The Twin Deficits Phenomenon in Petroleum Economy:

Evidence from Saudi Arabia

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I - Introduction:

The main purpose of this paper is to analyze the relationship between the budget and trade deficits in an open petroleum economy. The economy of The Kingdom of Saudi Arabia is taken as an example. National accounts annual data are used to explore the relationship between the two mentioned deficits. The data cover the period from 1970 to 1999. This study tries to test the Ricardian equivalence and the Keynesian proposition. The Ricardian equivalence argues that the budget and trade deficits are not correlated, whereas the Keynesian proposition confirms the existence of a positive relationship between the two deficits. Also, the later mentioned proposition notes the direction of the causality: budget deficit causes trade deficit.

In economic literature, many researches focused on the relationship between trade deficit and budget deficit. The recent empirical investigations provide mixed results. Evans (1988), Miller and Russek (1989), Dewald and Ulan (1990), Enders and Lee (1990) and Kim (1995) support the Ricardian equivalence that budget and trade deficits are not correlated. On the other hand, Darrat (1988), Abell (1990), Zietz and Pemberton (1990), Bauchman (1992), Rosensweing and Tallman (1993), Bahmani-Oskooee (1992,1995), Vamvoukas (1999) argue in favor of the Keyensian proposition (the conventional view) that these deficits are closely linked and the budget deficit causes the trade deficit.

This paper, unlike all other studies, is based on two principles. First, it investigates the relationship between the two deficits on petroleum economy where exports, government revenue, and income are closely linked with oil revenue. Second, this paper tries to prove that even in petroleum economy, the Keynesian proposition is still partially valid. Budget deficit and trade deficit are linked, but the direction of the causality is reversed, because of the important role of the oil revenue in this economy, the trade deficit causes the budget deficit.

The relationship between budget and trade deficits will be analyzed in the short and the long run by using three complementary approaches: the Error Correction Model, the Johansen Cointegration and the Granger bivarite causality.

This research will be presented in five sections. Section II deals with the theoretical basis of the twin deficit phenomenon. Section III discusses the econometric methodology. Section IV provides the estimated results. Section V is reserved to the summary and concluding remarks.

II: Theoretical basis of the Twin Deficit Phenomenon:

The national account identity presents the theoretical basis of the relationship between budget deficit and trade deficit. From the national income accounts:

$$GDP = C + I + G + X - M = C + S + T \qquad \{1\}$$

From this identity, we can conclude the accounting principle that leakages must equal injections, and determine the conditions that would make these deficits related.

$$S + T + M = I + G + X \qquad \{2\}$$

Where C is consumption, G is government spending, S is saving, T is taxes, X is exports of goods and services, and M is imports of goods and services. The twin deficits are referred to by deficit in the budget (T-G) and the trade deficit by (X-M). To see the relation, from the income accounting identity, we get:

$$(X - M) = (T - G) + (S - I) \qquad \{3\}$$

Or:

$$TD = BD + SD \qquad \{4\}$$

Where: TD is the trade deficit representing the difference between exports and imports of goods and services. BD is the budget deficit representing the difference between public revenues and public spendings. The SD is the saving deficit, symbolizes the difference between private saving and private investment.

The relation (3) is derived from an accounting identity. This relation is equality between two sides. The left side is the foreign deficit. The right side is composed from two deficits, the budget deficit and the private saving deficit. There is no reason to assume, a priori, that any deficit is an explanatory variable of other deficits. Because of the equality between the two sides of the equation, it is not useful to explain any deficit by the others two deficits. Usually, a dual analysis of these deficits is explored. The most important of them is the analysis of the relationship between the current trade deficit and the budget deficit, named as the twin deficits.

In the economic literature, two approaches are known to explore the relationship between current trade deficit and budget deficit, the Ricardian

Equivalence and the Keynesian conventional proposition, which are explained briefly below.

A - The Ricardian equivalence:

The Ricardian equivalence claims the absence of any relationship between the current trade deficit and the budget deficit. This approach reveals that the budget deficit is a result of a tax cut which will have no effect on the national savings. Tax cut reduces public revenues and public savings. The decrease of the public savings enlarges the budget deficit. But, the decrease of the public savings will be matched by an equal increase in the private savings. So, the domestic savings will not be affected. That is because people will rationally presume that decreased tax (the budget deficit) will have to be paid for in the future. So, they will increase savings to pay for future increased burden. People know that taxes will go again to pay for the budget deficit so they save the extra money and they use it to pay for the future tax increases. The tax has simply been delayed, not actually taken away. If this were perfectly true, then the budget deficit would have no impact on anything because it would not change national savings. The Ricardian equivalence reveals that the tax cut is a temporary procedure. The decrease of the public savings will be compensated for by an equal increase of private savings. The national savings will not be affected. Therefore, the budget deficit has no effect on the current trade deficit.

B -The Keynesian proposition:

The strongest argument against the Ricardian equivalence is the Keynesian proposition. This proposition argues that there is a positive relationship between trade and budget deficits. The twin deficits hypothesis states that a budget deficit will lead to a current account deficit. And obviously a budget surplus will improve the current account deficit. If the budget is in deficit then the government is a net borrower. Total national savings are equal to the private plus the public savings. If the public is negatively saving, then the national savings will decrease. With a lower level of national savings, the interest rates should increase, which will lead to an increase in the exchange rate. An increasing exchange rate will make exports less attractive, and increase the attractiveness of imports, subsequently worsening the trade balance which is the major factor in the current deficit account variability. So, the budget deficit leads to increase in the trade and the current accounts deficits. The Keynesian proposition can be summarized in two principles: First, a positive relationship between trade defict (TD) and budget deficits (BD). Second, the direction of the causality

is from budget deficit to trade deficit. More specifically, we can write the Keynesian proposition as: $TD = f(BD)$.

The following additional explanations can be advanced to assert the relationship between budget and trade deficits:

1 – Some economists argue that the budget deficit results from the increase in public spending. As public consumption is an element of the effective demand, the increase of public consumption will increase the domestic income by the multiplier effect. When domestic income increases, imports of goods and services will increase, and the trade deficit will also increase.

2 - The linkage between the budget and the trade deficits is an automatic result of the National Account identity. In equilibrium:

$$(S - I) = (G - T) + (X - M) \qquad \{5\}$$

A decrease in public savings (results from a tax cut or an increase in public spending) implies a decline in national savings. The decrease of the national saving leads to a disequilibrium between saving and investment $(S \neq I)$. This disequilibrium implies that: $if: S < I \Rightarrow (G > T) \Rightarrow (X < M)$. So, the budget deficit results from the decline in savings capacity to finance domestic investment. The savings deficit can be offset by foreign direct investment. The inflow of the FDI will increase the external debt. So, the budget deficit is correlated with the current accounts deficit via the increase in the external debt.

3 – The increase in public expenditure or the decrease in its tax revenue results increase in budget deficit. This budget deficit implies a decline in local savings due to the decline in public savings, because local savings equal the total public and private savings. Some economists argue that the budget deficit will be followed by a surplus in the balance of capital accounts instead of a deficit in the balance of the current accounts. This surplus will result from the increase in the flow of foreign investments due to the increase in local interest rates to restore the equilibrium between investment and savings. That will give rise to the surplus in the capital accounts, because its balance is the opposite of the current accounts balance.

C -Criticism of the twin deficits hypothesis:

1 -During the Ronald Regan administration of the USA, and specifically in 1981, the United States suffered from huge budget deficit and current account deficit. The most important reasons of these two deficits are the

huge military expenditures, the increasing interest rates and the decline in the savings rates compared to other industrial countries. The liberals claimed that the budget deficit due to the decrease in the income tax policy resulted in huge deficit in the balance of payments. That means the United States debts to the rest of the world increased, which led to a decline in the living standards of the Americans (Barlett,1999).

For a period of time, it appeared that data had supported the twin deficit hypothesis:

- During 1980-1989 budget deficits coexisted with the current account deficits, which led to huge flows of financial transfers and foreign direct investment into the United States.
- From 1990, the current account and the federal budget followed two opposite directions: The federal budget showed huge surplus whereas the current account deficit registered a very high index.
- In 1998, the federal budget showed a surplus of $ 450 billions whereas the current account showed a deficit of $ 300 billions. Budget surplus continued with the growth of the American economy whereas the deficit of the balance of payment also continued. Thus, the budget and the current account went in opposite directions. (Nigel Morgan, 1999).

2 – Although, the twin deficit hypothesis theoretically sounds, there are big doubt about its applicability in real world. Some economists showed the lack of a systematic relation between the budget deficit and the interest rate on the one hand, and between the budget and the current account deficits, on the other hand. In Norway, for example, a big deficit in the current account coexists with equilibrium in the current account. In the United States, the surplus in federal budget during the sixties of the past century coexisted with the deficit in the current account. (Jackson1996).

Applying the twin deficit hypothesis in the seven big industrial countries using data for the period 1972-1990, Polzo (1992) explained that the results of testing this hypothesis varied considerably among those countries.

3 – Others indicated that the relationship between the budget and the current account deficits was analyzed by an unacceptable manner due to the lack of precise definition for the components of each of these two deficits. The increase in government expenditure leads to a budget deficit, but its impacts on the performance of the economy differs according to whether it is current or investment. Additionally, the increase in imports results in an increase in the current account deficit, but the impacts of the increase in

imports on the performance of the economy differs depending upon if its spent in consumers or investment goods. That is why removing the investment expenditures from the budget deficit and removing capital goods imports from the current account deficit will reduce each of the two deficits and will change the nature of the relationship between them. (Hummel, 1997).

4 – The twin deficit hypothesis neglects two important variables; the money supply and the price level. Under the hypothesis of constant money supply, the equilibrium condition (S=I) will be released and local savings will equal local investment. But, due to the expansion of the financial system in creating credit and its increase for the money supply, investment level will increase over the ability to save (S<I). The expansion in the money supply will lead to an increase in nominal incomes which will increase demand for exports, thus increasing the deficit in the current account. It will also lead to an increase in the general prices level (inflation), consequently it will lead to an increase in export prices and a decline in imports prices. In its turn, which will increase imports and reduce exports thus increasing the balance of payment and the current accounts deficits. (Jackson, 1999).

5 – Many economists got concerned with the twin deficit hypothesis because they believed that the public budget surplus would reduce the trade deficit. This means that the independent and effective variable is the budget deficit whereas the trade deficit is a dependant and ineffective variable. The equilibrium relationships are:

$$(S-I)=(G-T)+(X-M)$$
$$(X-M)=(T-G)+(I-S) \qquad \{6\}$$
$$TD = BD + (I-S)$$

Assuming the government does not need to borrow and its budget is balanced (BD=0). The trade deficit will decline by reducing investment, and increasing savings or both. However, this conclusion is incorrect, because investment is one of the determinants of economic growth, income level and imports.

6 –Some economists used the twin deficit hypothesis to confirm the existence of a direct relationship between the budget and the current account deficits. Some American economists are trying to get rid of the current accounts deficit by reducing the budget deficit. But, other economists believed that the current accounts deficit per say does not cause a problem.

The current accounts deficit continued in the United States since almost 100 years, and the Americans borrowed from the rest of the world to import capital goods. The borrowing for investment helped to establish the strongest economy of the world without using its private savings. That is why we have to differentiate between the reasons of the current accounts deficit and whether it results from the money supply expansion policy or from importing capital goods. If the current accounts deficit was due to the expansion of money supply policy we can use the twin deficit hypothesis to reduce the budget deficit in order to reduce the current account deficit. If the current account deficit is due to importing capital goods it will not hurt to leave this deficit as it is (Davidson, 1996).

7 – Normandin (1994) evaluated the causality relationship between budget and current accounts deficits using Blanchard ‘s Overlapping Generations Model. This model analyzes the overlapping between the twin deficit and the Ricardian equivalence. This model requires consumers expectations about the future budget deficit when they consider the development in the budget and the current accounts deficit. This requirement for the derivation of constrains that can be tested for consumers planning horizons. For reasonable horizons the response of the current accounts deficit for an increase in the budget deficit was tested. It was found that the consumer time horizon is 83 years in the United States and Canada. Considering stability and continuity of the budget deficit, this horizon results in statistically significant responses. In spite of the importance of this study, to compromise between the twin deficit hypothesis and the Ricaridian equivalence, the length of the time horizon which was estimated at 83 years, reduces the importance of estimated results. That is because, this time horizon approaches the life expectancy at birth in most developed countries, and exceeds the period of the consumer looks at his time horizon which is basically related to his productive age.

D -The Budget and Trade Deficits in an Oil Economy:

The Keynesian approach which implies the existence of a direct relationship from the budget deficit towards the trade deficit may not be applicable to oil based economy. The basic source of income in an oil based economy is revenues of oil export. These revenues affect the government revenue (T) and the exports of goods and services (X). Considering the important role of the oil revenues of the components of the trade balance accounts and the public budget, it is possible to expect a relationship

between their deficits different than their relationship in non oil economy. And it is possible to expect a positive relationship between the budget and the trade deficit. It is expected also, that the trade deficit causes the budget deficit.

The increase in oil exports (X) increase the surplus (or reduces the deficit) in the trade balance (X-M). However, oil exports are the most important component of the government revenue (T). That is why increasing exports will increase the government revenue, and consequently it will increase the surplus (or reduce the deficit) in the government budget (T-G), assuming constant imports (M) and government expenditure (G). Assuming (X=T), the relationship between trade balance account and budget deficits will be a relationship between government expenditure and imports, which is be beyond the scope of this study.

Being able to finance its budget from oil revenues, Saudi Arabia dose not need to collect taxes from the public as it is the usual case in non oil economies. That is why the Keynesian approach which depends upon the tax cut mechanism does not apply in the case understudy. The closest variable to tax in the Saudi economy is Alzakat which is based upon a fixed rate, the policy maker can not play with to use it as an economic policy instrument. Also, Alzakat collection is not meant to finance the government budget and it is only for income distribution. So, it is not a proxy for tax.

Even though, the tax cut affects public and private savings in any market economy, in the case under consideration mainly the oil revenue affects savings. That is why interest rate which is very nominal and almost fixed in the Saudi economy, will not increase when public and domestic savings decrease due to the tax cut, and the exchange rate, in its turn, will not be affected. Consequently, the inflow of foreign investment will not increase to restore the equilibrium of savings and investment.

Under all these circumstances, government expenditure becomes the main mechanism as policy instrument in the Saudi economy. Oil exports determine the ability of the government to spend. Public expenditure plays the major role in the economy for both production and income distribution. Government expenditure cut is very limited because of the size of the government and at the same time, it can not be increased by the policy decision-maker because it is determined outside of this economy. It depends mainly upon the international energy market forces.

In a petroleum economy, like the Saudi case, the linkage between trade account balance and budget deficit may differ notably from the relationship among current account balance and budget deficit. Even though, the trade balance is an important component of the current account balance, the two accounts will have different balances. Due to the huge volume of the foreign labor force in the Saudi economy, the transfer of its wages to the rest of the world affects considerably the current account balance. For this reason our econometric investigations are based on the trade balance resulting directly from the national account identity (relation 1). Note that the correlation coefficient between the trade balance deficit and the current account deficit in Saudi economy is about 0.7 only.

III: Econometric methodology

Based upon the above discussion we will study the relationship between the deficits (trade and budget deficits) under consideration using the following variables:

TD = trade deficit which is defined as the difference between exports (X) and imports (M) of goods and services.

BD = budget deficit which is defined as the difference between government revenues (T) and government expenditures (G).

t =time.

In the statistical analysis of the models, all variable components (T,G,X,M) will be in logarithmic forms.

In our research, we used the modern econometric approach for analyzing the time series relationships. First, we tested the stationarity of the variables by using ADF test. Second, we tested the cointegration of the variables by using Engle-Granger two step approach of the error correction model. Third, we tested the Johansen cointegration model. Forth, we tested the Granger causality direction.

A- Unit Roots testing:

Based on Wold's theorem, a stationary time series with no deterministic components has an infinite moving average representation (ARMA) that can be approximated by a finite process. A priori, many economic time series will be non-stationary integrated processes. Thus, if a non-stationary time series (X) needs to be differenced (d) times until reaching stationarity, then the time series is said to be integrated of order (d), denoted by $X_t \sim I(d)$.

For a pair of series, X_t and Y_t, which are both integrated of the same order (d) or $I(d)$, any linear combination of the form $Z_t = Y_t - aX_t$, will be integrated of order (d), where α is a constant. If α fulfills the relation, $Z_t \sim I(d-b), b>0$, then X_t and Y_t are integrated.

According to Engle and Granger methodology, the first step is to examine whether the time series contained in the equation has a unit root. In the cointegration literature, the more frequently used tests for a unit root are the Dickey-Fuller (1979 and 1981), Philips-Perron (1988), and Perron (1986 and 1988) test. These tests agreed in their treatment to the intercept parameter μ. Thus, the null model to test for unit root has the following form:

$$X_t = \mu + \alpha X_{t-1} + \varepsilon_t \qquad \{7\}$$

and the model under the alternative hypothesis:

$$X_t = \mu + \theta(t - T/2) + \alpha X_{t-1} + \varepsilon_t \qquad \{8\}$$

Where X_t is the logarithm of the time series, and under the null hypothesis; $\alpha = 1$ and $\theta = 0$, and T represent the number of observations. In this paper, we use the Augmented Dickey-Fuller (ADF) to test for the stationarity of the time series.

The ADF test can be obtained by applying OLS to estimate the coefficients of the following relation:

$$\Delta X_t = \mu + \theta t + \gamma X_{t-1} + \sum_{i=1}^{n} \lambda_i \Delta X_{t-i} + u_t \qquad \{9\}$$

Where n is chosen to eliminate the autocorrelation. If a unit root exists, then $\gamma = \alpha - 1$ would not be statistically different from zero. The ADF test can be conducted by comparing the t-value on the coefficient of X_{t-1} by either the critical values presented by Fuller (1976) or by the extended tables of Dickey-Fuller that presented by Guilkey and Schmidt (1989) and denoted by τ_t.

B - Error Correction Mechanism:

The Granger representation indicates that if X_t and $Y_{t\ are}$ integrated, they will have an error correction representation as follow:

$$a(L)\Delta Y_t = \alpha_0 - \lambda(Y_t - \alpha_1 X_t) + b(L)\Delta X_t + c(L)\varepsilon_t \qquad \{10\}$$

Where a (L), b (L) and c (L) are stable and invertible polynomials, respectively. Such models provide a more attractive way of presenting and

modeling cointegrating series. The error correction models combine the long run $(Y_t - \alpha X_t)$ and the short run dynamics.

The second step of Engle and Granger methodology consists to estimate the following regression:

$$\Delta Y_t = a + \sum_{i=1}^{T} \alpha_i \Delta Y_{t-i} + \sum_{j}^{T} \beta_j \Delta X_{t-j} + bEC_{t-1} \qquad \{11\}$$

Where Δ denotes the first difference, and the EC represents the error term. The estimated error term coefficient must have statistically significant negative sign. This coefficient indicates the percentage of the desequilibrium in the dependent variable that would be adjusted from period to another.

C- Johansen Method for Cointegration

It is widely recognizable that Engle and Granger test for cointegration would be enough if we want to examine the effect of error correction mechanism on the dependent variable for two sequences periods such as t and t-1. However, since our concern is concentrated on the whole structure of the twin deficit function, it is more useful to apply Johansen multivariate cointegration analysis.

The Maximum Likelihood procedure (Johansen's test), suggested by Johansen (1988 and 1991) and Johansen and Juselius (1990), is particularly preferable when the number of variables in the study exceeds two variables due to the possibility of existence of multiple cointegtating vectors. The advantage of Johansen's test is not only limited to multivariate case, but it is also preferable than Engle-Granger approach even with a two-variable-model (Gonzalo, 1990).

To determine the number of cointegrating vectors, Johansen (1988 and 1991) and Johansen and Juselius (1990) suggested two statistic tests. The first one is the trace test (λ_{trace}). It tests the null hypothesis, says that the number of distinct cointegrating vectors is less than or equal to (q), against a general unrestricted alternative (q = r). This test is calculated as follow:

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{p} ln(1-\hat{\lambda}_i) \qquad \{12\}$$

Where $\lambda_{r+1},.....,\lambda_n$ are the smallest value eigenvectors (p-r). The null hypothesis stated that the number of cointegrating vectors equals at most to (r). In other words, the number of cointegrating vectors equals or less than (r) (where r=0,1,2, in our study). The second statistical test is the maximal eigenvalue test $(\lambda_{\max})$ that is calculated according the following formula:

$$\lambda_{max}(r,r+1) = -T\, ln(1-\hat{\lambda}_{r+1}) \qquad \{13\}$$

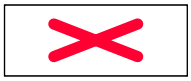
This test concerns a test of the null hypothesis that there is (r) of cointegrating vectors against the alternative that (r+1) cointegrating vectors.

D - Granger Causality Testing

In the case of time series data, tests of the direction of causality are available. Granger (1969) has argued that the ability of a variable X to improve the predication of a variable Y is an operationally meaningful interpretation of the statement that X causes Y. Following Granger (1969), a variable X is said to cause another variable Y, with respect to a given

information set that includes X and Y, if current Y can be predicted better by using past values of X than by not doing so, given that all other past information in the information set is used. Formally, let $A_t, t = ...,-1,0,1,2,....,$ be the given information set, A_t includes at least (X_t, Y_t), the bivariate process of interest. Let $\overline{A}_t = \{A_s, s < t\}$. Define $\overline{X}_t and \overline{Y}_t$ similarly. Then X causes Y if:

$$\sigma^2(Y_t|\overline{A}_t) < \sigma^2(Y_t|\overline{A}_t - \overline{X}_t) \qquad \{14\}$$



Where $\sigma^2(Y_t|Z)$ denotes the variance of the minimum variance unbiased predictor of Y given information set Z.

In what follows, the usual assumption that $A = \{(X, Y)\}$ is made. X and Y are presumed to be a pair of linear covariance-stationary, time series. Thus X and Y can be written as:

$$X_t = \sum_{i=1}^{m} a_i X_{t-i} + \sum_{j=1}^{n} b_j Y_{t-j} + U_t$$

$$Y_t = \sum_{i=1}^{r} c_i Y_{t-i} + \sum_{j=1}^{s} d_j X_{t-j} + V_t \qquad \{15\}$$

Where $(U_t, V_t)'$ is a serially independent random vector with mean zero and finite covariance matrix. The causality test to be performed can be stated simply.

(a) X causes Y if $H_0 : d_j = 0, j = 1,..., s$ can be rejected.

(b) Y causes X if $H_0 : b_j = 0, j = 1,..., n$ can be rejected.

Feedback is said to occur if both (a) and (b) hold.

These causality tests have certain advantages over the simple contemporaneous correlation-based tests that are usually employed to investigate the twin deficit hypothesis. There are other methods of testing causality, as in Sims (1972) and in Pierce and Haugh (1977). The original causality test is chosen here because its straightforwardness and because it saves degree of freedom. Since the number of observation is limited, the later is an important consideration in this study (Jung and Marshall, 1985).

IV. Estimated results:

If (TD_t) and (BD_t) are considered to be stochastic trends and if they follow a common long-run equilibrium relationship, then (TD_t) and (BD_t) should be cointegrated. Cointegration tests the long-run equilibrium relationship between non-stationary time series integrated of the same order. According to Engle and Granger (1987), cointegrated time series must have an Error Correction Model (ECM) representation. The cointegration analysis permits to test and estimate short and long run relationship between variables. Furthermore, the ECM approach helps to solve the spurious correlation problem among economic variables. Johansen cointegration approach allows testing and estimating the long-run relationship among budget deficit and trade deficit, and Granger causality helps to test the existence of causality and determine its direction.

A: Testing For Unit Roots:

Table (1) shows the t values on the level obtained from ADF tests. These values are clearly less than the critical values and therefore the null hypothesis of a unit root cannot be rejected for each series at the 1 percent significant level. Thus, budget deficit and trade balance deficit are non stationary time series.

Table (1)
ADF Unit Roots tests

Variables	Specifications	Lags	Levels	First Differences
BD	No intercept No trend	0	-1.683	-4.737
		1	-1.075	-4.673
		2	-2.277	-4.588
		3	-2.014	-4.603
	With intercept No trend	0	-1.967	-4.147
		1	-1.993	-4.110
		2	-2.716	-4.065
		3	-2.236	-5.074
	With intercept and trend	0	-1.737	-3.833
		1	-1.802	-3.954
		2	-2.317	-4.120
		3	-2.020	-6.673
TD	No intercept No trend	0	-1.532	-3.773
		1	-1.476	-3.739
		2	-1.222	-3.786
		3	-1.151	-3.795

	With intercept No trend	0 1 2 3	-1.830 -1.987 -1.823 -1.745	-3.553 -3.556 -3.771 -3.845
	With intercept and trend	0 1 2 3	-1.968 -2.008 -1.489 -1.434	-3.918 -4.114 -5.365 -4.302

Critical values at 5 % level of significance, for T=30: with intercept and trend -3.573, with intercept-2.966, no trend or intercept –1.953. (Davidson and Mackinonon, 1992)

Also, table (1) shows the calculated t values of the first differences. These results prove that the hypothesis of unit root can be rejected, or to say that the variables in their first difference are stationary time series. So the variables of the equilibrium twin deficit relationship are cointegrated of order one, I (1). Taking the AIC as criterion to select the number of lags, we get the results summarized in table (2):

Table (2): Unit Root tests, 1970-1999

Specifications	Variables	AIC criterion	
		Levels	First Difference
No intercept No trend	BD TD	-1682 (0) -1.830 (1)	-4.147* (2) -3.773* (2)
With intercept No trend	BD TD	-1.705 (0) -1.978 (1)	-4.673* (0) -4.114* (2)
With intercept and trend	BD TD	-2.271 (1) -1.434 (3)	-4.120* (2) -5.365* (2)

Significant at 1% significant level.
Number in parenthesis is lags order.

Finding that the two variables TD and BD have the same order of integratedness implies that these variables move together over time and hence there exists a long-run relationship known as the cointegrating regression. Therefore, it is essential to note, that the residuals of the cointegrating regression are stationary time series, i.e. I (0).

B: Error Correction Model:

Having obtained the above results of non-stationarty of the time series, we then test the error correction model between trade deficit and budget deficit. The error correction model allows testing the cointegration among the variable TD and BD. To reatch this purpose we apply Engle-Granger two-step method. In the first step, the cointegrating regression will be estimated. In the second step, the lagged error term is introduced in the error correction representation. So, the first step consists to run the following regression by applying OLS method:

$$BD_t = \alpha_0 + \alpha_1 TD_t + \varepsilon_t$$
$$TD_t = \beta_0 + \beta_1 BD_t + \mu_t \qquad \{16\}$$

The second step to estimate the ECM representation, will be as follow:

$$\Delta BD_t = \alpha_0 + \sum_{i=1} \alpha_{1i} \Delta TD_{t-i} + \sum_{j=1} \alpha_{2j} \Delta BD_{t-j} + \lambda e_{t-1}$$
$$\Delta TD_t = \beta_0 + \sum_{i=1} \beta_{1i} \Delta BD_{t-i} + \sum_{j=1} \beta_{2j} \Delta TD_{t-j} + \delta \mu_{t-1} \qquad \{17\}$$

The estimation of the cointegrating regressions (16) by OLS method, is presented in the table (3):

Table. (3): Cointegration Regression

	BD_t	TD_t
C	-0.33 (-8.14)	0.49 (11.33)
TD_t	0.66 (11.0)	
BD_t		1.23 (11.0)
R^2	0.81	0.81
DW	1.14	0.95
SE	0.172	0.235

Notes: numbers in brackets are t-ratios;
D-W is Durbin Watson statistic,
SE is the standard error of regression.

Testing the stationarity of the error terms in the cointegrating regression (16) reveals that the error terms are stationary i.e. I (0). The null hypothesis of unit root can be rejected at 1% level. This stationarity of the error terms is

a significant indication of the cointegratedness of the variables BD and TD of the twin deficit equations. The cointegrating regressions reveal a positive relationship between the budget deficit and the trade deficit. An increase in (X/M) by 1% will be matched by an increase in (T/G) by 0.66%. In other words, the long-run elasticity of BD with respect to TD equals to 0.66, and the elasticity of TD with respect to BD equals to 1.23.

The error correction models estimations are summarized in table (4). The lagged error term coefficient of (e_{t-1}) is statistically negative, but the coefficient of (μ_{t-1}) is negatively insignificant. These results provide an indication of the direction of causality between BD and TD. It seems that TD causes BD rather than TD causes BD.

Table. (4): Error Correction Model

	ΔBD_t	ΔTD_t
C	0.002 (0.073)	-0.040 (-1.098)
ΔBD_{t-1}		0.657 (3.295)
ΔBD_{t-2}	0.266 (1.788)	
ΔTD_{t-1}	0.401 (2.833)	
ΔTD_{t-3}	-0.255 (-1.67)	
ΔTD_{t-4}		-0.133 (-0.658)
e_{t-1}	-0.803 (-4.058)	
μ_{t-1}		-0.259 (-1.201)
R^2	0.674	0.428
DW	2.012	1.445
SE	0.153	0.179

Notes: numbers in brackets are t-ratios;
D-W is Durbin Watson statistic,
SE is the standard error of regression.

The coefficient of e_{t-1} is statistically significant. It has a negative sign and it is in accordance with the ECM implications. This coefficient expresses the speed of adjustment. The ECM estimation reveals that 80% of the desiquilibrium of the budget deficit would be adjusted every year by the trade deficit.

C: The Twin Deficit and Johansen Method for Cointegration:

The results of trace and maximal value tests summarized in table (5) indicate the possibility of rejecting the null hypothesis that says there is no cointegrating vectors at 5 percent significant level. This means that the whole structure of the twin deficit variables is cointegrated. In addition, it means that there is a stationary linear combination between the budget deficit and the trade deficit, despite that each variable is nonstationary. Finally, this result confirmed the existing of long-run equilibrium relationship between the two variables, which means that they do not diverge away from each other where it shows similar behavior.

Table (5) Cointegrating Test

Eigenvalue $\hat{\lambda}_i$	Maximal Value $\lambda_{\max} = -T\ln(1-\hat{\lambda}_{r+1})$	Trace $\lambda_{trace} = -T\sum_{i=r+1}^{p}\ln(1-\hat{\lambda}_i)$	Critical Value 5% for Maximal Value test	Critical Value 5% for Trace test	Null Hypothesis
0.677142	29.394	35.402	18.96	25.52	$r \le 0$
0.203256	5.908	5.908	12.25	12.25	$r \le 1$

Critical values are taken from Osterwald-Lenum (1992).

Since the calculated value of trace test (29.394) exceeds the critical value (25.52) at the 5 percent level of significance, it is possible to reject the null hypothesis that there is any cointegrating vector. Because the calculated value of trace test (5.91) is less than the critical value (12.25), likelihood ratio test indicates one cointegrating vector at 5% significance. The reported results of Johansen procedure shown in Table 6 can not reject the hypothesis that there is at most one cointegrating vector. The normalized cointegrating equation is summarized in table (6).

Table (6)
Normalized Cointegrating Vector

BD	TD	Trend	Constant	Log

				likelihood
1	-0.395 (0.044)	0.008 (0.002)	0.086	33.6

(Three lags are used in the VAR; values in parenthesis are standard errors)

Results in table (6) mean that the long run budget deficit elasticity with respect to trade deficit equals to 0.395, In the relation $\pi = \alpha\beta'$, the first term in α (0.975) represents the speed at which ΔBD_t, the dependent variable in the first equation of VECM, adjusts towards the single long-run cointegration relationship. So, we can conclude that the cointegration analysis confirms the existence of a long- run relationship between budget deficit and trade deficit in Saudi Arabia.

D: Granger Causality Testing

Johansen cointegration method confirms the existence of a long-run equilibrium relationship between budget deficit and trade deficit, but this method does not say which of the two deficits cause the other deficit. Granger causality test helps to determine the direction of causality between the two deficits.

By using the AIC criterion to choose the number of lags, we found the AIC is minimal when the number of lags equals three for both deficit variables. The estimated results of Granger causality test are presented in table (7).

Table (7): Granger Causality and Wald Test

	Coefficients	Dependent variables	
		BD_t	TD_t
constant		-0.315 (-2.278)	-0.224 (-1.717)
BD_{t-1}	a_1	0.353 (1.427)	-0.187 (-0.654)
BD_{t-2}	a_2	-0.159 (-0.614)	-0.207 (-0.691)
BD_{t-3}	a_3	-0.155 (-0.641)	-0.447 (-1.606)

TD_{t-1}	b_1	0.784 (3.606)	1.123 (4.468)
TD_{t-2}	b_2	-0.627 (-2.00)	-0.257 (-0.710)
TD_{t-3}	b_3	0.454 (1.685)	0.489 (1.571)
R^2		0.833	0.863
DW		2.09	2.166
SE		0.181	0.209
Wald test for causality		H0 : $b_i = 0$ F= 8.86 (0.001) χ^2 =17.72 (0.00)	H0 : $a_i = 0$ F= 1.69 (0.207) χ^2 =3.76 (0.184)

Notes: numbers in brackets are t-ratios;
D-W is Durbin Watson statistic,
SE is the standard error of regression.

Applying Wald test, the results of table (7) provide that the causality between budget deficit and trade deficit does exist. More important, the direction of the causation running from trade deficit to budget deficit cannot be rejected at 1% level of significance. These results coupled with the existence of a long-run relationship between budget deficit and trade deficit confirm that the budget deficit, in Saudi Arabia, over the period of estimation, was heavily dependent on trade deficit.

V - Summary and Concluding Remarks

This paper analyzes the relationship between budget deficit and trade deficit in petroleum economy, by taking the case of Saudi Arabia as an example. This research used annual time series data covering the period 1970-1999. We present the theoretical framework based on two hypotheses. The Ricardian equivalence neglects any relationship between the two deficits, and the Keynesian proposition confirms the existence of a positive relationship between them.

Because of the special characters of the petroleum economy, we tried to argue that any of the two hypotheses is not valid in this economy. The basic source of income, in oil based economy, is the oil export revenue. This revenue affects the government revenues and the exports of goods and services. Considering the important role of oil revenue of the components of the trade accounts and the public budget, we expected a positive relationship

among budget deficit and trade deficit, but the direction of the causality is reversed, trade deficit causes budget deficit.

To reach our purpose, the paper is based on budget deficit and trade deficit time series. The paper analyzes the stationarity, estimates the cointegrating regression and the error correction model representation, applies the Johansen cointegration method and tests the existence and the direction of causality. Our research revealing that the time series are integrated of order one, confirms the existence of a long-run equilibrium relationship between the deficits and affirms the direction of causality from trade deficit to budget deficit.

The economic implications of this paper are very important. If the government would like to reduce trade and budget deficits, the government must begin by reducing trade deficit. Since the trade deficit depends on oil prices, the government has to diversify the sources of the national income. When the oil revenues become less important in domestic income, the structural economic transformation may reverse the causality direction between the deficits, and the Keynesian proposition will be more valid.

References:

1 – Journals & Books:

Abell, J.D (1990):"Twin Deficits During the 1980's: An Empirical Investigation", Journal of Macroeconomics, 12, 81-96.

Bachman, D.D. (1992):"Why is the US Current Account Deficit so Large? Evidence From Vector Autoregressions, Southern Economic Journal, 59,232-40.

Bahmani-Oskooee, M. (1992):"What are the Long-Run Determinations of the US Trade Balance?", Journal of Post Keynesian Economics, 14,85-97.

Bahmani-Oskooee, M. (1995):"The Long-Run Determinations of the US Trade Balance Revisited?", Journal of Post Keynesian Economics, 17,457-65.

Banners A., Dolado, J., Galbraith, J., and Hendry, D (1993). " Cointegration Error-Correction, and Econometric Analysis of Non-Stationary Data," Oxford University Press.

Belker, R.A., (1992):" Beyond the Twin Deficit: A Trade Strategy For 1990's". Ed. M.E. Sharpe Inc.

Bhargava, A. S., (1986)"On the Theory of Testing for Unit Roots in Observed Time Series " Review of Economic Studies. 53,369-384.

Cheng B, (1998), "The Causality Between Budget Deficit and Interest Rates in Japan: An Application of Time Series Analysis", Applied Economics Letters, 5, 419-422.

Darrat, A.F. (1988): " Have Large Budget Deficits Caused Rising Trade Deficits?", Southern Economic Journal, 54, 879-87.

Dewald, W.G. and Ulan, M. (1990): "The Twin Deficit Illusion", Cato Journal, 10, 689-707.

Dickey, D. A., and Fuller, W. A., (1979) " Distribution of the Estimators for Autoregressive Time Series with a Unit Root". Journal of the American Statistical Association, 74, 427-431.

Dickey, D. A., and Fuller, W. A (1981) “Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root “ Econometrica, 49, 1057-1072.
Dickey, D. A., and Fuller, W. A (1979) “Autoregression Time Series with a Unit Root”, Journal of the American Statistical Association, 26, 427-431.
Dickey, D. A., and Rossana, R. J (1994).” Cointegrated Time Series: A Guide to Estimation and Hypothesis Testing”, Oxford Bulletin of Economics and Statistics, 56, (3), 25-353.
Enders, W. and Lee, B.S. (1990):” Current Account and Budget Deficits: Twins or Distant Cousins?”. The Review of Economics and Statistics. 72. 373-81.
Enders, W. (1995): “Applied Econometric Time Series”, Wiley and Sons, New York.
Engle, R.F and Granger, C.W.J.: (1987):” Cointegration and Error- Correction: Representation, Estimation and Testing”, Econometrica, 66, 251-76.
Engle, R, and Yoo, B.S., (1987) “Forecasting and Testing in Cointegrated Systems”, Journal of Econometrics, 35, 143-159.
Evans, P. (1988):” Do Budget Deficits Affect the Current Account”, Unpublished Paper. Ohio State University.
Ewing, B. (1998), The Impact of Federal Budget Deficits on Movements in the Stock Market: Evidence from Australia and France”, Applied Economics Letters, 5, 49-651.
Granger, C.W.J. (1986): “ Developments in the Study of Cointegrated Economic Variables”, Oxford Bulletin of Economics and Statistics, 48, 213-28.
Granger, C.W.J., (1988):” Some Recent Developments in a Concept of Causality”, Journal of Econometrics, 39, 199-211.
Granger, C.W.J., and Newbold, P. (1974)“ Spurious Regression in Econometrics” Journal of Econometrics, .2,111-120,
Gonzalo, C., (1994) “Five Alternative Methods of Estimating Long-Run Equilibrium Relationship”, Journal of Econometrics, 60, 203-233.
Griliches, Z., (1967):”Distributed Lags: A Survey”, Econometrica, .35. 16-49.
Hondoroyiannis G. and Papapetrou E., (1997) “ Are Budget Deficits Inflationary? A Cointegration Approach”, Applied Economics Letters, 4, 493-496.
Hsiao, C., (1979)“Causality Tests in Econometrics.” Journal of Economic Dynamics and Control, 321-239.
Hsiao, C. (1981) Autoregressive Modeling and Money-Income Causality Detection.” Journal of Monetary Economics, 7 .85-106.
Johansen, S., (1988):” Statistical Analysis of Cointegration Vectors”, Journal of Economics, Dynamics and Control. 12, 231-54.
Johansen, S. (1991):” Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models”, Econometrica. 59, 1551-80.
Johansen S., and Juselius, K. (1990), “ Maximum Likelihood Estimation and Interference on Cointegration with Application to the Demand for Money,” Oxford Bulletin of Economics and Statistics, Vol., 52, 169-210.
Jung W.S and Marshall P.J (1985).” Exports, Growth and Causality in Developing Countries”, Journal of Development Economics, 18, 1-12.
Kim.K.H. (1995):” On the Long-run Determinants of the US Trade Balance: A Comment”. Journal of Post Keynesian Economics. 17, 447-55.

Mackinnon. J. G (1991): “Critical Values for Cointegration Tests in Long-run Economic Relationships. In Engle, R.F. and Granger, C.W.J (eds.). Readings in Cointegration (Oxford University Press, Oxford).
Miller, S.M. and Russek, F.S. (1989): “Are the Twin Deficits Really elated?”. Contemporary Policy Issues. 7, 91-115.
Normandin M, (1994), “Budget Deficit Persistence and the Twin Deficits Hypothesis”. Center for Research on Economic Fluctuations and Employment”. Universite du Quebec, Montreal. Working Paper No. 31.
Osterwald-Lenum, M. (1992):” A note with Quantiles of the Asymptotic Distribution of The Maximum Likelihood Cointegration Rank Test Statistics”. Oxford Bulletin of Economics and Statistics, 54.461-72.
Payne, J.E., (1997) “ International Evidence on the Sustainability of Budget Deficits”, Applied Economics Letters, 4, 775-779.
Phillips, P.C. B., (1986) “Understanding Spurious Regression in Econometrics”, Journal Of Econometrics, 33, 311-340.
Pierce, D. and Laugh L., (1977), “Causality in Temporal Systems: Characterization and A Survey”, Journal of Econometrics, no. 3, 265- 293.
Rosenweing.J.A and Tallman, E.W (1993):” Fiscal Policy and Trade Adjustment: Are The Deficits Really Twins?” Economic Inquiry.31.580-94.
SAMA (1999): “Annual Report no 35”, Riyadh.
Seater, J.J (1993):’Ricardian Equivalence”, Journal of Economic Literature, 31. 142-190.
Sim, C., (1972), “Money Income and Causality”, American Economic Review, 62, 4, 540-552.
Toda, H.Y., and Phillips, P.C.B. (1991),”Vector Autoregression and Causality, Discussion Paper 977, Cowles Foundation, New Haven CT.
Vamvoukas. G.A (1997):”A Note on Budget Deficits and Interest Rates: Evidence from A Small-Open Economy”, Southern Economic Journal. 63.803-11.
Vamvoukas, G. (1999).”The Twin Deficits Phenomenon: Evidence from Greece”, Applied Economics, 31, 1093-1100.
Zietz, J. and Pemberton, D.K. (1990):” The US Budget and Trade Deficits: a Simultaneous Equation Model”. Southern Economic Journal. 57, 23- 34.

2 -World Wide Web/Internet

Barlett, B. (1999),“Current Account Deficit Unrelated to Budget Surplus”National Center for Policy Analysis. http://www.ncpa.org. /barlett.html

Catherine L. Mann, Senior Fellow Institute for International Economics.
Briefing for the Trade Deficit Review Commission. August 19, 1999.
Web site: http://www.iie.com/TESTMONY/currenta.htm

Davidson Kenneth. (1996).
Web Site: http://www.iinet.net.au/~tommy/wwwboard/wwwboard.html

Hayek (1996), “Paradox of Thrift/Twin Deficits”
Web site: http://www.geocities.com/libertarian_aust/honours.html

Heller, Robert H. (1987)
"Trim Twin Deficits, Hold Line on Prices", Federal Reserve Bank of Atlanta in its Journal Southeastern Economic Insight.

Hummel, William, F. (1997) "Twin Deficits".
Web Site: http://www.conentric.net/~wHummel/

Jackson, Gerard (1996):"The Deficits Bogey Returns',
Jackson, Gerard (1999), "Deficit Fallacies, Imports and Information Technology"
Web Site: http://www.iinet.net.au/~tommy/wwwboard/wwwboard.html

Morgan, Nigel, (1999):"Twin Deficits, What Twin Deficits?
Web Site: http://www.iinet.net.au/~tommy/wwwboard/wwwboard.html

Poloz, Stephan S. (1992), "Fiscal Policy and External Balance in the G-7 Countries", Technical Report No 60. http://www.bank-banque-canada.ca/english/intro-e.htm
Bank of Canada, Ottawa, Canada K1A 0G9.

Abstract

The Twin Deficits Phenomenon in Petroleum Economy: Evidence from Saudi Arabia

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This paper examines the relationship between budget and trade deficits in the Saudi economy. Annual data covering the period 1970-1999 are used. The paper discusses the theoretical basis of the twin deficit. The Ricardian equivalence argues the absence of any relationship between the deficits, while the Keynesian proposition affirms that budget deficit led to trade deficit.

Econometric investigations reveal that budget and trade deficits are cointegrated. The application of the ECM and the Johansen cointegration confirms a short and long run relationship among the deficits. But, Granger causality test asserts that trade deficit causes budget deficit. So, in oil economy, neither the Ricardian equivalence nor the Keynesian proposition is valid. The two deficits are positively linked, but the direction of causality is from trade deficit to budget deficit.