An Analysis of the U.S. Trade Balance, Its Long-Run Determinants, and Its Future Outlook

by
Kyle Getsiv

A THESIS

submitted to
Oregon State University
Honors College

in partial fulfillment of
the requirements for the
degree of

Honors Baccalaureate of Science in Finance
(Honors Associate)

Presented June 4, 2019
Commencement June 2019

AN ABSTRACT OF THE THESIS OF

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Abstract approved:_____
Jon Chesbro

This paper analyzes macroeconomic variables to determine which affect the United States' trade balance. Data on GDP, exchange rates, money supply and the trade balance are adjusted for changing price levels to get inflation-adjusted variables. This will lead to a regression with the goal of determining which factors explain the variability of the trade balance. 4 specific conclusions came from the regression, the first being that real GDP is the most significant variable in determining the movement of the United States' trade balance. The second conclusions is that the exchange rate has no statistical relationship with the U.S.'s trade balance. The third conclusion is that the U.S. real money supply has no statistical relationship with the trade balance. The fourth and final conclusion is that time effects that are based on changes in trade policies had no effect on the U.S. trade balance outside of the variables affected in my model.

Key Words: Trade balance, Gross Domestic Product (GDP), inflation, price index, exchange rates, exports, imports, tariffs, money supply

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I understand that my project will become part of the permanent collection of Oregon State University, Honors College. My signature below authorizes release of my project to any reader upon request.

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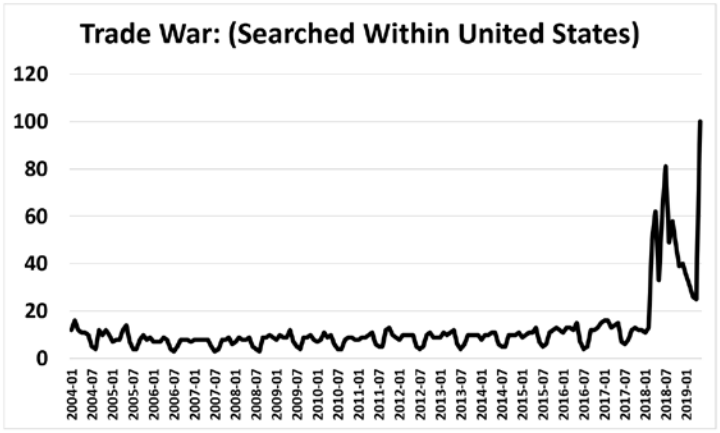
Kyle Getsiv, Author

Introduction

In the recent political environment, there has been a lot of talk on U.S. trade. Using Google Trends, search rates for the phrase “trade war” have increased dramatically since the beginning of 2018. During his Presidential campaign, Donald Trump repeatedly labeled China as “a currency manipulator” while promising to impose tariffs on Chinese goods in an effort to decrease its U.S. exports and increasing U.S. production. Trump accused China of unfair trade deals at nearly every rally of his presidential campaign (Corasaniti, NY Times). China has recently seen their currency, the Chinese Yuan, decrease in value rapidly against the U.S. dollar since early 2018, shown by the graph above. Some believe that China’s central bank is purposely devaluing the currency in an effort to make their exports more attractive when compared to another country or the world, a strategy known as a currency war (CNN). The Trump administration, in an effort to increase U.S. production and punish China for what has been called “unfair trade practices”, imposed tariffs on $250bn worth of Chinese imports (BBC). While tariffs might increase production within the U.S. by making imports more expensive, this also makes consumers pay higher prices for goods.



Currency wars, tariffs, and other strategies can be used to improve a countries trade balance. The trade balance is commonly known as the net trade of a country, meaning their exports minus their imports, but sometimes calculated as exports divided by imports. A trade surplus, more exports than imports, is thought of as favorable “because it’s like making a profit as a country” (Amadeo). Theoretically, selling more than you are buying is favorable and can give a person, business, or country more capital to work with. By having a trade surplus and producing many exports for other countries, those domestic companies have a comparative advantage in production. A positive trade balance is not a guarantee of success in a country, as a trade deficit can be favorable at times. Hong Kong is a country with a large trade deficit caused by importing so many raw materials before exporting them as finished goods (Amadeo). On the other side, Romania improved its trade balances by using tariffs to slow imports, then using income generated from exports to pay off sovereign debt in the 1980s. By raising prices of imports, this increased Romania’s domestic production and led to a more favorable trade balance, but decreased the standard of living within Romania. This led to the overthrow of the regime who enacted these changes (Krauss). The trade balance can be a good indicator of the financial success of a country, but should not be looked at as the sole indicator of said success. Quality of life, size, and other factors should be considered.

The purpose of this paper is to determine how various macroeconomic factors influence our trade balance in the long-run. In the next section, I will review literature on how various factors have determined a country's trade balance. After this, I will display data on U.S. and international macroeconomic factors along with the U.S. trade balance. For the purpose of this paper, all instances of trade balances refer to the formula “Exports - Imports” unless explicitly

said otherwise. This will lead to a regression with the goal of determining which factors explain the variability of the trade balance. The results from my regression led to 4 specific conclusions:

1. Real GDP is the most significant variable in determining the movement of the United States' trade balance. U.S. real GDP also has a larger effect than real world GDP.
2. The exchange rate has no statistical relationship with the U.S.'s trade balance.
3. The U.S. real money supply has no statistical relationship with the trade balance.
4. Time effects that are based on changes in trade policies had no effect on the U.S. trade balance outside of the variables affected in my model.

Summary of Past Literature

Michael Mussa (1974), in his analysis of a country's balance of payments, compared two approaches to an analysis of the balance of payments before and after tariffs. The first approach, called the real theory, looks at the effect of a tariff on "real" variables like relative prices, trade volume, consumption levels, and production levels. When the tariff rate is increased, the imports decrease while the value of exports at world prices decreases by the same amount. While domestic income increases, expenditure increases, also by the same amount. Based on this model, tariffs have no effect on the balance of payments.

The monetary model includes behavior with respect to money. The demand for money in this model is proportional to nominal income but dependent on interest rates of domestic securities. Mussa (1974) found that the change in a tariff rates effect on the money balance is proportional to the change in income, given the assumption that the money supply changes only through changes in the balance of payments. This assumption is unreasonable for the United States, as the money supply can be changed by monetary policy and not only through changes in

the balance of payments. While the monetary approach is considered necessary for finding the effects of tariffs on the balance of payments, it may not be suitable for the United States.

Jonathan Ostry (1992) found that tariffs had no effect on the real exchange rate, real trade balance, and real output (foreign and domestic). Ostry (1992) used 5 different data sets, looking at the short run and long run data. While bilateral trade statistics weren't affected by tariffs, tariffs were found to have significant effects on the volume of international trade. Ostry (1992) found no significant effects of tariffs on trade flows or real exchange rates.

Looking to see which variables had long-term effects on a country's trade balance, Mohsen Bahmani-Oskooee (2002) used a cointegration technique. Bahamni-Oskooee wanted to see if, while the trade balance can be somewhat unpredictable, certain variables had patterns with the trade balance and could be looked at as determinants of which direction the trade balance would go. In his data analysis, the full employment budget had a long-run relationship with a country's trade balance and current account, with a budget deficit increasing a trade deficit.

By looking at the M2 measure of money supply, Bahmani-Oskooee (1992) found that a decrease in the money supply should increase the trade balance. Theoretically, a decrease in the money supply would strengthen a country's currency, making their exports less attractive and their imports more attractive, decreasing the trade balance measure (Exports over imports in this paper). A decreased money supply would also lower the country's GDP/income growth, which would decrease imports and has no effect on exports. Bahmani-Oskooee (1992) found the opposite, in that decreasing the money supply leads to a higher export-import ratio. The decreasing money supply would decrease the TB measure (from a stronger currency) while increasing the TB measure (from lower income decreasing imports). Bahmani-Oskooee (1992)

found that the lower GDP had a far greater impact on the trade balance than the stronger currency, which is why decreasing the money supply increased the trade balance.

The full-employment budget, a variable used to represent government fiscal policy, was also found to have a long-run relationship with the current account and trade balance, with a decrease in the budget causing a decrease in the trade balance. This also means that contractionary fiscal policy would improve the trade balance, meaning a higher exports-to-imports ratio. The full employment budget was defined as the real natural federal surplus.

The most interesting finding was that real or nominal exchange rate changes did not have any long-term effects on the current account or trade balance. Prices did not appear to have any long-term effects on a country's trade balance. This paper suggests that fiscal policy is a good way to manipulate the U.S.'s trade balance, going against other claims that fiscal policy would have little effect on trade measures.

Conflicting with Bahmani-Oskooee's results, Olugbenga Onafowora (2003) saw a statistically significant relationship between exchange rates and trade measures. Onafowora (2003) looked at real exchange rates and how they affect trade balances within Asian countries. Some countries have employed the tactic of devaluing their own currency, theoretically increasing exports and improving the trade balance. Onafowora (2003) looked at 3 specific countries, Thailand, Malaysia, and Indonesia, and analyzed their bilateral trade balance with the U.S. and Japan along with their exchange rates. It also should be noted that Onafowora looked at bilateral trade balance as opposed to their trade balances with the world.

A devalued currency increased the volume of exports (known as the "volume effect"). The higher real exchange rate also increased the value of each import (known as the "import value effect"), diminishing the effect of increased exports. The increased value of each import

takes effect more so in the short-run than the volume effect, which would cause the trade balance to decrease. The volume effect is believed to take effect more so in the long run, creating a "J" line on a graph with TB on the Y-axis and time on the X-axis.

In 5 of the 6 cases analyzed, the depreciation in domestic currency caused an initial worsening in the trade balance. This typically lasted about 4 quarters before beginning to improve over the long-run. 1 case, Thailand and its bilateral trade balance with Japan, saw an initial improvement, followed by a worsening and then improving again in the long run. While the 5 cases followed the J-curve effect, the 6th case followed the S-curve pattern (The S-curve is much like a J-curve but with 2 changes in direction instead of 1). In conclusion, a devaluation of the domestic currency (increase in the real exchange rate) was seen to cause long-term improvement in bilateral trade balances.

In a study done by Lane and Milesi-Ferretti (2002), they found a negative long-run relationship between trade balance and the real exchange rate, as expected. This followed general intuition, as a devalued currency would increase exports and increase imports. While Bahmani-Oskooee looked at the U.S. trade balance specifically, Lane used data from 21 different countries. Lane (2002) also separated his data into 3 groups: the full sample, G3 countries (Germany, Japan, United States), and non-G3 (full sample, less G3). Lane did not find any relationship between exchange rate and trade balance in the G3 countries alone, but found significance in the non-G3 and full sample groups.

The model made by Pacheco-Lopez (2005) found that trade liberalization prior to NAFTA increased the growth of both Mexico's exports and imports, with imports responding earlier. NAFTA (enacted in 1994) showed no effect on Mexico's export growth with a "statistically significant effect" on import growth. Given changes in domestic income and the

real exchange rate, the study suggests, the import growth rate was 84% higher after 1994. She also found that the trade reforms of 1980 have decreased the trade balance (imports growing faster than exports). Export growth was slower than imports, making the ratio of exports to imports lower. Pacheco-Lopez found that, in this application, free trade was not found to guarantee an increase or decrease in the balance of payments or trade balance.

From the past studies, it appears that monetary policy could be the driving force behind the trade balance, as well as exchange rates. Bahmani-Oskooee (1992) suggested that fiscal and monetary policy can be used to manipulate the trade balance. His paper also suggested that the exchange rate (real and nominal) had no effect on the trade balance in the long-run. This goes against the results of Lane (2002) and Onafowora (2003), which showed that depreciating exchange rates improved the countries trade balance (exports - imports). What *was* significant was that Lane found no relationship between exchange rate and trade balance when only looking at G3 countries (Germany, Japan, U.S.). While Lane and Bahmani-Oskooee had different final points, they both found no relationship between exchange rate and trade balance with the United States. Onafowora also found a long-run relationship while only looking at countries relatively smaller than the U.S. and using bilateral trade balances and not total trade balances.

It appears that, in the long run, domestic GDP is what determines the trade balance. The change in money supply can affect the exchange rate, which appears to affect a smaller country's trade balance but no significant effect on a larger country's trade balance. The change in money supply also can affect a country's GDP, which was shown to affect the trade balance (shown in Bahmani-Oskooee's analysis of the U.S. TB). GDP growth relative to the world would make sense intuitively as a trade balance determinant. If a country suddenly had more income than

others, it would increase spending on imports, worsening their trade balance ratio, and vice versa.

Another note of interest was that tariffs were found to not affect the trade balance in the long-run trade measures (from Ostry's research). While all the variables I have described appear to have some effects on the short run trade balance, only GDP looks to affect the trade balance in larger countries (with exchange rate having an effect in smaller countries).

By seeing how tariffs and other macroeconomic events in previous time periods have impacted a country's trade balance, one could apply these concepts to the current situation the U.S. is in. By predicting each component of the trade balance using historical data and predictions based on what has happened, a prediction could be made on how the United States' balance will change if at all.

Data Analysis

Based on previous research, I chose 6 variables to collect data on and see how they affected the U.S. trade balance. I collected data on GDP and inflation from both the U.S. and World to see if the income effect described in Bahmani-Oskooee's paper could be seen. Bahmani-Oskooee (1992) also saw the money supply of the domestic country play a factor in their trade balance, concluding his paper by saying that monetary policy was the best way of increasing/decreasing the trade balance. For this reason, I also included the money supply, specifically the M2 money stock, in my data.

Pacheco-Lopez (2005) saw that changes in world trade policy had an effect on Mexico's trade balance. By using dummy variables to show different time periods, she was able to see if

certain periods affect the trade balance differently than others. Because of this, I will also use dummy variables to represent different periods in the U.S.'s history.

Using data from 1981-2017, the first significant trade agreement was NAFTA, the North American Free Trade Agreement, which took effect in 1994. In 1995, the World Trade Organization (WTO) took effect to become the largest international economic organization, with 164 current members. The organization has laid out steps to handling trade disputes and negotiations, lowering trade barriers within members. In December of 2001, China joined the WTO in an effort to become more integrated with the World economy. This allowed China to liberalize more sectors and bring inflows of foreign investment while following many more rules on foreign trade and intellectual property. The period between 2008 and 2009 marks the beginning of the Great Recession. Dummy variables will be used for these periods.

Based on work by Mussa (1974) and Ostry (1992), tariffs were found to not have a significant impact on a countries trade balance. Mussa (1974) theorized that an increase in the tariff rate would decrease imports while increasing a countries GDP. With the increase in income, expenditure also increased by the same amount, causing no effect on the trade balance. Ostry (1992) found that tariffs only changed the *overall volume* of international trade and not a country's trade balance. For these reasons, I decided not to include any variable representative of tariff rates in my data.

After studying 3 Asian countries and their exchange rate's effect on the trade balance, Olugbenga Onafowora (2003) saw a significant relationship between the two. Lane (2002) also found a significant relationship between exchange rate and trade balance, but only in non-G3 countries, suggesting it may only be a factor in smaller countries. To see whether this was true for the U.S., I chose to include the exchange rate in my data set. Since there is no "World

Currency", the U.S. Federal Reserve System created a trade-weighted index to show "A weighted average of the foreign exchange value of the U.S. dollar against the currencies of a broad group of major U.S. trading partners" (Federal Reserve Bank of St. Louis). While there other options of World currency substitutes, I felt this was the best as it weighed currencies based on which countries the U.S. was trading with at the time. This gives an accurate view of the exchange rate the U.S. truly had in their trade with the world at any specific time.

Table 1: Initial Data Table

1	2	3	4	5	6	7	8
Year	**US GDP**	**W GDP**	**US Price Index**	**World Price Index**	**ER**	**US MS**	**US TB**
1981	3,211	8,362	109.34	110.62	1.10	1,918	(16,172)
1982	3,345	8,117	116.12	119.57	1.05	2,123	(24,156)
1983	3,638	8,055	120.70	128.47	0.98	2,317	(57,767)
1984	4,041	8,093	124.99	138.58	1.10	2,494	(109,072)
1985	4,347	8,403	128.99	146.07	1.22	2,744	(121,880)
1986	4,590	10,479	131.59	153.65	1.42	2,829	(138,538)
1987	4,870	12,275	134.95	163.89	1.35	2,990	(151,684)
1988	5,253	13,931	139.67	174.02	1.31	3,157	(114,566)
1989	5,658	14,446	145.10	186.03	1.42	3,281	(93,141)
1990	5,980	16,628	150.47	200.17	1.43	3,368	(80,864)
1991	6,174	17,777	155.48	216.42	1.38	3,423	(31,135)
1992	6,539	18,899	159.02	230.38	1.37	3,475	(39,212)
1993	6,879	18,974	162.80	246.69	1.46	3,486	(70,311)
1994	7,309	20,459	166.27	270.41	1.49	3,632	(98,493)
1995	7,664	23,206	169.74	291.47	1.44	3,811	(96,384)
1996	8,100	23,462	172.83	308.96	1.35	4,029	(104,065)
1997	8,609	22,845	175.79	323.98	1.41	4,371	(108,273)
1998	9,089	22,285	177.70	338.03	1.37	4,639	(166,140)
1999	9,661	22,880	180.42	351.84	1.30	4,924	(258,617)
2000	10,285	23,313	184.53	367.65	1.26	5,439	(372,517)
2001	10,622	22,779	188.73	381.07	1.36	5,763	(361,511)
2002	10,978	23,709	191.63	394.18	1.49	6,054	(418,955)
2003	11,511	27,416	195.45	409.85	1.55	6,420	(493,890)
2004	12,275	31,570	200.82	432.80	1.43	6,677	(609,883)
2005	13,094	34,393	207.29	458.03	1.50	7,076	(714,245)
2006	13,856	37,590	213.65	484.48	1.58	7,468	(761,716)
2007	14,478	43,476	219.34	510.34	1.54	8,218	(705,375)
2008	14,719	48,856	223.64	551.56	1.57	8,470	(708,726)
2009	14,419	45,848	225.34	564.84	1.54	8,811	(383,774)
2010	14,964	51,002	228.09	589.51	1.54	9,640	(495,225)
2011	15,518	57,799	232.80	623.96	1.54	10,515	(549,699)
2012	16,155	58,838	237.09	646.08	1.54	11,028	(537,408)
2013	16,692	60,407	240.92	659.72	1.45	11,696	(461,135)
2014	17,428	61,761	245.24	673.22	1.39	12,364	(489,584)
2015	18,121	56,795	247.90	686.83	1.34	13,216	(498,525)
2016	18,624	57,373	251.07	700.41	1.42	13,848	(502,001)
2017	19,391	61,347	255.58	724.38	1.39	14,425	(552,277)
Average	*10,218*	*29,834*	*184.08*	*377.25*	*1.39*	*6,220*	*(310,727)*
Standard Deviation	*4,949*	*18,199*	*43.27*	*195.77*	*0.15*	*3,678*	*239,502*
R-Squared	*0.730*	*0.606*	*0.692*	*0.678*	*0.369*	*0.597*	*1.00*
Correlation With TB	*(0.85)*	*(0.78)*	*(0.83)*	*(0.82)*	*(0.61)*	*(0.77)*	*1.00*

Comments:

(1) Calendar Year

(2) U.S. GDP (current US$), WorldBank, Indicator Code NY.GDP.MKTP.CD in Billions

(3) World GDP (current US$) with U.S. GDP taken out, WorldBank, Indicator Code NY.GDP.MKTP.CD, in Billions

(4) U.S. Price Index made from U.S. Inflation, GDP deflator (annual %), WorldBank, Indicator Code NY.GDP.DEFL.KD.ZG, in Billions

(5) World Price Index made from World Inflation, GDP deflator (annual %), WorldBank, Indicator Code NY.GDP.DEFL.KD.ZG

(6) Board of Governors of the Federal Reserve System (US), Trade Weighted U.S. Dollar Index: Broad, Goods [TWEXBANL], retrieved from FRED, Federal Reserve Bank of St. Louis

(7) Board of Governors of the Federal Reserve System (US), M2 Money Stock [M2], retrieved from FRED, Federal Reserve Bank of St. Louis, in Billions, annual, end of year

(8) U.S. Trade in Goods and Services - Balance of Payments (BOP) Basis, U.S. Census Bureau, Economic Indicator Division, in Millions

Table 1 shows the initial statistics calculated at the end of each period. Along with initial data, the average, standard deviation, R-squared (with USTB as the dependent variable) and correlation with USTB is shown. The trade balance was calculated as (Exports-Imports). World GDP in this paper has had U.S. GDP subtracted from it, representing "the world less U.S.".

U.S. GDP has a correlation with USTB of -0.85, suggest that when GDP increases, the trade balance gets lower. When GDP increases (all else equal), Americans have more income and will theoretically spend more, increasing imports relative to exports and lowering the trade balance. This theory is consistent with findings from Bahmani-Oskooee (1992). Surprisingly, World GDP also has a negative correlation with USTB.

The U.S. and World price index was calculated from inflation data, using 1980 as a base year to show the price index in this period. The U.S. Price Index has a negative correlation with USTB, suggesting that when inflation is positive (the dollar is losing value), trade balance gets worse.

High inflation would make exports more attractive and increase TB, consistent with the study done by Lane (2002). The opposite is seen in the data, as an increase U.S. price index is decreasing USTB. This is likely shown for two reasons, the first being that world inflation isn't factored in. If world inflation is higher than U.S. inflation (which it was on average), then increasing world inflation would be increasing the value of a U.S. dollar if coupled with higher world inflation. The other reason would be that exchange rates have no significant effect on the trade balance of a large country like the U.S. In his study, Lane (2002) found that larger country's trade balances were unaffected by changes in exchange rates.

When looking at this table, the U.S. M2 money supply has a -0.77 correlation with USTB. This is consistent with research by Bahmani-Oskooee (1992) that a decrease in money supply leads to an increase in the trade balance.

The R-squared of each variable's relationship with USTB was also calculated, with USGDP having the highest at 0.73, meaning about 73% of the variability can be explained by changes in U.S. GDP. This is considerably high, suggesting that domestic income has a large impact on their trade balance. Every variable except ER has an R-squared above 0.58, while ER has an R-squared of only 0.35, suggesting it has a considerably lower effect on the trade balance than every other variable.

Table 2: Correlation and R-Squared Matrix

	US GDP	W GDP	US PI	W PI	ER	US MS	US TB
US GDP		**0.9699** *0.941*	**0.9931** *0.986*	**0.9959** *0.992*	**0.6001** *0.360*	**0.9738** *0.948*	**-0.8545** *0.730*
W GDP	**0.9699** *0.941*		**0.9652** *0.932*	**0.9826** *0.966*	**0.5733** *0.329*	**0.9732** *0.947*	**-0.7787** *0.606*
US PI	**0.9931** *0.986*	**0.9652** *0.932*		**0.9913** *0.983*	**0.6578** *0.433*	**0.9531** *0.908*	**-0.8321** *0.692*
W PI	**0.9959** *0.992*	**0.9826** *0.966*	**0.9913** *0.983*		**0.5860** *0.343*	**0.9778** *0.956*	**-0.8234** *0.678*
ER	**0.6001** *0.360*	**0.5733** *0.329*	**0.6578** *0.433*	**0.5860** *0.343*		**0.4830** *0.233*	**-0.6077** *0.369*
US MS	**0.9738** *0.948*	**0.9732** *0.947*	**0.9531** *0.908*	**0.9778** *0.956*	**0.4830** *0.233*		**-0.7724** *0.597*
US TB	**-0.8545** *0.730*	**-0.7787** *0.606*	**-0.8321** *0.692*	**-0.8234** *0.678*	**-0.6077** *0.369*	**-0.7724** *0.597*	

(Correlation)
(R-Squared)

Table 2 shows a correlation and R-Squared matrix between each variable, using the initial data. The highest correlations are between the U.S. price index (US PI) and USGDP and the World price index (W PI) and USGDP, both with correlations above 0.99. USMS and USGDP also have a correlation of 0.9738. USTB has the highest correlation and R-Squared with USGDP, making it seem to be the most important factor of these variables. Then looking at GDP, inflation

(both U.S. and World) and USMS have the highest correlations and R-Squared. Based on this, manipulating the M2 money supply (USMS) to change GDP growth and inflation would be an effective way of increasing or decreasing the U.S. Trade Balance, consistent with Bahmani-Oskooee (1992)'s work.

Table 3: Rates of Change from Initial Values

1	2	3	4	5	6	7	8
Year	**US GDP**	**W GDP**	**US Inflation**	**W Inflation**	**ER**	**US MS**	**US TB**
1982	4.17%	-2.93%	6.20%	8.10%	-5.09%	10.70%	49.37%
1983	8.76%	-0.76%	3.95%	7.44%	-6.38%	9.15%	139.14%
1984	11.06%	0.47%	3.55%	7.87%	12.06%	7.66%	88.81%
1985	7.57%	3.83%	3.20%	5.41%	11.36%	10.01%	11.74%
1986	5.60%	24.71%	2.02%	5.19%	15.98%	3.08%	13.67%
1987	6.10%	17.14%	2.55%	6.66%	-5.14%	5.69%	9.49%
1988	7.85%	13.49%	3.50%	6.18%	-2.34%	5.61%	-24.47%
1989	7.71%	3.70%	3.89%	6.90%	8.26%	3.91%	-18.70%
1990	5.69%	15.10%	3.70%	7.60%	0.55%	2.66%	-13.18%
1991	3.25%	6.91%	3.33%	8.12%	-3.87%	1.65%	-61.50%
1992	5.92%	6.31%	2.28%	6.45%	-0.11%	1.50%	25.94%
1993	5.19%	0.40%	2.38%	7.08%	6.28%	0.33%	79.31%
1994	6.25%	7.82%	2.13%	9.62%	1.82%	4.19%	40.08%
1995	4.86%	13.43%	2.09%	7.78%	-3.26%	4.92%	-2.14%
1996	5.69%	1.10%	1.83%	6.00%	-6.17%	5.74%	7.97%
1997	6.28%	-2.63%	1.71%	4.86%	4.36%	8.47%	4.04%
1998	5.58%	-2.45%	1.09%	4.34%	-2.52%	6.14%	53.45%
1999	6.29%	2.67%	1.53%	4.08%	-5.07%	6.16%	55.66%
2000	6.46%	1.89%	2.28%	4.49%	-3.55%	10.45%	44.04%
2001	3.28%	-2.29%	2.28%	3.65%	8.18%	5.96%	-2.95%
2002	3.35%	4.08%	1.54%	3.44%	9.30%	5.04%	15.89%
2003	4.86%	15.64%	1.99%	3.97%	4.51%	6.05%	17.89%
2004	6.64%	15.15%	2.75%	5.60%	-7.97%	4.01%	23.49%
2005	6.67%	8.94%	3.22%	5.83%	5.26%	5.97%	17.11%
2006	5.82%	9.29%	3.07%	5.78%	5.04%	5.54%	6.65%
2007	4.49%	15.66%	2.66%	5.34%	-2.53%	10.03%	-7.40%
2008	1.66%	12.38%	1.96%	8.08%	1.78%	3.07%	0.48%
2009	-2.04%	-6.16%	0.76%	2.41%	-1.76%	4.03%	-45.85%
2010	3.78%	11.24%	1.22%	4.37%	-0.31%	9.41%	29.04%
2011	3.70%	13.33%	2.06%	5.84%	0.11%	9.08%	11.00%
2012	4.11%	1.80%	1.84%	3.54%	0.20%	4.88%	-2.24%
2013	3.32%	2.67%	1.62%	2.11%	-5.92%	6.05%	-14.19%
2014	4.41%	2.24%	1.79%	2.05%	-4.35%	5.71%	6.17%
2015	3.98%	-8.04%	1.08%	2.02%	-2.99%	6.89%	1.83%
2016	2.78%	1.02%	1.28%	1.98%	5.94%	4.79%	0.70%
2017	4.11%	6.93%	1.80%	3.42%	-2.34%	4.16%	10.02%
Average	*5.14%*	*5.95%*	*2.39%*	*5.38%*	*0.81%*	*5.80%*	*15.84%*
Standard Deviation	*2.23%*	*7.49%*	*1.07%*	*2.04%*	*5.98%*	*2.60%*	*36.82%*
Correlation With TB	*(0.34)*	*(0.41)*	*(0.14)*	*(0.42)*	*(0.07)*	*0.32*	*0.15*

Comments:

Rates of change from initial values in Table 1

Table 3 shows the growth rates of the same statistics from Table 1. While U.S. and World GDP growth was very similar (5.14% average growth per year compared to 5.95%), this is misleading. Inflation is not factored in, which would drastically change these numbers considering the U.S. price index increased an average of 2.39% each year compared to the world increasing 5.38% each year. Along with this, the standard deviation is 2.23% for the U.S. and almost 7.5% for the World, making it 3 times as volatile.

Looking at the U.S. inflation, almost all of the highest values came in the 1980s and early 1990s, with the only other year inflation was above 3% being 2005 and 2006.

The exchange rate had an average growth of 0.81%, meaning the dollar slightly decreases in comparison to World currency each year. This is somewhat contradictory as world inflation has increased faster on average than U.S. inflation.

Looking at 1998, the trade balance decreased by 53.45%. U.S. GDP increased by 5.58% (compared to World GDP *falling* by 2.45%) and the U.S. M2 money supply also increased by 6.14%. This increase in income would likely cause Americans to purchase more relative to the world, increasing imports into the U.S., decreasing our trade balance.

The exchange rate also decreased by 5.52%, making the dollar stronger compared to a world currency. This would suggest a decrease in the trade balance due to attractive exchange rates for non-U.S. trade partners, consistent with the data shown.

Table 4: Compound Annual Growth Rates by Specific Periods

1	2	3	4	5	6	7	8
Period	**US GDP**	**W GDP**	**US Inflation**	**W Inflation**	**ER**	**US MS**	**US TB**
1981-1993	6.04%	6.51%	3.11%	6.36%	2.18%	4.71%	-11.97%
1994-2001	4.78%	1.35%	1.60%	4.38%	-1.11%	5.94%	-17.65%
2002-2008	4.28%	10.88%	2.23%	4.92%	0.77%	4.91%	-7.80%
2009-2017	3.35%	3.29%	1.41%	2.80%	-1.13%	5.63%	-4.13%
Total	4.98%	5.53%	2.32%	5.21%	0.63%	5.61%	-10.01%

Comments:

Compound annual growth rates for the variables from Table 1

Table 4 shows compound annual growth rates for 4 different time periods. The first time period, 1982-1993, is meant to show data up until NAFTA took effect in 1994. 1994-2001 is meant to show the effects of NAFTA while going up until China joined the World Trade Organization (China joined in December 2001). 2002-2008 shows the data until the U.S. financial crisis, while 2009-2017 covers the crisis and data since then.

Looking at the growth rates before and after NAFTA, U.S. GDP dropped from 6% annual growth to 4.8%, while World GDP dropped from 6.5% to 1.35%. The U.S. dollar also was decreasing in value before NAFTA while increasing in value relative to other currencies. After NAFTA, the U.S. Trade Balance decreased faster than before (-17.65% after NAFTA and -11.97% before). This could be explained by U.S. GDP growing much faster than the World GDP in this time period, resulting in Americans buying much more and importing more as a result of increased income and trade liberalization. With World GDP slowing in this time, the U.S. likely did not export as much, causing the trade balance to lower the fastest.

Looking at the totals, the trade balance has steadily declined even as World GDP increased slightly more than U.S. GDP (More world income would theoretically increase U.S. exports and increase USTB). While nominal GDP growth was close between the U.S. and World, inflation was over twice as large with the world than the U.S.

Table 5: Initial Data Adjusted for Price Levels

1	2	3	4	5	6
Year	**US RGDP**	**W RGDP**	**RER**	**US RMS**	**US RTB**
1981	2,937	7,560	1.12	1,754	(14,791)
1982	2,881	6,789	1.08	1,828	(20,803)
1983	3,014	6,270	1.04	1,919	(47,858)
1984	3,233	5,840	1.22	1,996	(87,267)
1985	3,370	5,752	1.39	2,127	(94,491)
1986	3,488	6,820	1.66	2,150	(105,281)
1987	3,609	7,490	1.63	2,215	(112,404)
1988	3,761	8,005	1.64	2,261	(82,026)
1989	3,899	7,766	1.82	2,261	(64,191)
1990	3,974	8,307	1.90	2,238	(53,742)
1991	3,971	8,214	1.91	2,202	(20,026)
1992	4,112	8,203	1.99	2,185	(24,658)
1993	4,225	7,692	2.21	2,141	(43,188)
1994	4,396	7,566	2.42	2,185	(59,237)
1995	4,515	7,962	2.47	2,245	(56,785)
1996	4,687	7,594	2.41	2,331	(60,211)
1997	4,897	7,051	2.59	2,486	(61,591)
1998	5,115	6,593	2.61	2,610	(93,494)
1999	5,355	6,503	2.54	2,729	(143,341)
2000	5,574	6,341	2.50	2,947	(201,878)
2001	5,628	5,978	2.75	3,054	(191,548)
2002	5,729	6,015	3.06	3,159	(218,629)
2003	5,889	6,689	3.26	3,285	(252,695)
2004	6,112	7,294	3.08	3,325	(303,691)
2005	6,317	7,509	3.32	3,414	(344,571)
2006	6,485	7,759	3.58	3,496	(356,519)
2007	6,601	8,519	3.58	3,747	(321,590)
2008	6,581	8,858	3.87	3,787	(316,901)
2009	6,399	8,117	3.86	3,910	(170,308)
2010	6,561	8,651	3.97	4,226	(217,115)
2011	6,666	9,263	4.12	4,517	(236,123)
2012	6,814	9,107	4.20	4,651	(226,668)
2013	6,928	9,157	3.97	4,855	(191,406)
2014	7,106	9,174	3.80	5,041	(199,632)
2015	7,310	8,269	3.72	5,331	(201,097)
2016	7,418	8,191	3.97	5,516	(199,948)
2017	7,587	8,469	3.94	5,644	(216,085)
Average	*5,220*	*7,604*	*2.708*	*3,129*	*(151,670)*
Standard Deviation	*1,460*	*1,009*	*1.01*	*1,155*	*101,380*
R-Squared	*0.644*	*0.061*	*0.597*	*0.456*	*1.00*
Correlation With TB	*(0.80)*	*(0.25)*	*(0.77)*	*(0.68)*	*1.00*

Comments:

(1) Calendar Year

(2) U.S. Real GDP in Billions, in 1980 dollars

(3) World Real GDP less U.S. Real GDP in Billions, in 1980 dollars

(4) Real Exchange Rate, as calculated as ([World PI x ER] / U.S. PI)

(5) Real M2 Money Supply in Billions, in 1980 dollars

(6) Real U.S. Trade Balance in Millions, in 1980 dollars

Table 5 shows the values from the initial values table adjusted for the change in price levels, showing “real” values. These were calculated by taking that years value and dividing it by the corresponding price index, then multiplying by 100. One thing to note is that real USGDP is only slightly less than real WGDP, meaning the U.S. makes up almost half of the world GDP, as WRGDP is still less-U.S. When looking back at table 4, the world experienced inflation twice the size as the U.S. and very similar GDP growth. This, along with the fact that these numbers are displayed in “1980 dollars”, may explain why U.S. real GDP is almost half of the entire world’s real GDP. The RWGDP correlation with USTB is also now negative, following the concept that more world income would increase U.S. exports, increasing the trade balance.

Table 6: Compound Annual Growth Rates by Specific Periods

1	2	3	4	5	6
Period	**US RGDP**	**W RGDP**	**RER**	**US RMS**	**US RTB**
1981-1993	2.84%	0.13%	5.40%	1.55%	-8.59%
1994-2001	3.14%	-2.90%	1.60%	4.28%	-15.80%
2002-2008	2.00%	5.69%	3.41%	2.62%	-5.45%
2009-2017	1.91%	0.47%	0.23%	4.16%	-2.68%
Total	2.60%	0.31%	3.47%	3.21%	-7.52%

Comments:
Compound annual growth rates for the variables from Table 5

Table 6 shows compound annual growth rates of the real values in Table 5. In the period after NAFTA (1994-2001), USTB decreased at its fastest rate of almost 16% per year. During this period, U.S. RGDP grew the fastest increasing 3.14% each year, and World RGDP decreased the most decreasing by almost 3% each year. With U.S. income decreasing, expenditures would theoretically increase along with imports, decreasing the trade balance. Along with this, a decreasing world RGDP would decrease global expenditure and U.S. exports, also decreasing the trade balance. These two variables could explain why this period had the fastest drop in the trade balance.

From 2002-2008, world RGDP increased 6% compared to the U.S.'s 2% growth. This would theoretically cause the trade balance to increase, but it only decreased slightly less than the 1982-2017 rate.

Model Results

For my model, an ordinary least-squares regression was used. By using all of these variables simultaneously against the trade balance, one can see how one variable can affect the trade balance, ceteris paribus.

Table 7: Model Results

Variable	Model 1		Model 2		Model 3	
Real U.S. GDP	-91.391	*(0.049)*				
Real World GDP	17.133	*(0.244)*				
Real Exchange Rate	-641.792	*(0.991)*				
Real Money Supply	40.516	*(0.589)*				
RGDP Growth			-9.745	*(0.002)*	-9.352	*(0.006)*
RWGDP Growth			1.499	*(0.059)*	1.826	*(0.043)*
REX Growth			-0.020	*(0.981)*	0.304	*(0.729)*
RMS Growth			-1.379	*(0.513)*	2.404	*0.238*
1994-2001					0.188	*0.238*
2002-2008					-0.003	*0.985*
2009-2017					0.104	*0.231*
N	*37*		*36*		*36*	
Adjusted R-Squared	*0.6707*		*0.287*		*0.2775*	

Coefficient *(P-Value)*

Note: OLS regression run in Stata with assistance from Professor J. Chesbro

Model 1 used U.S. real GDP, world real GDP, the real exchange rate, and the real money supply, with the real trade balance as the dependent variable. In this, U.S. real GDP had a t-statistic of -2.05 and a negative coefficient. This is consistent with previous research that a

positive change in U.S. GDP would negatively affect the trade balance by increasing imports. Its p-value is also at 0.049.

Real money supply has a positive coefficient, suggesting an increase in the money supply would increase the trade balance. While previous research concluded that increasing the money supply would decrease the trade balance, this was thought to happen because of the increasing income and expenditure from increasing the money supply. In this case, U.S. real GDP is held constant, and an increase in the money supply is increasing the trade balance. While this might follow intuition, its p-value is 0.141 and isn't statistically significant.

Model 2 uses the rates of change for the same variables. In this model, real U.S. GDP growth is shown to be very significant to the trade balance, with a t-value of -3.48 and a p-value of 0.002. U.S. GDP has consistently shown to be the most significant factor in determining the direction of the trade balance.

Money supply growth also now has a negative coefficient, suggesting a decreasing rate of change in the money supply would lead to an increasing rate of change in the trade balance. With a p-value of 0.513, however, mu is no longer significant.

World real GDP is also significant at the 10% confidence level with a positive coefficient, suggesting an increase in world real GDP would increase the trade balance. World GDP is also more significant when using rates of change as opposed to the levels of each variable. These results are consistent with previous research that, when world income rises relative to U.S. income, U.S. exports would increase faster than imports and the trade balance would increase.

Model 3 uses 3 dummy variables used to represent the periods used in tables 4 and 6. This model only returned an adjusted R-squared of 0.2775, with none of the dummy variables

returning a p-value lower than 0.23 or a t-value larger than 1.3. Based on these results and holding constant domestic/world growth, monetary policy and exchange rates, these time periods had no significant impact on the trade balance, suggesting these changes in trade policy had no effect on the trade balance outside of the variables in the model.

In the model 3, both real U.S. GDP growth and real world GDP growth were statistically significant, with U.S. having a positive coefficient and the world having a negative coefficient. When holding the periods constant, real world GDP became more significant.

Looking at all of the models, the real exchange rate had the lowest t-values and highest p-values. Exchange rates were seen to have very little impact on the trade balance. This has been consistent with Lane (2002)'s theory that larger countries' trade balances are unaffected by exchange rates.

In all 3 models, real U.S. GDP was significant holding all else constant, while real world GDP was significant in models 2 and 3. The coefficient of U.S. real GDP was almost 10 times the size of the world's. A 1% change in the growth rate of the U.S. GDP rate of change would change the trade balance growth rate by 10% in the opposite direction, while a 1% change in real world GDP growth would change real U.S. trade balance growth by 1%. U.S. GDP appeared to have a more significant effect on the trade balance. While the rate of change in world GDP was shown to have a positive effect on the trade balance rate of change, the impact was much less than U.S. GDP's effect.

The U.S. money supply was never seen as significant to the trade balance. A reason for this is likely that GDP in the U.S. and world are held constant. The money supply was seen as a driving force in changing the trade balance because of its effect on GDP.

Conclusions

The objectives of this paper have been to use regression analysis to identify the determinants of the U.S. trade balance. Based on previous research, tariff rates were found to have no effect on the trade balances. While they were found to affect overall world trade by volume, they do not appear to have an effect. The results from my regression led to 4 specific conclusions:

1. Real GDP is the most significant variable in determining the movement of the United States' trade balance. U.S. real GDP also has a larger effect than real world GDP.
2. The exchange rate has no statistical relationship with the U.S.'s trade balance.
3. The U.S. real money supply has no statistical relationship with the trade balance.
4. Time effects that are based on changes in trade policies had no effect on the U.S. trade balance outside of the variables affected in my model.

Using an ordinary least-squares regression, U.S. GDP was seen to have the largest and most significant effect on the U.S. trade balance. The effect was negative, suggesting that increasing U.S. GDP will increase imports more than exports, worsening the trade balance. World GDP was also found to have a small effect on the U.S. trade balance. Finally, the world exchange rate (trade-weighted index) was found to be insignificant in its effect on the trade balance. Other research has found that exchange rates may affect trade balances, but not for large countries like the U.S.

Looking forward, the U.S. trade balance will be determined by our GDP growth relative to the rest of the world. While there may be considerable talk about trade negotiations, tariffs, and counter-tariffs from other countries, these actions will not likely impact our trade balance.

Fluctuating exchange rates will also not appear to affect our trade balance. While the money supply was being decreased in late 2018, it is currently being held stable. If the money supply was to be decreased again, our GDP would see a drop in growth and, due to the decreased consumption, our trade balance would increase due to a resulting increase in exports relative to imports.

Looking at further research on the determinants of a country's trade balance, fiscal policy should be researched and its effect on world trade. Tax revenue, government expenditures, or net federal spending (Tax revenue - government expenditures) could be used as measures of fiscal policy. Seeing how our trade balance is affected when taxes are raised or when the government cuts spending could have a significant effect on our trade balance. The U.S. money supply was seen to have a positive effect on the U.S. trade balance when U.S. and world GDP was held constant.

These conclusions are important in seeing what determines our trade balance but has not answered what the implications of this can be. Looking at the compound annual growth rates of U.S. real GDP and the real trade balance, our real GDP has increased by 2.6% on average each year while our real trade balance has decreased by 7.52% on average each year. Despite the increase in imports relative to exports, our real GDP has grown from 1982-2017 while the world's real GDP has only increased by 0.31% on average each year over the same period. For further research, determining the factors that trade balance influences instead of what influences the trade balance would be interesting. As seen in articles by Amadeo and Krauss, a trade surplus is not always good for a country, while other countries do very well while running a trade deficit. Determining how a change in the trade balance effects citizens of the country would be a fitting paper to pursue.

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Appendix

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                                                      ___  ____  ____  ____  ____(R)
                                                     /__    /   ____/   /   ____/
                                                    ___/   /   /___/   /   /___/
                                                      Statistics/Data Analysis

                                                        User: Kyle Getsiv
                                                     Project: Thesis

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     /__    /   ____/   /   ____/
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    Notes:
          1.  Unicode is supported; see help unicode_advice.
          2.  Maximum number of variables is set to 5000; see help set_maxvar.

  1 . *(6 variables, 37 observations pasted into data editor)

  2 . do "C:\Users\getsivk\AppData\Local\Temp\STD00000000.tmp"

  3 . sort year

  4 .
  5 . gen usg=(usrgdp/usrgdp[_n-1])-1
    (1 missing value generated)

  6 . gen wg=(wrgdp/wrgdp[_n-1])-1
    (1 missing value generated)

  7 . gen reg=(rer/rer[_n-1])-1
    (1 missing value generated)

  8 . gen mu=(usrms/usrms[_n-1])-1
    (1 missing value generated)

  9 . gen dtb=-((usrtb/usrtb[_n-1])-1)
    (1 missing value generated)

 10 .
 11 . gen d1993=year<=1993

 12 . gen d2001=year>1993 & year<=2001

 13 . gen d2008=year>2001 & year<=2008

 14 . gen d2017=year>2008 & year<=2017

 15 .
 16 . capture log close

 17 . log using tbreg, replace
    (note: file C:\Users\getsivk\Documents\tbreg.smcl not found)
    -------------------------------------------------------------------------------
          name:  <unnamed>
           log:  C:\Users\getsivk\Documents\tbreg.smcl
      log type:  smcl
     opened on:  29 May 2019, 16:03:34
```

```
18 . sum
```

Variable	Obs	Mean	Std. Dev.	Min	Max
year	37	1999	10.82436	1981	2017
usrgdp	37	5220.046	1460.261	2880.65	7586.81
wrgdp	37	7603.681	1008.712	5752.38	9263.27
rer	37	2.708108	1.004785	1.04	4.2
usrms	37	3128.851	1154.735	1753.76	5643.84
usrtb	37	-151670	101379.7	-356518.9	-14791.07
usg	36	.0268869	.0189866	-.0277543	.0725888
wg	36	.0053196	.0673745	-.1020084	.1855772
reg	36	.0374685	.0644707	-.0552147	.1942446
mu	36	.0333097	.0256361	-.0200046	.0808516
dtb	36	-.1307523	.3551188	-1.300578	.6273738
d1993	37	.3513514	.4839775	0	1
d2001	37	.2162162	.4173418	0	1
d2008	37	.1891892	.3970613	0	1
d2017	37	.2432432	.4349588	0	1

```
19 . reg usrtb usrgdp wrgdp rer usrms
```

Source	SS	df	MS		
Model	2.6170e+11	4	6.5424e+10	Number of obs	= 37
Residual	1.0831e+11	32	3.3846e+09	F(4, 32)	= 19.33
				Prob > F	= 0.0000
Total	3.7000e+11	36	1.0278e+10	R-squared	= 0.7073
				Adj R-squared	= 0.6707
				Root MSE	= 58177

usrtb	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
usrgdp	-91.39083	44.61625	-2.05	0.049	-182.2712	-.5105096
wrgdp	17.13291	14.45025	1.19	0.244	-12.30129	46.5671
rer	-641.7919	54124.23	-0.01	0.991	-110889.2	109605.7
usrms	40.51581	26.86412	1.51	0.141	-14.20462	95.23623
_cons	70091.33	128519.7	0.55	0.589	-191694.7	331877.3

```
20 . reg dtb usg wg reg mu
```

Source	SS	df	MS		
Model	1.62651775	4	.406629437	Number of obs	= 36
Residual	2.78731088	31	.089913254	F(4, 31)	= 4.52
				Prob > F	= 0.0054
Total	4.41382863	35	.126109389	R-squared	= 0.3685
				Adj R-squared	= 0.2870
				Root MSE	= .29986

dtb	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
usg	-9.745266	2.802202	-3.48	0.002	-15.4604	-4.030137
wg	1.498632	.7631614	1.96	0.059	-.0578463	3.05511
reg	-.0197925	.8384213	-0.02	0.981	-1.729764	1.690179
mu	-1.378996	2.083733	-0.66	0.513	-5.628796	2.870805
_cons	.1699707	.108004	1.57	0.126	-.0503049	.3902463

```
21 . reg dtb usg wg reg mu d2*
```

Source	SS	df	MS	Number of obs	=	36
				F(7, 28)	=	2.92
Model	1.86263956	7	.266091365	Prob > F	=	0.0200
Residual	2.55118907	28	.091113895	R-squared	=	0.4220
				Adj R-squared	=	0.2775
Total	4.41382863	35	.126109389	Root MSE	=	.30185

dtb	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
usg	-9.352014	3.159804	-2.96	0.006	-15.82458	-2.87945
wg	1.825952	.8593322	2.12	0.043	.0656893	3.586214
reg	.304362	.8692324	0.35	0.729	-1.47618	2.084904
mu	-2.898467	2.404368	-1.21	0.238	-7.823592	2.026658
d2001	.1882276	.156244	1.20	0.238	-.1318237	.5082789
d2008	-.0030277	.16071	-0.02	0.985	-.3322272	.3261719
d2017	.2019353	.1648474	1.22	0.231	-.1357393	.5396098
_cons	.1044003	.133766	0.78	0.442	-.169607	.3784076

```
22 . log close
      name:  <unnamed>
       log:  C:\Users\getsivk\Documents\tbreg.smcl
  log type:  smcl
 closed on:  29 May 2019, 16:03:35

23 .
end of do-file

24 . save "C:\Users\getsivk\Desktop\tbreg 2.dta"
file C:\Users\getsivk\Desktop\tbreg 2.dta saved

25 .
```