-0.559	0.355	1.000	-----	-----	-----	-----
HC	-0.131	0.207	0.054	0.2056	1.000	-----	-----	-----
CK	-0.297	-0.080	0.579	0.358	0.063	1.000	-----	-----
GPOPULATION	-0.383	0.100	0.257	0.109	-0.003	0.395	1.000	-----
RTFPA	-0.352	-0.080	0.475	0.33	-0.081	0.204	0.210	1.000

Source: Author's calculations

As can be seen in Table 4 for this data sample from 22 countries, there is no variable that violates the assumption of no perfect correlation for these panel data. In addition, all of them are to a greater or lesser degree correlated. The correlation indicates, in this case, the economic relation between both variables. Regarding this analysis:

We can see how the economic openness changes in the direct sense with the rate of economic growth. Just as the negative influence of the rest of the variables on it, with the exception of human capital, as is expected, the increase triggers a greater trade openness.

As is expected, in addition, there is an inverse relationship between the exchange rate and the growth rate, in the face of increases, appreciations, a negative effect is expected. A currency increase predictably decreases economic movement between economies and by that also growth. It can also be observed that all the variables considered influence positively on REER.

In relation to population growth, there is an inverse relationship with the dependent variable as expected, influencing the rest of the factors in a positive way to the exception of the years of schooling, that is, a higher education, lower birth rate.

As we see these results correspond with our previous forecasts. In fact, these commented effects can be observed in the adjusted regression lines, as shown below in Table 5.

TABLE 5. CORRELATIONS

ILLUSTRATION 1.OPENNESS-GDP GROWTH

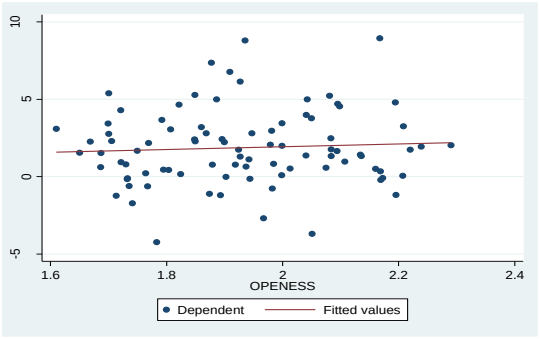


ILLUSTRATION 2.REER-GDP GROWTH

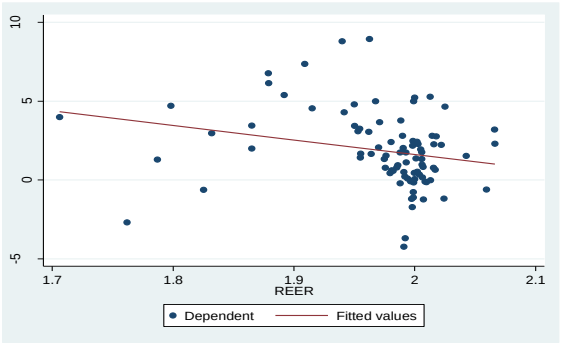


ILLUSTRATION 3. LOG.GDP-GDP GROWTH

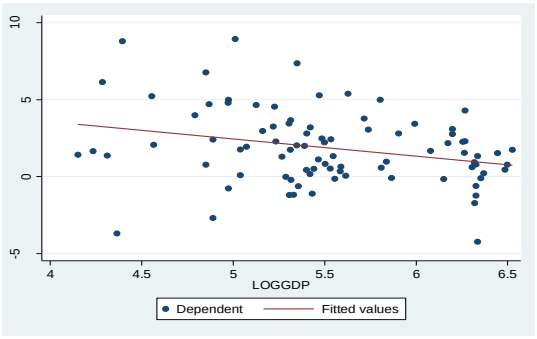


ILLUSTRATION 4. HC-GDP GROWTH

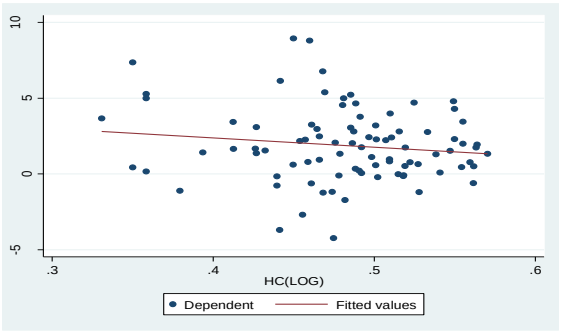


ILLUSTRATION 5. CK-GDP GROWTH

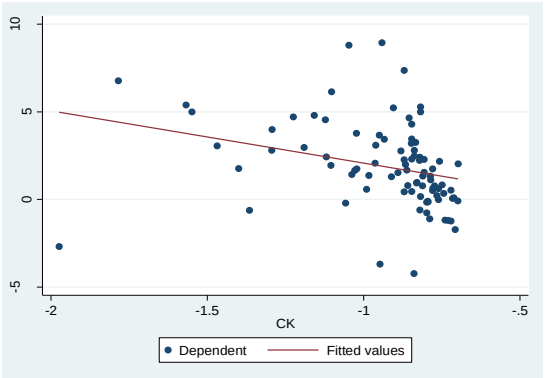


ILLUSTRATION 6.G.POPULATION-GDP GROWTH

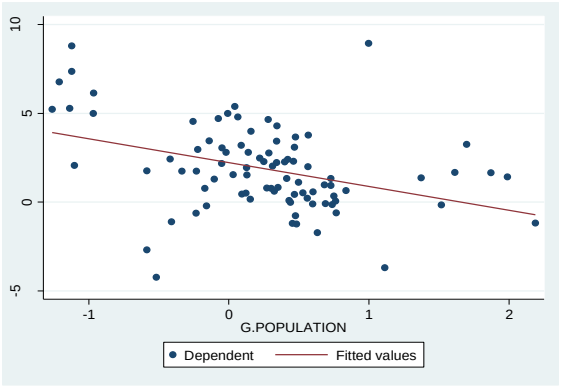
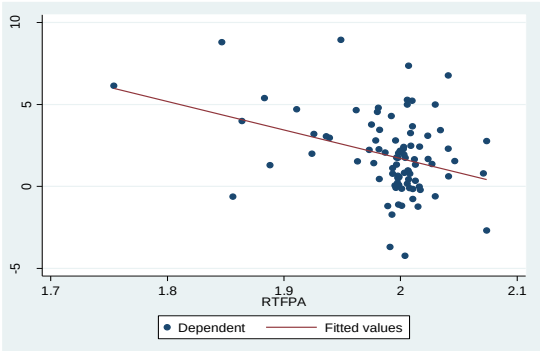


ILLUSTRATION 7. RTFPA-GDP GROWTH



Source: Author's calculations

SECTION 4.2. ECONOMETRIC SPECIFICATION.

After the descriptive analysis, in this section, we will use different specifications to analyze the role of the explanatory variables proposed above on GDP growth.

As we mentioned earlier we specify a panel data model to study the variables that impact on GDP growth. As our datasets contain observations of different variables and countries over time, we use panel data. The panel data is a set of data combining a temporal dimension (time series) and a cross-section dimension (individuals). Panel data is used to control cross-section dependency and unobserved heterogeneity.

To estimate our regression model in the panel context we will use an Ordinary Least Square model (OLS), hereafter referred to as OLS, because it is the best estimator that adapts our data, as we will demonstrate after the tests. Our data consists of 88 observations and 22 cross-sectional units, corresponding to countries of the European Union. The software used is Stata, an econometric integrated statistical package.

In the following regressions, we test the null hypothesis that the coefficient on the different indicators is equal to zero (Ho: $\beta = 0$) and the alternative that the coefficient is different from zero (H1: $\beta \neq 0$). The chosen level of significance is 5 %.

In the following section, we will specify and estimate our models as well as explain the results obtained.

SECTION 4.3. REGRESSIONS AND EMPIRICAL RESULTS.

Before checking compliance with the assumptions, we have tested the most appropriate estimation method through the Breusch-Pagan test.

Hausman's Test would be used to choose between fixed effects and random effects panel estimation, but the Breusch-Pagan test results suggest that it will not be necessary. As we will see attached under the first regression, for to choose between the Panel estimate and the OLS estimate.

In Table 6 attached below, we can see the results obtained in the Panel and OLS regression. We are going to work following a general to specific modelling approach, which will give us more significant results. In the tests, we have eliminated the non-significant variables. The selected regression is the model (4).

TABLE 6. RESULTS OF THE MODEL APPLY FOR THE STUDY OF GDP GROWTH

DEPENDENT VARIABLE: GDP growth per capita.	PANEL RANDOM EFFECTS	PANEL OLS	PANEL OLS [ROBUST TO HETEROSKEDASTICITY]	PANEL OLS
INDEPENDENT VARIABLES:	**(1) Full specification**	**(2) Full specification**	**(3) Robustness specification**	**(4) Specification restricted**
OPENNESS	4.409(**) (1.985)	4.263(**) (1.829)	4.263(**) (1.918)	3.874(*) (1.352)
REER	9.175(**) (4.656)	8.788(***) (4.539)	8.788 (4.787)	7.276 (4.004)
LOG. GDP	0.052 (0.574)	0.118 (0.520)	0.118 (0.497)	-------
HC	-5.953 (4.676)	-5.762 (4.329)	-5.762 (4.521)	-------
CK	-0.375 (1.245)	-0.686 (1.160)	-0.686 (1.297)	-------
POPULATON	-1.526(*) (0.363)	-1.447(*) (0.349)	-1.447(*) (0.341)	-1.515(*) (0.318)
RTFPA	-10.442(***) (5.390)	-11.802(**) (5.288)	-11.800 (7.514)	-10.014(**) (4.791)
PERIOD2 (Dummy)	-0.000 (0.590)	0.069 (0.606)	0.069 (0.634)	-0.053 (0.595)
PERIOD3 (Dummy)	-1.914(*) (0.653)	-1.788(*) (0.664)	-1.788(*) (0.635)	-1.892(*) (0.649)
PERIOD4 (Dummy)	-2.965 (0.718)*	-2.895(*) (0.720)	-2.830(*) (0.795)	-3.069(*) (0.683)
CONSTANT	-0.109 (12.38)	2.797 (12.022)	2.830 (13.399)	1.616 (11.221)
Observations **Groups**	88 22	84 22	84 22	84 22
R^2	44.8%	45.0%	45.0%	43.4%
SK TEST ON RESIDUALS FOR NORMALITY	----------	Statistic: 3.97 P-Value:0.13	Statistic: 3.97 P-Value:0.13	Statistic: 2.20 P-Value:0.33
TEST: BREUSCH-PAGAN LAGRANGE MULTIPLIER TEST	Statistic: 0.01 P-Value:0.46	----------	----------	Statistic: 0.15 P-Value:0.34
HETEROSKEDAS-TICITY TEST	----------	Statistic:22.22 P-value:0.014	Robust to it.	Statistic:13.20 P-value=0.067

Note: Standard errors in parentheses. (*), (**), (***) represent significativity at 1%, 5% and 10% respectively.

Source: Author's calculations

Results from regression (1):

The Hausman test has been only applied to specification 1 and we obtained that it was better to apply random effects.

We then test for the choice between the use of ordinary least squares (OLS) and random effects through the Breusch-Pagan test. If the variance of the residuals in this test is significantly different from 0 we will use the Random Effects estimator.

The hypotheses are the following:

TEST: BREUSCH-PAGAN LAGRANGE MULTIPLIER TEST

$$H_o: Var(u) = 0$$

$$H_1: Var(u) \neq 0$$

The results attached above in Table 6 suggests that we do not have enough empirical evidence to reject the null hypothesis, so the OLS method is the most appropriate.

Therefore, we have verified that the estimation is not the most adequate, as we indicated in the previous test, our model does not have individual effects. Therefore, we will estimate the model by OLS.

To approach to the correct economical regression, we have done contrast and matrix to test the lack of correlation, heterogeneity and normal distributions of the residuals. Results of which there are reports of the presence of heterogeneity in the model (2) with the Breusch-Pagan test.

The obtained results of regression (2):

To determine if this regression is the most adequate, we have tested whether the model passed the specification tests, detecting the presence of heteroskedasticity[5] in the model with the Breusch-Pagan test. The obstacle that has been faced by a robust regression to standard errors (3).

The regression fails to fulfill one of the basic assumptions on which the linear regression model is based, which may be due to an asymmetric distribution of variables or atypical values in our observations, as we can see in the graphs in figure 5. This is probably the reason why our estimators are consistent but inefficient, that is, they do not have the smallest possible variance.

[5] Specification contrasts are included in the table.

On the other hand, adding all considered variables produces poor estimates because it causes the non-significance of the rest of variables, possibly due to the existence of either multicollinearity or correlation among them.

Therefore, the estimation of the model is sensitive to the inclusion of the variables because of the correlation or otherwise said interaction between them produces heteroskedasticity.

Results from specification (3):

This Regression typified by its consistence, efficiency, and robustness to heteroskedasticity, suggests that we have enough empirical evidence to reject the null hypothesis of non-significance of trade openness, population growth, and the last two time periods.
On the one hand, the relationship between openness and the growth rate is positive, as we the theory predicts. Thus, more trade openness would increase growth. On the other hand, the relationship between population growth and GDP per capita is also negative, as we expected, because an increase in population reduces income per capita.

Results from specification (4):

In this regression, we move from the general equation to a more specific one by eliminating the non-significant variables.
The remaining significant variables, as expected, are openness, population growth rate and productivity, as well as the last two time dummies.

To determine if this regression is the most adequate, we have tested whether the model passed the specification tests, and fulfilled the assumptions. In the model, the presence of heteroskedasticity is not detected. Specification tests are included in the attached images.

At a 1% level of significance, we have enough empirical evidence to reject the null hypothesis of non-significance, in openness and population growth. They affect economic growth in a very significant way and maintain the same signs as in the previous equation, positive in the case of openness and negative in population growth.

Productivity, on the other hand, is significant at 5% but has an unexpected negative effect on Gross Domestic Product growth. It seems that, as already indicated by the previous

empirical review, there are many factors that may affect the evolution of productivity as Durlauf (2008) stated, that may explain this unexpected sign. Due to all the economic events that happened during the sample period, we consider the effect of the economic crisis, adding this new dummy to the regression after having evaluated the assumptions. The variable added is the economic crisis that covers the periods 3 and 4 of the previous estimations as we can see next in Table 7.

The crisis dummy turns out to be significant at 1% and has a negative sign, reflecting effect of the global economic slowdown, from the crack of 2007 to the present.

TABLE 7.RESULTS OF THE CRISIS IN PRODUCTIVITY (RTFPA)

DEPENDENT VARIABLE: **GDP growth per capita.**	**PANEL OLS**	**PANEL OLS [ROBUST TO HETEROSKEDASTICITY]**
INDEPENDENT VARIABLES:	**(5) Specification restricted to The significant variables**	**(6) Specification restricted to the significant variables**
OPENNESS	3.439 (**) (1.360)	3.439 (**) (1.438)
REER	6.454 (4.058)	6.454 (5.468)
POPULATION	-1.429(*) (0.321)	-1.429(*) (0.342)
RTFPA	-9.562 (5.004)	-9.562 (7.377)
PERIOD 2	-0.033 (0.606)	-0.033 (0.655)
CRISIS	-2.403(*) (0.609)	-2.403(*) (0.643)
CONSTANT	3.111 (11.40)	3.111 (12.117)
Observations **Groups**	88	88
R^2	40.5%	40.5%
SK RESIDUAL NORMALITY TEST	Statistic: 3.82 P-value:0.14	Statistic: 3.82 P-value:0.14
TEST: BREUSCH-PAGAN AND LAGRANGE MULTIPLIER TEST	Statistic:0.00 P-value:1.00	----------
BREUSCH-PAGAN TEST (HTC)	Statistic:13.05 P-value:0.0422	Robust to it
Note: Standard errors in parentheses. (*), (**), (***) represent significativity at 1%, 5% and 10% respectively		

Source: Author's calculations

The Results obtained by regression (5):

As we see in Table 7, after doing all the tests we detected as previously the presence of heteroskedasticity with a level of significance of 5%, so the regression fails to fulfill one of the basic assumptions.

The Results obtained by regression (6):

Adding this variable to regression 6 produces substantial changes in results with respect to regression 4. The most important result is that RTFPA is now not significant and, as we expected its puzzling significance was due to the period of economic crisis.

In this regression, we are considering the factors that are correlated positively with trade openness and population growth and correlated negatively with two others, namely REER and RTFPA. Due to this correlation, our estimate can be biased. However, as we have seen in the literature review, heterogeneity affects this variable as it was already stated by Billmeier & Nannicini (2007).

For all estimates conducted we have tested whether the residuals were of normality.

Results of the sample regression:

$\Delta \widehat{\text{Growth GDP}}_{\text{it}} = 3.111_{it} + 3.439\ \text{Openness}_{it} + 6.454\text{REER}$

$-1.429\ \text{population growth}_{\text{it}} - 9.562\text{RTFPA}_{\text{it}} - 0.033_{\text{Period 2}}$

$-2.403_{Crisis} + \varepsilon_{it}$

Countries=22

Thus, we have obtained the predicted result in the significant variables of the model as shown in the following Table 8.

TABLE 8. RESULTS OF THE MODEL VS. EXPECTED RESULTS

Variables	**Expected results**	**Results obtained**
Openness	**+**	**+**
Population	**-**	**-**
RTFPA (non-significant)	**+**	**-**
Period 2(non-significant)	**-**	**-**
Crisis	**-**	**-**

Source: Author's calculations

SECTION 5. CONCLUSIONS

Throughout this paper, we have studied the determinants of per capita GDP growth in 22 European Union countries for 19 years summarized in 4 periods, estimating a multiple linear regression models of Ordinary Least Squares (OLS) with panel data.

After several estimates and restricting the estimation to the significant variables, the results suggest that we have enough empirical evidence to affirm that in the periods of time considered the following variables are significant with respect to GDP growth:

a) Trade openness affects positively GDP growth per capita in the European countries. This result is natural, as the countries included in the model are members of a highly integrated area not only internally, but also in relation to the rest of the world.

b) Population growth affects negatively on per capita GDP growth in the European countries. This variable was already considered by Solow and Swan (1956), and resulted to be significant at the 1% level in all estimates so it plays a key role. The role of demography is confirmed as a relevant factor to study growth in the European countries.

c) And finally, the economic recession has produced significantly negative effects on the growth rate, as already detected in the exploratory analysis. Therefore their effects are indisputable in this period of the time considered, as is also the case as we have previously discussed as the RTFPA.

d) Other variables normally considered in this type of analysis have turned out to be non-significant, such as capital stock, human capital and productivity.

To conclude, this research has limitations, since we have based them on a single economic technique and the time period is relatively short for an in-depth analysis of the factors that determine growth. For future research, it would be interesting to apply other techniques and extend the study to the determinants of each of the variables yet used as repressors.

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SECTION 7. APPENDIX 1

The estimated model covers the years 1995-2014. The following variables are included in the linear regression.

TABLE 9: DATA SOURCES AND MEASUREMENT ISSUES:

Name of the variable	Variable	Source	Transformation	Role in the model
Rate of growth per capita Dependent variable	Real GDP at constant national prices (in mil. 2011US$)	World Penn Tables. International comparisons of production, income and prices 9.0	We have calculated 4-period averages of the logarithm of real per capita GDP growth.	The value added is the value of the gross output of producers less the value of intermediate goods and services consumed in production.
Trade Openness	Trade Openness $= \frac{X+M}{GDP}$	World Bank national accounts data, and OECD National Accounts data files.	Trade openness consists of: • Exports of goods and services (% of GDP) or X. • Imports of goods and services (% of GDP) or M.	Trade openness is expected to have a positive effect on growth.
Real effective exchange rate (REER)	(2010=100)	International Monetary Found	In logarithms	The REER is an indicator of competitiveness
Human Capital per person (HC)	The use of this variable provide us a measure of the relative importance of the employee's Skills	Penn World Tables, version 9.0		The Human Capital index is based on years of schooling and returns to education'.
Capital stock (CK)	Measured at current PPPs (in mil. 2011US$)	Penn World Tables, version 9.0	Logarithm of the average	The use of this variable at the regression is as a rate of returns of capital investment to the economy.
RTFPA	Total Factor Productivity at constant national prices (2011=1)	Penn World Tables, version 9.0		Productivity effects on growth are expected to be relevant.
Growth of Population	Population, total	World Bank	4-period averages of population growth.	To measure the effect of demography on the economy.

Source: Author's calculations

SECTION 8: APPENDIX 2

TEST BREUSCH-PAGAN MODEL 1.

```
. xttest0

Breusch and Pagan Lagrangian multiplier test for random effects

        Dependent[i,t] = Xb + u[i] + e[i,t]

        Estimated results:
                         |       Var      sd = sqrt(Var)
                ---------+------------------------------
                Dependent |   5.854943        2.419699
                        e |   2.204864        1.484878
                        u |   .1916604        .4377903

        Test:   Var(u) = 0
                                chibar2(01) =      0.01
                            Prob > chibar2 =    0.4606
```

TEST BREUSCH-PAGAN MODEL 4.

```
. xttest0

Breusch and Pagan Lagrangian multiplier test for random effects

        Dependent[Period,t] = Xb + u[Period] + e[Period,t]

        Estimated results:
                         |       Var      sd = sqrt(Var)
                ---------+------------------------------
                Dependent |   5.854943        2.419699
                        e |   3.601755        1.897829
                        u |          0               0

        Test:   Var(u) = 0
                                chibar2(01) =      0.00
                            Prob > chibar2 =    1.0000
```

HETEROSKEDASTICITY MODEL 4.

```
. hettest OPENESS GPOPULATION RTFPA REER PERIOD2 PERIOD3 PERIOD4

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
        Ho: Constant variance
        Variables: OPENESS GPOPULATION RTFPA REER PERIOD2 PERIOD3 PERIOD4

        chi2(7)      =    13.20
        Prob > chi2  =   0.0674
```

HETEROSKEDASTICITY MODEL 5

```
. hettest OPENESS REER  GPOPULATION RTFPA PERIOD2 Crisis

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: OPENESS REER GPOPULATION RTFPA PERIOD2 Crisis

         chi2(6)      =    13.05
         Prob > chi2  =   0.0422
```

MODEL 6.

```
. do "C:\Users\Anabel\AppData\Local\Temp\STD01000000.tmp"

. regress Dependent OPENESS REER GPOPULATION  RTFPA PERIOD2 Crisis ,vce(robust)

Linear regression                               Number of obs =      88
                                                F(  6,     81) =   10.64
                                                Prob > F      =  0.0000
                                                R-squared     =  0.4057
                                                Root MSE      =  1.9332
```

Dependent	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
OPENESS	3.439748	1.438256	2.39	0.019	.5780706	6.301426
REER	6.454812	5.468038	1.18	0.241	-4.424868	17.33449
GPOPULATION	-1.429604	.3421632	-4.18	0.000	-2.110401	-.7488063
RTFPA	-9.562341	7.377518	-1.30	0.199	-24.24129	5.116606
PERIOD2	-.0334369	.6551851	-0.05	0.959	-1.33705	1.270176
Crisis	-2.403178	.6432229	-3.74	0.000	-3.68299	-1.123366
_cons	3.111733	12.11759	0.26	0.798	-20.99847	27.22194

MODEL 2.

Assumption of normality of residuals model 2	Scatter Plot of residuals model 2