Article: An empirical analysis of the relationship between the budget deficit and the trade deficit.

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ABSTRACT

This paper is an attempt to find the statistical evidence of the **relationship** between the U.S. government's **budget deficit** and the **trade deficit** by applying the cointegration and the Granger causality tests. For this purpose, the **trade** data are collected from the U.S. Census Bureau, Foreign **Trade** Division. The data on the government **budget** deficits are from the Executive Office of the President, Fiscal Year, 2005. The data on **trade deficit** and **budget deficit** covers the period from 1960 through 2003. Applying Johansen's cointegration tests, we find long run equilibrium **relationship** between the **budget deficit** and the **trade deficit**. Granger causality tests show that there is a unidirectional causality between the **trade deficit** and the **budget deficit**. Contrary to the previous findings, our results show that the **trade deficit** "Granger Cause" the **budget deficit**.

Keywords: **Trade Deficit**, **Budget Deficit**, Cointegration Test, Granger Causality Test

1. INTRODUCTION

Since the mid-seventies the U.S. current account balance has consistently been in the negative territory. By the end of the year 2004, the **trade deficit** amounted to about 6 percent of GDP and the net international investment position was about 25 percent of the GDP. At the end of December 2004, U.S. exports had risen by 11.2 percent, while imports had grown by 16.8 percent. Yearly exports receipts have consistently lagged behind imports expenditures. During the same period of time with the exception of a few years, the U.S. government's **budget deficit** has been widening. Economic theory attributes the **trade deficit** to the increase in the U.S. government's **budget deficit**. Economists largely accept this view. This **relationship** is known as the "twin deficits". Economic theory suggests that the link between the U.S. **trade deficit** and the **budget deficit** is through the interest rate and its effect on the value of dollar. While there is consensus among the economists that reducing **budget** deficits and debt will reduce interest rates, debate continues on the effects on the exchange rate. However, this growing U.S. "twin deficits" is a major concern among economists and policy makers. The paper is organized as follows. Section 2 discusses the available literature and data sources while in section 3 the methodology and testable hypotheses are discussed. **Empirical** results are presented in section 4 and section 5 concludes the paper.

2. LITERATURE REVIEW

Many researchers have tested the link between "twin deficits". In general, there are mixed results. Darrat (1988) has tested the causal **relationship** between the **trade deficit** and the **budget deficit** of the U.S. using a technique suggested by Granger (1980). He has concluded there is some evidence that government **budget deficit** is a causal determinant of the **trade deficit**. Hutchison and Pigott (1984) have investigated the **relationship** between the government **budget deficit**, exchange rates, and the current account balance. They have concluded that an increase in the **budget deficit** is likely to raise domestic real interest rates, which in turn, would raise the value of dollar and subsequently would increase the **trade** balance. Research by Dewald (1983), Dwyer (1982), Holelscher (1983), and Evans (1985) show that interest rates are not affected by the size of the **budget deficit**. Feldstein (1992) has argued that the **trade deficit** is not a derivative of the **budget deficit** but rather, the result of the spendthrift habits of American consumers. Americans are spending more than they produce. To do this, they must borrow from foreigners and, thus, pay attractive interest rates to foreign creditor. The study by Mahdavi and Sorabian (1993) attempts to empirically investigate the dynamic relationships between the exchange rate and the **trade** balance. Their study performed tests of Granger Causality between the nominal and real exchange rates of the dollar and the U.S. **trade** balance. Their results suggest …

trade balance. Their study performed tests of Granger Causality between the nominal and real exchange rates of the dollar and the U.S. trade balance. Their results suggest weak statistical evidence of causality running from the nominal exchange rate, which indicates that the movements in the exchange rate have a rather limited effect on the trade balance. Bahmani-Oskoee, et. al study (1993) examines the statistical relationship between the U.S. budget deficit and the value of the dollar applying cointegration and error correction techniques on the quarterly data over the period 1971-1990. Their initial study showed no evidence of cointegration. But, when the 1985 foreign exchange market intervention was incorporated into the model, it was found that the two variables are cointegrated. Their results of error correction model have shown bidirectional causality between budget deficits and the effective exchange rate of dollar. No conclusive evidence of a relationship between large budget deficits and high interest rates has been found by Beck (1993) study. Two competing explanations are tested by examining the impact of government budget announcements on the exchange rates. Thorbecke (1993) study supports the argument that a reduction in the U.S. budget deficit would reduce excess spending and lower the trade deficit. A study by Eravi and et. al (1992) shows that dollar's strength during the 1980s appears to have been directly linked to that decade's large budget deficits and the subsequent increase in the stock of federal debt outstanding. However, evidence on the relationship between the federal deficit and the dollar value is not clear. Their study also shows that deficits do not directly Granger cause the exchange rate changes, but there is evidence of an indirect effect working through the money supply and the price level. Humpage (1992) applied the cointegration tests and found no evidence of long term relationship between the common aggregate measures of U.S. fiscal policy and the real long-term interest rates, the real dollar exchange rates, and the real net exports. Mohammadi and Skaggs (1996) in their study have found that the effect of the budget balance on the trade balance, if any, is modest. Hooper, Johnson and Marquez (1998) found that the long-run elasticity of U.S. exports of goods and services with respect to foreign national income was 0.80, while the long-run elasticity of U.S. imports of goods and services with respect to U.S. national income was 1.80. This asymmetry has consistently appeared in several analyses over different estimation periods, data and econometric techniques (see Houthakker and Magee, 1996; Cline, 1989; Wren-Lewis and Driver, 1998). Mann (2002) argues that focusing too much attention to current account balance is misguided, because the current account is not a fundamental economic force in itself, but only one out of many factors of the general equilibrium, such as domestic rate of saving and investment, economic growth and trade, international investment and capital flows, prices and rates of return and the exchange rate, and fiscal and monetary policy.

Thus the debate continues because there is no conclusive empirical evidence on the relationship between the deficit and the exchange rate. Our paper is an attempt to find further evidence of the

relationship between the budget deficit and the trade deficit by applying the cointegration and the Granger causality tests.

2.1 Data Sources

The variables of our study are the U.S. trade deficit and the government budget deficit, the Fed Funds rate (proxy for interest rate), the trade weighted exchange rate index (proxy for exchange rate), exports, imports and trade balance (percentage of GDP) For this purpose, the trade data are collected from the U.S. Census Bureau, Foreign Trade Division. The data on the government budget deficits are from the Executive Office of the President, Fiscal Year, 2005. The data on trade deficit and budget deficit covers the period from 1960 through 2003. The exports, imports, and GDP data cover the period from 1940 through 2003.

3 METHODOLOGY

3.1 Unit Root Test

The Augmented Dickey Fuller (ADF) test is used to determine whether the variables are nonstationary (unit root). ADF requires running a regression of the first difference of the series against the series lagged once, lagged difference terms, a constant and a time trend such as

[DELTA][x.sub.t] = [[lambda].sub.0] + [[lambda].sub.1] [X.sub.t-1] + [[lambda].sub.2] T + [summation] [[lambda].sub.i] [DELTA] [x.sub.t-l] + [[epsilon].sub.t] i = 1 ... k (1)

where [DELTA] is the first difference operator, [[epsilon].sub.t] is an error term, k is the number of lagged first difference term and is determined such that [[epsilon].sub.t] approaches to white noise. The null hypothesis specifies nonsationary series or unit root ([H.sub.o]: [[lambda].sub.1] = 0) . The output of the ADF test consists of the t-statistic on the estimated coefficient of the lagged variable ([[lambda].sub.1]) and the Mackinnon critical values for the test of a zero coefficient. If the estimated coefficient is significantly different from zero then the [H.sub.o] is rejected, suggesting the series are stationary.

3.2 Cointegration Test:

The theory of cointegration, first introduced first by Granger (1981) and then developed by Granger (1986) and Engle aqnd Granger (1987), integrates the short-run dynamics with long-run equilibrium relationship. A set of time-series variables are said to be cointegrated if they are integrated of the same

order and a linear combination of them is stationary. Such linear combination would then point to the existence of a long-term relationship among the variables. If there are r stable long-run relationships (cointegrating equations) in k dimensional vector of time series, then these k series share k-r common stochastic trends. On the other hand, given the unique relationship between cointegration and the error correction models, then there must be some Granger causality (i.e., precedence) in at least one direction. This paper exploits these relationships and investigates the presence of common stochastic trends by means of the vector autoregressive representation. Our study used maximum likelihood approach of Johansen for estimating and testing the number of cointegrating relationships among the components of a k-vector [x.sub.i] of variables.

3.3 The Granger Causality Test:

The Granger approach to the question of whether X and Y are Granger causality related is thus to see how much of the current Y can be explained by past values of Y and then to see whether adding lagged values of X can improve the explanation. Y is said to be Granger-caused by X if X helps in the prediction of Y, or equivalently if the coefficients on the lagged values of X are statistically significant. More specifically let us consider the following two variable VAR model:

[Y.sub.t] = [[alpha].sub.10] + [summation] [[alpha].sub.1i] [X.sub.t-i] + [summation] [[beta].sub.1j] [Y.sub.t-j] + [[epsilon].sub.1t] (2)

[X.sub.t] = [[alpha].sub.20] + [summation] [[alpha].sub.21] [X.sub.t-i] + [summation] [[beta].sub.2j] [Y.sub.t-j] + [[epsilon].sub.2t] (3)

where [[epsilon].sub.t] is white noise, p is the order of the lag for X, and q is the order of the lag for Y.

With respect to this model we can distinguish the following cases:

(i) If [[[alpha].sub.11], [[alpha].sub.12], ..., [[alpha].sub.1]] [not equal to] 0 and [[[beta].sub.21], [[beta].sub.22], ..., [[beta].sub.2q]] = 0, there exists a unidirectional causality from [X.sub.t] to [Y.sub.t], denoted as X [right arrow] Y.

(ii) If [[[alpha].sub.11], [[alpha].sub.12], ..., [[alpha].sub.1p]] = 0 and [[[beta].sub.21], [[beta].sub.22], ..., [[beta].sub.2q]] [not equal to] 0, there exists a unidirectional causality from [Y.sub.t], to [X.sub.t], denoted as Y [right arrow] X.

(iii) If [[[alpha].sub.11], [[alpha].sub.12], ..., [[alpha].sub.1p]] [not equal to] 0 and [[[beta].sub.21], [[beta].sub.22], ..., [[beta].sub.2q]] [not equal to] 0, there exists a bidirectional causality between [X.sub.t] to [Y.sub.t], denoted as X [left and right arrow] Y.

In order to test the hypotheses related to the significance or not of the sets of the coefficients of the VAR model of equation (2) and (3) the usual Wald F-statistic could be applied.

The hypotheses in this test may be formulated as follows:

[H.sub.0]: X does not Granger-cause Y, i.e. [[[alpha].sub.11], [[alpha].sub.12], ..., [[alpha].sub.1p]] = 0, if F-statistic < critical value of F.

Ha: X does Granger-cause Y, i.e. [[[alpha].sub.11], [[alpha].sub.12], ..., [[alpha].sub.1p]] [not equal to] 0, if F-statistic > critical value of F.

and

[H.sub.0]: Y does not Granger-cause X, i.e., [[[beta].sub.21], [[beta].sub.22], ..., [[beta].sub.2q]] = 0 if F-statistic < critical value of F.

Ha: Y does Granger-cause X, i.e. [[[beta].sub.21], [[beta].sub.22], ..., [[beta].sub.2q]] [not equal to] 0, if F-statistic > critical value of F.

4. EMPIRICAL RESULTS:

Empirical results reported here are comprised of ADF unit root test, Johansen cointegration test and the Granger causality test. Results reported here are also intended to have some prior descriptive information on how these variables behave during our selected sample period. Graph I exhibits the behavior of U.S. trade and budget deficits from 1960 through 2003. The graph shows since the mid-seventies both the current account and the budget deficits are in the negative territory. Although the fiscal budget was surplus from mid-nineties to the end of the century but the trade deficit has consistently been rising.

Table 1 provides the statistical results for ADF unit root tests for trade deficit (TB) and the Budget Deficit (BD) in levels and in first differences. Statistical results do not lead us to reject the null hypothesis of a unit root for level series. However, ADF tests statistics for first difference series show stationarity for the series.

We then test for cointegration by applying the Johansen likelihood ratio test to the series from 1960 through 2003. We begin the investigation by assuming various stochastic trends (linear and the quadratic deterministic trends). Table 2 provides the summary of statistical results of Johansen's trace statistics and maximum Eigen value statistics assuming various trends. Applying the lag interval 1, both the trace test and the maximum eigen value test confirm one cointegrating rank at the 1 percent level of significance.

Thus our results suggest the existence of long-run equilibrium relationships between the trade deficit and the budget deficit.

[GRAPHIC OMITTED]

We then examined the Granger causality (lead-lag) between the tarde deficit and the budget deficit. Results of pairwise Granger causality tests are reported in table 3. Here we test the null hypothesis that the trade deficit does not Granger-cause the fiscal deficit and vice versa at the 1 percent and 5 percent significance levels from 1 to 3 years lag using the same set of data from 1960 to 2003. Contrary to the theory, our results show a strong unidirectional causality running from the trade deficit to the budget deficit. No causality has been found from the budget deficit to the trade deficit.

Since the breakdown of the Breton woods system, the growing U.S. trade deficit has been a major concern among economists and policy makers. During the same period of time, it has been observed with the exception of a short period that the government's budget deficit has been rising. Economic theory attributes the trade deficit to the increase in the budget deficit, and this view is largely accepted by economists. However, the statistical evidence on the relationship between the trade deficit and the budget deficit has not yet been resolved and is ambiguous. Our paper is an attempt to find further evidence of the relationship between the budget deficit and the trade deficit by applying the cointegration and the Granger causality tests. For this purpose, the trade data are collected from the U.S. Census Bureau, Foreign Trade Division. The data on the government budget deficits are from the Executive Office of the President, Fiscal Year, 2005. The data on trade deficit and budget deficit covers the period from 1960 through 2003. Applying Johansen's cointegration tests, we find long run relationship between the budget deficit and the trade deficit. Pairwise Granger causality tests show a unidirectional causality between the trade deficit and the budget deficit. Contrary to the theory, our results show that the trade deficit "Granger Cause" the budget deficit. The future study will investigate whether there is any linkage between the interest rates and the exchange rates and how there are related to the "twin deficits". In addition we will also estimate the U.S. income elasticity of imports and the foreign income elasticities of U.S. exports in order to verify the Houthakker-Magee income effect.

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TABLE 1: UNIT ROOT TEST

Variables	ADF coefficients I in levels [[tau].sub.[micro] (tau)]	Mackinon critical value [[tau].sub.t] (tau)]
USTB	-1.1068	-4.1865
USBD	-3.3071	-4.1923

Variables	ADF coefficients in first difference	Mackinon critical value
	[[tau].sub.[micro] (tau)	[[tau].sub.t] (tau)
USTB	−3.3440 **	−2.6212
USBD	−2.1051 *	−1.9489

Note: "**" & "*" indicate rejection of null hypothesis of unit root at the 1% and 5% level of significance, respectively. Mackinnon critical value for rejection of hypothesis of a unit root has been applied at the 1 % and the 5% level. Optimum lag structures are determined by the Akaike and Schwarz information criteria.

TABLE 2 SUMMARY OF JOHANSEN'S COINTEGRATION TESTS

S Sample: 1960 2003
S Series: USTB USBD
L Lags interval: 1 to 1

Data Trend:	None	None	Linear	Linear	Quadratic
Rank or No. of CEs	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend

Selected 5% level Number of Cointegrating Relations by Model (columns)

Trace	1	1	1	1	2

Max-Eig 1 1 1 1 2

Log Likelihood by Rank (rows) and Model (columns)

0	-1003.871	-1003.871	-1001.991	-1001.991	-997.5212
1	-986.0822	-984.7363	-984.0200	-982.7886	-981.4794
2	-984.9653	-983.5954	-983.5954	-979.4741	-979.4741

Akaike Information Criteria by Rank (rows) and Model (columns)

0	47.99384	47.99384	47.99958	47.99958	47.88196
1	47.33725	47.32078	47.33428	47.32327	47.30854 *
2	47.47454	47.50454	47.50454	47.40353	47.40353

Schwarz Criteria by Rank (rows) and Model (columns)

0	48.15934	48.15934	48.24782	48.24782	48.21295
1	47.66823 *	47.69314	47.74802	47.77837	47.80502
2	47.97102	48.08376	48.08376	48.06550	48.06550

TABLE 3 GRANGER CAUSALITY TEST

PPairwise Granger Causality Tests
SSample: 1960 2003

Lags: 1

Null Hypothesis:	Obs	F-Statistic	Probability
USTB does not Granger Cause USBD	43	5.63768	0.02247
USBD does not Granger Cause USTB		0.00068	0.97932

Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability
USTB does not Granger Cause USBD	42	5.94037	0.00579
USBD does not Granger Cause USTB		0.78741	0.46250

L Lags: 3

Null Hypothesis:	Obs	F-Statistic	Probability
USTB does not Granger Cause USBD	41	10.17472	6.3E-05
USBD does not Granger Cause USTB		2.08511	0.12048

L Lags: 4

Null Hypothesis:	Obs	F-Statistic	Probability
USTB does not Granger Cause USBD	40	8.09936	0.00014
USBD does not Granger Cause USTB		1.48914	0.22948