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Determinants of Economic Growth in Asian Countries: A Panel Data Perspective

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Abstract

Panel data analysis refers to two or multi-dimensional data set containing observations on multiple phenomena observed over multiple time periods (Baltagi, 2005; Gujarati, 2003 among many others). Real gross domestic product (CGDP) per capita is the most commonly used measure of a country's economic welfare. It is the number reached by valuing all the productive activity within the country at a specific year's prices. Determinants of economics growth are evaluated, gathered for nine Asian countries for forty years that leads to use the panel data analysis, whereas panel data may have group effects, time effects or both. Data is taken from Penn Word Table (an expanded set of international comparisons), Version 6.1 (2003) for different Asian countries contributing in the world economy. In this article, the comparison of ordinary least square, fixed and random effects for panel data analysis is carried out. Different specification tests, e.g. Breusch Pagan Lagrange Multiplier test, F-test, and Hausman specification test, etc., are used to make selection among ordinary least square, fixed effect model or random effect model. Random effect model seems best to handle such situation.

Keywords: Fixed effect; Gross domestic product; panel data analysis; random effect; specification test

I. Introduction

Gross domestic product (GDP) is used as an indicator of economic health of a country and also gauges a country's standard of living. It is monetary value of all the finished goods and services, produced within a country's borders in a specified time period and calculated on annual basis. So GDP is a measure of average real income in a country but not a complete measure of economic well being. For measuring complete economic well being, real gross domestic product (CGDP) is used and is intended to be a measure of particular types of economic activity within a country, because it is the number reached by valuing all the productive activity within the country at a specific year's price. Economic activities, such as price-parity comparisons have direct implications for real quantity comparison, and purchasing power parity (PPP) is calculated over GDP. GDP comparisons are the most common of real quantity comparisons, while price associated with GDP, PPP is the most common of the price comparison.

The purpose of current study is to evaluate the determinants of economic growth (CGDP) on the basis of panel data analysis for different Asian countries, i.e. Pakistan, Bangladesh, India, Iran, Sri-Lanka, Indonesia, Philippines, Thailand and Japan, contributing in world economy. We are interested in finding out how CGDP per capita depends on the exchange rate, purchasing power parity over GDP, price level of GDP, price level of Government, price level of investment, per capita GDP relative to the US and real GDP chain per worker. Data is taken from Penn Word Table (PWT: an expanded set of international comparisons), Version 6.1 (2003).

Panel data models in macroeconomic have become popular since last decades. The idea of a panel data set is that a cross-section of observational units, typically individuals or economic entities, is selected and a response and explanatory variables are observed for each unit. So panel data set contains observations on multiple phenomena observed over multiple time periods. Panel data sets generally include chronological blocks or cross-sections of data, within each of which resides a time series. The data we have selected holds the above mentioned characteristics, which leads us to carry out panel data analysis.

Panel data are of two types; balanced panel data which has equal number of observations for each individual (cross-section), whereas unbalanced panel data does not contain equal number of observations for each individual.

Primary reason for increased utilization of panel data is that it offers opportunity for controlling unobserved individual and/ or time specific heterogeneity, which may be correlated with the included explanatory variables. Both time series and cross-section when combined, enhances the quality and quantity of data in ways that would be impossible using only one of these two dimensions (Gujarati, 2003). Klevmoarken (1989), Hsiao (2003, 2005), Woolridge (2002), Baltagi (2005), Greene (2005), etc., listed several benefits for using panel data, such as it increases the precision of parameter estimates, allows to sort out model temporal effects without aggregation bias, gives more informative data, less collinearity among variables, more efficiency, etc. Hausman and Taylor (1981) revealed that by combining time-series and cross-sectional data, individual-specific unobservable effects (may be correlated with other explanatory variables) can be controlled.

Hsiao (2004) provided the review of linear panel data models with slope heterogeneity, various types of random coefficients models, heterogeneous dynamic panels, testing for homogeneity under weak exogeneity, simultaneous equation random coefficient models and more recent developments in the area of cross-sectional dependence in panel data models, and also suggested a common framework for dealing with them. For panel data estimation they used Bayesian approach.

The evidence in Nelson and Ploseer (1982) that hypothesis cannot be rejected for most long-term United States (US) macroeconomic time series, ran contrary to many economic theories that relied on the idea of cyclical fluctuations around stable long run trends and set off an explosion of research. They investigated real GDP, real exchange rates, and real interest rates, among many variables for which the unit root question arises.

Heston and Summers (1996) studied CGDP data with other economic variables using cross-sectional and some other techniques. They said that, in the policy arena, comparable national income estimates across countries are needed for variety of reasons. They founded that benchmark quantity and price data may not be right because of a country's unregistered economic activities, goods prices in different countries and expenditure of national accounts. Also the comparison of the share of GDP devoted to the national accounts of rich and poor countries is misleading.

Bahmani-Oskooee and Abm (2001) studied the productivity bias hypothesis claims that a relatively more productive country should experience a real appreciation in currency. Their results were stronger than previous research in support of the productivity bias hypothesis by pooling data across countries and over time period. Their empirical results strongly supported the hypothesis were not sensitive to model specification and estimation procedure. They also tested the relevance of other variables such as a measure of resource abundance and the black market premium in explaining the national price levels, which confirms the previous research.

Frees et al. (2001) examined the case studies from three different areas of insurance (health care, workers' compensation and group term life). The purpose of their study was to illustrate how the broad class of panel data models can be applied to different functional areas and to data that have different features. Data they used having heteroscedasticity, random and fixed effect covariates, outlier, serial correlation and limited dependent variable bias. They also showed how examination of the data could provide opportunities to enhance the model specification using graphical and numerical diagnostic tools from standard statistical software.

Greene (2001) treated the selection of the random and fixed effects models as a Hobson's choice. Due to computational difficulties and the inconsistency caused by small time (T(i)) problem, fixed effects model are unattractive and implemented the computation in over twenty different modeling frameworks (linear regression, binary choice, multinomial choice, count data, log linear models, limited dependent variables, survival models, stochastic frontier, etc). The estimation of the fixed effects model is quite feasible even in panels with huge number of groups.

Aten and Menezes (2002) discussed complex issues, among many related to international comparisons of poverty that how to adjust the purchasing power of currencies (PPPs) to reflect the relative price levels of the goods and services faced by poor consumers. They concluded that the variation in prices and expenditures across cities and across income group is significant and they suggested that the use of natural average price and expenditure in a study of poverty levels may be misleading, because poor consumers often face different prices than the average consumer, and price levels for food in some of the poorer cities are higher than those in higher income cities.

Rapach (2002) realized that panel data procedures have been proposed as an avenue to increase power. He applied four different panel unit root tests to international real GDP and read GDP per capita data. The results strongly indicate the international real GDP and real GDP per capita levels are non-stationary.

Choi et al. (2004) revealed that complications for panel data estimation of half-life of purchasing power parity (PPP) deviations are introduced by (i) inappropriate cross-sectional aggregation of heterogeneous coefficients (ii) small sample estimation bias of dynamic lag coefficients and (iii) time aggregation of commodity prices. They got information for different countries in the world (i.e country level data) and after manipulation they concluded that cross-sectional heterogeneity of convergence rates to PPP do not appear to be a quantitatively important source of bias.

Liao (2006) presented a method for analyzing categorical panel data with attrition, and assessed the robustness of the method. For micro panels of moderate time dimension, approximate solutions to the incidental parameter problem from a time-series perspective are a promising avenue for progress.

Besides the popularity of panel data, problems may arise when designing panel surveys, which include design and data collection problem, measurement errors, selectivity problems, short time series dimension, cross-section dependence, etc. (Baltagi, 2005).

II. Methodology

We used ordinary least square (OLS), fixed effect model (FEM) and random effect model (REM) for estimation of CGDP data. A balanced panel data set is used which has equal number of observations for each individual (cross-section) and for best model selection, FEM hypothesis testing, REM versus FEM, Hausman specification test and Breusch-Pagan Lagrange Multiplier test are used (see Breusch and Pagan, 1979, Gujarati, 2003, Hsiao, 2003 etc).

Data is taken from PWT, based on benchmark data, consists of price and expenditure data for basic heading of consumption, government expenditures, investment and imports & exports in local currency units, including nine Asian countries, i.e. Pakistan, Bangladesh, India, Iran, Sri-Lanka, Indonesia, Philippines, Thailand and Japan. The base year for this data is 1996 as mentioned in the PWT. We are interested in finding out how real gross domestic product per capita depends on the exchange rate, purchasing power parity over GDP, price level of GDP, price level of government, price level of investment, per capita GDP relative to the US and real GDP chain per worker. Data for each country on the above mentioned variables is taken for the period 1961-2000. So there are nine cross-sectional units and 40 time periods. In all there are 360 observations. Different types of panel data models are applied to above mentioned data. They include the constant coefficients model, the fixed effects model, i.e. least squares dummy variable (LSDV) model and the random effects model.

In constant coefficient model all intercepts and coefficients are assumed to be same (i.e. there is neither significant country nor significant temporal effects), in this way space and time dimensions of the pooled data are disregarded, data is pooled and an ordinary least squares (OLS) regression model is run. So these models are highly restricted assumptions about the model. Regardless of the simplicity of the model, the pooled regression may disfigure the true picture of the relationship between Y and the X's across the cross-sections.

Different variations with reference to cross-section or time are applied to the fixed effects models here. The fixed effects model has constant slopes but intercepts differ according to the cross-sectional (group) unit. For i classes $i-1$ dummy variables are used to designate the particular country, this model is sometimes called the LSDV model. Another fixed effects panel model where the slope coefficients are constant, but the intercept varies over individual/ country as well as time. FEM with differential intercepts and slopes can also be applied on data, but inclusion of lot of variables and dummies may give results for which interpretation is cumbersome, because many dummies may cause the problem of multicollinearity. There is also a fixed effects panel model in which both intercepts and slopes might vary according to country and time. This model specifies i-1 country dummies, t-1 time dummies, the variables under consideration and the interactions between them. If all of these are statistically significant, there is no reason to pool (Gujarati, 2003).

In the random effects model the intercept is assumed to be a random outcome variable, whereas the random outcome is a function of a mean value plus a random error. Two way random effects model is used for estimation purpose.

Swamy (1971) suggested the random effects model and Swamy and Arora (1972) and Swamy et al. (1988a, 1989) suggested an extension of the random effects model as;

$$y_{it} = \beta_i' x_{it} + \varepsilon_{it}, \quad t = 1, \cdots T(i),\ i = i, \cdots, N$$

$$\beta_i = \beta + v_i$$

where $E[v] = 0$ and $Var[v_i] = \Omega$.

This model is a generalized, group-wise heteroscedastic model.

For best model selection among these three types of models, significance test with an F test, Hausman Specification Test, Breusch-Pagan Lagrange Multiplier test are conducted.

a. Pooled OLS

While using the assumption that all coefficients are constant across time and individuals, we assume that there is neither significant country nor significant temporal effects, we could pool all of the data and run an ordinary least squares (*OLS*) regression model;

$$CGDP_{it} = \beta_{1i} + \beta_2 XRAT_{it} + \beta_3 PPPX_{it} + \beta_4 P_{it} + \beta_5 PG_{it} + \beta_6 PI_{it} + \beta_7 Y_{it} + \beta_8 RGDPWORK_{it} + \varepsilon_{it} \qquad 3.1$$

Where i stands for the ith cross-sectional unit and t for the tth time period.

b. Fixed Effects Models

To take into account the individuality of each country/ cross-sectional unit, intercept is varied by using dummy variable for fixed effects. Dummy for Pakistan is used as comparison.

Fixed effect models for cross section (intercept or individual)

$$Y_{it} = \alpha_1 + \alpha_2 D_{2i} + \alpha_3 D_{3i} + \alpha_4 D_{4i} + \alpha_5 D_{5i} + \alpha_6 D_{6i} + \alpha_7 D_{7i} + \alpha_8 D_{8i} + \alpha_9 D_{9i} + \beta_2 XRAT_{it} + \beta_3 PPPX_{it} + \beta_4 P_{it} + \beta_5 PG_{it} + \beta_6 PI_{it} + \beta_7 Y_{it} + \beta_8 RGDPWORK_{it} + e_{it} \quad 3.2$$

Where D_{2i} =1 if the observation belongs to cross-section 2 (Bangladesh), 0 otherwise; D_{3i} =1 if the observation belongs to cross-section 3 (India), 0 otherwise. Similarly follows in the same ways for all cross-sections/ group. Since there are nine countries, only eight dummies are used to avoid falling in to the dummy variable trap (Gujarati, 2003), we didn't use the dummy for Pakistan. In other words α_1 represents the intercept of Pakistan and α_2, α_3,…, and α_9, the differential intercept coefficients, tell by how much the intercepts of the countries differ from the intercept of Pakistan as Pakistan is the comparison country.

c. Random Effects Models

In the random effects model the intercept is assumed to be a random outcome variable, whereas the random outcome is a function of a mean value plus a random error. Two way random effects model is used for estimation purpose.

$$CGDP_{it} = \beta_{1i} + \beta_2 XRAT_{it} + \beta_3 PPPX_{it} + \beta_4 P_{it} + \beta_5 PG_{it} + \beta_6 PI_{it} + \beta_7 Y_{it} + \beta_8 RGDPWORK_{it} + \varepsilon_{it}$$

Instead of treating β_{1i} as fixed, it is assumed to be a random variable with a mean value of β_1 and the intercept for an individual company can be expressed as;

$$\beta_{1i} = \beta_1 + \varepsilon_i \qquad i = 1,2,..., N$$

Where ε_i is a random error with a mean value of zero and variance of σ_ε^2. Therefore

$$CGDP_{it} = \beta_1 + \beta_2 XRAT_{it} + \beta_3 PPPX_{it} + \beta_4 P_{it} + \beta_5 PG_{it} + \beta_6 PI_{it} + \beta_7 Y_{it} + \beta_8 RGDPWORK_{it} + \varepsilon_{it} + \mu_{it}$$

$$CGDP_{it} = \beta_1 + \beta_2 XRAT_{it} + \beta_3 PPPX_{it} + \beta_4 P_{it} + \beta_5 PG_{it} + \beta_6 PI_{it} + \beta_7 Y_{it} + \beta_8 RGDPWORK_{it} + w_{it} \quad 3.5$$

Where $w_{it} = \varepsilon_i + u_{it}$

Under these circumstances, the random error v_i is heterogeneity specific to a cross-sectional unit. This random error v_i is constant over time. Therefore, $E[v_i^2 \mid x] = \sigma_i^2$. The random error ε_{it} is specific to a particular observation. For v_i to be properly specified, it must be orthogonal to the individual effects. Because of the separate cross-sectional error term, these models are sometimes called one-way random effects models. Owing to this intra-panel variation, the random effects model has the distinct advantage of allowing for time-invariant variables to be included among the regressors.

d. Model Specification Test

One can think of fixed effects and random effects can be the same model, having different assumptions about $Cov(\beta_i, X_{it})$. There are different tests available for fixed and/ or random effect models. These tests include Hausman test, Breusch-Pagan test, Bhargarva and Sargan Test. In the current study we are using F-test, Hausman test, and Breusch-Pagan test.

Fixed Effects Hypothesis Testing

To check which model is better, we use a formal test for two models. Pooled regression model is used as the baseline for our comparison. We can perform this significance test with an *F* test resembling the structure of the *F* test for R^2 change.

$$F_{groupseffects} = \frac{\left(R_{fix}^2 - R_{pooled}^2\right)/(N-1)}{\left(1 - R_{LSDV}^2\right)/(NT - N - k)} \tag{3.6}$$

Here *T* is the total number of temporal observations, *N* is the number of groups or cross-sections, and k is the number of regressors in the model. If we find significant improvements in the R^2, then there is a statistically significant group effects.

Random or Fixed Effect Models

The most commonly used specification test is Hausman specification test, which tests the null hypothesis that the coefficients estimated by the efficient random effects estimator are the same as the ones estimated by the consistent fixed effects estimator. If they are insignificant, then it is safe to use random effects. If we get a significant P-value, however, we should use fixed effects. The Hausman test is a kind of Wald χ^2 test with *k-1* degrees of freedom (where *k* = number of regressors) on the difference matrix between the variance-covariance of the LSDV with that of the Random Effects model. The Wald statistic is

$$W = (\beta_{FE} - \beta_{RE})'(V_{FE} - V_{RE})^{-1}(\beta_{FE} - \beta_{RE}) \tag{3.7}$$

Breusch-Pagan Lagrange Multiplier (LM) Test

The Breusch–Pagan LM statistic, tests the null hypothesis that the pooled *OLS* estimator is adequate against the random effects alternative. The specific hypothesis under investigation is the following.

H_0: $\sigma_T = 0$

H_a: $\sigma_T \neq 0$

The LM Statistics is

$$\text{LM} = \frac{nT}{2(T-1)}\left[\frac{\sum_i\left(\sum_t \hat{e}_{it}\right)^2}{\sum_i\sum_t \hat{e}_{it}^2} - 1\right]^2 \sim \chi_1^2 \quad \text{under } H_o$$

III. Results and Discussions

After having the thorough discussion regarding the methods used in the current study we have reached on the following results.

Table 1 OLS Results for CGDP Data

Variable	Coefficient	Std. Error	t-statistic	P-value
Constant	5.74	0.1094	52.442	<0.00001*
XRAT	0.000146	8.09×10^{-05}	1.815	0.0704*
PPP	–0.000223	0.000386	–0.578	0.5633
P	0.002039	0.007724	0.264	0.7919
PG	–0.02035	0.00663	–3.070	0.0023*
PI	0.007472	0.002548	2.933	0.0035*
Y	–0.005999	0.004184	–1.434	0.1525
RGDPWOK	0.000193	1.34×10^{-05}	14.403	<0.00001*

* Significant at 5% level of significance.

Table 2 Fixed Effects Model (LSDV) for CGDP Data

Variable	Coefficient	Std. Error	t-statistic	P-value
Constant	5.56	0.113483	49.03	<0.00001*
XRAT	0.0000968	0.0000696	1.39	0.16497
PPP	0.000484	0.000356	1.35	0.17546
P	0.001776	0.007490	0.2371	0.81269
PG	–0.026830	0.006073	–4.4181	0.00001*
PI	0.012096	0.002671	4.5282	<0.00001*
Y	–0.028842	0.009589	–3.01	0.00283*
RGDPWOK	0.000248	0.0000144	17.09	<0.00001*
Bangladesh	–0.405687	0.121007	–3.35	0.00089*
India	–0.016046	0.118627	–0.1353	0.89248
Indonesia	–0.492438	0.136785	–3.6001	0.00036*
Iran	–0.678589	0.152959	–4.44	0.00001*
Japan	0.532792	0.450337	1.18	0.23759
Sri Lanka	0.030021	0.131192	0.2288	0.81913
Philippines	0.177152	0.124606	1.42	0.15602
Thailand	0.875107	0.133264	6.57	<0.00001*

Table 3 Corresponding Cross-Section/ Country Intercept Value (Fixed Effect)

Intercept	Country	Value
1	Pakistan	5.564
2	Bangladesh	5.159
3	India	5.548
4	Indonesia	5.072
5	Iran	4.886
6	Japan	6.097
7	Sri Lanka	5.594
8	Philippines	5.741
9	Thailand	6.439

Table 4 Random Effects Model for CGDP data: All Factors Included

Variable	Coefficient	Std. Error	t-Statistic	P-value
CONST	5.51	0.13349	41.27	0.0000*
XRAT	9.41×10^{-05}	6.85×10^{-05}	1.37	0.1702
PPP	0.00044	0.000344	1.28	0.2011
P	0.00186	0.007328	0.2538	0.7997
PG	-0.02605	0.005987	-4.35	0.0000*
PI	0.01145	0.002591	4.43	0.0000*
Y	-0.01748	0.006059	-2.88	0.0041*
RGDPWOK	0.000232	1.28×10^{-05}	18.20	0.0000*

Table 5 Effects Specification

	t-Statistic	P-value
Cross-section random S.D. / Rho (Sigma_u)	0.242910	0.1805
Idiosyncratic random S.D. / Rho (Sgima_e)	0.517539	0.8195

Table 6 Cross-Section Random Effects (Intercept Value)

Cross Section	Country	Value
1	Pakistan	0.0531
2	Bangladesh	-0.2979
3	India	0.0347
4	Indonesia	-0.3727
5	Iran	-0.5582
6	Japan	0.1208
7	Sri Lanka	0.0689
8	Philippines	0.1824
9	Thailand	0.7687

From Table 1 it is clear that all the coefficients are statistically significant except *PPP* (p-value 0.5633), *P* (p-value 0.7919) and *Y* (p-value 0.1525) while R^2 (0.7155) is reasonably high, also there is positive relationship of *LNCGDP* to *XRAT*, *P*, *PI*, *RGDPWOK* and *PPP*, *PG* and *Y* have negative effect on *CGDP*. To take into account the individuality of each country/ cross-sectional unit, intercept is varied by using dummy variable for fixed effects. Dummy for Pakistan is used as comparison country. Usual *OLS* method is applied for all variables. A low p-value (0.00001) counts against the null hypothesis that the pooled *OLS* model is adequate, which is in favor of the fixed effects as an alternative.

Individuality of each country/ cross-sectional unit is accounted by letting the intercept vary for each country. It is also assumed that the slope coefficients are still constant across cross-section (following Gujarati, 2003). The intercept of Pakistan is taken as comparison country. From Table 2 it is evident that the estimated coefficients of factors; *PG*, *PI*, *Y* and *RGDPWOK* are highly significant (p-value < 0.00001) and R^2 (0.808865) is high, while dummy for countries *Bangladesh* and *Indonesia*, *Iran* and *Thailand* coefficients are significant (Table 3). The *CGDP* has positive relationship with *XRAT*, *PPP*, *P, PI* and *RGDPWOK*, and dummy for countries *Japan*, Sr*i L*anka, *Philippines* and *Thailand.* While *PG, Y* and dummy for countries Bangladesh, India, Indonesia and Iran have negative relationship with *CGDP*.

The difference in the intercepts of the countries may be due to the unique policy of Government about trade of import and export of goods, prices of goods in other countries, exchange rate, *CGDP* relative to United States and/ or other economic variables. To measure the random deviation (error component) of individual intercept from mean value of all cross-sectional intercept which is β_1 one way Random Effects model is applied on the *CGDP* data. From Table 4, it is clear that all the coefficients have significant effect (p-value ≤ 0.0001) on *CGDP* except *XRAT*, *PPP, P,* While *PPP, P*, *PI* and *RGDPWOK* have a certain relation with *CGDP*, and *XRAT*, *PG*, *Y* has depressing relationship with *CGDP*. The mean value of the random error component ε_i is the common intercept value of 5.51. The cross-section's random value of *Pakistan* of 0.0531 tells us by how much the random error component of *Pakistan* differs from the common intercept value. Similarly Cross-section random value of *Bangladesh* = -0.2979, *India* = 0.0347, *Indonesia* = -0.3727, *Iran* = -0.5582, *Japan* = 0.1208, *Sri Lanka* = 0.0689, *Philippines* = 0.1824 and *Thailand* = 0.7687 differs from the common intercept value as given in the table 6.

F test

$$F_{groupseffects} = \frac{\left(R^2_{fix} - R^2_{pooled}\right)/(N-1)}{\left(1 - R^2_{LSDV}\right)/(NT - N - k)}$$

$$= \frac{(0.808865 - 0.7155)/8}{(1 - 0.808865)/(360 - 9 - 7)}$$

$$= \frac{0.011671}{0.000556} = 21.0045$$

P-value = 0.0000

For significance test with an *F* test with R^2 have low p-value which counts against the null hypothesis that the Pooled *OLS* model is adequate, in favor of the fixed effects alternative.

Hausman test

To choose *FEM* or *REM* the Hausman test should be used which has an asymptotic chi-square distribution. The statement of hypothesis related to *FEM* and *ECM* (Error Component Model).

H_0: FEM and ECM estimators do not differ substantially
H_1: FEM and ECM estimators differ substantially

H = 15.0306
P-value = prob(chi-square(7) > 15.0306) = 0.0356085

Small p-value, by Hausman test shows that coefficient estimated by random effects model and fixed effects model are not same. The P-value is significant which is in favour of fixed effects when we stack the cross section but Hausman test matrix is not positive definite (this result may be treated as "fail to reject" the random effects specification) when stacking is with respect to time series.

To choose Pooled *OLS* or *REM* the Breusch-Pagan test should be used which has chi-square distribution. The statement of hypothesis related to *OLS* and *ECM* (Error Component Model). For Breusch and Pagan LM test, low p-value counts against the null hypothesis that the pooled *OLS* model is adequate, in favor of the random effects alternative.

Table 7 Specification Tests

Spec. Tests	p-value	Tested	Selection
Hausman	0.0356085	Fixed/Random	Fixed
Breusch-Pagen	0.00001	OLS/Random	Random
F-test	0.00001	OLS/Fixed	Fixed

IV. Conclusion

To evaluate the determinants of economic growth the panel data analysis is carried out. *PPP*, *P* and *Y* were not found as an important factor for *CGDP,* by pooled *OLS* model*,* while *LSDV* model is appropriate as compared to pooled *OLS*. *XRAT*, *PPP* and *P* are non-effecting factors for *LSDV*. While increased R^2 and decreased standard error makes *LSDV* best choice as compared to pooled *OLS*. For Random effect model *XRAT*, *PPP* and *P* are found to be non-significant.

Although Hausman test is in favour of fixed effects model but, Hausman matrix is not a positive definite matrix, making it in favour of random effects model, when stacking the time series for this panel data. When stacking with reference to the cross section, Hausman matrix becomes positive definite which make the fixed effects as an alternative choice.

Breusch-Pagan test statistic having large value of *LM* (i.e. 341.87), for comparison of *OLS* and *REM* goes in favour of random effects model. Small Hausman statistic and large *LM* statistic indicates that the appropriate specification is the random effects model. So *REM* is best choice for this data.

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