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Research Paper

Measuring economic growth in OPEC countries : A panel data approach

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Abstract

Most of the developing and under-developed countries have been facing a lot of challenges on the issue of economic growth, despite the fact that they are endowed with both natural and human resources. This study examines the determinants of real per Capita GDP growth in Organization of the Petroleum Exporting Countries (OPEC) using a panel of twelve countries for the period of 1986 and 2010.The pooled Ordinary Least Squares (OLS), Fixed Effect (FE) and Random Effect (RE) models were employed to assess the relationship between CGDP and other economic variables used. The result showed that price level of consumptions (pc) and investment share (ci) are the important factors of CGDP that contribute to the economic growth of OPEC countries. The result also established that exchange rate (Xrat), price of GDP (p), purchasing power parity (ppp) and ci have a positive influence on CGDP. The test statistic revealed that Random Effects Model (REM) estimator is more efficient than OLS and that there is no significance difference between Fixed Effects Model (FEM) and REM estimators.

Keywords:*Exchange Rate; Fixed Effect; Gross Domestic Product; Panel Data Model; Random Effect*.

1. Introduction

Growth is an increase in the output that economy produces over a period of time, meanwhile economic growth is an increase in what an economy can produce if it's using all it scarce resources. Gross domestic product (GDP) is a monetary value of all the finished goods and services produced within a country's boarders in a specified time period calculated on annual basis; it is used as an economic health of a country. Most of the developing countries face major challenge in terms of economic growth as a result of low investment, poverty level, interest rate, exchange rates, etc. Majority of the Organization of the Petroleum Exporting Countries (OPEC) suffer from this setback of economic growth, despite the fact that they are oil-producing countries. Economic growth rates are still not improved to reduce the poverty level and enable these countries to catch up with other countries in the world. Investment remains subdued, limiting efforts to diversify economic structures and boost growth [15].

Some of the main determinants of economic growth that apply for both developing and developed countries, although the relative weighing that we might attach to each will depend on the individual circumstances facing each country or region are: growth in physical capital stock, growth in the size of the active labour forced available for production, growth in the quality of labour, technological progress and innovation during productivity improvements (i.e. higher GDP per hour worked), institutions (including maintaining the rule of law, stable democracy, macroeconomic stability) and rising demand for goods and services (either led by domestic demand or from external trade).The challenges to growth are changes in the real exchange rate affecting competitiveness, cyclical fluctuation in national output and external trade, volatility in world prices for essential input, and key exports, political instability, natural disasters and other external supply shocks and unexpected breakthrough in the state of technology.

Among the notable study in economic growth are : [1], [2], [5], [6], [14], [15]. [12] examined the relationship between oil consumption and economic growth in OPEC countries within a panel cointegration and panel based correction error model by using data from 1980-2011; he found out that energy efficiency has not a significant effect on economic

growth in long-run. Those that work on economic growth using linear regression or panel data models to establish the relationship between growth and determinants of economic growth include: [1], [3], [6], and [12].
This study is about the empirical analysis of some of the determinants of economic growth of OPEC countries using a panel data approach. Panels of twelve OPEC countries for a period of 1986-2010 were considered. The study involves the estimation of panel data growth model to identify the major determinant of per capita real GDP growth. We intend to find out how CGDP per capital depends on exchange rate (Xrat), price level of investment (pi), purchasing power parity (ppp), investment share (ci), price level of consumption (pc), price of GDP (p) and price level of government consumption (pg).

2. Methodology

2.1. Data source

Data used for this study were obtained from Penn World table (PWT) 7.1. It covers the period of 1986 to 2010. The lists of countries considered are: Algeria, Angola, Ecuador, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, United Arab Emirates and Venezuela

2.2. The model

Consider a linear regression model for N individual countries for T time dimension:

$$y_{it} = \alpha + X'_{it}\beta + u_{it} \qquad i = 1, 2, \cdots, T \;\; ; \; t = 1, 2, \cdots, T \tag{1}$$

Where y_{it} represents the dependent variable for country i in period t , X_{it} is the vector of independent (explanatory) variables; β is a vector of k regression coefficients for country i and u_{it} is the disturbance term.
The Economic model used is:

$$y_{it} = \beta_1 + \beta_2 Xrat_{it} + \beta_3 p_{it} + \beta_4 ppp_{it} + \beta_5 ci_{it} + \beta_6 pc_{it} + \beta_7 pi_{it} + \beta_8 pg_{it} + u_{it} \tag{2}$$

Where i represents the different OPEC countries, and t is the time period.

2.3. Brief discussion of some of the estimators of panel data models

2.3.1. Pooled OLS

OLS (Ordinary Least square) stacks the data over i and t into one long regression with NT observation, and estimates of parameters are obtained by OLS using the model [7].

$$y = X'\beta + V \tag{3}$$

Where y is an $NT \times 1$ column vector of dependent variables, X is an $NT \times k$ matrix of regressors; β is a $(k \times 1) \times 1$ column vector of regression coefficients, V is an $NT \times 1$ column vector of the combined terms (i.e. $\mu_i + u_{it}$) .
The pooled estimator is given as:

$$\beta_{pooled} = (X'X)^{-1} X'Y \tag{4}$$

2.3.2. Fixed effect (FE) models

Fixed effects arises from assumption that the omitted effects, μ_i in the model, $y_{it} = X'_{it}\beta + \mu_i + u_{it}$ are correlated with the included variables [7]. In a general form,

$$E[\mu_i / X_i] = h(X_i) \tag{5}$$

Because the conditional mean is the same in every period, we can write the model as

$$\begin{aligned} y_{it} &= X'_{it}\beta + h(X_i) + \mu_i + u_{it} + [\mu_i - h(X_i)] \\ &= X'_{it}\beta + \mu_i + u_{it} + [\mu_i - h(X_i)] \end{aligned} \tag{6}$$

By construction, the bracketed term is uncorrelated with X_i', so we may absorb it in the disturbance, and write the model as

$$y_{it} = X_{it}'\beta + \mu_i + u_{it} \tag{7}$$

2.3.3. Random effects (RE) model

The structure for the random effects' model is given as:

$$y_{it} = X_{it}'\beta + \varepsilon_{it} \tag{8}$$

Where

$$\varepsilon_{it} = \mu_i + u_{it} \tag{9}$$

The substantive assumption that distinguishes this model from the fixed effects model is the time-invariant person-specific effect μ_i is uncorrelated with u_{it} .The following assumptions hold for the error term.

$$\begin{array}{ll} E[u_{it}] = 0, & E[u'u] = \sigma_u^2 I_{nT} \\ E[\mu_i \mu_j] = 0,\ for\ i \neq j, & E[\mu_i \mu_i] = \sigma_\mu^2 \\ E[\mu_i u_{jt}] = 0, & E[\mu_i] = 0 \end{array}$$

Where all expectations are conditional on X .

3. Hypothesis testing

3.1. Hypothesis testing for the fixed effect (FE)

If we are interested in the difference across the groups, then we can perform this significance test with an F test. The F ratio used for their test is.

$$F_{(n-1,\ nT-n-k)} = \frac{(R_{FE}^2 - R_{pooled}^2)/(n-1)}{(1-R_{FE}^2)/(n-1-k)} \tag{10}$$

3.2. Testing for random effect (RE)

Breusch and Pagan (1980) have devised a Lagrange Multiplier (LM) test for the random effect models (REM) based on the OLS residuals. The hypothesis is as follows:

$$H_0 : \sigma_T = 0$$
$$H_1 : \sigma_T \neq 0$$

The LM test statistic is.

$$LM = \frac{nT}{2(T-1)}\left[\frac{\sum_{i=1}^{n}(Te_i)^2}{\sum_{i=1}^{n}\sum_{t=1}^{T}e_{it}^2} - 1\right]^2 \sim \chi^2 \tag{11}$$

Under the null hypothesis.

3.3. Hausman test for fixed versus random effects

The Hausman test is a useful device for determining the preferred specification of the common effect model.The Hausman test is defined as:

$$H = (\hat{\beta}_{FE} - \hat{\beta}_{RE})'(V_{FE} - V_{RE})^{-1}(\hat{\beta}_{FE} - \hat{\beta}_{RE}) \tag{12}$$

The Hausman test statistic is distributed asymptotically as χ^2 with k degrees of freedom under the null hypothesis that the RE estimation is correct.

4. Main results

In this section, we discuss the results of analysis of the pooled effect, fixed effects and random effect specifications. Table 1 reports the OLS estimates on a full sample for 300 observations, Table 2 reports the fixed effect model while Table 3 reports the random effects model.

Table 1: Pooled Regression Results for CGDP

Variable	Coefficient	SE	t-statistic	p-value
Xrat	-2.9484	3.0103	-0.98	0.328
P	-47.0914	111.9123	-0.42	0.674
Ppp	3.654	8.0289	-0.46	0.649
Pc	-54.3051	29.9412	-1.81	0.071**
Ci	485.3729	120.1654	4.04	0.000**
Pi	129.2302	95.5423	1.35	0.177
Pg	11.5367	20.3104	0.57	0.57
Constant	1934.429	3819.74	0.51	0.613

*significant at 1% level of significance ** significant at 10% level of significance

From table 1, the results show that there is positive relationship of the CGDP to ppp, ci, pi *and* pg while $Xrat, p$ *and* pc has a negative relationship. Therefore, 1% increase in ppp, ci, pi *and* pg leads to significant rise in CGDP by $3.65, $485.37, $129.23 and $11.54 respectively on the average. Conversely, 1% increase in $Xrat, p$ *and* pc leads to a reduction in CGDP by $2.95, $47.09 and $54.31 on the average respectively.
Also, the result revealed that only ci and pc are significant to the model ($p = 0.0000$ and 0.071) at 1% and 10 % respectively while others such as $Xrat$, p, ppp pc, pi *and* pg are not significant. The overall parameters are significant (since $p = 0.0025 < \alpha$) while R^2 (0.072) is low. This indicates that 7.2% of the economic growth is explained by the model.

Table 2: Fixed Effects Regression for CGDP

Variable	Coefficient	SE	t-statistic	p-value
Xrat	0.9779	1.95445	0.50	0.617
P	146.2765	99.3152	1.47	0.142
Ppp	0 .9367	4.8943	0.19	0.848
pc	-33.2399	19.1142	-1.74	0.083**
ci	401.5182	98.4346	4.08	0.000**
pi	-84.1331	91.3433	-0.92	0.358
pg	-11.8341	15.9172	-0.74	0.458
Constant	2499.659	2963.38	0.84	0.400

*significant at 1% level of significance ** significant at 10% level of significance
R-sq: within = 0.0710 between = 0.0026 overall = 0.0173

The result of the fixed effect model in the above table shows that $Xrat$, p, ppp and ci have a positive relationship on the CGDP while pc, pi and pg have a negative relationship on CGDP. This revealed that 1% increase in $Xrat$, p, ppp and ci leads to significant rise in CGDP by $0.98, $146.28, $0.94 and $401.52 on the average respectively. On the other hand, 1% increase in pc, pi and pg leads to a significant reduction in CGDP by $33.24, $84.13 and $11.83 respectively on the average. In addition, it was observed that all the explanatory variables are not statistically significant to the model except ci and pc that are significant at 1% and 10% respectively. The significance test based on R^2 for the fixed effect revealed that the overall parameter is statistically significant to the model since p-value (0.0000) is less than the significant level. Therefore, the evidence is strongly in favor of an individual-specific effect. To examine the quality of the model fit, the R^2 within is 7.1% of the intra-country CGDP is explained by the model while R^2 between indicates 0.26% variability of the inter-country CGDP growth is explained by the specific behaviour of each country fixed.

Table 3: Random Effects Regression for CGDP

Variable	Coefficient	SE	t-statistic	p-value
Xrat	0.8884	1.9328	0.46	0.646
p	140.8299	97.6894	1.44	0.149
ppp	1.00147	4.8472	0.21	0.836
pc	-33.2884	18.9194	-1.76	0.078**
ci	399.89	97.0057	4.12	0.000**
pi	-78.9858	89.7781	-0.88	0.379
pg	-11.1473	15.7014	-0.71	0.478
Constant	2585.583	7727.182	0.33	0.738

*significant at 1% level of significance ** significant at 10% level of significance
Test: Var(u) =0
Chi2(1) = 1312
Prob> chi2 = 0.0000

The results in the above table show that $Xrat, p, ppp$ and ci has a positive relationship on CGDP while pc, pi and pg has depressing relationship with CGDP. The average value of the random error component is the common intercept of 2585.58.It is also noted that only ci is significant at 1% and pc that is significant at 10 %.The LM test suggested by Breusch and Pagan is used to test the hypothesis: H0: no random effects against H1 : presence of random effects. The p-value associated $prob > chi\,2 = 0.0000$ leads us to the rejection of the null hypothesis that there is no random effect. The LM test therefore suggests that GLS estimator is significantly more efficient than OLS in the total size.

Table 4: Model Tests

Model tests	Selection	P-value
F-test	OLS	0.0025
F-test	Fixed	0.0000
Breusch-Pagan	Random	0.0000
Hausman	Fixed-Random	0.9998

Table 5: Hausman Test of Fixed Effects Model (FEM) or Random Effects Model (REM)

	Coefficients			
	b	B	(b-B)	Sqrt(diag(V_b-V_B))
Variable	Fixed	Random	Diference	SE
Xrat	0.977974	0 .8884	0 .0896	0.2898
P	146.2765	140.8299	5.4466	17.8968
Ppp	0 .93667	1.00147	-0.0648	0.6773
Pc	-33.2399	-33.2884	0.0484	2.7215
Ci	401.5182	399.89	1.6282	16.7111
Pi	-84.1331	-78.9858	-5.1473	16.8371
Pg	-11.8341	-11.1473	-0.6869	2.6118

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg
Test: Ho: difference in coefficients not systematic
H= chi2(7) = (b-B)'[(V_b-V_B) ^(-1)](b-B)
= 0.39
Prob>chi2 = 0.999

The Hausman test is used to choose whether to adopt the assumption of the FEM or the hypothesis of REM. The hypothesis is specified as:

H_0 :FEM and REM estimators are not significantly different from each other.

H_1 :FEM and REM estimators are significantly different

The large p-value in table 5 shows that the difference between FEM and REM are not statistically significant. This means that the estimates of both FE and RE are close.

5. Conclusion

The result of our findings shows that pc and ci were found to be important or major factors of CGDP that contribute to the economic growth of OPEC countries by pooled OLS, FE and RE models while $Xrat, p, ppp, pi$ and pg are not significant to the model. The overall parameter test of both pooled OLS and FEM are significant to the model. It is also

discovered that pc, pi and pg have a negative influence on the CGDP while $Xrat$, p, ppp and ci have a positive influence on CGDP.
The Breusch and Pagan test statistic revealed that REM estimator is significantly more efficient than OLS having a higher value of LM (i.e. 1312.03) which indicates that REM is the appropriate specification. Also the Hausman test statistic shows that FEM and REM estimators do not differ substantially.

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