Determinants of Economic Growth in G20 Countries: A Panel Data Approach

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Abstract **– During last 10 years some G20 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 G20 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 G20 countries including Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Mexico, Russia, Saudi Arabia, South Africa, Republic of Korea, Turkey, the United Kingdom and the United States of America. 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 18 (unemployment rate variable of India was not available on our data set, therefore India was excluded from analysis) of G20 members (cross sectional units). The effects of 11 macroeconomic indicators on gross domestic product volume were examined by using panel data series. The findings of this paper would help G20 countries and investors for creating more effective macroeconomic strategies. For the government side, future rises, falls, and turning points of the macro indicators puts into perspective the effects of government policy created to deal with them. For the investors' side, future values might increase the possibility of diligent investor in the financial market.**

Keywords - *G20 Counties, Macro Economic Parameters, Panel Data Analysis, Gross Domestic Product, Economic Growth*

1. Introduction

The Group of Twenty (G20) is the premier forum for international cooperation on the most important issues of the global economic and financial agenda. The objectives of the G20 refer to: (1) Policy coordination between its members in order to achieve global economic stability, sustainable growth; (2) Promoting financial regulations that reduce risks and prevent future financial crises; (3) Modernizing international financial architecture. The G20 brings together finance ministers and central bank governors from 19 countries: Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, the Republic of Korea, Mexico, Russia, Saudi Arabia, South Africa, Turkey, the United Kingdom, the United States of America plus the European Union, which is represented by the President of the European Council and by Head of the European Central Bank.

The G20 was formally established in September 1999 when finance ministers and central bank governors of seven major industrial countries (Canada, France, Germany, Italy, Japan, the United Kingdom and the United States) met in Washington, D.C. in the aftermath of the financial crisis of 1997-1998, which revealed the vulnerability of the international financial system in context of economic globalization and showed that key developing countries were insufficiently involved in discussions and decisions concerning global economic issues. Finance ministers and central

bank governors started to hold annual meetings after the inaugural meeting on December 15-16, 1999, in Berlin.

The first meeting of the G20 Leaders took place in Washington, D.C., on November 14-15, 2008, where the Leaders agreed to an action plan to stabilize the global economy and prevent future crises. As a result the premier forum acquired its current name and significance. At the Leaders' level, Mexico was the second episode, following the Republic of Korea, that an emerging country held the Presidency of the Group. At their first meeting in Washington, the G20 Leaders achieved general agreement amongst the G20 on how to cooperate in key areas so as to strengthen economic growth, deal with the financial crisis and agreed upon three key objectives: (1) restoring global economic growth; (2) strengthening the international financial system; (3) reforming international financial institutions.

G20 members represent almost: (1) 90% of global GDP; (2) 80% of international global-trade; (3) 2/3 of the world's population lives in G20 member countries; (4) 84% of all fossil fuel emissions are produced by G20 countries.

In this study it is aimed to analyze macroeconomic indicators of G20 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 G20 countries.

2. Overview of the Data

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 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.

3. The 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 observations, 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 may 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:

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

$$i = 1,...,N, \qquad t = 1,...,T$$

Random Effects Model

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

$$i = 1,...,N, \qquad t = 1,...,T$$

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.

4. Analyzing Macro Economic Indicators Using Panel Data

4.1. Variables and Descriptive Statistics

In this study, used database consists of the panel data set of 18 countries (N) for the 2002-2012 term (T). Dataset is a balanced panel and has NxTxk = 18x11x12 = 2376 observations. Each variable has NxT = 18x11 = 198 observations.

Dependent variable is ngdp (Gross domestic product, *billion dollars) and there are 11 independent variables. Average value of ngdp for 18 countries is 2248 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	198	2247.547	3077.303	97.403	15653.37
nid_ngdp	198	.2280678	.0666081	.10778	.48584
ngsd_ngdp	198	.2407581	.0950934	.11134	.53474
pcpipch	198	.0465638	.0496962	-.01344	.45134
tm_rpch	198	.0738092	.1196233	-.54587	.52255
tx_rpch	198	.0476785	.0789862	-.24196	.27765
lur	196	.0830784	.050227	.02978	.30409
lp	198	16.47114	29.0687	1.9771	135.3821
bca_ngdpd	198	.0129634	.0631424	-.09962	.28538
ggxwdg_gr	198	1.090097	.222862	.7317608	3.563901
ggr_gr	198	1.104398	.1254302	.490437	1.623843
ggx_gr	198	1.100209	.08843	.9401937	1.519621

Table 3 below displays the correlation coefficiencies between the variables. Highest correlations among the independent variables are coefficient between nid_ngdp and ngsd_ngdp which is 0.78; between nid_ngdpd and lp which is 0.74 and between ngsd_ngdp and bca_ngdp which is 0.70.

Table 3: Correlation Coefficients between the Variables

	ngdp	nid_ngdp	ngsd_n~p	pcpipch	tm_rpch	tx_rpch	lur	lp
ngdp	1.0000							
nid_ngdp	-0.0398	1.0000						
ngsd_ngdp	-0.1310	0.7785	1.0000					
pcpipch	-0.2860	-0.1209	-0.0651	1.0000				
tm_rpch	-0.1310	0.2098	0.2403	0.0965	1.0000			
tx_rpch	0.0304	0.2911	0.2571	0.0939	0.5484	1.0000		
lur	-0.2428	-0.4046	-0.3250	0.2803	-0.0277	-0.1446	1.0000	
lp	0.3018	0.7439	0.6243	-0.0811	0.1238	0.3155	-0.2359	1.0000
bca_ngdpd	-0.1713	0.0942	0.6964	0.0388	0.1454	0.0719	-0.0562	0.1344
ggxwdg_gr	0.0203	0.0307	-0.0401	0.2908	-0.3356	0.0522	0.1121	0.1261
ggr_gr	-0.2394	0.1985	0.3395	0.4460	0.5490	0.3652	0.1211	0.1810
ggx_gr	-0.2568	0.2607	0.3012	0.5777	0.1184	0.0601	0.1736	0.2370

Table 4: (continued)

	bca_ng~d	ggxwdg~r	ggr_gr	ggx_gr
bca_ngdpd	1.0000			
ggxwdg_gr	-0.1063	1.0000		
ggr_gr	0.3225	-0.0110	1.0000	
ggx_gr	0.1972	0.3283	0.5840	1.0000

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

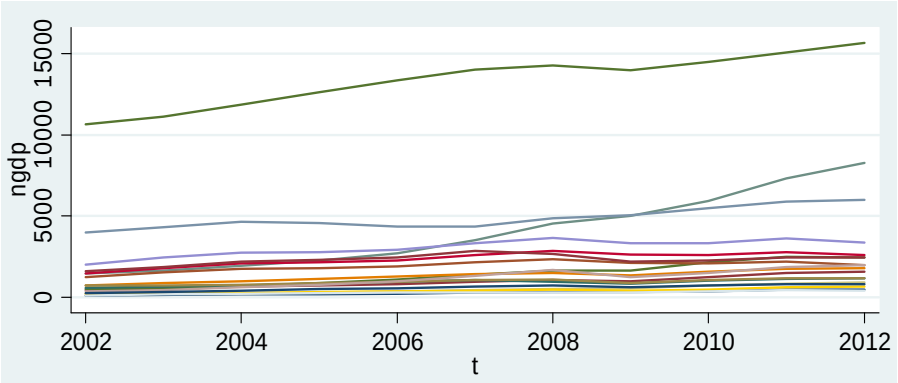

Figure 1: Panel Line Graph for the Dependent Variable ngdp.

4.2. 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

$$ngdp_{it} = \alpha_i + \beta_1 bca\_ngdpd_{it} + \beta_2 lp_{it} + \beta_3 lur_{it} + \beta_4 pcpipch_{it} + \beta_5 tx\_rpch_{it} + \beta_6 tm\_rpch_{it} + \beta_7 ggxwdg\_gr_{it} + \beta_8 ggr\_gr_{it} + \beta_9 ggx\_gr_{it} + \beta_{10} ngsd\_ngd_{it} + \beta_{11} nid\_ngdp_{it} + u_{it} \quad (3)$$

and the random effects model is

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

i stands for the country number, t stands for the year, u_{it} is the error term for the fixed effects model and $(\alpha_i + u_{it})$ 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

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

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

$H_0 : \alpha_1 = \alpha_2 = ... = \alpha_N = 0$
$F(17; 167) = 318.63 \quad prob > F = 0.0000$

and 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	-20795.508	-1273.3258	10244.125
	40536.146	8281.4613	12731.097
	0.6086	0.8780	0.4210
lp	86.6794	1047.0582	161.524
	9.0726365	60.570788	35.401347
	0.0000	0.0000	0.0000
lur	-19105.686	-7344.7459	7631.6385
	3937.8631	3077.0753	4409.526
	0.0000	0.0181	0.0835
pcpipch	-11643.572	804.78161	954.79785
	4633.4907	1027.2994	1586.31
	0.0128	0.4345	0.5472
tx_rpch	-288.05526	-627.2042	-2468.7299
	2860.1311	568.21817	858.77948
	0.9199	0.2713	0.0040
tm_rpch	-258.61622	210.82021	8.9230555
	2144.3833	415.00306	641.09106
	0.9041	0.6121	0.9889
ggxwdg_gr	246.20577	194.70315	440.1285
	957.27342	195.14302	300.43694
	0.7973	0.3198	0.1429
ggr_gr	-369.91052	567.05566	1094.4565
	2213.26	437.08882	672.70532
	0.8674	0.1963	0.1037
ggx_gr	-1470.7494	-1125.6047	-2542.3342
	3177.0526	674.98903	1033.498
	0.6440	0.0973	0.0139
ngsd_ngdp	10012.573	-1888.8218	-11345.537
	40128.229	8118.2812	12495.492
	0.8032	0.8163	0.3639
nid_ngdp	-45072.857	-6527.8979	23325.73
	40157.543	8658.1863	12989.709
	0.2632	0.4519	0.0725
_cons	12860.605	-12186.613	-2590.0982
	2928.3727	1062.7447	1725.3333
	0.0000	0.0000	0.1333

Because there is country specific effects, pooled ols model shown in the first column is inappropriate. Most of the regressors are not significant. The model reviewed by using different combinations of the regressors because there are some high correlations between the explanatory variables shown in Table 3. Finally 4 of all independent variables are significant and by using these regressors which are lur, lp, bca_ngdpd and nid_ngdp, the fixed (FE) and the random effects (RE) models are estimated and the results are shown in the first two coloumns of the Table 7 below.

Table 7: Static Linear Panel Data Models

Variable	FE	RE	FE_RB	FE_PCSE	FE_DK
lur	-7763.6146	6660.6738	-7763.6146	-12882.199	-7763.6146
	2790.0497	4186.0231	3654.8707	3212.5937	2389.7306
	0.0060	0.1116	0.0486	0.0001	0.0047
lp	1064.4479	137.73187	1064.4479	44.541245	1064.4479
	57.338028	31.8472	144.65103	10.596397	94.631885
	0.0000	0.0000	0.0000	0.0000	0.0000
bca_ngdpd	-2493.4479	-869.34636	-2493.4479	-3293.0229	-2493.4479
	1322.6402	2117.0613	2345.6457	1703.7132	1095.4531
	0.0611	0.6813	0.3026	0.0533	0.0361
nid_ngdp	-9320.9708	9957.238	-9320.9708	-7272.8518	-9320.9708
	2405.3268	3336.5945	5340.5012	3740.521	4666.9423
	0.0002	0.0028	0.0990	0.0519	0.0621
_cons	-12618.191	-2838.3459	-12618.191	4252.7806	-12618.191
	829.86401	1373.2236	2022.8941	1044.4052	754.83991
	0.0000	0.0387	0.0000	0.0000	0.0000

For the new model that contains 4 regressors, 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 also tested by the Likelihood Ratio test. Results are given in the Table 8.

Table 8: The Lagrange Multiplier and the Likelihood Ratio Test Results

Lagrange Multiplier Test	**Likelihood Ratio Test**
$H_0 : \sigma^2_{\alpha_i} = 0$ (Pooled ols regression is appropriate.)	$H_0 : \sigma_{\alpha_i} = 0$ (Pooled ols regression is appropriate.)
$LM \ \ \chi^2_1 = 619.58 \qquad prob > \chi^2 = 0.0000$	$\chi^2_1 = 483.62 \qquad prob > \chi^2 = 0.0000$

Each test *p* values are 0.0000 and null hypotheses are rejected. There is strong evidence for the case for retaining country specific effects in the model.

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)**
lur	-7763.615	6660.674	-14424.29
lp	1064.448	137.732	926.72
bca_ngdpd	-2493.448	-869.346	-1624.10
nid_ngdp	-9320.971	9957.238	-19278.21

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

$$\chi^2_4 = (b-B)' \left[(V_b - V_B)^{-1} \right] (b-B) = 376.65$$

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

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 the fixed effects model, diagnostic tests for the model assumptions 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 contemporenaous 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.

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 294.61 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 0.8328 and 0.4128 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 7 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).

Table 10: Results of the Diagnostic Tests

Test	Hypothesis	Test Statistic	Probability
Homoscedasticity			
Modified Wald	$H_0 : \sigma_i^2 = \sigma^2$	$\chi^2_{18} = 1663.07$	$p > \chi^2_{18} = 0.0000$
Serial Correlation			
Baltagi-Wu LBI.	$H_0 : \rho = 0$	$LBI = 0.8328$	
Modif. Bhargavaet.al. DW	$H_0 : \rho = 0$	$DW = 0.4128$	
Wooldridge's Serial Correlation	H_0 :No first order serial correlation	$F_{1;17} = 294.61$	$p > F_{1;17} = 0.0000$
Contemporaneous Correlation			
Breusch-Pagan LM	H_0 :No contemporaneous correlation	$\chi^2_{153} = 526.44$	$p > \chi^2_{153} = 0.0000$
Pesaran CD	H_0 :No contemporaneous correlation	$CD = 6.81$	$p > CD = 0.0000$
Friedman's R	H_0 :No contemporaneous correlation	$R = 33.07$	$p > R = 0.0111$
Frees' Q	H_0 :No contemporaneous correlation	$Q_{test} = 4.254$	
	Critical Values from Frees' Q distribution:		
		$\alpha = 0.10$	: 0.2828
		$\alpha = 0.05$	: 0.3826
		$\alpha = 0.01$	: 0.5811

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 two models can be used to interpret the relationship between the dependent variable and the regressors (independent

variables) with 5.33% and 6.21% significance levels respectively. If the unemployment rate increases 1%, the gross domestic product decreases about -128.82 (-77.64 for FE_DK) billion dollars because the coefficient of lur is -12882.20 (-7763.61 for FE_DK). The coefficient of lp is 44.54 (1064.45 for FE_DK) and indicates that if the population increases 10 million, the dependent variable gross domestic product (ngdp) increases about 45 billion (1.06 trillion for FE_DK) dollars. The estimated coefficient of the bca_ngdpd is -3293.02 (-2493.45 for FE_DK) and it can be interpreted as if the current account balance (percent of GDP) increases 1%, the gross domestic product decreases about -32.93 (-24.93 for FE_DK) billion dollars. Finally, the estimated coefficient of nid_ngdp is -7272.85 (-9320.97 for FE_DK). It can be said that 1% increase in total investment (percent of GDP) decreases the gross domestic product -72.73 (-93.21 for FE_DK) billion dollars.

5. Concluding Remarks

GDP is the value of total production of goods and services in a country over a specified period. When government officials plan for the future, they consider the various macroeconomic indicators affecting to it. 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 18 G20 countries over during the 2002–2012 period.

Empirical results show that level of population positively affects economic growth. That is, 10 million increase in population leads to rise in GDP 45 billion (1.1 trillion for the FE_DK model) dollars. Whereas the level of unemployment rate, current account balance and total investment negatively affect economic growth. One percent increase in the unemployment rate decreases GDP by 128.8 (or 77.6) billion dollars, one percent increase in the current account balance decreases GDP by 32.93 (or 24.93) billion dollars and one percent increase in the total investment decreases GDP by 72.73 (or 93.21) billion dollars.

The results provide useful insights for governments and investors for creating more effective macroeconomic strategies. For the government side, future rises, falls, and turning points of the macro indicators puts into perspective the effects of government policy created to deal with them. For the investors' side, future values might increase the possibility of diligent investor in the financial market.

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References

[1] Ahn, S. C., Moon, H. R. (2001). Large-N and Large-T Properties of Panel Data Estimators and the Hausman Test", USC CLEO Research Paper, No. C01-20

[2] Baltagi, B. H. (2010). Econometric Analysis of Panel Data, Fourth Edition, John Wiley&Sons Ltd, 2010

[3] Beine, M., Docquier, F., Oden-Defoort, C. (2011). A Panel Data Analysis of the Brain Gain. World Development (39), 4, 523–532

[4] Bortolotti, B., Fantini, M., Siniscalco, D. (2003). Privatisation around the world: evidence from panel data. Journal of Public Economics, 88, 305 – 332

[5] Current Account Surpluses in the EU, European Economic Series, September 2012.

[6] Frees, E. W., (2004). Longitudinal and Panel Data, Analysis and Applications in the Social Sciences, New York, Cambridge University Press

[7] Gujarati, D. N., Porter, D. C., (2009). Basic Econometrics, Fifth Edition, McGraw Hill, New York

[8] Haas, R. de, Lelyveld, I. van, (2006). Foreign banks and credit stability in Central and Eastern Europe. A panel data analysis. Journal of Banking & Finance 30, 1927–1952

[9] Hill, R. C., Griffiths, W. E., Lim, G. C. (2008). Principles of Econometrics, 3rd press, John Wiley & Sons

[10] Hsiao, C. (2003). Analysis of Panel Data, 2nd press, New York, Cambridge University Press, 2003

[11] Maddala, G.S., Lahiri, K. (2009). Introduction to Econometrics, 4th press., West Sussex, John Wiley & Sons

[12] Lee, C. C., Chang, C. P., (2007). Energy consumption and GDP revisited: A panel analysis of developed and developing countries. Energy Economics, 29, 1206 – 1223

[13] Lee, C. C., Chang, C. P., (2008). Tourism development and economic growth: A closer look at panels. Tourism Management 29 (2008) 180 – 192

[14] Pazarlıoğlu, M.V. (2001). 1980-1990 Döneminde Türkiye'de İç Göç Üzerine Ekonometrik Model Çalışması", V. Ulusal Ekonometri ve İstatistik Sempozyumu, Çukurova Üniversitesi, Adana (In Turkish)

[15] Sukiassyan, G. (2007). Inequality and growth: What does the transition economy data say? Journal of Comparative Economics, 35, 35–56

[16] Tari, R. (2010). Ekonometri, Extended 6th press, Umuttepe Kitabevi, Kocaeli, (In Turkish)

[17] Tsoukas, S., (2011). Firm survival and financial development: Evidence from a panel of emerging Asian economies. Journal of Banking & Finance, 35, 1736–1752

[18] Wooldridge, J. M. (2009). Introductory Econometrics, 4th press, Canada, South Western

[19] What is the G20; http://www.g20.org/ docs/about/about_G20.html, 26/08/2013