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THE U.S. TRADE DEFICIT, UNEMPLOYMENT RATE AND DEBT: AN EMPIRICAL STUDY

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Abstract

This paper examines the relationship between US trade deficit, unemployment rate and its national debt between 1980 and 2016. The empirical analysis on the relationship between trade deficit and unemployment was carried out using an Autoregressive Distributed Lag model while that of the relationship between the trade deficit and national debt was estimated using a 2-Stage Least Square estimation technique because of endogeneity problem associated with the model. The variables used in the study include trade deficit, growth rate, unemployment rate, public debt, interest rate, government expenditure, real oil price and foreign direct investment. This variables were tested for stationary and the result showed that only public debt was I(0) while the rest of the variables were I(1) which justifies the use of the ARDL model for the study. The study finds that a billion dollar reduction in the US trade deficit is associated with about a 0.27 percentage point increase in the Unemployment rate and associated with about a 0.36 percent reduction on the US national debt.

Keywords: Trade deficit, Unemployment, Debt, United States, International trade, Trade Policy.

JEL classification: F13

Introduction

Trade deficit is an unfavorable balance of trade where the value of imports of a country exceeds its exports. There has been growing concerns over the current US trade deficit and its possible effects on the economy which made it one of the focal issues in the last US presidential election.

There has been theories associating the wellbeing of an economy to its trade deficit but there hasn't been a consensus on the nature of this relationship. While some economists believe it has a positive effect on an economy others believe a negative relationship is the case which can be seen from the different opinions expressed by today's policy and political analysts.

The United States was not a pro free trade country until after the second world war when the General Agreement on Tariffs and trade and the International trade Organization were established. GATT (1947) was an agreement meant to negotiate trade barrier reduction among different nations so as to boost economic recovery. According to Bovard (1994), "GATT was the broadest and most comprehensive trade agreement in history equivalent to a one-third cut in tariff levels around the world". This trade agreement was signed by 23 nations in Geneva

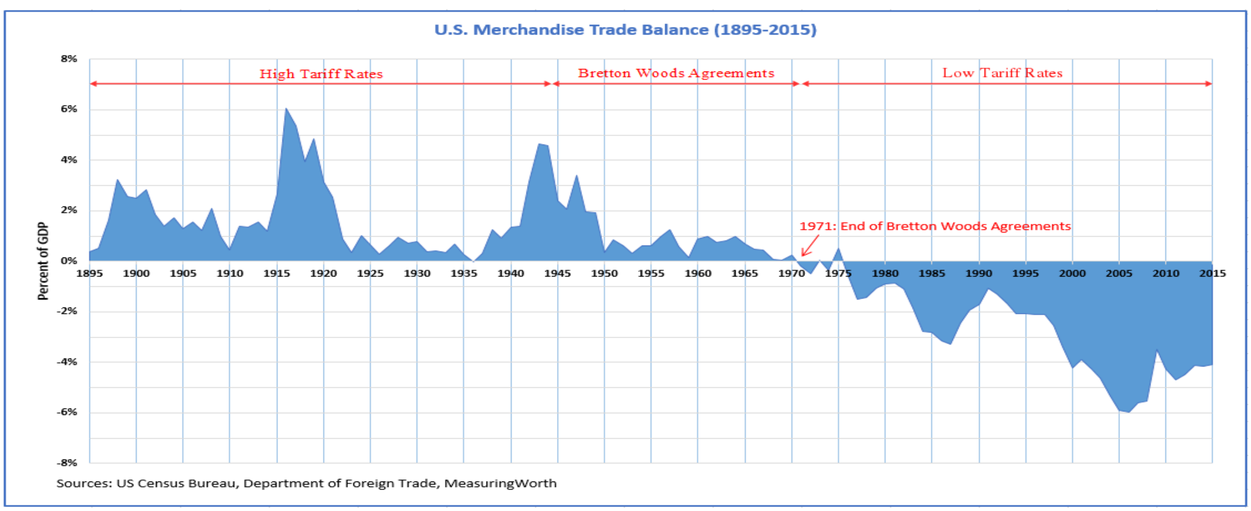
October 1947 and was in effect from 1948 to 1993 when it was ended and replaced by the World Trade Organization in1995. While GATT applied only on merchandise goods the WTO incorporated trade of services and intellectual property and functioned as an independent institution that provides rules regulating trade among its 154 member countries.

According to the office of the United States trade representative, the United States has free trade agreements in force with 20 countries including Canada, Singapore, Korea, Israel, Australia etc. The United States recently completed the negotiations of a regional Asia Pacific trade agreement (TPP) and currently in negotiations of the Trans-Atlantic Trade and Investment Partnership (T-TIP) with the European Union and also the North American Free Trade Agreement (NAFTA) with Canada and Mexico.

Participation in free trade since the end of WWII has played a huge role in the growth of the American economy over the decades. Opening the economy to international trade has led to the expansion of America's most productive industries including Agriculture. Gorham (2016), United States agricultural output has more than doubled between 1948 and 2011 which makes US the top agricultural output exporter with $182 billion with the second Brazil at $88 billion (WTO).

Over the last few years there has been growing concerns over the growing US trade deficit and there is no consensus on what is responsible for this growing deficit either. Economists have pointed out different factors including US over consumption behavior, Over valued dollar, nature of exports (goods vs services), among others.

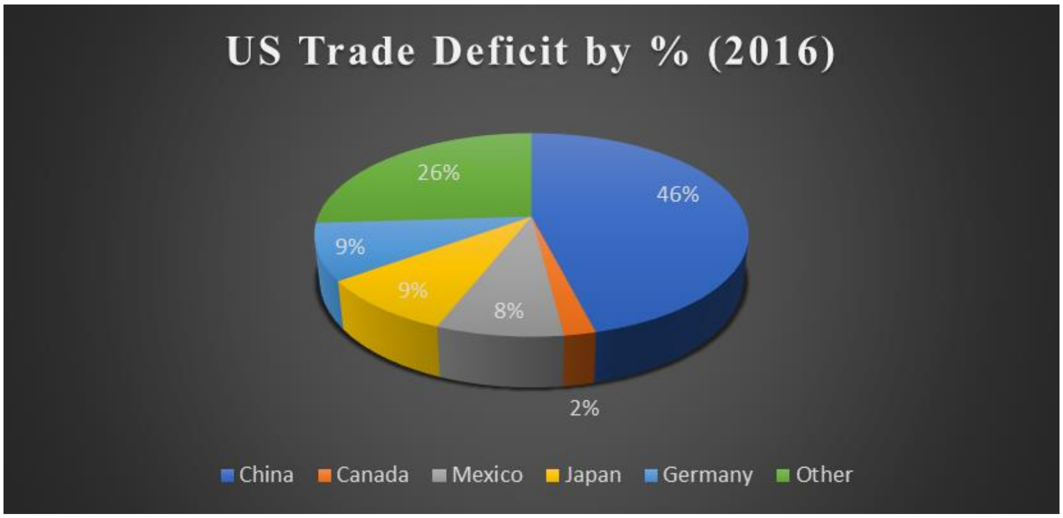
Chart 1: US Trade Balance.



By James 4 - Own work, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=59196484

The huge increase in the US trade deficit in the early 2000s has been attributed to the inclusion of China in the World Trade Organization and it is no coincidence that they hold almost half of the current US deficit. Their relative trade advantage can also be attributed to the weaker Asian currencies as a result of the Asian financial crises (1997-1999).

Chart 2: US trade deficit with countries by percent



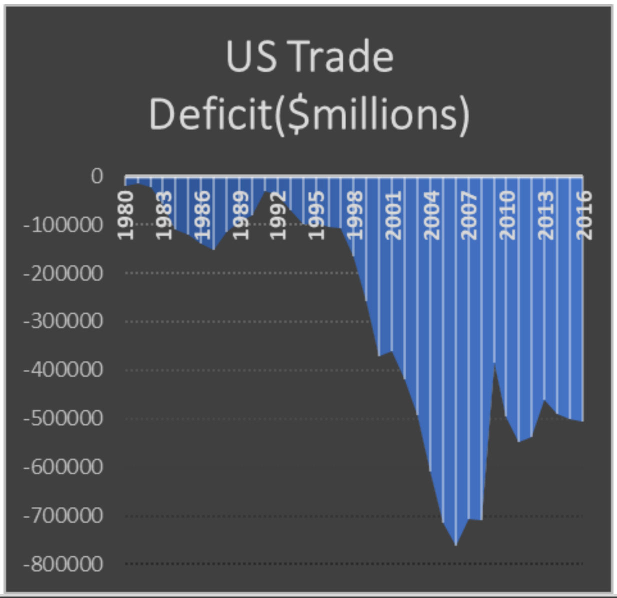
This paper is focused on investigating the nature of relationship between the US budget deficit, its unemployment rate and public debt. Therefore this paper answers the following two questions:

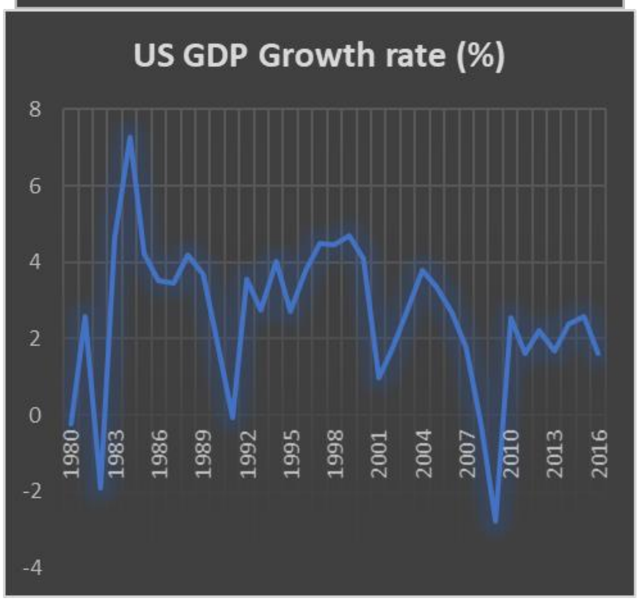
1. Is there a significant relationship between the US trade deficit and unemployment rate.
2. Is there a significant relationship between the US trade deficit and the magnitude of its national debt?

Literature Review

Over the years there has been a lot of theories, articles and reports on trade liberalization as well as how trade deficit affects an economy. Even though some believe trade deficit is a sign of a healthy economy such as witnessed in the United States other economies such as Germany, China, and Japan are thriving on trade surpluses and my next research interest is to investigate this diverging behavior.

Chart 3: US trade deficit and Growth rate 1980-2016





As can be seen in the chart 3 above, periods of declining GDP growth coincides with shrinking of the trade deficit (1991, 2001 and 2009) while the reverse can be seen in 2005.

One of the prominent names in history of economic thoughts, Adam Smith (1776) was of the view that it is unnecessary to lay extraordinary restraints upon the importation of goods from those countries with which the balance of trade is supposed to be unfavorable. He believed that if the balance of trade is even neither party gains nor loses. Keynes (1944) on the other hand was

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an advocate of balance of trade. Be proposed a plan in which international would be regulated in order to achieve balance of trade.

The monetary economists like Bastiat and later Freidman argued that trade deficits were actually a manifestation of profit rather than a loss. Bastiat (1845) was of the view that trade deficit was an indicator of a successful economy rather than a failing one. A successful growing economy would result in greater trade deficit while an unsuccessful economy would result in lower trade deficits.

There has also been a number of empirical studies on the effect of trade deficits, Gould and Ruffin (1996) argues that trade deficits are not necessarily a concern in predicting future economic growth. Large trade deficits may indicate high growth rates as countries import capital to expand productive capacity. On the issue of trade deficit and unemployment they argued that even though some economists believe that growing trade deficits translate into loss of jobs for Americans, this belief is based on the "fallacious assumption" that the capital inflows associated with the growing trade deficit are not used to enhance productivity. Gould and Ruffin went ahead to explain that the loss of jobs due to trade deficit would be restored by the inflows of capital which expands the economy. This view is also supported by David Griswold (1998) in his article Trade Deficits Don't Mean Lost Jobs, where he asserted that "*Trade with other nations does not reduce the number of jobs, but it does quicken the pace at which production shifts from one sector to another. Trade, like new technology, lowers demand for some jobs while raising demand for others. Trade allows the United States to produce more Boeing jetliners, pharmaceuticals, software, and financial services for export, but trade also means we produce fewer shoes, T-shirts, Happy Meal toys, and computer memory chips. Meanwhile, total output and total employment keep growing.* He believed that according to US trade deficit data there exists a positive correlation between large trade deficit and employment.

Papaioannou and Yi (2001) analyzed the effects of the US economic expansion on its trade balance by posing a hypothetical question "What would the US trade deficit have been if the United States and its trading partners were operating at potential rather than actual output holding all else equal?" which they answered by computing a potential output trade balance that represents the trade balance without the effect of cyclical force. By comparing this potential output trade balance with the actual trade balance, they were able to determine the extent to which cyclical forces contributed to the larger U.S. trade deficit. Their main finding was that the 1996-1999 economic boom can account for roughly a third of the sharp rise in the merchandise trade deficit during that period.

Hojjat (2014) investigated the relationship between the US current account balance and the U.S. rate of unemployment and found that as the US current account improves, the unemployment rate falls using a simple linear regression model.

Pinto (2012) investigated the labor market effects of trade liberalization using the Melitz framework and found that trade liberalization harms low-ability worker, benefits the high-ability worker and harms the welfare of an economy endowed with large fraction of low-ability worker.

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On the issue of trade deficit and national debt many economists believe that the US trade deficit has nothing to do with its huge national debt. The increase in the national debt is believed to be as a result of the recurring budget deficit over the past decade. Hansen (2012) was of the view that the US federal debt is unlikely a product of trade imbalances and more likely the inability of elected officials to balance its revenues against expenditures.

Some economists argue otherwise, Solman (2009) believed that US trade deficits affects its National debt indirectly, that when we spend more than we earn, the rest of the world has more of our dollars which they can use to buy US assets and also buy US treasury bills, notes and bonds from the Government like the Chinese. There has been little or no empirical evidence supporting these relationships.

Data and Methodology

This study uses time series data (1980-2016) obtained from secondary sources: Federal Reserve Bank of St. Louis, census.gov, World Bank open data and U.S. Energy Information Administration. Before the estimation, we examined the properties of the variables of interest, the extent of cointegration between the variables of interest and then performed a test for the problem of endogeneity in the model.

Model specification and estimation: The objective of this study is to examine the nature of correlation between US trade deficit and its unemployment rate and also its national debt. To achieve the above objectives, for model 1, the Autoregressive Distributed Lag model (ARDL) was adopted because of the differences in the integration levels of the variables of interest. For model 2 which investigates the relationship between the US debt and its trade deficit this study uses the 2-Stage Least squares estimation technique to correct for the endogeneity problem detected from the Durbin-Wu-Hausman test for endogeneity.

Model 1

$$Unemp_t = \alpha_0 + \alpha_1 \sum_{i=1}^{n} Unemp_{t-i} + \alpha_2 \sum_{i=1}^{n} Tdef_{t-i} + \alpha_3 \sum_{i=1}^{n} Pbdt_{t-i} + \alpha_4 \sum_{i=1}^{n} Lnfdi_{t-i} + u_t$$

Where:

Unemp=Unemployment rate

Tdef=Trade deficit

Pbdt=National debt

Lnfdi=Logged values of Foreign Direct Investment

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α_1, α_2, α_3 and α_4 are parameters to be estimated and u_t represents the serially uncorrelated error terms. This study uses the Akaike's Information Criterion (AIC) to determine the optimum lag length for the ARDL model.

Model 2

$$Tdef_t = \pi_0 + \pi_1 Intr_t + \pi_2 Psavert_t + v_{1t}$$

$$Lnpbdt_t = \beta_0 + \beta_1 Tdef_t + \beta_2 Bdef_t + v_{2t}$$

Where:

Tdef = Trade Deficit

Intr = Interest Rate

Psavert = Private Savings rate

Lnpbdt = Logged value of the National debt

β_1 and β_2 are parameters to be estimated and v_{2t} represents the serially uncorrelated error terms.

RESULTS AND DISCUSSION

Analysis of variables: The study first tests for unit root in the time series to be used for analysis. This is important because most time series exhibit non-stationarity traits in their level form, which often pose a serious problem to econometric analysis and may therefore lead to spurious result if appropriate measures are not taken. To guard against spurious result, this study takes the step in checking the properties of the variables using the Augmented Dickey-Fuller (ADF) test developed by Dickey and Fuller (1981). The results are presented in Table 1 below;

Table 1: Unit Root Test

Variable	ADF value at levels	ADF value after first difference	Order of integration
Unemp	-1.775 [-2.969]	-3.679 [-2.972]	I(1)
Tdef	-1.078 [-2.969]	-5.547 [-2.972]	I(1)
Pbdt	5.625 [-2.969] **		I(0)

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Lnfdi	-1.366 [-2.969]	-6.392 [-2.972]	I(1)
Intr	-1.420 [-2.969]	-5.940 [-2.972]	I(1)
Psavert	-2.579 [-2.969]	-8.034 [-2.972]	I(1)

Source: Researcher's Estimation using Stata 13

Note:- *, ** and * denotes** significance at 1%, 5% and 10% level respectively.

Figures within parenthesis indicate critical values. Mackinnon (1991) critical value for rejection of hypothesis of unit root applied. The table reveals that all the variables were integrated of order 1 except Pbdt which is stationary at level form.

Cointegration test: This study employed the Engle-Granger and augmented Engle-Granger test to test for cointegration among the variables of interest which involves performing a unit root test on residuals obtained from regressing Unemp on Tdef, Pbdt, Intr, realoilprices, Lnfdi, Psavert and Bdef and regressing Lnpbdt on Tdef, Intr, Psavert and Bdef. The results are shown in the table below;

TABLE 2: Cointegration test

Variable	Test Statistic	5% Critical value	P- value
u(model1)	-3.923	-2.969	0.0019
u(model2)	-3.552	-2.969	0.0068

Source: Researcher's Estimation using Stata 13

The result of the co-integration test in Table 2 fails to rejects the null hypothesis of at most one co-integrating variable at 5% critical value. It fails to rejects any co-integration at 5% significance level when compared with the critical values, which implies that there is presence of cointegrating relationship between the variables of interest.

Test for Endogeneity: The study uses the Durbin-Wu-Hausman test for endogeneity. The table below shows the results (full test results can be seen in the appendices).

TABLE 3: Test For Endogeneity

Variables	Coefficients	T- values	P- values
v(model1)	-1.01e-07	-0.03	0.977
v(model2)	3.63e-06	6.61**	0.000

Source: Researcher's Estimation using Stata 13

From the table above, using the t-test, at 5% level of significance, the coefficient of "v(model2)" is statistically significant, which indicates the presence of endogeneity problem thereby justifying the use of 2SLS for our second estimation.

Autoregressive Distributed Lag result: This estimated was carried out using stata and allowed stata to automatically select the optimal lag level using the Akaike's Information Criterion (AIC). It is alsoThe result is shown in the table below:

TABLE 4: ARDL result. Dependent Variable: Unemp

Variables	Coefficients	T- values	P-values
Unemp L1	0.6096066	5.56**	0.000
Tdef	2.71e-06	2.74**	0.012
L1	-3.23e-06	-2.65**	0.015
L2	1.45e-06	1.27	0.219
Pbdt	0.0014067	5.13**	0.000
L1	-0.0002785	-0.65	0.520
L2	-0.0020352	-3.50**	0.002
L3	0.0008341	2.19**	0.040
Lnfdi	-0.5639011	-3.18**	0.005

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L1	0.1809109	0.80	0.435
L2	0.4290785	2.60**	0.017
CONS	1.102921	0.20	0.840

Source: Researcher's Estimation using Stata 13

The L in the table above indicates the different lag levels and ** indicates t-values significant at 5% level. R-squared of 0.97.

The coefficient on Tdef implies that a billion dollar reduction in the US trade deficit is associated with about a 0.27 percentage point increase in the Unemployment rate keeping all other factors. This coefficient is also statistically significant at 5% level given a t-stat of 2.74 and p-value 0.012.

It is also important to note from our result that the past value of the unemployment rate is also significantly associated with the current value.

The coefficient on Pbdt indicates that a billion dollar increase in the US national debt is associated with about a 0.14 percentage point increase in the unemployment rate keeping all other factors and is statistically significant at 5% level. The relationship between the Unemployment rate and the past values of debt seem to be ambiguous.

The coefficient on Lnfdi implies that a one percentage increase in Foreign Direct Investment is associated with about a 0.6 percentage point decrease in the US Unemployment rate keeping all other factors constant and is also statistically significant at 5% level.

The sign of the above coefficients conform to my expectations.

Post Estimation tests:

The study uses **Durbin Watson and Breusch Godfrey to test for serial correlation**, the result gave a chi-stat of 2.170 with a p-value of 0.1407, therefore we fail to reject the null hypothesis of no serial correlation at 5% level of significance which implies absence of serial correlation among the error terms.

The study uses the **Breusch Pagan/Cook Weisberg test to test for heteroscedasticity**, the result gave a chi-stat of 0.06 with a p-value of 0.8094, and therefore we fail to reject the null hypothesis of constant variance at 5% level of significance which implies absence of heteroscedasticity in the model.

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The study uses **Ramsey RESET test to test for specification error in the model** and the result gave an F-stat of 2.49 with a p-value of 0.0933, therefore we fail to reject the null hypothesis of model has no omitted variables which implies this model was correctly specified.

The 2SLS result

The table below compares the 2SLS result with the OLS estimates.

Table 5: OLS and 2SLS results

Log of US debt regressed on trade deficit and budget deficit

	OLS results	2-Stage Least Square result
Dependent Var: LnPbdt		
Trade Deficit	-0.0313 (0.0448)	-0.364 (0.0563)**
Budget Deficit	-0.051 (0.025)**	-0.0293 (0.0288)
Interest Rate	-17.18 (5.01)**	
Private savings rate	-14.89 (3.44)**	
Constant	10.07 (0.44)**	
Observations	37	37
R-squared	0.8365	0.5543

Source: Researcher's Estimation using Stata 13

The coefficient on Trade deficit in the 2SLS model indicates that a billion dollar reduction in the trade deficit is associated with about a 0.36 percent reduction on the US national debt keeping all other factors constant. This coefficient is also significant at 5% level.

The result also show negative relationship between the budget deficit and the US national debt which implies that a billion dollars reduction in the budget deficit is associated with about a 0.03 percent reduction in debt. This coefficient is not significant at 5% level even though that of the OLS (0.051%) is significant at 5% level.

Post Estimation tests:

This study uses the Wooldridge test score to test the null hypothesis that Trade Deficit is exogenous. The result is presented in the table below:

Table 6: Test of endogeneity

Durbin (score) chi2(1)	18.7897	p- value = 0.0000
Wu-Hausman F(1,33)	34.05	p-value = 0.000

Source: Researcher's Estimation using Stata 13

The Wooldridge test score reject the null hypothesis that Trade Deficit is exogenous at 5% level of significance and the regression based test also rejects the null hypothesis that Trade deficit is exogenous. This implies that the estimates generated by the OLS estimation are inconsistent while the 2 Stage Least Squares estimates are consistent.

The study also uses the Stock and Yogo (2005) test to test the null hypothesis that the set of instruments is weak. This test satisfies the requirement that instrumental variables (Interest rate and Personal Savings rate) be correlated with the endogenous regressor (Trade Deficit). The result is presented in the table below:

Table 7: Test for Weak Instruments

Minimum eigenvalue statistic = 24.6221

	10%	15%	20%	25%
2SLS Size of nominal 5% Wald test	19.93	11.59	8.75	7.25
LIML Size of nominal 5% Wald test	8.68	5.33	4.42	3.92

Source: Researcher's Estimation using Stata 13

The 2SLS Size of nominal 5% Wald test shows the critical values pertaining to Stock and Yogo (2005) characterization of weak instrument. If the Minimum eigenvalue statistic is greater than the critical value, we reject the null hypothesis that the set of instrument is weak. Since 24.62 is greater than 19.93 we reject the null hypothesis of weak instruments and using the LIML estimator gives us the same conclusion since 24.62 is greater than 8.68.

The study also uses Sargan's (1958) and Basmann's (1960) x^2 procedure to test for over identifying restrictions. This test justifies the requirement that the instruments must be uncorrelated with the structural error term and also tests if the structural equation is misspecified. If the test statistic of the Sargan and Basmann are significant at a specified level, it implies that either one or both of our my instrument is invalid or that there is a problem of misspecification in my structural model. The result of the test is presented in the table below:

Table 8: Test of overidentifying restrictions

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Sargan (score) chi2(1)	0.01103	p- value = 0.9164
Basmann chi2(1)	0.009841	p-value = 0.9210

Source: Researcher's Estimation using Stata 13

Both of the test statistics above are not significant at 5% level which implies that my instruments are valid and that the model was correctly specified.

CONCLUSION AND RECCOMENDATIONS

This paper discussed the history of US international trade participation and how its evolving trade policies interacting with the dynamics of the Global economy contributed to the economic state of the country and particularly its current trade deficit. The paper went further to analyze the different views held by different economic schools of thought including contemporary economists regarding the benefits from trade liberalization and how trade deficits which can be referred to as a negative balance of trade affects an economy. The study finally conducts an empirical analysis testing the relationship between trade deficit and unemployment rate in the US and finds that a billion dollar reduction in the US trade deficit is associated with about a 0.27 percentage point increase in the Unemployment rate. Another empirical test was also conducted to test the relationship between the US trade deficit and its national debt and the paper finds that a billion dollar reduction in the trade deficit is associated with about a 0.36 percent reduction on the US national debt.

This paper is relatively consistent with Bastiat (1845) whom was of the view that trade deficit was an indicator of a successful economy rather than a failing one and that a successful growing economy would result in greater trade deficit. He also argued that it would be necessary to take the balance of trade backward and calculate gains from trade by the excess of imports over exports. This paper is also consistent with David Griswold's (1998) finding that there is a there exists a positive correlation between large trade deficit and employment. Even though most economists believe that the trade deficit does not have anything to do with the level of our national debt, this study argues otherwise.

Looking at my results and through my research I believe that in order to maintain the sustainability of both the US trade deficits and its national debt, the government should to more to improve the private savings rate. According to Gramlich (2004) the optimal level of government debt is related to the optimal level of savings which can be defined as the long-term path of consumption per worker. Countries like Japan, Germany and China thriving in trade surpluses have one thing in common a relatively high private savings rate compared to the United States. The OLS result in my result above also shows that an increase in the private savings rate reduce the level of the national debt. Private savings could be improved through encouraging workers to take full advantage of their employer's retirement programs. In conclusion, the US huge trade deficit is not necessarily a threat to the economy or employment, it indicates a dynamic economy moving towards the industries in which it is more competitive in the global economy.

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APPENDIX

STATIONARITY TESTS

```
. dfuller tdef

Dickey-Fuller test for unit root                   Number of obs   =        36

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -1.078            -3.675            -2.969            -2.617
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.7236

. gen dtdef=d.tdef
(1 missing value generated)

. dfuller dtdef

Dickey-Fuller test for unit root                   Number of obs   =        35

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -5.547            -3.682            -2.972            -2.618
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller pbdt

Dickey-Fuller test for unit root                   Number of obs   =        36

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)              5.625            -3.675            -2.969            -2.617
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 1.0000

. dfuller lnpbdt

Dickey-Fuller test for unit root                   Number of obs   =        36

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -3.205            -3.675            -2.969            -2.617
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0197
```

```
. dfuller intr

Dickey-Fuller test for unit root                   Number of obs   =        36

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -1.420            -3.675            -2.969            -2.617
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.5729

. gen dintr=d.intr
(1 missing value generated)

. dfuller dintr

Dickey-Fuller test for unit root                   Number of obs   =        35

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -5.940            -3.682            -2.972            -2.618
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller realoilprices

Dickey-Fuller test for unit root                   Number of obs   =        36

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -1.913            -3.675            -2.969            -2.617
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.3259

. gen drealoilprices= d.realoilprices
(1 missing value generated)

. dfuller drealoilprices

Dickey-Fuller test for unit root                   Number of obs   =        35

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -5.574            -3.682            -2.972            -2.618
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000
```

```
. dfuller gvexp

Dickey-Fuller test for unit root                   Number of obs   =        36

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             1.444            -3.675            -2.969            -2.617
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.9973

. gen dgvexp=d.gvexp
(1 missing value generated)

. dfuller dgvexp

Dickey-Fuller test for unit root                   Number of obs   =        35

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)            -3.072            -3.682            -2.972            -2.618
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0287

. dfuller lnfdi

Dickey-Fuller test for unit root                   Number of obs   =        36

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)            -1.366            -3.675            -2.969            -2.617
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.5985

. gen dlnfdi=d.lnfdi
(1 missing value generated)

. dfuller dlnfdi

Dickey-Fuller test for unit root                   Number of obs   =        35

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)            -6.392            -3.682            -2.972            -2.618
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller psavert

Dickey-Fuller test for unit root                   Number of obs   =        36

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)            -2.579            -3.675            -2.969            -2.617
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0974

. gen dpsavert=d.psavert
(1 missing value generated)

. dfuller dpsavert

Dickey-Fuller test for unit root                   Number of obs   =        35

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)            -8.034            -3.682            -2.972            -2.618
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000
```

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```
. dfuller bdef

Dickey-Fuller test for unit root                   Number of obs   =        36

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -1.607            -3.675            -2.969            -2.617
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.4803

. gen dbdef=d.bdef
(1 missing value generated)

. dfuller dbdef

Dickey-Fuller test for unit root                   Number of obs   =        35

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -4.209            -3.682            -2.972            -2.618
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0006
```

Cointegration and Endogeneity tests for model 1

```
. reg unemp tdef pbdt intr realoilprices lnfdi psavert bdef

      Source |       SS           df       MS      Number of obs   =        37
-------------+----------------------------------   F(  7,     29)   =     30.79
       Model |  82.0625014         7  11.7232145   Prob > F        =    0.0000
    Residual |  11.0423119        29  .380769377   R-squared       =    0.8814
-------------+----------------------------------   Adj R-squared   =    0.8528
       Total |  93.1048133        36  2.58624481   Root MSE        =    .61707

------------------------------------------------------------------------------
        unemp |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
--------------+---------------------------------------------------------------
         tdef |   1.42e-06   1.26e-06     1.13   0.269    -1.16e-06    4.00e-06
         pbdt |  -.0000142   .0000506    -0.28   0.781    -.0001178    .0000894
         intr |   .0104512   .1104003     0.09   0.925    -.2153428    .2362452
realoilprices |   .0192608   .0068673     2.80   0.009     .0052155    .0333061
        lnfdi |  -.8674027     .25709    -3.37   0.002    -1.393211   -.3415946
      psavert |  -.0647004   .0879817    -0.74   0.468    -.2446432    .1152425
         bdef |  -.0030714    .000464    -6.62   0.000    -.0040204   -.0021224
        _cons |   27.11764   6.214785     4.36   0.000     14.40698     39.8283
------------------------------------------------------------------------------

. predict u, residuals

. dfuller u

Dickey-Fuller test for unit root                   Number of obs   =        36

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -3.923            -3.675            -2.969            -2.617
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0019

. reg tdef pbdt intr realoilprices lnfdi psavert bdef

      Source |       SS           df       MS      Number of obs   =        37
-------------+----------------------------------   F(  6,     30)   =     38.52
       Model |  1.8457e+12         6  3.0762e+11   Prob > F        =    0.0000
    Residual |  2.3955e+11        30  7.9850e+09   R-squared       =    0.8851
-------------+----------------------------------   Adj R-squared   =    0.8621
       Total |  2.0852e+12        36  5.7924e+10   Root MSE        =     89359

------------------------------------------------------------------------------
         tdef |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
--------------+---------------------------------------------------------------
         pbdt |   15.49763   6.765459     2.29   0.029     1.680717    29.31454
         intr |   53500.08   12656.46     4.23   0.000     27652.15    79348.01
realoilprices |  -3965.227   681.8212    -5.82   0.000    -5357.692   -2572.763
        lnfdi |  -106559.4    31742.1    -3.36   0.002    -171385.4   -41733.38
      psavert |   37377.99   10759.11     3.47   0.002     15404.95    59351.03
         bdef |  -54.54918   66.45254    -0.82   0.418    -190.2634    81.16501
        _cons |    1991792   823236.2     2.42   0.022     310519.8     3673065
------------------------------------------------------------------------------

. predict v, residuals

. reg unemp tdef v

      Source |       SS           df       MS      Number of obs   =        37
-------------+----------------------------------   F(  2,     34)   =      0.92
       Model |  4.7649365         2  2.38246825   Prob > F        =    0.4094
    Residual |  88.3398768        34  2.59823167   R-squared       =    0.0512
-------------+----------------------------------   Adj R-squared   =   -0.0046
       Total |  93.1048133        36  2.58624481   Root MSE        =    1.6119

------------------------------------------------------------------------------
       unemp |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        tdef |   1.52e-06   1.19e-06     1.28   0.208    -8.88e-07    3.93e-06
           v |  -1.01e-07   3.50e-06    -0.03   0.977    -7.22e-06    7.01e-06
       _cons |   6.830502   .4403652    15.51   0.000     5.935572    7.725431
------------------------------------------------------------------------------
```

ARDL RESULTS

```
. ardl unemp tdef pbdt lnfdi, aic

ARDL regression
Model: level

Sample:     1984 -     2016
Number of obs  = 33
Log likelihood = -1.9464512
R-squared      = .9676711
Adj R-squared  = .95073691
Root MSE       = .32175574
```

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unemp	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
unemp						
L1.	.6096066	.1097378	5.56	0.000	.3813943	.8378189
tdef						
--.	2.71e-06	9.87e-07	2.74	0.012	6.55e-07	4.76e-06
L1.	-3.23e-06	1.22e-06	-2.65	0.015	-5.77e-06	-6.93e-07
L2.	1.45e-06	1.14e-06	1.27	0.219	-9.30e-07	3.83e-06
pbdt						
--.	.0014067	.0002742	5.13	0.000	.0008364	.001977
L1.	-.0002785	.0004256	-0.65	0.520	-.0011635	.0006065
L2.	-.0020352	.000582	-3.50	0.002	-.0032455	-.0008249
L3.	.0008341	.0003808	2.19	0.040	.0000422	.001626
lnfdi						
--.	-.5639011	.1772945	-3.18	0.005	-.9326052	-.1951969
L1.	.1809109	.227224	0.80	0.435	-.2916273	.653449
L2.	.4290785	.164886	2.60	0.017	.0861793	.7719778
_cons	1.102921	5.384099	0.20	0.840	-10.09393	12.29977

```
. ardl unemp tdef pbdt lnfdi, aic ec regstore(ecreg)

ARDL regression
Model: ec

Sample:     1984 -     2016
Number of obs  = 33
Log likelihood = -1.9464512
R-squared      = .9252019
Adj R-squared  = .88602195
Root MSE       = .32175574
```

D.unemp	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
ADJ						
unemp						
L1.	-.3903934	.1097378	-3.56	0.002	-.6186057	-.1621811
LR						
tdef	2.37e-06	1.42e-06	1.67	0.109	-5.78e-07	5.31e-06
pbdt	-.0001868	.0001017	-1.84	0.080	-.0003983	.0000247
lnfdi	.1180562	.5449058	0.22	0.831	-1.015138	1.25125
SR						
tdef						
D1.	1.78e-06	1.11e-06	1.61	0.123	-5.24e-07	4.09e-06
LD.	-1.45e-06	1.14e-06	-1.27	0.219	-3.83e-06	9.30e-07
pbdt						
D1.	.0014796	.0002729	5.42	0.000	.0009121	.0020471
LD.	.0012011	.0003513	3.42	0.003	.0004705	.0019317
L2D.	-.0008341	.0003808	-2.19	0.040	-.001626	-.0000422
lnfdi						
D1.	-.6099894	.1955855	-3.12	0.005	-1.016732	-.2032472
LD.	-.4290785	.164886	-2.60	0.017	-.7719778	-.0861793
_cons	1.102921	5.384099	0.20	0.840	-10.09393	12.29977

```
. ardl, noctable btest

ARDL regression
Model: ec

Sample:     1984 -     2016
Number of obs  = 33
Log likelihood = -1.9464512
R-squared      = .9252019
Adj R-squared  = .88602195
Root MSE       = .32175574


Pesaran/Shin/Smith (2001) ARDL Bounds Test
H0: no levels relationship             F =  7.790
                                       t = -3.558

Critical Values (0.1-0.01), F-statistic, Case 3

     | [I_0]   [I_1] | [I_0]   [I_1] | [I_0]   [I_1] | [I_0]   [I_1]
     |   L_1     L_1 |  L_05    L_05 | L_025   L_025 |  L_01    L_01
-----+---------------+---------------+---------------+---------------
 k_3 |  2.72    3.77 |  3.23    4.35 |  3.69    4.89 |  4.29    5.61
accept if F < critical value for I(0) regressors
reject if F > critical value for I(1) regressors

Critical Values (0.1-0.01), t-statistic, Case 3

     | [I_0]   [I_1] | [I_0]   [I_1] | [I_0]   [I_1] | [I_0]   [I_1]
     |   L_1     L_1 |  L_05    L_05 | L_025   L_025 |  L_01    L_01
-----+---------------+---------------+---------------+---------------
 k_3 | -2.57   -3.46 | -2.86   -3.78 | -3.13   -4.05 | -3.43   -4.37
accept if t > critical value for I(0) regressors
reject if t < critical value for I(1) regressors

k: # of non-deterministic regressors in long-run relationship
Critical values from Pesaran/Shin/Smith (2001)

. estimates restore ecreg
(results ecreg are active now)

. regress

      Source |       SS       df       MS              Number of obs =      33
-------------+------------------------------           F( 11,    21) =   23.61
       Model |  26.8916752    11  2.44469775           Prob > F      =  0.0000
    Residual |  2.17406184    21  .103526754           R-squared     =  0.9252
-------------+------------------------------           Adj R-squared =  0.8860
       Total |  29.0657371    32  .908304283           Root MSE      =  .32176

------------------------------------------------------------------------------
      D.unemp |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       unemp |
         L1. |  -.3903934   .1097378    -3.56   0.002    -.6186057   -.1621811
             |
        tdef |   9.24e-07   5.42e-07     1.70   0.103    -2.04e-07    2.05e-06
        pbdt |  -.0000729   .0000311    -2.35   0.029    -.0001376   -8.27e-06
       lnfdi |   .0460884   .2030769     0.23   0.823    -.3762331    .4684098
             |
        tdef |
         D1. |   1.78e-06   1.11e-06     1.61   0.123    -5.24e-07    4.09e-06
         LD. |  -1.45e-06   1.14e-06    -1.27   0.219    -3.83e-06    9.30e-07
             |
        pbdt |
         D1. |   .0014796   .0002729     5.42   0.000     .0009121    .0020471
         LD. |   .0012011   .0003513     3.42   0.003     .0004705    .0019317
        L2D. |  -.0008341   .0003808    -2.19   0.040     -.001626   -.0000422
             |
       lnfdi |
         D1. |  -.6099894   .1955855    -3.12   0.005    -1.016732   -.2032472
         LD. |  -.4290785    .164886    -2.60   0.017    -.7719778   -.0861793
             |
       _cons |   1.102921   5.384099     0.20   0.840    -10.09393    12.29977
------------------------------------------------------------------------------
```

POST ESTIMATION TESTS FOR ARDL

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```
. estat dwatson

Durbin-Watson d-statistic( 12,    33) =   1.54374

. estat bgodfrey

Breusch-Godfrey LM test for autocorrelation
```

lags(p)	chi2	df	Prob > chi2
1	2.170	1	0.1407

```
                        H0: no serial correlation

. estat archlm
LM test for autoregressive conditional heteroskedasticity (ARCH)
```

lags(p)	chi2	df	Prob > chi2
1	0.003	1	0.9588

```
         H0: no ARCH effects      vs.  H1: ARCH(p) disturbance

. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of D.unemp

         chi2(1)      =     0.06
         Prob > chi2  =   0.8094

. estat ovtest

Ramsey RESET test using powers of the fitted values of D.unemp
       Ho:  model has no omitted variables
                  F(3, 18) =      2.49
                  Prob > F =      0.0933
```

Cointegration and Endogeneity tests for model 2

```
. reg lnpbdt tdef intr psavert bdef

      Source |       SS       df       MS              Number of obs =      37
-------------+------------------------------           F(  4,    32) =   40.92
       Model |  22.3116606     4  5.57791514           Prob > F      =  0.0000
    Residual |  4.36205275    32  .136314149           R-squared     =  0.8365
-------------+------------------------------           Adj R-squared =  0.8160
       Total |  26.6737133    36  .740936481           Root MSE      =  .36921

------------------------------------------------------------------------------
      lnpbdt |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        tdef |  -3.13e-07   4.48e-07    -0.70   0.490    -1.23e-06    6.00e-07
        intr |  -.1718936   .0500537    -3.43   0.002    -.2738496   -.0699376
     psavert |  -.1489033   .0343738    -4.33   0.000    -.2189204   -.0788863
        bdef |  -.0005095   .0002462    -2.07   0.047     -.001011   -8.12e-06
       _cons |   10.07075    .442968    22.73   0.000     9.168455    10.97305
------------------------------------------------------------------------------

. predict u, residuals

. dfuller u

Dickey-Fuller test for unit root                   Number of obs   =        36

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -3.552            -3.675            -2.969            -2.617
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0068

. reg tdef intr psavert bdef

      Source |       SS       df       MS              Number of obs =      37
-------------+------------------------------           F(  3,    33) =   22.80
       Model |  1.4067e+12     3  4.6889e+11           Prob > F      =  0.0000
    Residual |  6.7857e+11    33  2.0563e+10           R-squared     =  0.6746
-------------+------------------------------           Adj R-squared =  0.6450
       Total |  2.0852e+12    36  5.7924e+10           Root MSE      =  1.4e+05

------------------------------------------------------------------------------
        tdef |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        intr |   49640.62   17414.29     2.85   0.007     14210.98    85070.25
     psavert |   45779.34   10711.11     4.27   0.000     23987.43    67571.25
        bdef |   73.30886    94.7516     0.77   0.445    -119.4647    266.0825
       _cons |  -808927.5   98844.69    -8.18   0.000     -1010029   -607826.5
------------------------------------------------------------------------------

. predict v, residuals

. reg lnpbdt tdef v

      Source |       SS       df       MS              Number of obs =      37
-------------+------------------------------           F(  2,    34) =   79.50
       Model |  21.9748842     2  10.9874421           Prob > F      =  0.0000
    Residual |  4.69882917    34  .138200858           R-squared     =  0.8238
-------------+------------------------------           Adj R-squared =  0.8135
       Total |  26.6737133    36  .740936481           Root MSE      =  .37175

------------------------------------------------------------------------------
      lnpbdt |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        tdef |  -3.95e-06   3.13e-07   -12.59   0.000    -4.58e-06   -3.31e-06
           v |   3.63e-06   5.49e-07     6.61   0.000     2.52e-06    4.75e-06
       _cons |    7.36501   .1112125    66.22   0.000     7.138999    7.591021
------------------------------------------------------------------------------
```

2-STAGE LEAST SQUARE RESULT

```
. ivregress 2sls lnpbdt bdef (tdef = intr psavert)

Instrumental variables (2SLS) regression          Number of obs =      37
                                                  Wald chi2(2)  =   69.22
                                                  Prob > chi2   =  0.0000
                                                  R-squared     =  0.5543
                                                  Root MSE      =  .56685

------------------------------------------------------------------------------
      lnpbdt |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        tdef |  -3.64e-06   5.63e-07    -6.47   0.000    -4.75e-06   -2.54e-06
        bdef |  -.0002929   .0002876    -1.02   0.309    -.0008567    .0002708
       _cons |   7.361041    .169621    43.40   0.000      7.02859    7.693492
------------------------------------------------------------------------------
Instrumented:  tdef
Instruments:   bdef intr psavert
```

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POST ESTIMATION TESTS FOR 2SLS

```
. estat endog

  Tests of endogeneity
  Ho: variables are exogenous

  Durbin (score) chi2(1)          =  18.7897  (p = 0.0000)
  Wu-Hausman F(1,33)              =    34.05  (p = 0.0000)

. estat firststage

  First-stage regression summary statistics
```

First-stage regression summary statistics

Variable	R-sq.	Adjusted R-sq.	Partial R-sq.	F(2,33)	Prob > F
tdef	0.6746	0.6450	0.5988	24.6221	0.0000

```
  Minimum eigenvalue statistic = 24.6221

  Critical Values                      # of endogenous regressors:    1
  Ho: Instruments are weak             # of excluded instruments:     2
```

	5%	10%	20%	30%
2SLS relative bias	(not available)			
	10%	15%	20%	25%
2SLS Size of nominal 5% Wald test	19.93	11.59	8.75	7.25
LIML Size of nominal 5% Wald test	8.68	5.33	4.42	3.92

```
. estat overid

  Tests of overidentifying restrictions:

  Sargan (score) chi2(1) =   .01103  (p = 0.9164)
  Basmann chi2(1)        =  .009841  (p = 0.9210)
```