Analyzing Macroeconomic Indicators of Economic Growth Using Panel Data

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Abstract

During last 10 years some EU countries had economic instability. They have short and long term challenges such as unemployment, population ageing, globalization etc. In this study it is aimed to analyze macroeconomic indicators of EU countries' economic growth using panel data approach. Static linear panel data models were used for determining the effects of independent macro-economic variables on gross domestic product (GDP) of EU member countries including Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom; acceding country: Croatia; and candidate countries: Iceland, Serbia and Turkey. While dependent variable of analyze is gross domestic product (volume), the independent variables are current account balance, general government gross debt, general government revenue, general government total expenditure, gross national savings, inflation (average consumer prices), population, total investment, unemployment rate, volume of exports of goods and services, volume of imports of goods and services. The analysis proposed is based on a panel data (cross sectional time series data) approach. The dataset of this research involves 31 EU member and EU candidate countries (cross sectional units). The effects of 11 macroeconomic indicators on gross domestic product volume were examined. The paper also empirically analyzes the negative impacts of global financial crisis (the 2007 U.S. Subprime Financial Crisis) into EU member and candidate countries' economic growth during the 2002–2012 periods (time series). In this context, the paper explains what a financial crisis is, the factors that promote a financial crisis, and the dynamics of a financial crisis. Thus, the effects of macroeconomic parameters are analyzed using panel data series. The findings of this research are especially useful for EU candidate countries such as Iceland, Serbia and Turkey for developing convenient economic strategies.

Keywords: European Union and Candidate Countries, Financial Crisis, Macro Economic Parameters, Panel Data Analysis, Gross Domestic Product, Economic Growth

Introduction

The relationship between economic growth and macroeconomic indicators has long been a popular issue of debate in the literature of economic development. In this content, the primary purpose of this research is to analyze macroeconomic indicators of EU member, acceding and candidate countries' economic growth using panel data approach. Annual

data are used for the period 2002 to 2012. The sample period is dependent on annual data availability. The data was gathered from the International Monetary Fund world economic outlook data base.

Beine et al. (2011) proposed new panel data approach for examined the impact of skilled emigration on human capital accumulation. The data was covering 147 countries during the period 1975–2000. Predictions were tested using dynamic regression models. They found that skilled migration prospects foster human capital accumulation in low-income countries. Bortolotti et al. (2003) determined the reasons why governments privatize, and the size and extent of privatization processes around the world with using a panel of 34 countries over the 1977 – 1999 period. They identified market, budget and institutional constraints affecting privatization. Lee and Chang (2007) applied a new panel data stationary testing procedure in order to re-investigate the dynamic interactions between energy consumption per capita and real GDP per capita in 22 developed and 18 developing countries. They found that in individual countries, structural breaks occur near other variables in both developed and developing countries because of a tight relationship between energy consumption and GDP. Sukiassyan (2007) attempted to empirically evaluate that relationship with data from the transition economies of Central and Eastern Europe and the Commonwealth of Independent States. He examined various dimensions of the growth-inequality debate. His findings for transition countries indicated a strong, negative contemporaneous growth-inequality relationship. Lee and Chang (2008) applied the new heterogeneous panel cointegration technique to re-investigate the long-run movements and causal relationships between tourism development and economic growth for OECD and nonOECD countries for the 1990–2002 period. They determined that tourism development has a greater impact on GDP in nonOECD countries than in OECD countries. Haas and Lelyveld (2006) examined whether foreign and domestic banks in Central and Eastern Europe react differently to business cycles and banking crises. Their panel dataset comprised data of more than 250 banks for the period 1993–2000. They showed that during crisis periods domestic banks contract their credit. In contrast, Greenfield foreign banks play a stabilizing role by keeping their credit base stable. Also they found a significant and negative relationship between home country economic growth and host country credit by foreign bank subsidiaries. Tsoukas (2011) used a panel of five Asian economies – Indonesia, Korea, Malaysia, Singapore and Thailand – over the period 1995–2007 for analyzing the links between firm survival and financial development. He found that country-level indicators of financial development have an important role to play in influencing firm survival and large firms would benefit the most from developments in the stock market, while small firms are most severely affected from high levels of financial intermediation.

Macro-Economic Indicators

Our model comprises twelve variables: while dependent variable of analyze is gross domestic product (GDP); the independent variables are current account balance, general government gross debt, general government revenue, general government total expenditure, gross national savings, inflation (average consumer prices), population, total investment, unemployment rate, volume of exports of goods and services, volume of imports of goods and services. Gross Domestic Product represents the economic health of a country. It presents a sum of a country's production which consists of all purchases of goods and services produced by a country and services used by individuals, firms, foreigners and the governing bodies. GDP consists of consumer spending, investment

expenditure, government spending and net exports hence it portrays an all-inclusive picture of an economy because of which it provides an insight to investors which highlights the trend of the economy by comparing GDP levels as an index. GDP is not only used as an indicator for most governments and economic decision-makers for planning and policy formulation; but also it helps the investors to manage their portfolios by providing them with guidance about the state of the economy. On the other hand, it is good measure for an economy and with improvement in research and quality of data, statisticians and governments are trying to find out measures to strengthen GDP and make it a comprehensive indicator of national income.

International standards regarding the compilation of balance of payments statistics are described in the fifth edition of the Balance of Payments Manual prepared by the International Monetary Fund (IMF) in order to provide guidance to member countries. In a general sense, the balance of payments is a statistical statement that systematically records all the economic transactions between residents of a country (Central Government, monetary authority, banks, other sector) and nonresidents for a specific time period. The balance of payments statistics are classified under two major groups: "Current Account" and "Capital and Financial Account". In summary, the current account covers all transactions that involve real sources (including volume of exports and imports of goods and services,) and current transfers; the capital and financial accounts show how these transactions are financed (by means of capital transfer or investment in financial instruments). As mentioned in the European Economic series (Current Account Surpluses in the EU, 9/2012, p.10), current account deficits and surpluses are not necessarily macroeconomic imbalances in the sense of developments which are adversely affecting, or have the potential to affect the proper functioning of economies, of the monetary union, or on a wider scale. Deficits and surpluses are a natural consequence of economic interactions between countries. They show to which extent a country relies on borrowing from the rest of the world or how much of its resources it lends abroad. In this way, external borrowing and lending allows countries to trade consumption over time: a country with a current account surplus transfers consumption from today to tomorrow by investing abroad. In turn, a country with a current account deficit can increase its consumption or investment today but must transfer future income abroad to redeem its external debt. Deficits and surpluses can thus simply be the result of an appropriate allocation of savings, taking into account different investment opportunities across countries. Differences in economic prospects lead to differences in saving behavior, with brighter expectations reducing the tendency of economic agents to save and hence contributing to the accumulation of deficits. In particular, countries with a rapidly ageing population may find it opportune to save today (i.e. run surpluses) to smooth consumption over time. On the other hand, current account deficits and surpluses are part of the adjustment process in a monetary union. They absorb asymmetric shocks in the absence of independent monetary policy and nominal exchange rate adjustment.

This paper also attempts to analyze the correlation that exists between GDP and inflation. It is widely believed that there is a relationship between the two. The problem is that there are disagreements as to what that relationship is or how it operates. As a result, when governments make decisions based on these pieces of information, the outcome often cannot be guaranteed. Exploration of the relationship between GDP and inflation is best begun by developing an understanding of each term individually. As mentioned above, GDP is an acronym for gross domestic product, which is the value of a nation's goods and services during a specified period. This figure is generally regarded as an important

indicator of an economy's health. Inflation refers the rate at which the general level of prices for goods and services is rising, and, subsequently, purchasing power is falling.

In determining the economic position of a country is through a comparison of general government gross debt, revenue, total expenditure, national savings and total investments to the gross domestic product of the country. For instance, a low government gross debt to GDP percentage is usually an indication of economic health, while a high debt to GDP percentage can indicate financial trouble for a country.

Panel Data Analysis

"Panel Data" is set of data obtained by observation of the characteristics of a variety of units (cross-sectional variables) over time (Ahn and Moon, 2001). Panel data set have both cross-sectional and time-series dimensions. The size of the time series is formed by monitoring the same cross-section units during a given period (Wooldridge, 2009).

When each subject (cross sectional unit) has the same number of obsevations, this type of panel is called a balanced panel data set. If some subjects have different number of observations, this situation is known as the unbalanced data case (Wooldridge, 2009).

Panel data sets that thousands of cross sectional units observed through the time are used in many micro-economic researches (Hill et al., 2008). Panel data provide more informative data, more variability, more degrees of freedom, less collinearity among the variables and more efficiency (Baltagi, 2010).

Panel data analysis can be considered as a combination of regression and time series analysis (Frees, 2004). This analysis is based on repetitive variance models because the observations of the units are repetitive through time dimension (Pazarlıoğlu, 2001).

The main superiority of panel data due to working with the one dimensional cross-sectional series or repeated cross sectional series that same units are not observed through the time is to loosen the standard assumptions (Maddala and Lahiri, 2009).

By studying the repeated cross section of observations Panel data can better detect and measure effects that cannot be observed in pure cross section or pure time series data (Gujarati and Porter, 2009).

Analyzing the observations of cross section and time series provide more flexibility compared to when used them separately by increasing the quantity and quality of data. In panel data analysis, the cross-sectional units are considered to be heterogeneous and controlled for the variation (heterogeneity). Pure time series or cross section studies which are not controlling this heterogeneity there run the risk of obtaining biased results. Panel data are able to control variables which are subject or time invariant (Baltagi, 2010).

Because panel data has time based dynamics with the observations of cross sectional data repeated through time, the effect of unmeasured variables can be controlled (Hsiao, 2003). With the use of cross-sectional observations over time, panel data analysis provides more clarification character, less collinearity and more degrees of freedom and efficiency than only cross sectional analysis or time series analysis (Tarı, 2010).

In static panel data models, the covariance estimators (pooled panel data), fixed effects and random effects estimators are widely used. When the cross-sectional units are homogenous, pooled ordinary least squares panel model is used. In the presence of unit-specific or time-specific effects, in the case of assuming these effects to be fixed parameters to be estimated, model is called as the fixed effects. The term "fixed effects" expresses nonrandom quantities are accounted for the heterogeneity. If the subject specific effects are assumed random and not correlated with the regressors (independent variables), the model becomes random effects. These effects are included to the random effects model as a component of the error term (Baltagi, 2010).

The panel models that do not have any lagged values of the dependent or/and independent variables in the model as a regressor are called "static models".

Fixed effects model and random effects model can be shown as follow:

Fixes Effects Model:

$$y_{it} = \alpha_i + \sum_{k=1}^{K} \beta_k x_{kit} + u_{it}, \qquad i = 1, ..., N, \qquad t = 1, ..., T \qquad (1)$$

Random Effects Model

$$y_{it} = \sum_{k=1}^{K} \beta_k x_{kit} + (\alpha_i + u_{it}), \qquad i = 1, ..., N, \qquad t = 1, ..., T \qquad (2)$$

Index *i* differentiates the subjects and ranges from *1* to *N*. *N* is the number of subjects. Each subject is observed *T* times and the index *t* differentiates the observation times through *1* to *T*. *K* is the number of the explanatory (independent) variables.

Analyzing Macro Economic Indicators in Turkey Using Panel Data

Variables and Descriptive Statistics

In this study, used database consists of the panel data set of 31 countries for the 2002-2012 term. Dataset is a balanced panel and has NxTxk = 31x11x12 = 4092 observations. Each variable has NxT = 31x11 = 341 observations.

Dependent variable is ngdp (Gross domestic product, *billion dollars) and there are 11 independent variables. Average value of ngdp for 31 countries is 504 billion dollars. Independent variables and measuring units are listed in Table 1.

Table 1: Independent Variables and Measuring Units

Code	Variable	Units
bca_ngdpd	Current account balance	Percent of GDP
lp	Population (*10,000,000)	Persons
lur	Unemployment rate	Percent of total labor force
pcpipch	Inflation, average consumer prices	Percent change
tx_rpch	Volume of exports of goods and services	Percent change
tm_rpch	Volume of imports of goods and services	Percent change
ggxwdg_gr	Growth rate in general government gross debt	Rate
ggr_gr	Growth rate in general government revenue	Rate
ggx_gr	Growth rate in general government total expenditure	Rate
ngsd_ngd	Gross national savings	Percent of GDP
nid_ngdp	Total investment	Percent of GDP

Descriptive statistics for the variables used in the analysis are shown below in Table 2. Descriptive statistics values are ordinary and there are not exceptional values in the dataset.

Table 2: Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
ngdp	341	503.9614	800.7973	4.303	3640.727
bca_ngdpd	341	-.029675	.067328	-.28352	.11852
lp	341	1.858403	2.357604	.0288	8.252
lur	341	.0883615	.0435064	.01014	.25552
pcpipch	341	.0366609	.0385439	-.01706	.45134
tx_rpch	341	.0511077	.0796323	-.23794	.31648
tm_rpch	341	.0469935	.0990369	-.33327	.29259
ggxwdg_gr	341	1.097167	.1719402	.814583	2.736609
ggr_gr	341	1.063697	.0779949	.8267854	1.470259
ggx_gr	341	1.066551	.0766898	.7331372	1.604453
ngsd_ngd	341	.1909255	.058724	-.04103	.34076
nid_ngdp	341	.2206239	.0508613	.09755	.39959

Table 3 below displays the correlation coefficiencies between the variables. Highest correlations among the independent variables are coefficient between tx_rpch and tm_rpch which is 0.80; between bca_ngdpd and ngsd_ngd which is 0.68 and between ggr_gr and ggx_gr which is 0.67.

Table 3: Correlation Coefficiencies Between the Variables

	ngdp	bca_ng~d	lp	lur	pcpipch	tx_rpch	tm_rpch	ggxwdg~r	ggr_gr
ngdp	1.0000								
bca_ngdpd	0.2523	1.0000							
lp	0.8671	0.1296	1.0000						
lur	-0.0561	-0.1418	0.0814	1.0000					
pcpipch	-0.1781	-0.3444	0.0712	0.0973	1.0000				
tx_rpch	-0.1143	-0.1263	-0.0300	0.0952	0.2085	1.0000			
tm_rpch	-0.0812	-0.1587	0.0121	-0.0401	0.1792	0.8007	1.0000		
ggxwdg_gr	-0.0745	-0.1186	-0.0601	0.0332	0.2055	-0.1519	-0.3249	1.0000	
ggr_gr	-0.2088	-0.4142	-0.0224	-0.0132	0.5445	0.5022	0.6518	-0.1608	1.0000
ggx_gr	-0.2049	-0.4468	-0.0700	-0.0945	0.4881	0.1830	0.3087	0.1003	0.6678
ngsd_ngd	0.0662	0.6783	-0.0444	-0.2647	-0.2286	0.0428	0.1004	-0.1634	-0.1201
nid_ngdp	-0.2582	-0.5400	-0.2228	-0.1154	0.1894	0.2140	0.3200	-0.0270	0.4066

Table 4 (continued)

	ggx_gr	ngsd_ngd	nid_ngdp
ggx_gr	1.0000		
ngsd_ngd	-0.1760	1.0000	
nid_ngdp	0.3872	0.2491	1.0000

Figure 1 shows the panel line graph for the dependent variable ngdp.

Figure 1: Panel Line Graph for the Dependent Variable ngdp.
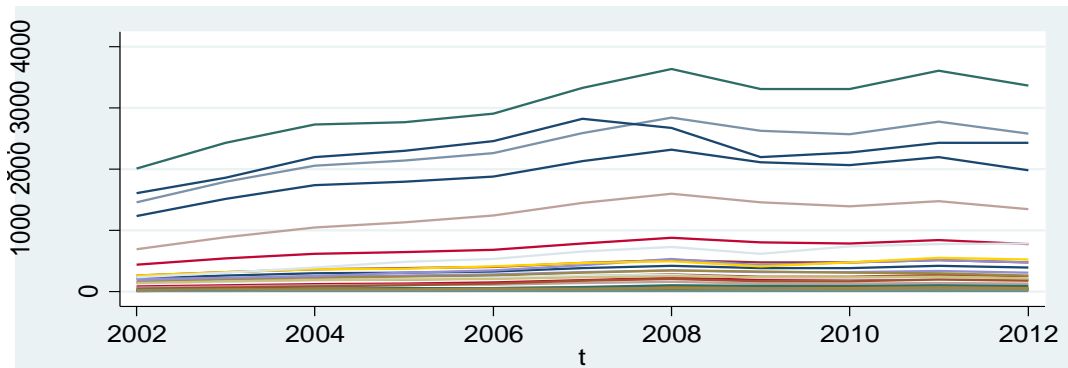
Static Linear Panel Data Models

To determine the relationship between the ngdp and the independent variables, the fixed effects model and the random effects model which are the most common static linear panel data analysis models are used. ngdp is modeled as a function of 11 factors. The fixed effects model is

$$ngdp_{it} = \alpha_i + \beta_1 bca\_ngdpd_{it} + \beta_2 lp_{it} + \beta_3 lur_{it} + \beta_4 pcpipch_{it} + \beta_5 tx\_rpch_{it} + \beta_6 tm\_rpch_{it} + \beta_7 ggxwdg\_gr_{it} + \beta_8 ggr\_gr_{it} + \beta_9 ggx\_gr_{it} + \beta_{10} ngsd\_ngd_{it} + \beta_{11} nid\_ngdp_{it} + u_{it}$$

(3)

and the random effects model is

$$
\begin{aligned}
ngdp_{it} = {} & \beta_1 bca\_ngdpd_{it} + \beta_2 lp_{it} + \beta_3 lur_{it} + \beta_4 pcpipch_{it} + \beta_5 tx\_rpch_{it} + \beta_6 tm\_rpch_{it} + \\
& \beta_7 ggxwdg\_gr_{it} + \beta_8 ggr\_gr_{it} + \beta_9 ggx\_gr_{it} + \beta_{10} ngsd\_ngd_{it} + \beta_{11} nid\_ngdp_{it} + \left(\alpha_i + u_{it} \right)
\end{aligned}
\tag{4}
$$

i stands for the country number, t stands for the year, u_{it} is the error term for the fixed effects model and $\left(\alpha_i + u_{it} \right)$ is the composite error term for the random effects model. If the country effects are uncorrelated with the regressors, they are known as random effects. In the random effects model, because there is no correlation between the country specific effects and the regressors, country specific effects are parameterized as additional random disturbances. If the country effects are correlated with the regressors, then they are known as fixed effects. If there is no country specific effect in the model, then the model becomes as the pooled ordinary least squares regression which is

$$
\begin{aligned}
ngdp_{it} = {} & \mu + \beta_1 bca\_ngdpd_{it} + \beta_2 lp_{it} + \beta_3 lur_{it} + \beta_4 pcpipch_{it} + \beta_5 tx\_rpch_{it} + \beta_6 tm\_rpch_{it} + \\
& \beta_7 ggxwdg\_gr_{it} + \beta_8 ggr\_gr_{it} + \beta_9 ggx\_gr_{it} + \beta_{10} ngsd\_ngd_{it} + \beta_{11} nid\_ngdp_{it} + u_{it}
\end{aligned}
\tag{5}
$$

Firstly, the null hypothesis that constant terms are equal across countries is tested to determine if the pooled ols regression will produce inconsistent estimates. Pooling test examines whether the intercepts take on a common value α and also known as the test for heterogeneity. Hypothesis is tested with *F* test

Table 5: Testing for the Country Specific Effects

$H_0 : \alpha_1 = \alpha_2 = ... = \alpha_N = 0$
$F\left(30;\ 299\right) = 53.51\ prob > F = 0.0000$

The *p* value is 0.0000. Null hypothesis is rejected. This provides strong evidence for the case for retaining country specific effects in the model specification. So, the pooled ordinary least squares model is inconsistent. The Pooled ols model (OLS_ALL), the fixed effects model (FE_ALL) and the random effects model (RE_ALL) results are shown respectively in the Table 6.

Table 6: Pooled OLS, Fixed Effects and Random Effects Models

Variable	OLS_ALL	FE_ALL	RE_ALL
bca_ngdpd	-2262.4661	-226.33522	-1109.0438
	4370.5294	1857.8225	2124.4992
	0.6050	0.9031	0.6017
lp	301.64765	1307.4635	321.11738
	8.1437477	117.2346	21.354954
	0.0000	0.0000	0.0000
lur	-1999.2071	-1265.4896	-1035.926
	453.07528	423.61627	445.29327
	0.0000	0.0030	0.0200
pcpipch	-3815.9149	433.10129	-511.81024
	637.28187	315.38152	345.09672
	0.0000	0.1707	0.1380
tx_rpch	300.14161	-96.767791	7.3488318
	410.33191	178.34864	203.62366
	0.4650	0.5878	0.9712
tm_rpch	-322.03228	53.95787	-49.725872
	394.86506	170.45905	194.31987
	0.4153	0.7518	0.7980
ggxwdg_gr	28.853357	64.067478	50.45071
	123.78207	58.362333	66.448925
	0.8158	0.2732	0.4477
ggr_gr	-719.79669	80.987428	-85.169113
	461.1889	201.15488	229.66851
	0.1195	0.6875	0.7108
ggx_gr	-5.9833848	-297.12541	-270.85056
	356.36172	160.88146	183.05769
	0.9866	0.0658	0.1390
ngsd_ngd	2695.1518	799.33888	1138.2268
	4356.2346	1837.575	2106.3063
	0.5365	0.6639	0.5889
nid_ngdp	-2437.9341	-535.27354	-1057.3717
	4385.0456	1876.4762	2146.4956
	0.5786	0.7756	0.6223
_cons	956.24528	-1708.2562	326.62786
	473.76334	350.40975	303.98464
	0.0444	0.0000	0.2826

Also, the null hypothesis that the variances of the country specific effects are equal to zero is tested by the Lagrange Multiplier test and the null hypothesis that the standard deviations of the country specific effects are equal to zero is tested by the Likelihood Ratio test. Results are given in the Table 7.

Table 7: The Lagrange Multiplier and the Likelihood Ratio Test Results

Lagrange Multiplier Test	Likelihood Ratio Test
$H_0 : \sigma_{\alpha_i}^2 = 0$ (Pooled ols regression is appropriate.)	$H_0 : \sigma_{\alpha_i} = 0$ (Pooled ols regression is appropriate.)
$LM \ \chi_1^2 = 1014.36 \quad prob > \chi^2 = 0.0000$	$\chi_1^2 = 460.78 \qquad prob > \chi^2 = 0.0000$

Because there is country specific effects, pooled ols model shown in the first column is inappropriate. Most of the regressors are not significant. Finally 3 of all independent variables are significant and by using these regressors which are lp, lur and ggx_gr, the fixed and the random effects models are estimated and the results are shown in the first two coloumns of the Table 8 below.

Table 8: Static Linear Panel Data Models

Variable	FE	RE	FE_RB	FE_PCSE	FE_DK
lp	1197.3581	341.39549	1197.3581	285.99362	1197.3581
	106.32105	26.803482	403.34191	23.468885	248.13309
	0.0000	0.0000	0.0058	0.0000	0.0000
lur	-1184.4394	-929.58167	-1184.4394	-1825.0088	-1184.4394
	333.84411	357.12541	494.79103	353.80452	230.59185
	0.0004	0.0092	0.0231	0.0000	0.0000
ggx_gr	-280.13589	-349.138	-280.13589	-396.77413	-280.13589
	135.07513	147.50442	108.78589	124.34375	71.993731
	0.0389	0.0179	0.0152	0.0014	0.0005
_cons	-1317.7746	324.02372	-1317.7746	542.47688	-1317.7746
	252.77713	192.98142	721.32216	150.79341	474.06457
	0.0000	0.0931	0.0777	0.0003	0.0093

The random effects model specifies the country specific effects as a random draw that is uncorrelated with the regressors and the overall error term. The random effects estimator uses the assumption that the country specific effects are uncorrelated with the regressors and the extra orthogonality conditions are valid. This assumption is tested by using Hausman test and the results are given in Table 9.

Table 9: Hausman Specification Test Results

Variable	Fixed Effects (b)	Random Effects (B)	Difference (b-B)
lp	1197.36	.341.40	855.96
lur	-1184.44	-929.58	-254.86
ggx_gr	-280.14	-349.14	69.00

H_0 : Differences in coefficients are not systematic. (the RE estimator is consistent)

$$\chi_3^2 = (b-B)' \left[(V_b - V_B)^{-1} \right] (b-B) = 67.83$$

$$prob > \chi^2 = 0.0000$$

The Hausman test's null hypothesis is rejected. Country specific effects are correlated with the regressors. Because the random effects estimator is inconsistent, the fixed effects model is the appropriate one.

Before using the fixed effects model, diagnostic tests for the model assumption must be performed. The most important assumptions of the fixed effects estimator are homoscedasticity, no serial correlation and no contemporaneous correlation. Testing for homoscedasticity is performed by using modified Wald test for the null hypothesis of homoscedasticity against the heteroscedastic alternative. Testing for serial correlation is performed by using Baltagi-Wu locally best invariant test, modified Bhargava et.al. Durbin Watson test and Wooldridge's serial correlation test respectively. For testing the absence of the contemporaneous correlation assumption, Breusch-Pagan Lagrange Multiplier test, Pesaran CD test, Friedman's R test and Frees' Q test are performed. Test results are given below in Table 10.

Table 10: Results of the Diagnostic Tests

Test	Hypothesis	Test Statistic	Probability
Homoscedasticity			
Modified Wald	$H_0 : \sigma_i^2 = \sigma^2$	$\chi_{31}^2 = 5.8 * 10^5$	$p > \chi_{31}^2 = 0.0000$
Serial Correlation			
Baltagi-Wu LBI.	$H_0 : \rho = 0$	$LBI = 0.8299$	
Modif. Bhargavaet.al. DW	$H_0 : \rho = 0$	$DW = 0.4144$	
Wooldridge's Serial Correlation	$H_0 :$ No first order serial correlation	$F_{1;30} = 909.67$	$p > F_{1;30} = 0.0000$
Contemporaneous Correlation			
Breusch-Pagan LM	$H_0 :$ No contemporaneous correlation	$\chi_{465}^2 = 1838.14$	$p > \chi_{465}^2 = 0.0000$
Pesaran CD	$H_0 :$ No contemporaneous correlation	$CD = 22.53$	$p > CD = 0.0000$
Friedman's R	$H_0 :$ No contemporaneous correlation	$R = 106.31$	$p > R = 0.0000$
Frees' Q	$H_0 :$ No contemporaneous correlation	$Q_{test} = 7.89$	
	Critical Values from Frees' Q distribution:		
	$\alpha = 0.10$	$: 0.2333$	
	$\alpha = 0.05$	$: 0.3103$	
	$\alpha = 0.01$	$: 0.4649$	

Because the Modified Wald test *p* value is 0.0000, the null hypothesis is rejected and the model has heteroscedasticity. For serial correlation, Wooldridge' serial correlation *F* test statistic is 909.67 and the *p* value is 0.0000. Model has serial correlation problem. Additionally both Baltagi-Wu LBI. and modified Bhargava et. al. DW serial correlation test statistics which are 0.8299 and 0.4144 respectively indicate that the model has serial correlation problem. All tests performed for the contemporenaous correlation point that there is cross sectional correlation in the model.

The last three columns of the Table 6 shows the fixed effects model with the Huber-White standard errors that is robust to heteroscedasticity and serial correlation (FE_RB); the fixed effects model with panel corrected standard errors that is robust to heteroscedasticity and the cross sectional (contemporaneous) correlation (FE_PCSE); the fixed effects model with the Driskoll-Kraay standard errors that is robust to the heteroscedasticity, serial correlation and to the cross sectional correlation (FE_DK).

FE, FE_RB and the FE_DK models have the same coefficient estimates with the different standard errors. The FE_PCSE model has different coefficient estimates from the other three models. Finally, because of the violations of the assumptions and the nature of the model estimators, the last model can be used to interpret the relationship between the dependent variable and the regressors (independent variables).

The coefficient of lp (1197.36) indicates that if the population increases 10 million, the dependent variable gross domestic product (ngdp) increases about 1.2 billion dollars. Because the coefficient of lur is -1184.44, if the unemployment rate increases 1%, the gross domestic product decreases about -11.84 billion dollars. The estimated coefficient of the ggx_gr is -280.14 and it can be interpreted as if the growth rate in general government total expenditures increases 1%, the gross domestic product decreases about -2.80 billion dollars.

Conclusion and suggestions

In this paper the authors used panel data approach to analyze the individual effect of some of the key macroeconomic indicators (current account balance, general government gross debt, general government revenue, general government total expenditure, gross national savings, inflation (average consumer prices), population, total investment, unemployment rate, volume of exports of goods and services, volume of imports of goods and services) on economic growth (GDP) of EU, acceding and candidate countries over during the 2002–2012 period. The main findings of static model indicate that level of population positively affects economic growth. That is, 10 million increase in population leads to rise in GDP over 1.2 trillion dollars. Whereas the level of unemployment rate and total expenditure negatively affect economic growth. One percent increase in the unemployment rate decreases GDP by 11.8 billion dollars and one percent increase in the total expenditure decreases GDP by 2.80 billion dollars.

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