EXPORTS AND IMPORTS IN QATAR: EVIDENCE FROM COINTEGRATION AND ERROR CORRECTION MODEL

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ABSTRACT

This paper investigates the existence of long-run relationship between exports and imports in Qatar's economy using Johansen cointegration approach. Qatar is a small open economy that depends on the outside world for exporting its oil, natural gas and its hydrocarbons and to import consumer and capital goods. Exports compose a major proportion of GDP. Annual data for the period from 1980-2011 were used. ADF and Phillip-Perron unit root tests were applied to time series data and variables were found to be integrated of order one. Exports and imports were found to be cointegrated and hence, a long-run relationship exists between exports and imports, and Qatar is not in violation of its international budget constraints. An error correction model was specified and imports were found to Granger cause exports in the long-run.

Keywords: Exports, Imports, Cointegration, Error correction model, Qatar.
JEL: C22, C32, F10, F32.

INTRODUCTION

The relationship between exports and imports has attracted the attention from both researchers and policy makers. The fact that exports and imports constitute a major part of balance of payment in a country, unsustainable trade deficit depicts a violation of international budget constraints over time. The existence of long-run relationship between exports and imports is desirable to nations and was the subject of intensive research in developed and developing economies. Qatar is a small open economy that depends to a great extent on the outside world. Most of government revenues come from exports revenues of oil and gas. Exports and imports compose a major proportion of GDP. Exports as a percentage of GDP ranged from 50% to 72% during the period of study. Imports ratio to GDP varied from 18% to 43% for the same period. Oil and Liquefied Natural Gas (LNG) exports are the backbone of Qatar total exports, and the country imports almost everything else from consumer products to capital goods needed to promote its exports sector. Export oriented

industrial strategy, where the production of competitive industrial domestic goods and services for export purposes are encouraged. Although Qatar is small in area and population, it has considerable international links. Qatar international status as an oil and LNG exporter and capital surplus nation has extended its presence in world trade and investment. Total trade to GDP constitutes 75%, which make the economy open and vulnerable to world market volatilities. Qatar's GDP relies heavily on Oil and in the last decade on Oil and Gas. GDP growth has averaged a high 11.8% per annum for the period from 1981-2011. This rate of growth is unmatched by any developing countries, and is due to heavy investment in hydrocarbon industries. LNG project is the largest in the world with an annual production of about 77 million tons. Major industries that depend on oil and gas for input and directed for exports were established. Petrochemical industries, fertilizers and aluminum are such industries. Exports grew on average of 12% per annum for the period of study, and imports scored 12.4% of growth a year on average for the last thirty years of Qatar's economy. Table (1) shows data on exports, imports and their rate of growth for selected years. Figure (1) depicts GDP, exports and imports for the period from 1980-2011.

Table-1. Exports, Imports and rate of Growth for Selected Years

| Year	Exports	X Growth	Imports	M Growth	Openness
1985	11277	-31.3%	4145	-2%	0.70
1990	14159	44.8%	6169	27.8%	0.75
1995	13289.6	13.6%	12368.7	76%	0.86
2000	42202	60%	11838	30%	0.835
2005	93773.9	37.8%	36621	67.5%	0.83
2010	262277	49%	84593	-6.7%	0.75

Values for exports and imports are in Millions of Qatari Riyals (QR). X Growth and M Growth are growth rate of exports and imports respectively, and Openness is total trade GDP ratio. Qatar Central Bank, Annual Reports, Various Issues.
Qatar Statistical Authority, www.qsa.org.qa.

This study aims at empirically investigate the presence of a long run relationship between exports and imports for Qatar economy using cointegration methodology. To the best of author's knowledge, there is no study in the empirical literature that examined the long-run relationship between exports and imports in Qatar. Previous studies of this topic on Organization of Islamic Countries (OIC) member states by (Tang and Mohammad, 2005) and that on countries of the Gulf Cooperation Council (GCC) by (Rammadhan and Naseeb, 2008) excluded Qatar for lack of appropriate data. Therefore, it is of importance to test this relationship in this point in time to fill the gap in the literature.

The paper is divided into five sections. Following this introduction, section two reviews the literature on imports and exports relationship. Section three proposes the methodology to be used in this study. Data and empirical results are in section four, and section five will conclude.

Figure-1. Ln (GDP), Ln (exports) and Ln (Imports).
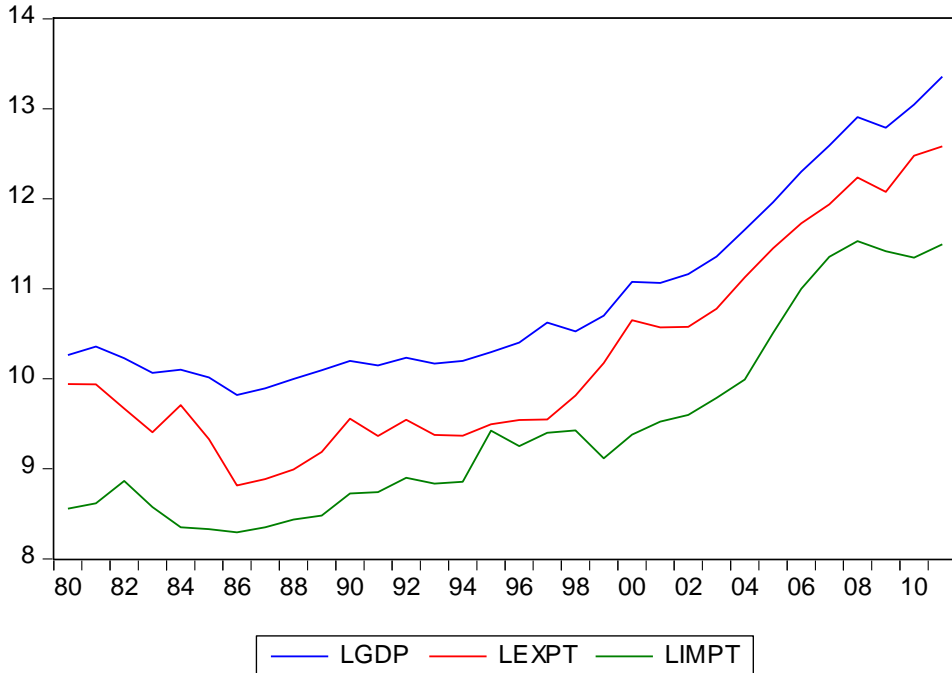
Theory and Literature Review

Husted (1992) proposed a simple theoretical model of intertemporal budget constraint where then he derived an empirically testable export model of the following representation:

$$X_t = \alpha_t + \beta M_t + \varepsilon_t \qquad (1)$$

Arize (2002) tested equation (1) alternatively as:

$$M_t = \alpha_t + \beta X_t + \varepsilon_t \qquad (2)$$

Where X_t and M_t are exports and imports respectively, and ε_t is error term. The presence of a long-run relationship between exports and imports, i.e. existence of cointegration, indicates that macroeconomic policies can be implemented in order to correct the trade imbalances (Tang and Mohammad, 2005). The relationship between exports and imports has been the subject of investigation in developed and developing economies. In a leading paper, Bahmani-Oskooee and Rhee (1997) investigated the long-run relationship between imports and exports for Korea. Quarterly data for the period from 1963-1991 were used and four different measures for each variable were employed. Nominal exports in both local currency and in U.S. dollar, and real values in both currencies were used. The same definitions of variable were applied to imports as well. All

measures of variables were found to be stationary at first difference. Johansen cointegration approach was performed and found for all pairs of variables. The study found that Korea is not in violation of its international budget constraint, and all Korea's macroeconomic policies are effective in bringing its imports and exports into a long-run equilibrium.

Rammadhan and Naseeb (2008) have studied the existence of long-run relationship between oil exports and imports in four Gulf Cooperation Council (GCC) countries. Those countries were Kuwait, Oman, Saudi Arabia and the United Arab Emirates (UAE). Qatar was excluded for the lack of data. Johansen method of cointegration was applied and found a strong evidence of long-run relationship between oil exports and imports in three members except Kuwait. The slope coefficients in the Johansen regression were close to unity in the case of Oman, Saudi Arabia and the UAE. This suggests that the long-run trade balance between oil exports and imports will be in equilibrium, and trade policies were effective in sustaining this log-run equilibrium. Tang and Mohammad (2005) examined whether a long-run relationship exist between imports and exports for 27 Organization of Islamic Conference (OIC) member countries. Qatar was also excluded for the lack of data. Annual data for real imports and exports levels rather than ratios were used, and Arize (2002) methodology was specified to detect the presence of long-run relationship. Engle-Granger's method of cointegration was performed on sample countries. Four countries were found to have long-run relationship between their imports and exports. Those were Benin, Burkina Faso, Cameroon and Guyana. A probable implication from the findings in these countries is that exchange rate and macroeconomic policies have a favorable outcome on trade balances in the long-run. Annan and Acquah (2011) examined the long-run relationship between exports and imports in Ghana for the period from 1948-2010. Engels-Granger's method of cointegration was used, and variables were found to be cointegrated. The paper adopted Husted (1992) and Arize (2002) models for testing the hypothesis. The study concluded that long-run relationship between nominal exports and imports in Ghana exist.

Hye and Siddiqui (2010) explored the link between exports earnings and imports expenditures for Pakistan using quarterly data for the period from 1985-2008. Variance decomposition method was applied to data and rolling window bound tests to check the stability of causal relationship. Husted (1992) theoretical model of imports and exports and Arize (2002) model were estimated using nominal values for exports and imports. Variables were found to be integrated once differenced using ADF unit root test. The variance decomposition results suggested that exports cause imports. The study also concluded that international budget constraint of Pakistan unsustainable; hence imports and exports are not cointegrated. In another study Hye et al. (2010) examined the link between agricultural raw material exports and agricultural raw material imports in Pakistan. Annual data were used for the period from 1971-2007. This study differs than previous one in that it tests the hypothesis in the sectoral level of GDP. The empirical results confirmed cointegration

between the agricultural raw material exports and imports. Also it was found that causality runs from agricultural raw material imports to agricultural raw material exports.

Uddin (2009) in a paper attempted at studying time series behavior of total exports and total imports in Bangladesh. Johansen cointegration method was applied to data, and revealed existence of long-run equilibrium relationship between the two variables. Long term causality was also investigated and found to be bidirectional between exports and imports in Bangladesh. Konya and Singh (2008) investigated the presence of equilibrium relationship between exports and imports in India using annual data for the period from 1949/50 – 2004/05. Exports and Imports variables were measured in current prices in both Indian Rupee and U.S. dollar currencies. Indian exports and imports were found to be integrated of order one. Johansen cointegration method was then performed on data, and failed to reject the no-cointegration hypothesis. The paper concluded that Indian exports and imports do not exhibit a cointegration relationship and therefore, India is in violation of its international budget constraint.

Tang (2005) in a commentary on Malaysian imports and exports argued that cointegration findings are not conclusive in the case of Malaysian economy. Using annual data for the period 1959-2000, he applied Johansen cointegration test and no cointegration was found. His findings were in contrast to studies on Malaysian economy conclusions, where long-run relationship between exports and imports are found. The commentary stressed the choice of lag length is crucial in applying Johansen cointegration. It is also argued that annual data of 31 to 42 observations are considered to be long enough to reflect the long-run relationship between imports and exports. Alias *et al.* (2009) investigated the relationship between exports and imports in Forestry domain for Malaysia. Annual data from 1961-2007 were used and Johansen cointegration method was applied on variables. The study found that exports and imports of Forestry domain are highly cointegrated. This shows that trade n Forestry is sustainable, which is a sign of good policy by authorities. Bidirectional Granger causality was found between exports and imports base on vector error correction model. Similar results were confirmed by Rahman (2011) in a study of the relationship between exports and imports of Indonesia and Malaysia. Annual data were used and variables were in real U.S. dollar. The study utilized Husted (1992) hypothesis for exports and imports, and applied Engle-Granger and Johansen cointegration approaches. Both tests of cointegration confirmed the existence of cointegration between exports and imports for Malaysia, but were not found in the case of Indonesia.

Jiranyakul (2012) examined the relationship between manufacturing exports and imports of capital good in Thailand using monthly data from January 2000 to July 2011. An autoregressive distributed lag (ARDL) bound was applied and variables were found to be cointegrated. Error correction model was specified in order to analyze short and long-run dynamics. The results support causality from imports to growth rate of manufacturing output. The policy implication is

that Thailand cannot reduce imports of capital goods for its effect on reducing manufacturing output and exports will decrease. Erbaykal and Karaca (2008) studied whether trade deficit in Turkey is sustainable or not. The paper stares with examining the relationship between imports and exports. Quarterly data for the period from 1982-2005 were used. ADF unit root test was performed on both nominal and real values of variables. Exports and imports were found to be first difference stationary. Engle-Granger's cointegration test was performed and residuals of long-run relationship were found to be stationary, hence imports and exports are cointegrated, and long-run relationship between them exists.

Herzer and Nowak-Lehmann (2006) in a study of exports and imports of Chile, the long-run relationship was examined. Annual data for the period from 1960-2000 and real values for total exports and imports at local currency were used. Unit root tests were performed on variables, and were found to be stationary when differenced. Engle-Granger's method of cointegration used to test for cointegration, and variables were cointegrated. An error correction model was specified, and the error correction term was found to be negative and statistically significant. This implies that a long-run Granger causality exists from exports to imports in Chile.

METHODOLOGY

Most of time series data are non-stationary. Unit root tests are necessary to ensure that all variables included in model are stationary. A variable that is stationary in its level is said to be integrated of order zero $I(0)$. If a variable is not stationary in its level form but stationary in its first difference form, it is said to be integrated of order one or $I(1)$. One of the most popular tests of unit root is the Augmented Dickey Fuller (ADF) test. The test is based on estimating the following regression:

$$\Delta X_t = a_0 + a_1 t + a_2 X_{t-1} + \sum_{i=1}^{\rho} c_i \, \Delta X_{t-i} + \varepsilon_{it} \qquad (3)$$

Where X_t is the series being tested, a_0 is a constant, a_1 is the coefficient of time trend, ρ is the number of lagged differences included to capture any autocorrelation, and Δ is the first difference operator. The null hypothesis for unit root is H_0: $a_2=0$. This test will be applied to each of the variables to determine the stationarity property in their levels and in their first-difference. Another unit root test is the Phillip and Perron (1988) test. This test proposes an alternative nonparametric method to take care of serial correlation in error terms without adding lagged difference terms when testing for a unit root (Gujarati and Porter, 2009). Both tests of unit root will be applied in this study. Two or more series will be cointegrated if they have a long-run relationship between them. The economic interpretation of cointegration is if the series are linked to form of equilibrium relationship in the long-run, then the series will be cointegrated. Thus the concept of cointegration mimics the existence of a long-run equilibrium to which an economic system converges over time (Harris, 1995).

The Johansen method of cointegration is the more used for testing the existence of cointegration between variables. It is a full information maximum likelihood procedure and is modeled via vector autoregressive (VAR) framework:

$$\Delta Y_t = C + \sum_{i=1}^{k} \Gamma_i \, \Delta Y_{t-1} + \Pi Y_{t-1} + \eta_t \qquad (4)$$

Where, Y_t is a vector of non-stationary variables, Γ and Π are the coefficient matrices, k denotes the lag length and C is a constant. The information in the coefficient matrix between the levels of the Π is decomposed as $\Pi = \alpha\beta$ where the relevant elements α matrix are adjustment coefficients and the β matrix contains cointegrating vectors. This approach is capable of determining the number of cointegrating vectors for any given number of nonstationary series of the same order. It allows feedback effects among the variables under investigation. Theprocedure is based on likelihood ratio (LR) test to determine the number ofcointegrating vectors in the regression. Johansen technique enables to test for the existence of non-unique Cointegration relationships.Two tests statistics are suggested to determine the number of Cointegratingvectors based on likelihood ratio test (LR); the trace test and maximum eigenvalues testStatistics.

The trace test (λ_{trace})is defined as:

$$\lambda_{\text{trace}} = -T \sum_{i=r+1}^{n} \log(1 - \hat{\lambda}_i) \qquad (5)$$

Where T is the number of unusable observations, and $\hat{\lambda}$ is the estimated values of the eigenvalues and n is the number of separate series to be analyzed. The null hypothesis is that the number of Cointegration vectors is $\leq r$ where r = 0, 1, or 2 against the alternative hypothesis that the number of Cointegration vectors = r.

The maximum eigenvalues test (λ_{max})is defined as:

$$\lambda_{\text{max}} = -T \log(1 - \hat{\lambda}_{r+1}) \qquad (6)$$

Which test the null hypothesis that the number of Cointegrating vectors = r against the alternative that there are r+1 cointegrating vectors, the null hypothesis, r = 0 is testedagainst the alternative that r = 1, and r = 0 is tested against the alternative r = 2. Theλ_{max}test has the sharper alternative hypothesis. It is usually preferred for trying to get the number of cointegrating vectors (Enders, 2010).

It is critical part for applying the Johansen approach, the determination of the lag length for the VAR model. It is of importance to specify proper lag length in estimating cointegrated system. Enders (2010) points out that one could select lag length using multivariate generalization of the Akaike information criterion (AIC) or Schwarz criterion (SC).

If time-series included in the analysis are $I(1)$ and cointegrated, then according to Granger (1988) there must exist at least one way causation. This causation is represented by an error-correction model of the following form:

$$\Delta X_t = a_0 + \sum a_{1i} \Delta X_{t-j} + \sum a_{2i} \Delta Y_{t-j} - a_3 \, ECT_{t-1} + \theta_t \qquad (7)$$

$$\Delta Y_t = b_0 + \sum b_{1i} \Delta X_{t-j} + \sum b_{2i} \Delta Y_{t-j} - b_3 \, ECT_{t-1} + \tau_t \qquad (8)$$

Where ECT_{t-1} is the error-correction term lagged one period. The ΔX and ΔY are differenced time-series of X and Y respectively. θ_t and τ_t are white noise error terms. The independent variable is said to cause the dependent variable if the error term (ECT_{t-1}) is significant, or the coefficients of the lagged independent variable are jointly significant. Negative and statistically significant values of the coefficients of the error correction terms indicate the existence of long-run causality. Causality test should be based on equations (7) and (8) when series are found to be cointegrated.

Data and Empirical Results

Annual data for exports and imports for the period from 1980-2011 were obtained from Qatar Central Bank annual reports and from Qatar Statistics Authority (QSA) publications. GDP deflator was used to convert nominal variables into real variables. This was sourced from QSA. Thirty two observations are considered to be long enough to reflect the long-run relationship between exports and imports, and the use of annual data to estimate long-run parameters is preferred to the use of monthly and quarterly data (Tang, 2005; Tang and Mohammad, 2005).

The univariate characteristics of the variables exports and imports are tested. Both Augmented Dickey-Fuller (ADF) and Phillip-Perron (PP) unit root tests were applied, and results are shown in tables (2) and (3). Both tests of unit root show that real exports and real imports in Qatar are non-stationary at level and became stationary at first difference.

Table-2. Augmented Dickey-Fuller Unit Root Test Results

Variable	Constant	Constant and Trend	None
LRX	0.7599 (0)	-2.7785 (7)	1.7481 (0)
ΔLRX	-4.8121*** (0)	-4.015** (6)	-0.2673 (7)
LRM	-0.3682 (6)	-2.6509 (0)	1.8236 (0)
ΔLRM	-5.9457*** (0)	-5.8604*** (0)	-5.351*** (0)

** and *** are 5% and 1% level of significance respectively. LRX is log of real exports, LRM is log of real imports, and Δ is first difference operator. Numbers between parenthesis are lag length using Schwarz Info criterion automatic maximum lag=7.

Table-3. Phillip-Perron Unit Root Test Results

Variable	Constant	Constant and Trend	None
LRX	0.7176 (2)	-3.0576 (7)	1.7481 (0)
ΔLRX	-4.8121*** (0)	-5.8362*** (7)	-4.4633*** (2)

LRM	-0.2114 (2)	-2.6259 (2)	2.1715 (2)
ΔLRM	-5.9466*** (1)	-5.8604*** (0)	-5.3638*** (3)

** and *** are 5% and 1% level of significance respectively. LRX is log of real exports, LRM is log of real imports, and Δ is first difference operator. Numbers between parentheses are Band width (Newey-West Automatic) using Bartlett Karnel.

To check for cointegration between exports and imports, Johansen method of cointegration was applied. This procedure requires the selection of appropriate lag length of VAR system. Allowing for a maximum lag length of four years, the lag length is selected by minimizing both Akaike information criterion (AIC) and Schwarz information criterion (SC). The lag length of one is chosen by criteria selected. Table (4) shows the results of different criterion of lag length order selection.

Table-4. VAR Lag Order Selection Criteria

Lags	LogL	LR	FPE	AIC	SC	HQ
0	-36.832	NA	0.0549	2.773	2.86	2.80
1	20.699	102.7	0.0012*	-1.049*	-0.764*	-0.96*
2	22.512	2.979	0.0014	-0.893	-0.417	-0.748
3	23.172	0.989	0.0018	-0.655	0.010	-0.451
4	26.455	4.455	0.0019	-0.603	0.252	-0.342

* indicates lag order selected by the criterion. LR: sequential modified LR test statistics, FPE: Final prediction error, AIC: Akaike information criterion, SC: Schwarz information criterion, and HQ: Hannan-Quinn information criterion.

The results of Johansen's cointegration test are presented in table (5). The results detect at least one cointegration relationship between exports and imports. Both trace statistics and maximum eigenvalues are significant at 10% significance level. This means that exports and imports in Qatar share stable long-run relationship, and Qatar is not in violation of its international budget constraints and macroeconomic policies have been effective in bringing exports and imports into a long-run equilibrium.

Table-5. Johansen Cointegration Tests: Real Exports and Real Imports

H_0	H_1	Test Statistics	0.10 critical value	Prob[a]
Trace Statistics				
r=0	r=1	13.8006*	13.4287	0.088
r=1	r=2	0.8207	2.70554	0.364

Maximum Eigenvalue Statistics				
r=0	r>0	12.9798*	12.2965	0.079
r≤0	r>0	0.8207	2.70554	0.364

* Denotes rejection of the null hypothesis at 0.10 level.

[a] (MacKinnon et al., 1999) p-values.

Since exports and imports are integrated of the same order and are cointegrated, we proceed to investigate the causality between these two variables. Equations (7) and (8) were specified, and the causality results are presented in table (6). It was found that there exists a long-run unidirectional causality from imports to exports in Qatar economy. The coefficient of error-correction term was found to be negative and significant when exports are the dependent variable. Short-run causality represented by coefficients of lagged independent variable was found to be insignificant, and hence no short-run causality was found. The significant error-correction term indicates that about 29% of disequilibrium is corrected each year by the changes in imports to bring long-run equilibrium between exports and imports.

Table-6. Results of Error Correction Model/Causality

Dependent Var.	Causal Var.	R^2	Error Correction Term
ΔLRX	ΔLRM	0.33	-0.290*** (-3.561)
ΔLRM	ΔLRX	0.08	0.102 (0.994)

*** indicate significant at 1%, number between parenthesis are t-stat, and lag length is 1.

CONCLUSION

The long-run relationship between exports and imports has been the subject of intensive research in developed and developing economies. This relationship is of significant importance due to the fact that it reflects the stability of foreign trade situation of a country. The main objective of this paper is to study and investigate the long-run relationship between exports and imports in Qatar's economy. A time series methodology of unit root tests, Johansen cointegration and error-correction mechanism were applied. Annual data for real exports and real imports for the period from 1980 – 2011 were used.The results of ADF and PP unit root tests suggest that the two variables exports and imports are integrated of order one i.e. $I(1)$. The evidence from Johansen cointegration test, that there is a long-run cointegrating relationship between exports and imports in Qatar. The causal relationship between the two variables was investigated by specifying error-correction model. The result found a long-run unidirectional causality from imports to exports.

The study confirms that Qatar is not in violation of its international budget constraints, and macroeconomic policies have been effective in bringing exports and imports into a long-run equilibrium.

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