Algeria Aggregate Import Demand (1970- Engle-Granger Test)

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Abstract— **The primary objective of this paper is to ascertain the existence of a long-run relationship between Algerian's aggregate import demand and its determinants, real income and relative import prices, using recent cointegration approach; namely, the bounds testing procedure (Pesaran et al., 2001) and here are this study results: there are positive and significant relationships between the Algerian demand for imports and its Determinants, namely: real income, international reserves and exchange rate. On the other hand, there are negative and significant relationships between the demand for imports and the relative price of imports to domestic price and government consumption in the long run, but negative and insignificant relationships in the short run.**

Index Terms— **Aggregate Import Demand, Cointegration, Engle-Granger**

I. INTRODUCTION

The paper attempts to analyse Algeria`s aggregate demand for imports; Cointegration analysis and Engle-Granger's approaches of Error Correction was applied to contrast their performance in fitting the Algeria data. It is found that the domestic price1, import price2, and income are important in determining the import demand. The empirical results show that aggregate import tends to be income and price elastic. Moreover, the results give evidence that Engel-Granger Engle-Granger approach out performs the other model in terms of having the smallest ex-post forecast errors.

The paper is set up as follows; The first section provides the problem statement with the literature review, the model and its theoretical underpinnings are laid out in the Second section, The third section, investigates a fairly detailed discussion of the econometric procedures which I used in the analysis of cointegration and I will conclude by the empirical results and discussion.

Problem statement

Cointegration methods have been very popular tools in applied economic work since their introduction about twenty years ago. However, the strict unit-root assumption that these methods typically rely upon is often not easy to justify on economic or theoretical grounds. The concept of cointegration was defined by granger (1981) and after the paper by Engle and Granger (1987)3 it has became one of the cornerstones in modern times series econometrics , although it was implicitly applied by Sargan (1964) ,And Davidson, Hendry, Srba and Yeo (1978). It is the purpose of this paper to give the analysis of Algerian Import Demand cointegrated time series and discuss in relation to a very simple economics problem , how cointegration can be useful ?Mathematical and statistical model which allow such phenomenon are given .

II. LITERATURE REVIEW

It is essential for policy makers to understand that how imports react to changing economic conditions for the effective implementation of trade policies. It is generally believed that imports react more rapidly than exports to trade liberalization. Therefore, it is necessary to predict imports demand more accurately to achieve the maximum benefits from the growing world economy.

There is plethora of empirical studies that have examined the causal factors of aggregate import demand models and a number of studies have been conducted to empirically investigate the major determinants of import demand behavior in LDCs[4] as well as developing countries. The conventionally used import demand function relates quantities of import demanded to real income and relative price (ratio of import prices to domestic prices).Dutta and Ahmed (1999) used Engle-Granger's (1987) and Johansen's multivariate approaches to estimate the aggregate import demand function for Bangladesh using quarterly data from 1974 to 1994. Their study found that Bangladesh's aggregate import demand and its determinants, real import prices, real gross domestic product (GDP) and real foreign exchange reserves, were cointegrated. The estimated long-run elasticities of the explanatory variables based on Engle-Granger's (1987) approach were –0.52 (for relative prices), 1.63 (for real GDP) and –0.10 (for real foreign exchange reserves, but insignificant at the 10 percent levels). A dummy variable was introduced to reflect the liberalization policies, but it was found to be insignificant. Afzal (2001) estimated the import demand function for Pakistan by using OLS and TSLS techniques on the annual data for the period of 1960-99. His results show that the signs of the price coefficient and income coefficient were as expected but price coefficient was insignificant. Tang and Nair (2002) re-investigated the aggregate import demand behavior for Malaysia using the bounds testing approach (Pesaran et al., 1996). The study involved annual data from 1970 to 1998 as employed by Tang and Alias (2000). The result of the bounds test indicated that volume of imports, real income and relative price were cointegrated. The estimated income and price elasticities were 1.5 and –1.3, respectively. The estimated parameter elasticities were consistent with those of Tang and Alias (2000). However, Tang and Alias (2000) found that import volume, real income and relative price were not cointegrated based on the insignificance of the estimated error correction term (see Kremers et al., 1992). Sinha's (1997) study found one cointegrating vector in Thailand's aggregate import demand function using Johansen's multivariate procedure for the

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[1] In the traditional Mundell-Fleming framework, domestic-currency prices of domestically produced goods are given, and the pass-through from exchange rates to prices is unitary. A depreciation of the domestic currency lowers the price of exports in the foreign currency, and increases the price of imports in the domestic currency. This relative price change a□ects the collocation of expenditure,"expenditure switching mechanism", which is at the heart of the adjustment process and is the key to the potency of monetary policy under flexible exchange rates.

[2]See more: Engel, Charles, "Real Exchange Rates and Relative Prices: An Empirical Investigation," Journal of Monetary Economics, 1993, pp. 35—50.

[3] Engel, Charles, "Real Exchange Rates and Relative Prices: An Empirical Investigation," Journal of Monetary Economics, 1993, pp. 35—50.

[4] Less developing countries

period 1953 to 1990. The study found that Thailand's aggregate import demand was price inelastic (-0.77) and cross-price inelastic (0.3) but highly income elastic (2.15). Rijal, Koshal and Jung (2000) estimated an aggregate import demand function for Nepal based on an annual series from 1968 to 1997. They applied the unit root test and Johansen-Juselius (1990) multivariate cointegration analysis. The results showed that real imports, real income, import price index and domestic price index were non-stationary but cointegrated. A partial adjustment mechanism showed that Nepalese import was inelastic with respect to its own price and cross-price, both in the short-run and the long-run. The Nepalese long-run import demand was found to be income elastic (2.13). A recent study by Tang (2002) investigated the aggregate import demand behavior in India using Johansen's multivariate cointegrating approach over an annual period from 1970 to 1999. He found that the volume of imports, real income and relative price were cointegrated. The estimated income and price elasticities were 1.4 and -0.34, respectively.

In some models, such as those involving sticky nominal prices, I'(pij) < I'(pii*) because nominal prices do not vary much over the short run and have a low forecast variance, while the nominal exchange rate may have a large forecast variance. If, however, the nominal exchange rate is fixed, or kept within narrow bands, this prediction would no longer necessarily hold5.

In the following sections I am going to analyse the Aggregate Algerian Import Demand using Angel-Granger procedure.

III. Modelling & methodology

1. Theoretical import demand for Algerian import demand & methodology

This study uses the traditional formulation of the aggregate import demand function as in equation (1) that relates the quantity of import demanded to domestic real income, the total reserves, the exchange rate and the ratio of import prices to domestic prices (relative price term).

$$M_t = f(Y_t, RFER_t, RTR_t, RP_t) \quad \ldots\ldots\ldots\ldots (1)$$

Where:

M_t Is the desired quantity of import demanded at period t, Y_t is real GDP, $RFER_t$ is the real exchange rate, RTR_t is the total reserves and RP_t is a relative price term that is the ratio of import price index to domestic price level. According to Doroodian et al. (1994), the log-linear formulation for the traditional import demand function is deemed to be more appropriate than the linear one. In addition, Gafar (1998) stated that the use of the log-linear specification also avoids some estimation problems, particularly multi collinearity. Thus, the log-linear specification used in this study is shown in equation (2).

$$\ln M_t = b_0 + b_1 \ln Y_t + b_2 \ln ER_t + b_3 \ln TR_t + b_4 \ln RP_t + e_t \quad (2)$$

Where

$\ln M_t$: is the natural logarithm of real quantity of aggregate import demanded by Algeria in time period (t).

$\ln Y_t$: is the natural logarithm of real quantity of aggregate import demanded by Algeria in time period (t).

$\ln ER_t$: is the natural logarithm of real exchange rate in time period (t).

$\ln TR_t$: is the natural logarithm of real total reserves in time period (t).

$\ln RP_t$: is the natural logarithm of real relative price in time period (t).

Lag lengths can be chosen using model selection rules or by starting at a maximum lag length, say 4, and eliminating lags one-by-one until the t-ratio on the last lag becomes significant.

In the above equation include the concept of constant term b_0 because of the fact that there will be some imports even all others variables are zero, e_t is white noise and normally distributed residual, it is the residual term, shown that imports are also affected by other variables which are not included in the model, and 'ln' indicating the natural logarithmic form, and we covert all the variables into log for some statistical reasons, such us to avoid the heteroskedasticity, when the variables are n log form it will estimate the elasticity. Based on economic theory, the signs of the coefficients are expected to be as follows: $b_1 > 0$, $b_2 0$, $b_3 0$ and $b_4 < 0$.

Data Source and Methodological Framework

The sample used in the present study covers annual observations from 1970 to 2010(40 observations). The raw data are obtained from International Monetary Fund, International Financial Statistics (2012). World Bank national accounts data, and OECD National Accounts data files (2012). The quantity of import demanded is **nominal** imports of goods and services deflated by consumer price index **(2000=100)**. An income variable is proxied by real GDP that is **nominal GDP** deflated by the **CPI (2000=100)**, the relative import price variable is the ratio of import price to domestic price (GDP deflator)[6], the total reserves is also deflated by the CPI (2000=100) ,and Real Effective Exchange Rate index (2005).

Unit roots panel

Before conducting cointegration analysis, we first need to check out the stationarity of the series[7]. Several unit root tests exist to check for stationarity of the series, and we apply augmented Dickey-Fuller (ADF) (1981) test to examine the series' characteristics of stationarity in this paper.

However, the series must be stationary8 in order to approximate it by an Engel-Granger. DickeyyFuller tests were conducted on all of the four determinants the results are stationary in the first differences (See table (01)).

If the two non-stationary series move together through time then we say they are "cointegrated." Economic theory would suggest that they should be tied together via arbitrage, but that is no guarantee, so we perform a formal statistical test. The test procedure is very simple. Regress one I (1) variable on another using least squares. Then test the residuals for non-stationarity using the (augmented) Dickey-Fuller test. If the series are cointegrated, the Dickey-Fuller test statistic will be statistically significant. The null hypothesis is that the residuals are non-stationary. Rejection of this leads to the conclusion that the residuals are stationary and the series are cointegrated.

Engel-Granger panel Modern approaches to cointegration testing originated with Engle and Granger. Their method is simple to describe: regress the first component y_1t of yt on the remaining

[5] Charles Engel, Real exchange rate and relative price: An empirical investigation, [J], Journal of Monetary Economics32 (1993) 35 50.Noth-Holland

[6] Essentially, GDP Deflator is an adjustment for the impact of changes in prices on changes in nominal GDP. GDP Deflator can be considered the most comprehensive measure of inflation since a wide array of goods and services are included in its construction. But it may not reflect the full impact of inflation on consumer welfare because it does not include imported goods and services that constitute a significant portion of what people buy.

[7] G. S. Maddala and Shaowen Wu, A Comparative study of unit root tests with panel data and a new simple test ,1999, OXFORD BULLETIN OF ECONOMICS AND STATISTICS, SPECIAL ISSUE (1999) ,0305-9049, P644-647

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components of *Yt* and test the residuals for a unit root. The null hypothesis is that the series in *Yt* are *not* cointegrated, so if the residual test fails to find evidence against the null of a unit root, the Engle-Granger test fails to find evidence that the estimated regression relation is cointegrating. A complication of the Engle-Granger approach is that the residual series is estimated rather than observed, so the standard asymptotic distributions of conventional unit root statistics do not apply. Augmented Dickey-Fuller tests (ADF test) cannot be used directly. For accurate testing, distributions of the test statistics must be computed specifically for the Engle-Granger test.

Estimating VEC Model Parameters

Once a cointegrating relation has been determined, remaining VEC model coefficients can be estimated by ordinary least-squares. Suppose, for example, that a model selection procedure has indicated the adequacy of $q = 1$ lags in a VEC (q) model, and we wish to estimate

Simulation and Forecasting

Once model coefficients have been estimated, the underlying data-generating process can be simulated. For example, the following code generates a single ADF test (Table.1) forecast path for a horizon 40 years beyond the data:

IV. EMPIRICAL RESULTS AND DISCUSSIONS

This section provides tables of critical values for some popular tests of cointegration and unit roots. Although these tables are necessarily based on computer simulations, they are much more accurate than those previously available. The results of the simulation experiments are summarized by means of response surface regressions in which critical values depend on the sample size

Unit roots panel:

Before conducting cointegration analysis, we first need to check out the stationarity of the series77. Several unit root tests exist to check for stationarity of the series, and we apply augmented Dickey-Fuller (ADF) test78 o examine the series' characteristics o stationary in his paper.

The null hypothesis of unit root is not rejected for all series. Hence, all the series are non-stationary in the level. We conduct the same test on the first difference of these series and find them stationary79.According to ADF test; all variables are not stationary at level. We differenced the data and run our test again (See table 1).

As can be shown in Table 1, the null hypothesis can't be rejected for levels of all variables in all tests, but the null hypothesis is rejected at least on one of the significance levels (1%, 5% or 10%) in every test for the first differences of all variables. Thus, it can be said that all variables are integrated of the first order.

Table (01): Unit roots & ADF Test results

Variable	*Levels/Fist Difference*	*ADF (Intercept and Trend)*	*Critical Values (at 5% level)*	*p-value*
Ln import	*Level*	*-0.953019*	*-3.5279*	*0.3471*
	1st Diff.	*-2.499956*	*-3.5312*	*0.0174*
Ln GDP	*Level*	*-2.068108*	*-3.5279*	*0.0461*
	1st Diff.	*-2.217653*	*-3.5312*	*0.0334*
Ln total reserve	*Level*	-0.692473	-3.5279	*0.4932*
	1st Diff.	*-3.868129*	-3.5312	*0.0005*
Ln exchange rate	*Level*	-1.882969	-3.5279	*0.0680*
	1st Diff.	-4.300441	-3.5312	*0.0001*
Ln relative price	*Level*	*-1.838622*	*-3.5279*	*0.0745*
	1st Diff.	*-4.300977*	*-3.5312*	*0.0001*

Notes: Null hypothesis: The variable has a unit root.
Source: Student's Estimation using Eviews 4.0
When the p-value for all the variables is less than 5% so they are significant

Engel-Granger Cointegration Panel

I focus in this paper on testing two causal relationships expected by the economic theory[9]. Testing is done on the annually economic data of the Algerian economy. The prerequisite for cointegration is that series are non-stationary at level, and become stationary after d time difference. Unit root tests are be applied to test the stationarity of the series. To assert the cointegration among variables, there are two tests can be applied: Engle and Granger (1987) two-step test and Johansen and Juselius test[10]. (See Table 2, 3)

Table (02): Engel-Granger likelihood

Dependent Variable: LNIMPORT

Method: Least Squares

Date: 03/11/13 Time: 03:31

Sample: 1970 2010

Included observations: 41

LNIMPORT=C(1)+C(2)*LNGDP+C(3)*LNERATE+C(4)

*LNTOTALRESERVE+C(5)*LNRELATIVEPRICE

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	9.450151	1.090158	8.668605	0.0000

[9] Pa ichis, C. A. (1999).. "Price and Income Elasticities Disaggregated Import Demand: Results from UECMs and an Applica ion," Applied Economics Vol.31: 1061-1071.

[10] Johansen and Juselius 1990, Johansen 1995

C(2)	0.525506	0.065670	8.002265	0.0000
C(3)	-0.058180	0.062055	-0.937548	0.3547
C(4)	0.172535	0.032114	5.372520	0.0000
C(5)	-0.582187	0.029218	-19.92558	0.0000

R-squared	0.986103	Mean dependent var	20.27039
Adjusted R-squared	0.984558	S.D. dependent var	1.247355
S.E. of regression	0.155001	Akaike info criterion	-0.776915
Sum squared resid	0.864917	Schwarz criterion	-0.567942
Log likelihood	20.92675	Durbin-Watson stat	1.096224

Table (03): Engel-Granger/ ECM cointegration: Error correction model

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(ECM)[11]
Method: Least Squares
Date: 03/25/13 Time: 23:58
Sample(adjusted): 1972 2010
Included observations: 39 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
MODELECM(-1)	-0.877703	0.178564	-4.915345	0.0000
D(MODELECM(-1))	0.574066	0.166406	3.449797	0.0014
C	0.001843	0.019790	0.093153	0.9263

R-squared	0.411451	Mean dependent var	0.012458
Adjusted R-squared	0.378754	S.D. dependent var	0.155779
S.E. of regression	0.122783	Akaike info criterion	-1.282985
Sum squared resid	0.542728	Schwarz criterion	-1.155019
Log likelihood	28.01821	F-statistic	12.58368
Durbin-Watson stat	1.772317	Prob(F-statistic)	0.000072

Table (04): Engel-Granger Short run estimation:

DLNIMPORT=-0.318668777611*DLNRELATIVEPRICE+0.0511918650645*DLNTOTAL RESERVE-0.0538813856508*DLNERATE+0.521932495904*DLNGDP -0.0185490009932 - 0.516356036004* ECM (-1)

Table (05): ADF test for the ECM

ADF Test Statistic	-4.915345	1% Critical Value*	-3.6067
		5% Critical Value	-2.9378
		10% Critical Value	-2.6069

*MacKinnon critical values for rejection of hypothesis of a unit root.

From the table above, it`s very clear that ADF test for the residuals (ECM) is less than the MacKinnon critical values so that led us to reject the null hypothesis, which mean that our model has no unit roots, that mean that there is a cointegration relationship among the variables, which confirm that there is no spurious regression, or there is a long relationship among the Algerian import demand and its determinants

Table (06): The coefficient Wald test

Equation: Untitled

Null Hypothesis: C(1)=0
C(2)=0
C(3)=0
C(4)=0
C(5)=0

[11] D(ECM)=ECM-ECM(-1) : the first difference

	C(6)=0		
F-statistic	1.91E+29	Probability	0.000000
Chi-square	1.15E+30	Probability	0.000000

p-value are very significant (0.00) and less than 5%

Table(07): Normality , ARCH Test and Breuch-Godfrey, and White Heteroskedasticity Test

Normality			
F-statistic	0.042862	Probability	0.837121
Obs*R-squared	0.045126	Probability	0.831772

usch-Godfrey Serial Correlation LM Test:			
tatistic	2.857434	Probability	0.072144
s*R-squared	6.061128	Probability	0.048288
ite Heteroskedasticity Test:			
tatistic	0.762721	Probability	0.662129
s*R-squared	8.329557	Probability	0.596680

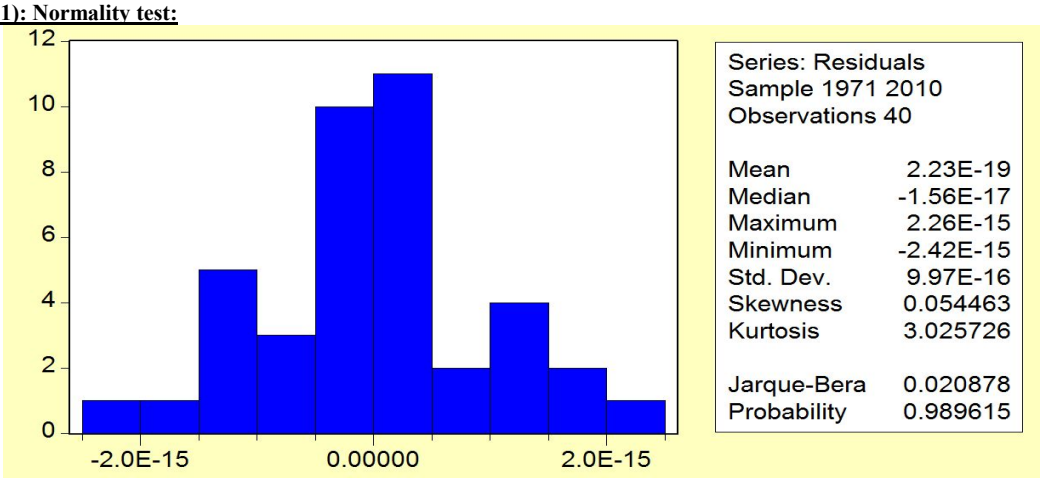
Table (08): Q-Test Correlogram of residuals

Included observations: 41

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. |*** |	. |*** |	1	0.335	0.335	4.9581	0.026
**| . |	***| . |	2	-0.214	-0.368	7.0220	0.030
**| . |	.*| . |	3	-0.271	-0.065	10.430	0.015
**| . |	**| . |	4	-0.280	-0.278	14.169	0.007
**| . |	.*| . |	5	-0.193	-0.125	15.995	0.007
. | . |	.*| . |	6	-0.034	-0.122	16.051	0.013
. |*. |	. | . |	7	0.098	-0.039	16.554	0.021
. |*. |	.*| . |	8	0.091	-0.111	16.993	0.030
. | . |	.*| . |	9	0.009	-0.105	16.997	0.049
. | . |	. | . |	10	0.063	0.047	17.221	0.070
. | . |	.*| . |	11	0.036	-0.074	17.297	0.099
**| . |	**| . |	12	-0.211	-0.284	20.015	0.067
**| . |	.*| . |	13	-0.199	-0.105	22.501	0.048
. |*. |	. | . |	14	0.069	0.008	22.809	0.063
. |*. |	. | . |	15	0.164	-0.049	24.642	0.055
. | . |	.*| . |	16	0.040	-0.182	24.753	0.074
. | . |	. | . |	17	0.036	-0.023	24.849	0.098
. |*. |	. | . |	18	0.096	0.025	25.549	0.111
. | . |	. | . |	19	0.046	0.034	25.720	0.138
. |*. |	. |** |	20	0.103	0.213	26.604	0.147

From the table above , it`s clear that all the point are included into the intervals so that confirm the cointegration relationship among the variables

Graph(1): Normality test:



Source: All the graphs and the tables are from the Eviews 4. Which the autor used during the modeling procedures.

CONCLUSION

Engle-Granger's type ECM was used to analyze the import demand function for Algeria It was found, in this model, that total reserves, exchange rate, import price and income (GDP) are all important in determining the aggregate import demand of Algeria.

The long and short run elasticities for the four determinants were also calculated as well as the coefficient of the disequilibrium error. More importantly, the empirical results of the estimated cointegration vector show that Algeria aggregate import demand tends to be income elastic (2.60); This result implies that demand for imports in Algeria increases more proportionately to an increase in the level of the country 's economic activity (GDP).

Moreover, the empirical results show that aggregate import demand tends to be elastic with respect to domestic prices while being inelastic with respect to import prices.

It is found that the domestic price[12], import price[13], and income are important in determining the import demand. The empirical results show that aggregate import tends to be income and price elastic.

The results have shown that, most of the variables in the model are statistically significant and consistent with the demand theory both in the long-run as well as in the short-run. However, some variables are found to be slightly inconsistent with the demand theory. In most instances there are explanations for this incidence.

From the above concluding remarks we can site some Economics evidence for the Algerian policy makers:

The government should realise effective macro-economic policies along with momentous improvements in the structure and functioning systems of governance for stabilising economic growth along with trade and financial liberalisation reforms.

Each case can have a different solution but good policies will help in all cases, a broad array of targeted policies, such as the creation of a well adapted export incentive structure, a reduction in trade-related costs, and proactive public export promotion institutions can help promote export diversifications14 which help the diversification of Algerian import.

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[13]See more: Engel, Charles, "Real Exchange Rates and Relative Prices: An Empirical Investigation," Journal of Monetary Economics, 1993, pp. 35—50.

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