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What's the Big Deal about a Trade Deficit?: A VECM Analysis of Causality of U.S. Economic Growth and its Trade Balance

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Abstract
Since 1981, the United States has managed a trade deficit that has become more negative with each passing year. Yet, economic growth has been on a positive trend. Is there a relationship between the two? Using annual data from 1950 to 2014, this paper investigates the causal relationship between the trade balance of the United States and its gross domestic product using a Johansen Vector Error Correction Model. The author analyzes the effects of the US Trade balance against US economic growth and controls for each member country's economic variables within NAFTA and China. Beginning with China and Mexico independently, Vector Autoregression models suggest that the US trade balance does not Granger cause US economic growth in the short run, nor in the long run. On the contrary, analyzing trade against Canada, a VECM suggests that US trade balance and economic growth are cointegrated and we observe negative short-run causation running from the trade balance to US economic growth. As a percentage of GDP, an increase of 1% in the trade balance, decreases economic growth by 1.159%. The results indicate no causal relationship from U.S. GDP to its trade balance in any of the subsamples and trade with NAFTA and China contemporaneously. This finding has trade policy implications.

Keywords: trade balance, economic growth, GDP, causality, protectionism, NAFTA

JEL Classification: F41, F43, F13, F14

1. Introduction

The United States has experienced a long trend of positive economic growth. As Figure 1 illustrates, but for a few recessionary periods since 1950, economic growth has trended positively over the long run. Yet, during the same period, the U.S. trade balance has oscillated around balance to a slight surplus but permanently turned negative in 1981. It has remained that way since. However, a great deal of attention has been placed on the trade deficit. Why?

According to contemporary economic theory, trade protectionism, be it tariffs, quotas, or any other policy designed to reduce the level of imports in the United States, is ineffective at impacting the trade deficit. Consider a tariff placed on imported goods from China. Such tariff will make American imported goods more expensive, reducing the quantity demanded of imported goods. Mission accomplished if this was the end of the story. But it is not.

In the short run, the supply of U.S. Dollars available in the global market is determined by the level of excess savings to the amount of national investments. Given the level of net foreign investments, there is a fixed level of Dollars available in the global market to conduct international transactions. These transactions include the purchase of American assets and products. When the

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demand for imports is decreased from the artificially inflated price because of the tariff, this increases the schedule of net exports or trade balance (exports minus imports) -- and increases the value of the U.S. Dollar vis-a-vas its trading partner -- in both nominal and real terms. For example, when the value of the Dollar appreciates against the Chinese Yuan Renminbi, this makes American-made products more expensive to Chinese residents, decreasing the level of exports to China, ceteris paribus. This assumes there is no retaliatory actions by China. If China imposes its own tariff on imported goods from the United States, then this results in further constriction of trade. As it stands, without retaliation, the tariff has the effect of reducing the level of imports and exports and putting tax revenue in the account of the U.S. Treasury. There is no net effect on the trade balance.

Figure 1: Annual GDP and Trade Balance for the United States

As we can see from the tariff example above, there should not be a significant effect on the gross domestic output of the United States. The benefits awarded to producers competing in the import sector are offset by the reduction in output by the export sector of the economy. The tariff has the net effect of picking winners and losers in the domestic and global economies and replacing consumer and producer surplus with tax revenues and deadweight losses. So, if there is no net benefit to an economy’s income why do governments practice mercantilism and the management of the trade balance? Why do we care that the United States has a trade deficit with the rest of the world and increasing ever so? Are there benefits extracted from a surplus in the trade balance not measured by our economic theory? Do improvements in the trade balance cause an increase in output and income? Does economic growth improve the trade balance?

The balance of the paper will focus on this issue. After a brief review of some selected literature, we will develop the short-run economic model of the trade balance in the following section. Section 4 follows with a discussion on the methodology and data used in the analysis. Section 5 discusses the results and findings and we conclude with a brief conclusion and policy implications.

2. Selected Literature Review

The dynamics of the trade balance and economic growth has attracted much attention in the macroeconomics literature, arguably dating back to Adam smith and David Ricardo. The literature is replete with studies looking at the effects of fiscal policies relating trade to economic growth. Most of these studies have focused on the effectiveness of trade policies of developing countries.

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Bastola et al. (2015) produced the first attempt of examining the causal relationship between real GDP of Nepal and its exports, imports, and exchange rates. Using annual data from 1965 to 2011, they employed an autoregressive distributed lag model to test for cointegration and Granger causality among the variables. They found short-run and long-run unidirectional causality running from export to GDP. Moreover, they find that imports negatively Granger-cause output in Nepal. Gallegos et. Al (2009) perform a similar analysis for the economy of Mexico. Using a cointegration that detects structural changes, they found a stable and causal relationship of foreign direct investment and other trade variables in the industrial sector. They failed to arrive at the same conclusion of long-term stability when analyzing the service sector.

Focusing on the relationship of tariffs and their effects on national savings, the trade balance and economic growth of countries in Central America, Caceres (2017) uses a VAR model and a resultant impulse response function to conclude that an increase in tariffs leads to an increase in national savings, national investments. A one-standard deviation shock to the residuals of the tariff variable results in a positive response to the national savings function over the next two years before dying out after 4 years. Similarly, a one-standard deviation shock to the tariffs residuals produces a consistent positive response of both private and public savings. Moreover, higher levels of economic growth tend to reduce trade deficits.

Akinwale and Grobler (2019) perform a similar analysis for South Africa. Using Word Development Indicator annual data from 1984 to 2015, they run a Johansen VECM to analyze the dynamics relating to trade openness, education, and economic growth. Their aim was to take a deep dive to determine if investments in human capital and trade liberalization were determinants of economic growth in South Africa. Their results suggested that in the long run, the level and economic growth Granger causes trade openness. They also found long run causality running from trade openness and education to economic growth. The only unidirectional short run causal relationship existed between trade openness and economic growth. Another analysis regarding the short and long run relationship for a developing country was performed by Onakoya et al. (2018). Employing an asymmetrical M-Tar and TAR cointegration models using annual WDI data for Nigeria, they found that GDP, exchange rate and the trade balance are cointegrated and that each of the variables respond to asymmetric shocks form disequilibrium. While there are a myriad of studies looking into the relationships between components of the trade balance and a developing country's economic growth, there are few studies for the United States and its trading partners. The purpose of this paper is to gain an understanding of the effects of recent macroeconomic policies of the United States have had on the trade balance, with little attention paid to economic growth.

3. The Model

A country's level of export is a function of many factors. Among others, the demand for U.S. exports, EX, can be defined as EX=EX[GDP^f, €, T]; where GDP is the real GDP of the foreign country, € is the real exchange rate in indirect terms; $EP/_{Pf}$. E is the number of units of foreign currency units per U.S. Dollar. T is a measure of tastes and preferences of foreign consumers of U.S. produced goods and services. The ex-ante relationships are as expected: $\frac{\partial EX}{\partial GDP^f} > 0; \frac{\partial EX}{\partial €} < 0; and \ \frac{\partial EX}{\partial T} > 0$. The econometric representation for the demand for U.S. Exports ca be expressed as:

$$EX_t = \theta_1 + \theta_2 GDP^f{}_t + \theta_3 E^f{}_t + e_t \qquad (1)$$

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Similarly, the demand for imported goods and services by American consumers is a function of similar factors. The demand for imported goods is IM=IM [GDP^{USA}, €, T], where the variables are defined as they are above. However, the ex-ante relationships are as follows: $\frac{\partial IM}{\partial GDP^{USA}} > 0; \frac{\partial IM}{\partial €} > 0; and \ \frac{\partial EX}{\partial T} > 0$. Econometrically, we write the estimating equation for imports as:

$$IM_t = \delta_1 + \delta_2 GDP^{USA}{}_t + \delta_3 E^f{}_t + u_t \quad (2)$$

We assume that all error terms are independently and identically distributed. The trade balance of the USA is defined as the difference between exports and imports. We subtract equation (1) by equation (2):

$$EX_t - IM_t = (\theta_1 - \delta_1) + \delta_2 GDP^f{}_t - \delta_2 GDP^{USA}{}_t + (\theta_3 - \delta_3)E^f{}_t + (e_t - u_t) \quad (3)$$

$$TB_t = \beta_1 + \beta_2 GDP^f{}_t - \beta_3 GDP^{USA}{}_t + \beta_4 E^f{}_t + \gamma_t \quad (4)$$

4. Methodology and Data

Using the national accounts data described in Table A1 for the North America Free Trade Agreement (NAFTA) countries from the Penn world Table 9.0, the objective is to test for short-run and long-run relationships between the variables in the trade balance Equation (4) for each subpanel (Mexico, China, and Canada) and the all members of NAFTA and China contemporaneously.

Enders (1995) and Johansen (2005) postulate the necessary conditions for establishing a long-run relationship are as follows:

a) Select a lag length structure that is optimal for all variables in the model. Because the cointegration tests are sensitive to the lag length of each series, we shall use a battery of information criteria tests for this process. We will select the lag length suggested by a simple majority of the criteria tests.
b) Using the optimal lag length from step 1, each series in the system equation is pretested for its order of integration. I will use the augmented Dickey-Fuller and Phillips – Perron tests for the existence of a unit root. Using the general form of the Augmented Dickey-Fuller tests as follows:

$$\Delta y_{i,t} = a_0 + a_i + \delta t + \theta_t + \tau y_{i,t-1} + \sum_{j=2}^{p} \beta_i \Delta y_{i,t-1+j} + \varepsilon_{i,t} \quad (5)$$

where $\varepsilon_{i,t}$ is a stationary and serially uncorrelated disturbance term. The series is said to be integrated of order (1) if we cannot reject the null hypothesis of a unit root in the level equation but reject the hypothesis of a unit-root after first-differencing this equation. In short, the level equation must contain at least one unit root and its first difference is stationary. If all series are integrated of order (1), then the system of equations could be cointegrated of order (1,1).

c) Once each series is determined to be I (1), we use the Johansen Cointegration test to determine the rank of the cointegration vector. Using the optimal lag length from step 1 above, we determine the rank of π in the model:

$$\Delta x_t = A_0 + \sum_{i=1}^{p-1} \pi_i \Delta x_{t-i} + \alpha\beta' x_{t-p} + \epsilon_t \quad (6)$$

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where the single cointegrating vector is $\beta = (1, \beta_2, \beta_3, \dots, \beta_n)'$

and the speed of adjustment parameters are $\alpha = (1, \alpha_2, \alpha_3, \dots, \alpha_n)'$. The test statistic involves comparing the number of cointegrating vectors under the null hypothesis and alternative hypotheses. Let $\hat{\gamma}_i$ denote the ordered characteristic root of the unrestricted model and $\hat{\gamma}_{\check{i}}$ be the restricted of each model. To test restrictions on β, we use the test statistic:

$$T\sum_{i=1}^{r}[\ln(1-\hat{\gamma}_{\check{i}}) - \ln(1-\hat{\gamma}_i)] \quad (7)$$

r refers to the number of cointegrating vectors. This test statistic has a Chi-Square distribution with the number of degrees of freedom equal to the number of restrictions placed on β**.**

d) If the rank of the cointegrating vector is 0, then the series are not cointegrated and no long-run relationship exists. In this case model the system is a vector autoregressive process and test for short-run Granger causality.
e) Determine if the model appears to be reasonable and perform diagnostics. Most importantly, determine if the residuals are a white noise process.

The concept of cointegration is an important one in economics. According to Granger and Engle (1987), economic time series, such as the trade balance and economic growth may, by themselves wander off and behave in a nonstationary and unstable way, but when combined with another economic variable that behaves in a similar way, they may have a long term relationship—perhaps a causal one. Granger and Engle refer to this concept as cointegration. Economic variables that constitute the trade balance, i.e. Equation (4), may behave in this way. Short run and long run causality among the trade variables will provide researchers with valuable insight. We shall analyze the true relationship between a country's trade balance and its economic growth by testing for cointegration and causality.

All data are extracted from the Penn-World Table 9.0. Gross domestic product and exchange rate data are taken for the United States, Mexico, Canada, and China for years from 1950 to 2014. These countries represent the major trading partners of the United States that constitute the NAFTA. A descriptive summary of the data is provided in Tables A1 and A2.

5. Results and Discussion

5.1 Trade with Mexico

The battery of tests to determine the optimal lag length is listed on Table 1. The FPE, AIC, and HQIC suggest that the optimal lag length is 2 for the model of U.S. trade with Mexico. Unit root tests for the variables contained in Equation (4.) are listed in Table A3. The results indicate that there is a unit root in the levels of the variables, but they are stationary in their first differences. This suggests that these series are I (1) – making them a candidate for cointegration. To determine if the variables in the model of trade with Mexico are cointegrated, we conduct the Johansen Test. These results are contained in Table 2.

To test for the statistical significance of restricted and unrestricted characteristic roots of β in Equation (6), we use Chi-Square tests. We accept the null hypothesis of a rank of zero, as the trace and max statistics are less than their critical values of 47.21 and 27.07, respectively. This suggests that the variables are not cointegrated and do not have a long-run relationship. Therefore, there is no long-run causality of any of the variables.

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Because the variables are I (1) and the rank of the of the cointegrating vector is zero, we will fit a vector autoregressive model to see if there is a short-term relationship and causality. Table 3 contains the results of the VAR model for U.S. trade with Mexico. Specifications (1) and (2) are of interest. They test for the short-run relationship of the U.S. trade balance and economic growth. While individually, the GDP of Mexico, the GDP of the USA, and nominal exchange rate do not Granger-cause the trade balance of the USA, collectively, they do. This is evident by the results of the Wald test for causality that is listed in Table 4. The test of joint significance rejects the null hypothesis that all the coefficients in specification (1) are zero is rejected at the 5% level. This speaks well for the model in Equation (4). This is corroborated by the impulse response function in Figure 2. A one-standard deviation shock to the trade balance of the U.S. has no effect on the U.S. GDP (flat line in column 1). There is a similar effect on the trade balance from one-standard deviation shock to each of the other variables (flat line as well).

Diagnostically, the econometric model bodes well also. The results of the likelihood maximization test of the residuals in the two previous lags (P-values of 0.56 and 0.24) indicate that we cannot reject the null hypothesis of no serial correlation. Moreover, the Jarque-Bera test suggests that we cannot reject the null hypothesis that the residuals are normally distributed.

Specification (2) in Table 4 provides us with a view of the possibility of feedback. The coefficients of the first and second lags of the trade balance are not statistically different from zero. When their joint effect is taken into consideration, there is no effect on the log of U.S. GDP. Hence, the U.S. trade balance does not Granger-cause GDP in the short-run as well.

Table 1. Lag Order Selection Tests – MEXICO

Lag	LL	LR	FPE	AIC	HQIC	SBIC
0	278		1.5E-09	-8.99	-8.94	-8.86
1	648	740 (0.000)	1.3E-14	-20.60	-20.33	-19.91*
2	680	64 (0.000)	7.9E-15*	-21.13*	-20.64*	-19.88
3	690	18 (0.317)	1.0E-14	-20.90	-20.20	-19.10
4	704	28*(0.030)	1.1E-14	-20.84	-19.92	-18.8

Sample: 1954 – 2014; N = 61; LL and LR are likelihood function and likelihood ratio test, respectively with p-values in parenthesis. FPE = Akaike's final prediction error; AIC=Akaike information criterion; HQIC= Hannan and Quinn's information criterion; and SBIC= Schwarz's Bayesian criterion; * represent preferred lag length

Table 2. Johansen Test for Cointegration -- MEXICO

Maximum Rank	Parms	Trace Statistic	5% Critical Value	Max Statistic	5% Critical Value
0	20	32.26*	47.21	13.52	27.07
1	27	18.75	29.68	9.26	20.97
2	32	9.49	15.41	6.98	14.07
3	35	2.51	3.76	2.51	3.76
4	36				

*indicates that the suggested rank order or cointegration

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Table 3. Vector Autoregressive Equations (VAR) for Mexico

	(1) TB_{USA_t}	(2) $Ln(GDP)_{USA_t}$	(3) $Ln(GDP)_{Mex}$	(4) $Ln(XR)_{Mex}$
$Ln(GDP_{Mex})_{t-1}$	.039 (.235)	.098 (.790)	.830 (.149)	3.759 (6.186)
$Ln(GDP_{Mex})t_{-2}$	-.052 (.029)	-.347 (.769)	-.063 (.145)	3.417 (6.023)
$Ln(XR_{Mex})_{t-1}$	-.002 (.005)	.037** (.015)	-.005 (.003)	1.536*** (.121)
$Ln(XR_{Mex})_{t-2}$	.001 (.005)	-.037** (.016)	.003 (.003)	-.505 (.124)
$Ln(GDP_{USA})_{t-1}$	.035 (.037)	.983*** (.124)	.052** (.023)	-.656 (.968)
$Ln(GDP_{USA})_{t-2}$	-.039 (.039)	.045 (.340)	-.014 (.025)	-.241 (1.034)
$(TB)_{t-1}$	1.220*** (.122)	-.608 (.409)	.111 (.078)	-5.818 (3.205)
$(TB)t_{-2}$	-.465*** (.121)	.946 (.408)	-.095 (.077)	5.183 (3.197)
Constant	.063 (.085)	.285 (.287)	.122** (.054)	-6.528***(2.258)
LM Test	$H_o: No\ autocorrelation => res_{-1}$: Prob>$X^2 = .56$; res_{-2}: Prob>$X^2 = .24$			
Jarque-Bera Test (Normality)				
Prob>$X^2 =$	.12	.47	.00	.00

Standard errors are in parentheses; **denotes significance at the 5% level; ***denotes significance at the 1% level

Table 4. Granger Causality Test for Mexico

	$Ln(GDP)_{Mex}$	$Ln(XR)_{Mex}$	TB_{USA_t}	$Ln(GDP)_{USA_t}$
$Ln(XR)_{Mex}$	11.14*** (.00)	---	.86 (.65)	5.80* (.06)
TB_{USA_t}	2.10 (.35)	3.33 (.19)	---	6.04** (.05)
$Ln(GDP)_{USA_t}$	12.81*** (.00)	3.23 (.20)	1.04 (.60)	---
$Ln(GDP)_{Mex}$	---	5.51** (.06)	.06 (.97)	.51 (.77)
All	18.42***(.01)	13.52** (.04)	11.54* (.07)	14.20** (.03)

Wald test: Each value is the X^2 test with respective p-value is in parentheses

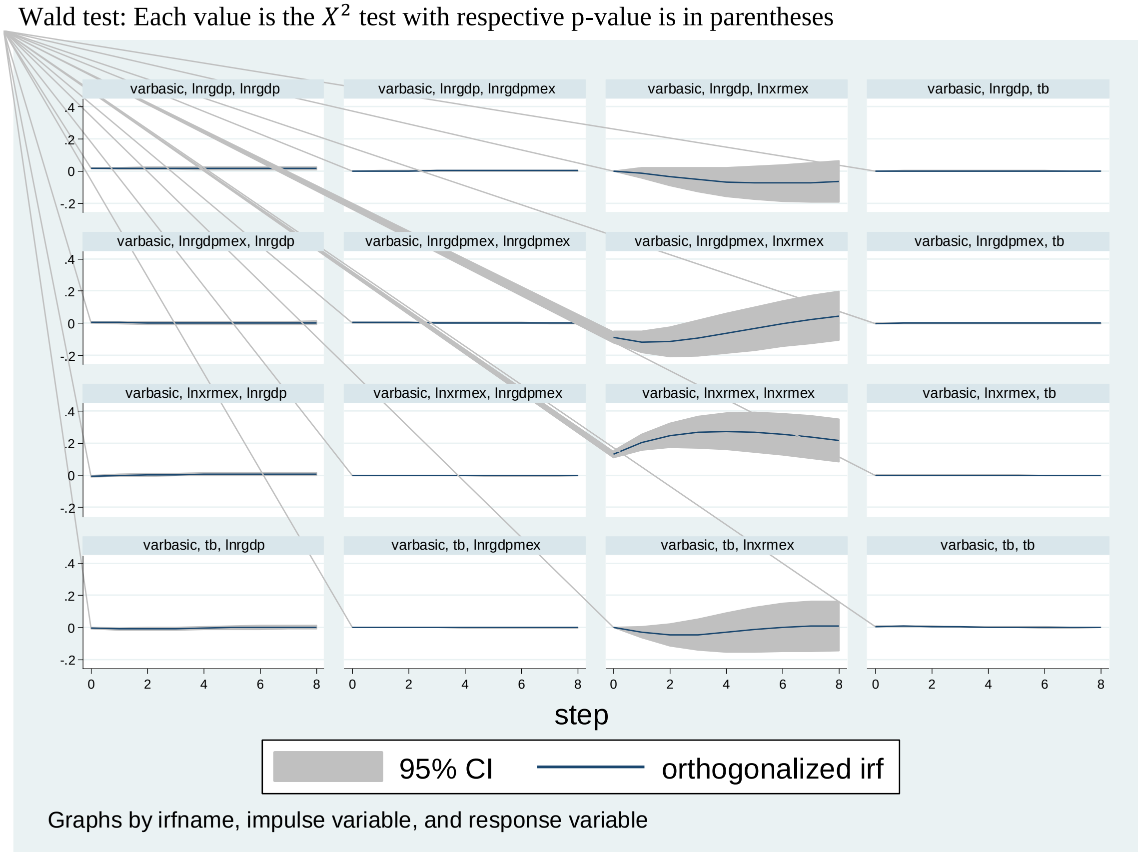

Figure 2: Impulse Response functions for Mexico

5.2 Trade with Canada

The level of GDP for Canada contains a unit root in the level and is stationary in its first difference (Table A3). Three of five of the lag selections tests suggest an optimal lag length of 4 in Table 6. The Johansen Test for cointegration in Table 7 rejects the null hypothesis of a zero rank of the number of cointegrating vectors at the 5% level. However, we cannot reject the null hypothesis of a rank of 1 cointegrating vector. The Trace test statistic and Max statistic of 23.67 and 15.13 are less than the critical values of 29.68 and 20.97, respectively. We can conclude that there is at least one cointegrating error term in the VECM for trade with Canada in Equation 4.

Table 6. Lag Order Selection Tests for Canada

Lag	LL	LR	FPE	AIC	HQIC	SBIC
0	333		2.4E-10	-10.80	-10.75	-10.66
1	645	622 (.000)	1.5E-14	-20.48	-20.21	-19.79*
2	674	59 (.000)	9.7E-15	-20.92	-20.44*	-19.68
3	687	26 (.060)	1.1E-14	-20.82	-20.11	-19.02
4	711	47***(.000)	8.8E-15*	-21.07*	-20.15	-18.71

Sample: 1954 – 2014; N = 61; LL and LR are likelihood function and likelihood ratio test, respectively with p-values in parenthesis. FPE = Akaike's final prediction error; AIC=Akaike information criterion; HQIC= Hannan and Quinn's information criterion; and SBIC= Schwarz's Bayesian criterion; * represent preferred lag length.

Again, Specifications (1) and (2) of Table 8 are equations of interest. The coefficient of the correction error term (ce_{t-1}) is negative and weakly statistically significant at the 10% level. This suggests two things. First, it implies that there is weak evidence of long-run causality running from Canadian GDP, U.S. GDP, and the Canadian Dollar to U.S. Dollar exchange rate to the U.S. trade balance. Second, 11.9% of the deviation from its long-run equilibrium in the previous year is recovered in the current year.

Table 7. Johansen Test for Cointegration (Canada)

Maximum Rank	Parms	Trace Statistic	5% Critical Value	Max Statistic	5% Critical Value
0	52	61.72	47.21	38.05	27.07
1	59	23.67*	29.68	15.13	20.97
2	64	8.53	15.41	6.19	14.07
3	67	2.34	3.76	2.34	3.76
4	68				

We observe short-run causality running from Canadian GDP to the U.S. trade balance. A 1% increase in Canadian GDP increases the U.S. Trade balance by .158%. This is consistent with economic theory. An increase in Canadian GDP causes an increase in the demand for American exports and trade balance, ceteris paribus. There is no short-run relationship between GDP in the U.S. and its trade balance. This is evident by the failure to reject that the coefficients of the lags of the U.S. GDP variable is not statistically different from zero. Moreover, the results of the Wald test of joint significance of all three coefficients has a p-value of .484. Diagnostically, the residuals of Specification (1) are identically and independently distributed. The p-value of 0.87 for the results of the Jarque-Bera test of normality suggests that we cannot reject the null hypothesis of normality. The likelihood ratio test for serial correlation of the first four lags of the residuals fails to reject the null hypothesis of no autocorrelation.

Specification (2) analyzes the policy that increasing the U.S. trade balance increases economic output. The coefficient of the correction error term is positive and statistically

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insignificant. We interpret that as Canadian GDP, the U.S. trade balance, and the Canadian Dollar/U.S. Dollar exchange do not Granger-cause U.S. GDP in the long run. However, in the short run, an increase of .01 unit in the trade balance (percentage of per GDP) decreases the change in the GDP by 1.159%. For example, if the U.S. is currently at its average trade balance (deficit) of -.021 (as a percentage of GDP) and performs fiscal policy to improve its trade balance to -.011, its economic growth two years forward is expected to fall by 1.159%, ceteris paribus. This not only contradicts the desired effect of managing the trade balance, but it inhibits U.S. economic growth drastically. A p-value of .097 from the Wald Test for joint significance (Short-term causality) of the U.S. trade balance indicates that the trade balance Granger-causes economic growth in the U.S., but negatively. A constant of .021 suggests a long-run annual growth rate of GDP of 2.1%, ceteris paribus. The diagnostics of specification (2) is strong and suggestive of adequate modeling. The LM test of autocorrelation fails to reject the null hypothesis of no serial correlation for all 4 lags of the residuals. Additionally, the Jarque-Bera tests fails to reject the null hypothesis of normally distributed residuals. Combined, these tests suggest that the residuals are white noise – a major assumption of the Johansen Cointegration Model.

Table 8. Vector Error Correction Models (VECM) -- Canada

	(1) ΔTB_{USA_t}	(2) $\Delta Ln(GDP)_{USA_t}$	(3) $\Delta Ln(GDP)_{Can}$	(4) $\Delta Ln(XR)_{Can}$
ce_{t-1}	-.119* (.070)	.026 (.049)	-.051 (.036)	-.147*** (.041)
$\Delta Ln(GDP_{Can})_{t-1}$	.158*** (.047)	-.232 (.181)	-.557** (.220)	.240 (.297)
$\Delta Ln(GDP_{Can})t_{-2}$	.000 (.047)	-.139 (.180)	-.275 (.219)	-.057 (.295)
$\Delta Ln(GDP_{Can})t_{-3}$	-.039 (.044)	.325* (.169)	.143 (.206)	-.271 (.278)
$\Delta Ln(XR_{Can})_{t-1}$	.023 (.024)	-.048 (.094)	-.178 (.113)	.416** (.153)
$\Delta Ln(XR_{Can})_{t-2}$	.015 (.025)	.019 (.098)	.052 (.119)	-.099 (.160)
$\Delta Ln(XR_{Can})_{t-3}$	-.086*** (.023)	.190** (.087)	.240** (.106)	-.068 (.142)
$\Delta Ln(GDP_{USA})_{t-1}$	-.049 (.052)	.159 (.200)	.502** (.243)	-.209 (.329)
$\Delta Ln(GDP_{USA})_{t-2}$	.033 (.055)	.051 (.210)	.087 (.255)	.102 (.344)
$\Delta Ln(GDP_{USA})_{t-3}$	.052 (.050)	-.326* (.191)	-.176 (.232)	-.023 (.312)
$\Delta(TB)_{t-1}$	.579*** (.150)	-.524 (.577)	-.309 (.702)	-2.235** (.947)
$\Delta(TB)t_{-2}$	.031 (.166)	-1.159* (.637)	-.946 (.775)	.145 (1.046)
$\Delta(TB)t_{-3}$	.109 (.162)	.496 (.623)	-1.256 (.757)	-1.635 (1.021)
Constant	-.003 (.001)	.021*** (.006)	.022 (.007)	-.009 (.009)
Joint probability tests	$x = Ln(y_{USA})$	$x = Ln(TB_{USA})$	$x = Ln(y_{USA})$	$= Ln(y_{USA})$
P[3 lags of x_{-j}=0]	2.454	6.31 $*$	4.97	0.62
where j =1,2,3,	(.484)	(.097)	(.174)	(.892
LM Test	$H_o: No\ autocorrelation =>\ res_{-1}$: Prob>$X^2 = .61$; res_{-2}: Prob>$X^2 = .78$; res_{-3}: Prob>$X^2 = .18$; res_{-4}: Prob>$X^2 = .63$			
Jarque-Bera Test (Normality) Prob>X^2	$.87$	$.62$	$.56$	$.92$

Standard errors are in parentheses; **denotes significance at the 5% level; ***denotes significance at the 1% level

5.3 Trade with China

After confirming that the real GDP and exchange rate variables are nonstationary in their levels and stationary in their first difference, we determined that the optimal lag length for the China trading equation (4) to be 1 (Refer to Tables A3 and 9). The results of the Johansen Cointegration test are illustrated in Table 10. The results of the Trace and Max statistics fail to reject the null hypothesis of a rank of 0 cointegrating vectors. This indicates that there is no long-run relationship among the endogenous variables. Therefore, we fit a VAR model to the China trade data.

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Specifications (1) and (2) suggest no evidence of Granger Causality in the short run. These results are also corroborated by the impulse response functions in Figure 3. That is, in the short run the U.S. trade balance does not cause changes in economic growth, and economic growth does not cause any movement in the trade balance. Again, the results of the LM tests do not allow us to reject the null hypothesis of no autocorrelation among the residuals. However, we can reject the null hypothesis of normality in both specifications. The Jarque-Bera normality test has p-values of 2% and 6%.

Table 9. Lag Order Selection Tests for China

Lag	LL	LR	FPE	AIC	HQIC	SBIC
0	131		1.6E-07	-4.31	-4.26	-4.17
1	508	753 (.000)	7.7E-13*	-16.53*	-16.26*	-15.83*
2	522	29 (.026)	8.3E-13	-16.48	-15.99	-15.21
3	534	23 (.121)	9.9E-13	-16.32	-15.61	-14.49
4	550	33* (.008)	1.0E-12	-16.33	-15.40	-13.94

Sample: 1954 – 2014; N = 61; LL and LR are likelihood function and likelihood ratio test, respectively with p-values in parenthesis. FPE = Akaike's final prediction error; AIC=Akaike information criterion; HQIC= Hannan and Quinn's information criterion; and SBIC= Schwarz's Bayesian criterion; * represent preferred lag length

Table 10. Johansen Test for Cointegration (China)

Maximum Rank	Parms	Trace Statistic	5% Critical Value	Max Statistic	5% Critical Value
0	52	40.58*	47.21	26.34	27.07
1	59	14.23	29.68	10.06	20.97
2	64	4.18	15.41	4.13	14.07
3	67	0.05	3.76	0.05	3.76
4	68				

Table 11. Vector Autoregressive Regressions (VAR) -- China

	(1) TB_{USA_t}	(2) $Ln(GDP)_{USA_t}$	(3) $Ln(GDP)_{Chi}$	(4) $Ln(XR)_{Chi}$
$Ln(GDP_{Chi})_{t-1}$	.000 (.004)	-.013 (.012)	.982*** (.032)	-.057 (043)
$Ln(XR_{Chi})_{t-1}$	-.002 (.003)	.008** (.009)	.006 (.024)	.988*** (.032)
$Ln(GDP_{USA})_{t-1}$	-.008 (.006)	1.006*** (.021)	.048 (.055)	.144* (.075)
$(TB)_{USA_{t-1}}$	.828*** (.079)	.024 (.261)	-.588 (.694)	.254 (.948)
Constant	.079 (.050)	.053 (.166)	-.336 (.442)	-1.003* (.604)
LM Test	$H_o: No\ autocorrelation => \ res_{-1}$: Prob>$X^2$ = .104;			
Jarque-Bera Test (Normality) Prob>X^2 =	.02	.06	.00	.02

Standard errors are in parentheses; **denotes significance at the 5% level; ***denotes significance at the 1% level

Table 12: Granger Causality Tests for China

	$Ln(GDP)_{Chi}$	$Ln(XR)_{Chi}$	TB_{USA_t}	$Ln(GDP)_{USA_t}$
$Ln(XR)_{Chi}$	.073 (.79)	---	.69 (.41)	.83 (.36)
TB_{USA_t}	.717 (.40)	.07 (.79)	---	.009 (.93)
$Ln(GDP)_{USA_t}$	.773 (.38)	3.66* (.06)	1.81 (.18)	---
$Ln(GDP)_{Chi}$	---	1.75 (.19)	.04 (.84)	1.26 (.26)
All	2.36 (.50)	3.76 (.29)	4.42 (.22)	1.67 (.64)

Wald test: Each value is the X^2 test with respective p-value is in parentheses

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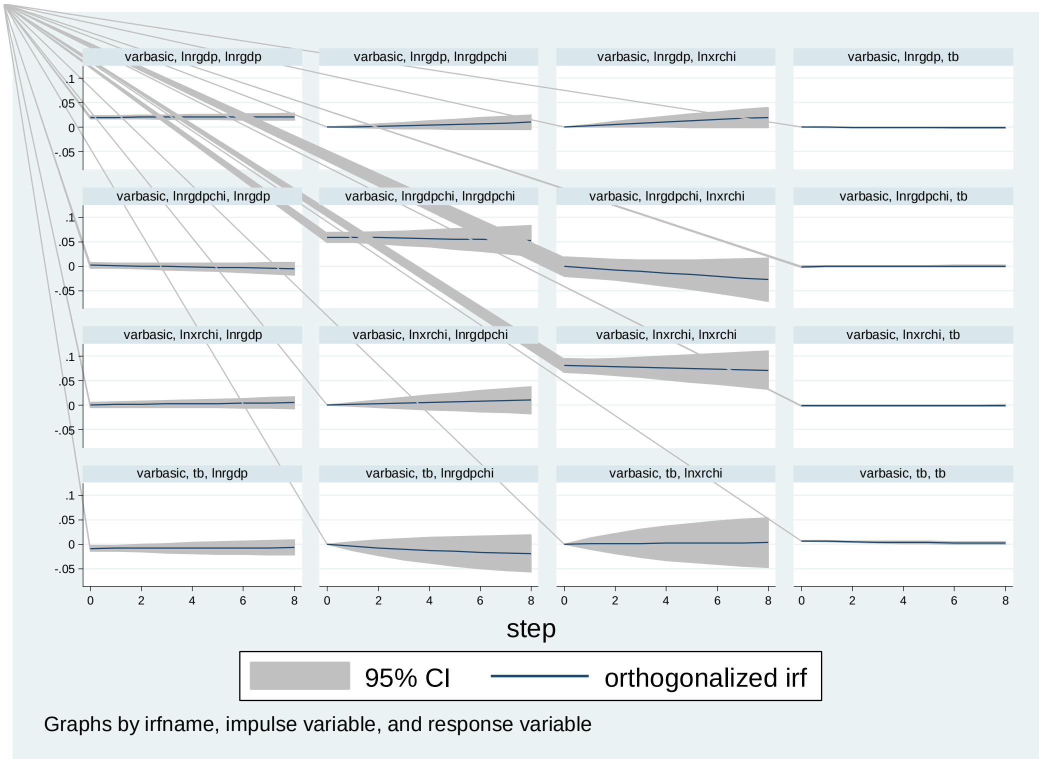

Figure 3: Impulse Response functions -- China

5.4 Trade with NAFTA and China

Consistent with the models of the United States and individual trading partners, we now incorporate all the trading partners within NAFTA and China. The lag order selection tests are displayed in Table 13. The results are bimodal: The Likelihood Ratio and AIC tests point to an optimal lag order of 4, while the HQC and FPE suggest a lag order of 2. To maximize on degrees of freedom and remain consistent with the previous models, we will use a lag structure of 2.

The results of the Johansen cointegration tests are found in Table 14. Both Trace and Max statistics cannot reject the null hypothesis of a maximum of three cointegrating equation at the 5 % significance level. However, we shall fit a vector error correction model with two cointegrating error terms. Table 15 contains the result for the two target variables and the remaining GDP-related variables (the results for the remaining non-endogenous variables are omitted).

Specification 1 of Table 15 has the log of the U.S. GDP (per person) and the dependent variable. The coefficient of the cointegrating error term is negative, but statistically insignificant. Therefore, it is safe to conclude that there is no long-run causality running from the endogenous variables and GDP of the U.S.. We can also state that there is also no short-run causality running from U.S. GDP to the trade balance of the U.S. However, there is evidence of short-run causality running from Canadian GDP and the U.S. trade balance. A one percent in the GDP of Canada Granger-causes a .136% increase in the trade balance of the United States the following year. This is consistent to the what is expected a priori. Holding GDP and exchange rates of the members of NAFTA and China constant increasing the income of residents of Canada increases the demand for U.S. products.

Specification 2 details the long-term and short-term relationships of the GDP of the U.S. and its trade balance, GDP, and foreign exchange rates of other trading partners—NAFTA and China. The coefficients of the cointegrating error terms are negative but statistically insignificant.

Table 13: Lag Order Selection Tess for NAFTA and China

Lag	LL	LR	FPE	AIC	HQIC	SBIC
0	546		1.6E-18	-18.26	-18.47	-17.98
1	1122	1151(.000)	4.9E-26	-35.60	-34.61	-33.06*
2	1218	192 (.000)	1.9E-26*	-36.68	-34.81*	-31.89
3	1275	114 (.000)	3.3E-26	-36.44	-33.69	-29.40
4	1368	186***(.000)	2.5E-26	-37.43*	-33.80	-2813

Sample: 1956 – 2014; N = 59; LL and LR are likelihood function and likelihood ratio test, respectively with p-values in parenthesis. FPE = Akaike's final prediction error; AIC=Akaike information criterion; HQIC= Hannan and Quinn's information criterion; and SBIC= Schwarz's Bayesian criterion; * represent preferred lag length

Table 14: Johansen Cointegration Test (NAFTA and China)

Maximum Rank	Parms	Trace Statistic	5% Critical Value	Max Statistic	5% Critical Value
0	72	221.20	156.00	58.98	51.42
1	87	162.21	124.24	45.62	45.28
2	100	116.59	94.15	40.72	39.37
3	111	75.87	68.52	32.26	33.46
4	120	43.61	47.21	24.19	27.07
5	127	19.43	29.68	13.44	20.97
6	132	5.99	15.41	5.48	14.07
7	135	0.51	3.76	0.51	3.76
8	136				

Table 15: Vector Error Correction Model for NAFTA & China

	(1) ΔTB_{USA_t}	(2) $\Delta Ln(GDP)_{USA_t}$	(3) $\Delta Ln(GDP)_{Chi_t}$	(4) $\Delta Ln(GDP)_{Can_t}$	(5) $\Delta Ln(GDP)_{Mex_t}$
$ce1_{t-1}$	-.026 (.025)	-.021 (.083)	-.394 (.243)	.106 (.112)	.035*** (.011)
$ce2_{t-1}$	.001 (.033)	-.112 (.108)	-.301 (.317)	-.088 (.146)	.063*** (.014)
$\Delta Ln(GDP_{USA})_{t-1}$	-.045 (.063)	.297 (.208)	.040 (.610)	.706** (.282)	.042 (.026)
$\Delta Ln(GDP_{Chi})_{t-1}$	-.002 (.014)	-.060 (.098)	.241 (.138)	-.047 (.064)	.005 (.006)
$\Delta Ln(GDP_{Can})_{t-1}$	.136*** (.051)	-.303 (.169)	-.055 (.496)	-.568** (.229)	-.047** (.022)
$\Delta Ln(GDP_{Mex})_{t-1}$	-.161 (.268)	.784 (.882)	.200 (2.576)	1.265 (1.194)	-.035 (.114)
$\Delta Ln(XR_{Chi})_{t-1}$	-.005 (.013)	-.063 (.043)	-.034 (.255)	-.026 (.058)	-.018 (.005)
$\Delta Ln(XR_{Can})_{t-1}$	.016 (.025)	.021 (.081)	-.034 (.125)	-.078 (.109)	-.037*** (.010)
$\Delta Ln(XR_{Mex})_{t-1}$	-.002 (.006)	.048*** (.019)	.021 (.055)	.046** (.025)	-.008*** (.002)
$\Delta TB_{USA_{t-1}}$	.461*** (.147)	-.972** (.486)	-1.134 (1.424)	-.234 (.657)	-.058 (.063)
Constant	-.001 (.002)	.016*** (.005)	.036** (.016)	.012 (.007)	.002*** (.001)
LM Test	$H_o: No\ autocorrelation => res_{-1}$: Prob>$X^2 = .66$; res_{-2}: Prob>$X^2 = .87$;				
Jarque-Bera Test (Normality)					
Prob>X^2	.62	.24	.00	.34	.56

Standard errors are in parentheses; **denotes significance at the 5% level; ***denotes significance at the 1% level

As was the case with Specification 1, the right-hand side endogenous explanatory variables do not Granger-cause GDP in the U.S.. However, the coefficient of the U.S. trade balance is statistically significant. This implies, there is short-run causality, running from the trade balance to GDP of the U.S. A one-unit increase in the trade balance/GDP ratio reduces the growth in

GDP by 97%. Alternatively, if the trade balance to GDP ratio increases by .10 (a 10% increase in the actual ratio), this will reduce economic growth by .97% in the subsequent year.

Diagnostically, the model VECM is adequately specified. The Chi-square tests using the LM test of the first two lags of the residuals do not allow rejection of the null hypothesis of no serial correlation. Moreover, we cannot reject the null hypothesis that the residuals are normally distributed. Therefore, we accept that the residuals are generated with a white process and conclude that the VECM is correctly specified.

6. Conclusion

The economics literature is quite conclusive about the factors that determine economic growth in the long run. The neoclassical economic growth model postulates that an economy's long-run steady state level of output is a function of several real variables: technological progress, the savings rate, physical and human capital investment, and other exogenous variables. This is encapsulated by a production function that exhibits diminishing returns to physical and human capital and constant returns to scale. These production function and economic growth characteristics are undisputed by many neoclassical growth economists. Endogenous growth models relax the assumption of diminishing return to the inputs of the production to arrive with different models. So the purpose of this paper was not to arrive at a new model, but to empirically test whether trade policies that favor exports and the management of a country's current account balance is an appropriate one for growth fostering--or--- antithetical to maximizing the output per person and economic growth, at least in the short term. So, the main question is whether maximizing a country's trade balance is growth enhancing in the short run.

Since David Ricardo and Adam smith, it has been common knowledge among economists that economic trade increases total surplus of market participants. So, the question is why restrict trade, namely imports? In recent years, administrations in power in the United States and in China have used a lot of political and economic power to restrict trade via tariffs. Abandoning the North Atlantic Free Trade Agreement (NAFTA) was a hallmark of the current administration in the U.S., as was renegotiating the bilateral trade agreement with China. The purpose of this paper was to determine if empirical evidence would support an export-led trade agenda for the United States. The underlying theme was to determine if improving the United States trade balance causes an improvement in economic growth in the short or long run, or vice versa.

Using the Penn world Table to test for cointegration of the U.S. trade balance equation for trade between the United States and each of its other trading partners in the NAFTA and China, we find no evidence to the theory that improving the trade balance having a positive effect on economic growth. When we analyze the trade relationship between the United States and Mexico, we find no evidence of long-run causality between the trade balance and economic growth of the United states. However, when we analyze the short-run dynamics, there is joint causality running from the GDP of Mexico and the United States, the Mexico/U.S. foreign exchange rate, and the U.S. trade balance. That is, our finding support equation (4).

When we look at the short run and long run dynamics of trade between Canada and the United States, we find weak support for long run causality of the GDP of the United States and Canada and their foreign exchange rates Granger-causing the trade balance of the United States. However, we find no evidence of GDP of the United States causing an effect on the trade balance in the short run. On the other hand, we do find reverse causality in the short run of the trade balance inhibiting economic growth of the United States. A 10% improvement in the trade balance will negatively affect economic growth by 1.159% in two years.

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Contrarily, when we look at the dynamics of trade between the United States and China, we find no evidence of short run nor long run causality. The trade balance does not Granger-cause U.S. economic growth and the trade balance is not caused by economic growth. These factors are determined exogenously.

When analyzing the dynamics of the U.S. trade balance jointly with its NAFTA trade partners and China, the results are like that of the isolated case with Canada in the short run. We find no evidence of long run causality in either direction. However, there is strong evidence of short run causality running from trade balance to its GDP. Similarly, to the case of Canada, a 10% improvement in the U.S. trade balance results in a .97% reduction in economic growth the following year.

As can be seen from these results, this can have a significant effect on fiscal policy and trade deficit management. U.S. policy makers should pay close attention when proposing policies that serve as barriers to trade with the aim of improving the trade deficit. To increase economic prosperity and cultural hegemony, countries have been encouraged, and rewarded for their degree of openness. Much of this analysis incorporate a long period where participation in a global economy was the norm. However, under what can be perceived as the new normal, brought about by the novel coronavirus, countries may in the future manage their current and capital accounts in a different way. Karabag (2020) argues that moving forward, countries may take a more nationalist approach, closing their borders to labor and goods produced elsewhere. This new approach will influence culture, politics, and just as importantly, trade and its balance. The pandemic has been an exogenous shock to world operations and presents a breeding ground for further research.

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Appendix

Table A1. Description of Variables

Variable	Description	Source
GDP^{USA}	Output-side real GDP of USA at chained PPPs (in mil. 2011 U.S.$) per capita	Penn World Table 9.0
GDP^{f}	Output-side real GDP of foreign countries (Mexico, Canada, and China) at chained PPPs (in mil. 2011 U.S.$) per capita	Penn World Table 9.0
E^{f}	Exchange rate, national currency/U.S.D (market, estimated)	Penn World Table 9.0

Table A2. Description of Data

	Mean	**Median**	**Min**	**Max**	**Std Deviation**
$RGDP_{USA}$	32025	29777	14619	51959	12098
$RGDP_{Mex}$	9618	9944	4363	15520	3128
$RGDP_{Can}$	25868	25016	11227	43650	10158
$RGDP_{Chi}$	3180	1825	837	12513	2968
XR_{Mex}	3.630	0.056	0.009	13.513	4.914
XR_{Can}	1.153	1.082	0.962	1.569	0.166
XR_{Chi}	4.344	2.462	1.500	8.619	2.556
TB_{USA}	-.021	-.014	-.087	.010	.025

$XR_{foreign} = foreign\ currency\ units/\$US$
TB_{USA}=Trade balance / GDP (PPP) ; $RGDP_i = GDP(PPP)_i\ /Pop_i$

Table A3. Unit Root Test and Order of Cointegration

Unit Root Tests for all subsamples

	Dickey-Fuller Z(t)	Phillips-Perron Z(t)	D-Fuller GLS τ	Order of Integration
Ln(GDP)USA	-0.750 (.970)	-1.608 (.480)	-1.647 (---)	I(1)
ΔLn(GDP)USA	-4.200*** (.005)	-7.259***(.000)	-5.496*** (3.717)	I(0)
Ln(GDP)MEX	-2.314 (0.426)	-1.493 (0.537)	-1.724 (0.000)	I(1)
ΔLn(GDP)MEX	-3.727** (0.021)	-6.220*** (0.000)	-3.688*** (3.717)	I(0)
Ln(GDP)CAN	-1.126 (0.925)	-1.514 (0.527)	-1.331 (---)	I(1)
ΔLn(GDP)CAN	-4.934*** (0.000)	-8.412*** (0.000)	-4.340*** (3.717)	I(0)
Ln(GDP)CHI	-0.392 (0.987)	2.595 (0.999)	-0.487 (---)	I(1)
ΔLn(GDP)CHI	-5.494*** (0.000)	-5.834*** (0.000)	-4.037*** (3.724)	I(0)
Ln(xrmex)	-2.051 (.573)	-0.164 (.943)	-1.569 (---)	I(1)
ΔLn(xrmex)	-2.190 (.495)	-3.559*** (.007)	-3.671** (-3.118)	I(0)
Ln(xrcan)	-2.404 (.377)	-1.658 (.453)	-2.291 (---)	I(1)
ΔLn(xrcan)	-3.342* (.060)	-4.869*** (.000)	-3.824*** (3.118)	I(0)
Ln(xrchi)	-1.871(.670)	-0.670 (.855)	-1.308 (---)	I(1)
ΔLn(xrchi)	-1.875 (.668)	-5.052*** (.000)	-3.808*** (3.725)	I(0)
TB	-3.506** (.039)	-1.253 (.650)	-2.280 (---)	I(1)
Δ(TB)	-5.395*** (.000)	-5.777*** (.000)	-4.690*** (3.717)	I(0)

P values are in parentheses for Df and PP statistics; respective critical values are in parentheses for DF-GLS τ statistic; All unit root test include a trend variable