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Is Ecuador Real Gross Domestic Product per Capita and Other Macroeconomic Variables Cointegrated? An Autoregressive Distribution Lag Bound Test Approach

Jesser Roberto Paladines Amaiquema*

Department of Economics, Faculty of Business Studies, Universidad Técnica de Machala, Equador.
*Email: jesserpaladines@gmail.com

ABSTRACT

Ecuador is an oil exporter country but it is also an importer of oil derivatives products. In this research the relationship between its real gross domestic product (GDP) per capita and the oil price, gas price, inflation and total expenditure is studied, taking annual data of all from 1980 to 2015 by using the methodology of autoregressive distribution lag bound test. It is concluded it exists a long run relationship between variables and the speed of adjustment to any disequilibrium in the short run is corrected at an approximately rate of 85%. The model showed itself stable. In addition it was demonstrated that there is a causal relationship from all regressors selected except total expenditure to real GDP per capita according to the Toda-Yamamoto technique.

Keywords: Autoregressive Distribution Lag, Toda-Yamamoto, Ecuador
JEL Classifications: C32, 040, F20

1. INTRODUCTION

The autoregressive distribution lag (ARDL) bound test model is used to explain the dynamics of relationships between regressors being I(1) or I(0) or a combination of both. This study analyzes the dependence of Ecuador economic growth to average oil price, total expenditure and gas price. The long run between these variables is studied as it is a very important issue, since economic policies should be focused on this point.

The price of oil has had an upward trend since the 80's, with the exception of the last two periods which has been affected due to global over-supply. Likewise the consumption of the same has increased for its use of industries and increase in oil prices affects domestic prices too in the long run. Another variable that is linked to oil prices is the gas price as Ecuador also imports it. Total expenditure is also analyze and is expected to be cointegrated as well. All these variables are studied though a cointegration technique called the ARDL bound test technique.

2. LITERATURE REVIEW

There are some papers concerning about the relation between gross domestic product (GDP) growth and oil price as (Hamilton, 1996) determined a correlation between the impact of oil prices and recessions on the US economy. Mork (1989) concluded that if data were included after 1995, that negative correlation did occur, otherwise the causality of Granger was lost.

Rodriguez and Sanchez (2004) determined that organization for economic co-operation and development (OECD) member countries have a direct relationship between changes in oil prices and GDP growth and Du et al. (2010) conducted a study on the ratio of GDP to oil prices in China, resulting in a dependence on GDP in relation to prices.

Lescaroux and Mignon (2008) studied the short- and long-term relationship of oil prices and several macroeconomic variables such as GDP, demonstrating that there is no causality of prices to GDP for oil-exporting countries. And long-term GDP is affected by the price of oil, and Aktaş et al. (2010) studied the relationship between oil prices and macroeconomic variables in Turkey and GDP among others, determined that high oil prices are not statistically significant in relation to macroeconomic variables.

Berument et al. (2010) concluded that positive impacts on the oil price affect the economies of the importing countries of oil other than the oil exporting countries. The price of oil could be considered as bad for oil importing countries but good for oil exporting countries, also Aydin and Acar (2011) in relation to the study of the same variables in Turkey resulted in a negative effect on GDP in terms of variations in the price of oil.

Gómez-Loscos et al., 2011 - The relation of oil prices and the GDP of Spain indicate a statistically significant dependence. Similarly, Leesombatpiboon (2009) calculated the elasticity of growth of the economy in relation to the price and consumption of oil. They showed that a decrease or an increase in the price of oil would cause a decrease in the growth of the economy in the same year.

Other studies considering variables like Expenditure and oil revenue show significant conclusions, as Javaid and Javed (2013) concluded a long term relationship between rate of inflation, economic growth and government expenditure in Pakistan, similar work show (Ahmad and Masan, 2015) indicate that there is a long-run relationship between these three macroeconomic variables; the real GDP, the real government expenditure and the real oil revenues in Oman. Mansour et al. (2012) found a significant impact of oil export revenues on government expenditure in Iran at different period of time, results show a strong positive relationship between these two variables during long term period.

Concerning relationship between inflation and economic growth there are studies as (de Gregorio, 1991) who established a negative association between inflation and growth from a sample group of Latin American countries, contrary on this was (Mallik and Chowdhury, 2002) who found a positive long run relationship between inflation and real income, besides the government expenditure is positively related to real income in the long run.

3. METHODOLOGY

In this research to study the dynamics between real GDP per capita as dependent variable and total expenditure, oil price, gas price and IPC as regressors. Data from 1980 to 2015 are taken from the World Bank's online database. World Bank Group, 2016 - except for the IPC. This last variable was taken from INEC (www.ecuadorencifras.gob.ec) in constant values. All variables are converted into its natural logs.

Inflation was calculated as the differenced of its logs. The average price for equal weights of oil according to Brent, Dubai and WTI prices and gas price are in nominal values, as presented at World Bank Data and total expenditure is the sum of private consumption, government consumption and private investment in constant 2010 dollars.

In order to analyze the relationship, the following form function was developed:

$$\ln Y_t = f(\ln EXPEND_t, \ln OILPRICE_t, \Delta \ln IPC_t, \ln GAS_t)$$

Where the descriptions of every variable is presented in Table 1.

4. FINDINGS

4.1. Unitary Root Test

There are important differences between stationary and non-stationary time series. Changes in stationary series are necessarily temporary, over time, the effects of shocks will dissipate and the series will return to their mean level in the long run. While a non-stationary series necessarily has permanent components. The mean and variance of a non-stationary series are time dependent (Enders, 2015).

Dickey and Fuller (1981) have computed the critical values of the t-statistic based on Monte Carlo simulations. This t-statistic is known as the Dickey-Fuller (DF) test, which does not follow the usual t-distribution. DF test is estimated using three different equations: With intercept, prone and intercept and random walk (random walk). In each case, the null hypothesis is that there is unit root (Agung, 2009). The DF tests assume that the errors are independent and have a constant variance (Enders, 2015).

The tests are valid only if u_t is white noise, i.e. it is assumed that is uncorrelated. If this is the case, the test would be overstating the value P. The solution is to "increase" the test using P delays (lags) of the dependent variable. Now the lags of Δ and t reduce any dynamic structure on the dependent variable, to ensure that u_t is not auto correlated. The test is known as the enhanced augmented Dickey-Fuller (ADF) test. Phillips and Perron (PP) have developed a more complete theory of the non-stationary unit root. The tests are similar to the ADF tests, but they incorporate an automatic correction of the DF procedure to allow autocorrelated residuals (Brooks, 2008).

Variables were subjected to a unit root test. Both the ADF test and the PP test (Phillips and Perron, 1988) showed that all series have unit root in levels, but at first difference they do not have unit root either intercept or with tendency and intercept at 1%, concluding none series is I(2), confirming the use of the ARDL technique (Nkoro and Uko, 2016) (Table 2).

4.2. ARDL

As Nkoro and Uko (2006) explain when one cointegrating vector exists, Johansen (1988) cointegration procedure cannot

Table 1: Variable description

Variables	Measurement	Symbol
Real GDP per capita	log(Yt)	logpibper
Total expenditure	log(EXPENDt)	logexpend
Oil price	log(OILPRICE)	logoilprice
Inflation	Δlog(IPC)	Dlogipc
Gas price	log(GAS)	loggas

GDP: Gross domestic product

be applied. Hence, it become imperative to explore Pesaran and Shin (1999) and Pesaran et al. (2001) proposed ARDL approach to cointegration or bound procedure for a long run relationship, irrespective of whether the underlying variables are I(0), I(1) or a combination of both. In such situation, the application of ARDL approach to cointegration will give realistic and efficient estimates.

The ARDL bounds test was employed to work with small samples[1] which makes it no suitable to employ other cointegration procedure as Johansen and Juselius. According to the Akaike Information Criteria, the best ARDL model chosen was an ARDL(1,0,3,3,1), Table 3 shows the results for the ARDL model.

4.2.1. Bounds test

Pesaran (2001) provide two sets of critical values in which one set is computed with the assumption that all variables in the ARDL model are I(1), and another with the assumption that they are I(0). For each application, the two sets provide the band covering all the possible classification of the variables into I(0) and I(1), or even fractionally integrated ones.

It can be 3 cases that the ARDL bound test faces according to the F computed:

1. If the computed F statistics is below the lower bound value I(0), the null hypothesis of no level relationship cannot be rejected
2. The null hypothesis of no level relationship is rejected if the F-statistic is higher than the upper boundary I(1) and,
3. The test of level relationship is inconclusive if the F statistics lies between the lower and upper bound values.

In this case Table 4 shows the null hypothesis is rejected even at 1% of significance, this implies a long run relationship between variables. Results suggest a causal link between variables in at least one direction if cointegration is found (Engle and Granger, 1987).

4.2.2. Long run estimation

From Table 5 is found the ARDL long run estimation, a 10% change in total expenditure will result in about 3% change in GDP real per capita, similarly a 10% change in inflation will cause a 2% reduce in GDP real per capita. A 10% change in oil price will result in a 0.7% change in GDP real per capital and a 10% change in the price of gas will cause a 0.8% reduce in GDP per capita.

All estimators are significative at 1%, the coefficients signs are correct as expected, increase in inflation will reduce the growth of GDP, result consistent with (de Gregorio, 1991) and (Javaid and Javed, 2013), total expenditure related positively to real GDP per capita, similar result with (Mallik and Chowdhury, 2002). Increase in oil revenue as share of GDP will increase GDP per capita, similar findings of (Berument et al., 2010) and (Leesombatpiboon, 2009) as Ecuador is a net exporter of Oil; but also is a net importer of gas, the growth of real GDP per capita will be affected in a change of prices, as being importer, similar result with (Rodriguez and Sanchez, 2004) and (Aydin and Acar, 2011).

Table 2: Unit root tests

Variables	P values in levels		P values in differences	
	ADF	PP	ADF	PP
With intercept				
logpibper	0.998	0.998	0.00	0.00
logexpend	0.994	0.999	0.00	0.00
loggas	0.335	0.329	0.00	0.00
logoilprice	0.725	0.718	0.00	0.00
dlogipc	0.361	0.322	0.00	0.00
With intercept and trend				
logpibper	0.938	0.938	0.00	0.00
logexpend	0.761	0.837	0.00	0.00
loggas	0.653	0.578	0.00	0.00
logoilprice	0.504	0.504	0.00	0.00
dlogipc	0.056	0.200	0.00	0.00

ADF: Augmented Dickey-Fuller, PP: Phillips and Perron

Table 3: ARDL

Variable	Coefficient	Standard error	t-statistic	Prob.
log(pibper(−1))	0.152555	0.101600	1.501523	0.1497
log(expend)	0.248297	0.037214	6.672077	0.0000*
d(log(ipc))	−0.024464	0.029237	−0.836729	0.4131
d(log(ipc(−1)))	−0.089379	0.032221	−2.773947	0.0121*
d(log(ipc(−2)))	−0.013851	0.029742	−0.465716	0.6467
d(log(ipc(−3)))	−0.042004	0.026586	−1.579892	0.1306
log(gas)	−0.005832	0.011294	−0.516365	0.6116
log(gas(−1))	−0.017580	0.012673	−1.387194	0.1814
log(gas(−2))	−0.037786	0.010869	−3.476429	0.0025*
log(gas(−3))	−0.013401	0.011851	−1.130765	0.2722
log(oilprice)	0.006726	0.013583	0.495228	0.6261
log(oilprice(−1))	0.049434	0.012308	4.016595	0.0007*
c	0.687523	0.412033	1.668609	0.1116

ARDL: Autoregressive distribution lag, Note: *Significant at 1%

Table 4: ARDL bound test

Test statistic	Value	k
F-statistic	7.551177	4
Critical value bounds		
Significance (%)	I(0) bound	I(1) bound
10	2.85	3.52
5	2.86	4.01
1	3.74	5.06

ARDL: Autoregressive distribution lag

Table 5: Long run estimation

Variable	Coefficient	Standard error	t-statistic	Prob.
log(expend)	0.292995	0.021057	13.914345	0.0000
d(log (ipc))	−0.200247	0.042071	−4.759743	0.0001
log(gas)	−0.088028	0.011215	−7.849337	0.0000
log(oilprice)	0.066271	0.012736	5.203280	0.0001
c	0.811289	0.492515	1.647237	0.1159

4.2.3. Short run

At Table 6 the short run estimation is shown, the estimator of total expenditure and gas result insignificant at 1% and with the expected signs, but the rest of estimators have insignificant estimators.

1 Pattichis (1999) – 20 observations, Mah (2000) – 17 observations, Narayan and Smyth (2004) and Narayan (2004) – 31 observations, Tang and Nair (2002) and Narayan and Narayan (2004) – 29 observations, and Enisan and Olufisayo (2009) – 24 observations.

According to the error correction term (ECT_{t-1}) is negative and significant at 1% level, meaning that the short run disequilibrium is corrected in the long run equilibrium at a rate of 81% in the next period.

4.3. Diagnostic Tests

The model was subject to diagnostic test, in order to see the stability of the model, the Jarque-Bera (JB) was calculated, giving the not rejection of the null hypothesis that residuals are multivariate normal, so it can be concluded that the residuals have a normal distribution. But taking into account that the sample is small, and the JB statistic follows an asymptotic distribution, this result cannot be truthful.

The LM test of autocorrelation of residues is applied, results in non-rejection of the null hypothesis of non-autocorrelation until the 4th lag. Determining the absence of correlation between residuals. The proof of Breusch-Pagan-Godfrey, in which the null hypothesis is absence of heteroskedasticity in the model, is not rejected in this model. Although the sample is small the F statistics is preferred according to (Pesaran and Pesaran, 1997), both F y LM statistics give similar conclusions.

One more stability test is carried; the cumulative sum of recursive residuals (CUSUM) and cumulative sum of squares of recursive residuals (CUSUMQ) plots are applied (Brown et al., 1975).

The fluctuations of the CUSUM or CUSUMSQ outside the critical lines of 5% significance level denotes parameter instability. As depicted in Figure 1, as both CUSUM and CUSUMSQ lie within the 5% critical lines, the model coefficients are stable.

4.4. Granger Causality Test in a VARM

Table 7 shows the Granger causality test using the Toda-Yamamoto procedure (Toda and Yamamoto, 1995), within a VARM. In the analysis it was excluded variables: Oil price and gas price as dependent variables, because both of them depends on other exogenous factors not described in this model.

From results and consistent with the long run estimations, it can be concluded that all variables except total expenditure Granger cause real GDP per capita, oil prices and inflation Granger cause total expenditure, total expenditure Granger cause inflation and oil prices and total expenditure Granger cause gas prices.

5. CONCLUSIONS

The dynamic relationship between Ecuador's GDP per capita c (considered as dependent variable) and the oil price, gas price, total expenditure and inflation (regressor variables) is very important in the development of economic policies. Due to the small sample the ARDL bound test Pesaran, et al. (1996) and Pesaran et al., (2001) was applied in order to establish the long run relationship between variables.

The bound test found a cointegration between real GDP per capita and the other regressor variables. Confirm the importance of watch

Table 6: Short run estimation

Variable	Coefficient	Standard error	t-statistic	Prob.
DLOG(EXPEND)	0.248297	0.037214	6.672077	0.0000*
DLOG(IPC, 2)	−0.024464	0.029237	−0.836729	0.4131
DLOG(IPC(−1), 2)	0.013851	0.029742	0.465716	0.6467
DLOG(IPC(−2), 2)	0.042004	0.026586	1.579892	0.1306
DLOG(GAS)	−0.005832	0.011294	−0.516365	0.6116
DLOG(GAS(−1))	0.037786	0.010869	3.476429	0.0025*
DLOG(GAS(−2))	0.013401	0.011851	1.130765	0.2722
DLOG(OILPRICE)	0.006726	0.013583	0.495228	0.6261
CointEq(−1)	−0.847445	0.10160	−8.340966	0.0000*

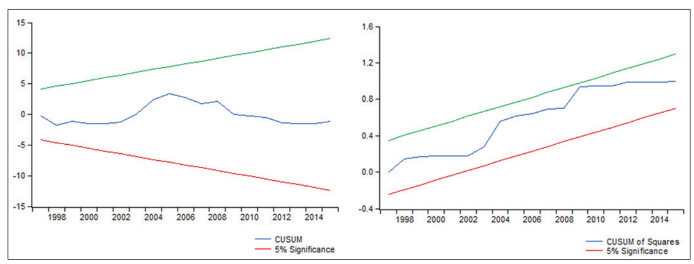
Note: *Significant at 1%

Table 7: Granger causality test within a VARM

Independents	Dependents		
	logpibper	logexpend	dlogipc
logpibper	-	0.936136	4.648712
logexpend	5.917059	-	11.38540*
dlogipc	7.926844**	6.920154***	-
loggas	7.06495***	2.524017	3.284075
logoilprice	7.060375***	7.814279**	4.260841

*Granger cause at 1%. **Granger cause at 5%. ***Granger cause at 10%

Figure 1: Cumulative sum and cumulative sum of squares



oil and gas prices as well inflation and expenditure, in order to stimulate the economic growth.

Inflation and gas price showed a negative long run relationship between the real GDP per capita. The oil price and expenditure showed a positive long run relationship with the dependent variable.

Any disequilibrium between in the short run is corrected at a rate of nearly 85% given by the ECM term.

Uni-direccional Causality was found from all regressors excluding expenditure to real GDP percapita. Also causality from oil price and inflation to total expenditure and causality from total expenditure to inflation was found.

This investigation concludes that regressor variables are very important to watch to safeguard the growth of real GDP, precise policies must correct any disequilibrium in order to ensure economic growth.

The limitation of this work is the small sample that makes impossible to model with other cointegration method. Nevertheless various statistics test were carried out to ensure the stability of the model.

REFERENCES

Agung, G.N. (2009), Time series data analysis using EViews. Stat Pap, 52(2), 497-499.

Ahmad, H., Masan, S. (2015), Dynamic relationships between oil revenue, government spending and economic growth in Oman. International Journal of Business and Economic Development, 3(2), 93-115.

Aktaş, E., Özenç, Ç., Arica, F. (2010), The Impact of Oil Prices in Turkey on Macroeconomics. MPRA Paper 8658. p1-16.

Aydin, L., Acar, M. (2011), Economic impact of oil price shocks on the Turkish economy in the coming decades: A dynamic CGE analysis. Energy Policy, 39(3), 1722-1731.

Berument, M., Ceylan, N., Dogan, N. (2010), The impact of oil price shocks on the economic growth of selected Mena1 countries. The Energy Journal International Association for Energy Economics, 31(1), 149-176.

Brown, R.L., Durbin, J., Evans, J. (1975), Techniques for testing the constancy of regression relationship over time. Journal of Royal Statistical Society, Series (B), 37, 149-163.

Brooks, C. (2008), Introductory Econometrics for Finance. 2nd ed. Estados Unidos, New York, NY: Cambridge University Press.

de Gregorio, J. (1991), The Effects of Inflation on Economic Growth: Lessons from Latin America. IMF Working Paper. p1-15.

Dickey, D., Fuller, W. (1981), Likelihood ratio statistics for autoregressive time series with a unit root. Econometrica, 49(4), 1057-1072.

Du, L., Yanan, H., Wei, C. (2010), The relationship between oil price shocks and China's macro-economy: An empirical analysis. Energy Policy, 38(8), 4142-4151.

Enders, W. (2015), Applied Econometric Time Series. 4th ed. Chichester, West Sussex: Jhon Wiley & Sons.

Engle, R., Granger, C. (1987), Co-integration and error correction: Representation , estimation, and testing. Econometrica, 55(2), 251-261.

Enisan, A.A., Olufisayo, A.O. (2009), Stock market development and economic growth: Evidence from seven Sub-Saharan African countries. Journal of Economics and Business, 61, 162-171.

Gómez-Loscos, A., Montañés, A., Gadea, M. (2011), The impact of oil shocks on the Spanish economy. Energy Economics, 33(6), 1070-1081.

Hamilton, J. (1996), This is what happened to the oil price-macroeconomy relationship. Journal of Monetary Economics, 38(2), 215-220.

Instituto Nacional de Estadísticas y Censos. (2016), Available from: http://www.ecuadorencifras.gob.ec.

Javaid, M., Javed, A.Y. (2013), Inflation, economic growth and government expenditure of Pakistan: 1980-2010. Procedia Economics and Finance, 5, 58-67.

Leesombatpiboon, P. (2009), Multivariate Cointegration Analysis of the Role of Oil in the Thai Macroeconomy. Washington: Ph.D. Dissertation, the George Washington University.

Lescaroux, F., Mignon, V. (2008), On the influence of oil prices on economic. OPEC Energy Review, 32, 343-380.

Mallik, G., Chowdhury, A. (2002), Inflation, government expenditure and real income in the long-run. Journal of Economic Studies, 29(3), 240-250.

Mansour, G., Fereydoon, A., Reza, J. (2012), Relationship between oil revenues and government expenditure using wavelet analysis method: Evidence from Iran. Economics and Finance Review, 2(5), 52-61.

Mah, J.S. (2000), An empirical examination of the disaggregated import demand of Korea: The case of information technology products. Journal of Asian Economics, 11, 237-244.

Mork, K. (1989), Oil and the macroeconomy when prices go up and down: An extension of Hamilton's results. Journal of Political Economy, 97(3), 740-744. Available from: http://www.jstor.org/stable/1830464.

Narayan, P.K., Smyth, R. (2004), Attendance and pricing at sporting events: Empirical results from Granger causality tests for the Melbourne Cup. Applied Economics, 35(15), 1649-1657.

Narayan, S., Narayan, P.K. (2004), Determinants of demand for Fiji's exports: An empirical investigation. Developing Economics, 42(1), 95-112.

Narayan, S. (2004), Fiji's tourism exports: An ARDL model. Tourism Economics, 10(2), 193-206.

Nkoro, E., Uko, K. (2016), Autoregressive distributed lag (ardl) cointegration technique: Application and interpretation. Journal of Statistical and Econometrics Methods, 5(4), 63-91.

Pattichis, C.A. (1999), Price and income elasticities of disaggregated import demand: Results from UECMs and an application. Applied Economics, 31(9), 1061-1071.

Pesaran, M., Pesaran, B. (1997), Working with Microfit 4.0: Interactive Econometric Analysis. Oxford: Oxford University Press.

Pesaran, M.H., Shin, Y. (1999), An autoregressive distributed lag modelling approach to cointegration analysis. In: Strom, S., editor. Econometrics and Economic Theory in the 20th Century: The Ragnar Frisch Centennial Symposium. Ch. 11. Cambridge: Cambridge University Press.

Pesaran, M.H., Shin, Y., Smith, R.J. (2001), Bounds testing approaches to the analysis of level relationships. Journal of Applied Econometrics, 16, 289-326.

Phillips, P., Perron, P. (1988), Testing for a unit root in time series regression. Biometrika, 75(2), 335-346.

Rodriguez, J., Sanchez, M. (2004), Oil Price Shocks and Real GDP Growth: Empirical Evidence From Some OECD Countries. Working Paper Series 0362. European Central Bank. p64.

Tang, T.C., Nair, M. (2002), A cointegration analysis of Malaysian import demand function: Reassessment from the bonds test. Applied Economics Letter, 9(5), 293-296.

Toda, H., Yamamoto, T. (1995), Statistical inference in vector autoregressions with possibly integrated processes. Journal of Econometrics, 66(1-2), 225-250.

World Bank Group. (2006), World Bank Group. Available from: http://www.worldbank.org.