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RESEARCH PAPER

Cointegration Analysis of Triple Deficits: An Indicator Saturation Approach

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ABSTRACT

The objective of this study to examine the econometric technique of the triple deficit's hypothesis in the existence of multiple structural breaks. Triple deficit theory is a put forward by expanding the twin deficit theory, to recognize the private deficit together with the trade deficit and budget deficit and to investigate the relationship among these under the Keynesian approach. The annual time series data has been used from 1975 to 2020. This study has applied econometric techniques that captured the impact of multiple structural breaks in the series. In this study we used the saturation approach (impulse indicator saturation and step indicator saturation) for multiple structural breaks and equilibrium correction model (EqCM) for cointegration analysis. Results concluded that in the static equilibrium correction model there has been a positive relationship between fiscal-deficit, private deficit, and trade-deficit in the existence of multiple breakpoints. In the dynamic equilibrium correction model, there exists a positive relationship both in (short-term and long-term) between budget-deficit, private deficit, and trade deficit in the presence of three-step indicators. Therefore, to control the deficits government should make such type of policies that mitigates the effects of structural breaks, and this will atomically reduce the adverse effects of shocks to the trade sector and financial sector.

KEYWORDS Cointegration, Saturation Approach, Triple Deficits, Structural Breaks

Introduction

Macroeconomic problems arise in the economy when a country fails to achieve the goal of full employment, inflation, and economic stability. After the second world war, the major problems faced by countries were unemployment, inflation, and an unstable economy (Keynes, 1936). To overcome these problems countries had been involved in international trade to decrease the existing huge budget-deficits. But large fiscal deficit and private deficits affects the trade balance hence, twin deficits (fiscal-deficit and trade-deficit) occur together in the economy.

Budget-deficit happens when the total government expenditures of a country exceed its whole revenue and trade-deficit is observed when a country face its imports greater than exports while private deficit occurs When interest rate increases in the economy the private investment decreases which leads to the private deficit (saving and investment ratio imbalance). Keynesian school of thought proposed that there is a causal relation between these three deficits. Keynesian model suggested that budget-deficit and private consumption has a positive impact on trade-deficit. According to Mundell Fleming model, trade balance is equivalent to the budget deficit, private saving, and investment gap. When interest rate increases in the economy the private investment decreases which leads to the private deficit (saving and investment ratio imbalance). While on the other hand, another economist David Ricardo gives Ricardian equivalence theory, which states that trade-deficit and budget-deficit both are independent, and no causal relationship exists between them. He argued that when the government increases the money supply in the market by printing money or taking loans from the external or internal resources, the saving ratio increases

because of the expected future tax. This additional money has no impact on the balance of payment, as the domestic consumer has the same consumption pattern.

To investigate the impact of the fiscal and private deficit on trade imbalance in the existence of multiple location shifts, in this study we have used equilibrium correction models (EqCM) to explore the long-term and short-term relationship. Equilibrium is a condition from which there has no inherent tendency to transform. While dealing with the stochastic process the equilibrium is the probable value of the variable in appropriate representation since that is the state in which the process would return in the absence of further shocks. Equilibrium correction models have a definite equilibrium and in which changes occur to that equilibrium. EqCM shows the strength of the relationship and openly stipulates the effect of the changes in independent variables over the time (short term) and the effect of variables which illustrate an equilibrium relationship (which are long term effects).

The purpose of this study is to examine and analyse the triple deficits hypothesis by considering the multiple break shifts in the case of Pakistan. The distinct features of this study are identification of multiple locations shifts through step and impulse indicator saturation. Next, the focus of this study is to examine the empirical short term and long-term relation among fiscal and trade imbalance. After the comprehensive description of the introduction, the remaining portion of this chapter describes the objectives of the study, contribution, and motivation. Objectives of the study to investigate a long-term relation between fiscal deficit, private deficit, and trade deficit in the existence of multiple location shifts. This study contributes specially to applied econometrics by locating the significant multiple breaks, in the case of triple deficits through indicator saturation approach. As indicator saturation (IIS and SIS) is tilled to date the most powerful and modern technique of detection of breaks in macroeconomic data while for long-term relationships this study used the equilibrium correction model to inspect the impact of budget-deficit on trade-deficit in the presence of multiple structural breaks.

Material and Methods

Theoretical framework:

While understanding the causal relationship among budget-imbalance and trade-imbalance, we first clarify the idea of Keynesian's closed economy and David Ricardo's open economy. Keynesian proposition describes that a closed economy is when a country's revenue is equivalent to the government expenses, total consumption, and investment and if we add the net exports (EX - IM) it becomes an open economy.

National income identity on the expenditure side,

$$Y = C + I + G + (EX - IM) \quad \textbf{(2.1)}$$

National income identity can be stated as a disposable side,

$$Y = C + S + T \quad \textbf{(2.2)}$$

by putting equation 2.2 into equation 2.1

$$C + S + T = C + I + G + (EX - IM) \quad \textbf{(2.3)}$$

By rearranging 2.3 equation we get,

$$(EX - IM) = (I - S) + (G - T) \quad \textbf{(2.4)}$$

Equation 2.4 shows that import and export balance is equivalent to the gap among private investment, private saving, and government expenditures minus taxes.

$$(IM - EX) = (I - S) + (G - T) \quad \textbf{(2.5)}$$

While investigating the triple deficits, Mundell-Fleming explains the IS-LM model in the context of the unrestricted economy by assuming the free capital movement. First-time twin deficit was investigated by Abell (1990) he used interest rate and exchange rate as an exogenous variable. Therefore, we analysed the triple deficits hypothesis by incorporating the exchange rate and interest rate Akdogana et al (2013), Bolat et al (2014). According to economic theory and past literature, the economic model of triple deficits becomes,

$$TD_t = f(PD, BD_t, int_t, ex_t) \quad \textbf{(2.6)}$$

The econometric model becomes,

$$TD_t = \propto_0 + \beta_1(PD_t) + \beta_2(BD_t) + \beta_3(int_{t)} + \beta_4(ex_t) + e_t \quad \textbf{(2.7)}$$

Where is;

TD = trade-deficit (Imports - Exports)

PD = investment saving gap (private deficit)

BD = budget-deficit (G-T)

Int = interest rate

E*x* = real exchange rate

e = error term

Econometric Technique

Stationarity

In time-series data there exists a problem of non-stationarity or a random walk. To check the stationarity, we applied KPSS (Kwiatkowski Phillips Schmidt Shin 1992) test in the detection of unit root because the null hypothesis of the test is, data is stationary. We applied ADF and KPSS tests for stationarity of the variables. If the variables are non-stationarity, it means that non-stationarity is due to the accumulation of past shocks. So, there is a need to identify the breakpoints in the series.

Impulse Indicator Saturation

The methodology of IIS is general to specific wherein an indicator is introduced for every observation in the set of explanatory variables, it means if "T" is the number of observations then "T" several variables will be created. In this study, we are using two kinds of saturation methods impulse indicator saturation and step indicator saturation.

Santos (2008), analyze the distribution properties of impulse indicator saturation when the observations are generated according to the model.

$$Y = \mu + \varepsilon_t \qquad \text{t = 1, ……., T}$$

and $\varepsilon_t \sim IID\ (0, \delta^2)$

For the model selection, impulse indicator saturation is considered as split-half approach T/2. For the first half sample added to the model.

$$Y_t = \mu + \sum_{k=1}^{T/2} \delta_{1k}\, I_t(k) + \varepsilon_t \qquad \text{t = 1, ……., T} \quad \textbf{(2.8)}$$

Form the first half an indicator has been chosen at α (significance level) then the selection procedure is repeated in the second half (T-T/2).

Step Indicator Saturation

Step indicator saturation (SIS) is specifically designed for the detection of multiple location shifts (Hendry et al, 2010). Step shifts are exactly a block of adjacent impulses having the same sign and magnitude. The step indicator method is the extension of impulse indicator to the case when It (T) represents a step or intercept dummy.

$$y_t = \beta_o + \beta'_1 z_t + \sum_{i=1}^{m} \varphi_i 1_{\{t=ti\}} + v_t \quad \textbf{(2.9)}$$

Where $v_t \sim IID\ (0, \delta_v^2)$

φ_i is a significant impulse indicator when the significance level α is used in testing their retention. Hendry et al (2013) examined that regressors could be retained without selection.

$$y_t = \sum_{J=1}^{T} \delta_j\, 1_{\{t \le j\}} + \mu_t \quad \textbf{(2.10)}$$

Where $\mu_t \sim$ IID $(0, \delta^2{}_\mu)$

Step indicators are the cumulation of impulse indicators up to each next observation. When a complete set of step indicators are added to a model,

$$S_1 = \{1_{\{t \le j\}}, j = 1, \ldots\ldots, T\}$$

Step indicators takes the form from whole sample vectors,

$$t_1 = (1,0,0,\ldots\ldots,0), \quad t_2 = (1,1,0,0,0,\ldots 0) \ldots\ldots\ldots\ldots t_T = (1,1,1,1,\ldots\ldots,1)$$

As a step indicator saturation follows the split-half approach T/2. Choose a significance level α for T indicators and add the first half T/2. Record the indicators which have significant coefficients, eliminate them, and add the second block of T/2 to the original model.

Equilibrium correction model (EqCM):

After the breakpoints identification, this study applies equilibrium correction models (EqCM) for long-term and short-term analysis. As equilibrium correction models incorporate the multiple breaks points (Hendry, D. F. (2015).

$$Y_t = \beta_o + \sum_{i=1}^{k} \beta_i z_{i,t} + \varepsilon_t \quad \textbf{(2.11)}$$

$$= \beta_o + \beta' z_t + \varepsilon_t$$

Where $\varepsilon_t \sim IN\ (0,\ \delta^2)$

ε_t is normal and independent from the past and present of the k regressors (Z_t) then,

$$E\ [\ Y_t\ -\ \beta_o\ -\ \beta' z_t\ ]\ =\ 0 \quad \textbf{(2.12)}$$

Where eq (2.12) shows the conditional equilibrium and adjustment to that equilibrium is instantaneous as in eq (2.11), by taking differencing from eq (2.12) delivers isomorphic EqCM formulation.

$$\Delta Y_t\ =\ \beta' \Delta z_t\ -\ (Y_{t-1}\ -\ \beta_o\ -\ \beta'\ z_{t-1})\ +\ \varepsilon_t \quad \textbf{(2.13)}$$

$(Y_{t-1}\ -\ \beta_o\ -\ \beta'\ z_{t-1})$ is an equilibrium correction term and its coefficient is (-1). Notice that a differencing is a linear transformation and not an operator in any setting

beyond a scalar time-series. The existence of eq (2.12) does not require that Y_t and Z_t are stationary.

From Error Correction to Equilibrium Correction:

In economics, explicit examples of equilibrium correction models are called error correction mechanisms (ECMs). The major developments in cointegration analysis by Engle and Granger (1987) established its isomorphism with equilibrium correction for integrated processes, leading to an explosion in the application of equilibrium correction models and the development of a formal analysis of vector EqCM systems in Johansen (1988; 1995).

$$\Delta Y_t = \beta_o + \beta_1 \Delta X_t + \beta_2 \Delta Y_{t-1} + \varepsilon_t \quad \textbf{(2.14)}$$

When E [ε_t] = 0 and the differenced variables are stationary with means $E\ [\Delta Y_t] = Y'$ and $E\ [\Delta X_t] = X'$ then the long-term steady state solution to eq (2.14) is,

$$Y' = \frac{\beta_o + \beta_1 X'}{1-\beta_2}$$

As formulated in eq (2.14) does not establish any relationship between the levels Y_t and X_t, hence these could drift apart.

$$(Y - X)_{e,t} = \delta_o + \delta_1 \Delta X_t + \delta'_2 z_t \quad \textbf{(2.15)}$$

Where z_t denotes a vector of additional variables.

The disequilibrium is,

$$v_t = Y_t - X_t - \delta_o - \delta_1 \Delta X_t - \delta'_2 z_t \quad \textbf{(2.16)}$$

To re-establish the equilibrium whenever level drifts apart (Sargan, 1964) used the explicit adjustment equation.

$$\Delta Y_t = \alpha(Y_{t-1} - X_{t-1} - (Y - X)_{e,t-1}) = \alpha v_{t-1} \quad \textbf{(2.17)}$$

In equation (2.16) if a relation is well defined like v_t is I (0), when the levels are I (1) and the difference are I (0), then Y_t forms a non-integrated combination with Xt and Zt. So, these variables are cointegrated (Engle and Granger, 1987) (Phillips and Loretan, 1991).

Data Source

For the analysis of the triple deficits in the case of Pakistan, this research has used annual data from 1975 to 2020. The explanation of data is described below in the table.

Table 1
Variables Description and Source

Variables	Measurements	Source
Trade-deficit (TD)	Difference between imports and exports (IM-EX)	IFS
Budget-deficit (BD)	Difference between receipts and taxes (G-T)	Pakistan Bureau of Statistics (PBS)
Private deficit (I-S)	Difference between gross total investment and national saving	Yearbook of Pakistan Bureau of Statistics (PBS)
Interest rate (i)	Call money rate	Yearbook of Pakistan Bureau of Statistics (PBS)
Real Exchange rate (e)	$RS/CPIPAK\ \$/CPIUS$	IFS

Results and Discussion

Stationarity

We have applied Augmented Dickey-Fuller (ADF) and Kwiatkowski Phillips Schmidt Shin (KPSS) to check the stationarity of variables whether our variables were stationary at the level or not, at 5% significance level. If the variables are non-stationarity, it means that non-stationarity is due to the accumulation of past shocks.

The hypothesis of Kwiatkowski Phillips Schmidt Shin (KPSS)

Ho: data is stationary.

$H_{A:}$ data is not stationary.

If the LM statistics are greater than the critical value at 5% then the null hypothesis is rejected, the series are non-stationary.

Hypothesis of Augmented Dickey-Fuller (ADF)

Ho: Series have a unit root.

$H_{A:}$ Series has no unit root.

If the probability value of the ADF test is less than 0.05 then we reject the null hypothesis which means that series have a unit root.

Table 2
Unit root tests

Variables	ADF at level	ADF at 1st diff	KPSS at level	KPSS at 1st diff
	P value		LM statistics value	
Trade-deficit	0.77	0.000	LM stat = 0.19 C.V at 5%= 0.14	LM stat = 0.07 C.V at 5%= 0.14
Budget-deficit	0.69	0.006	LM stat = 0.17 C.V at 5%= 0.14	LM stat = 0.07 C.V at 5%= 0.14
Interest rate	0.365	0.0001	LM stat =0.2 C.V at 5%=0.14	LM stat =0.04 C.V at 5%=0.14
Exchange rate	0.7794	0.0357	LM stat =0.15 C.V at 5%=0.14	LM stat =0.05 C.V at 5%=0.14
Private deficit	0.1060	0.0000	LM stat =0.15 C.V at 5%=0,14	LM stat =0.03 C.V at 5%=0.14

As shown in table 2 both test (ADF and KPSS) results showed that our variables are non-stationary at level. Now we must detect structural breaks by using indicator saturation approach.

Impulse and step indicator saturation:

For the analysis of multiple structural breaks, we used impulse indicator saturation and step indicator saturation. First, we applied impulse indicator saturation on our data to realize that how many impulse indicators have been identified in the series. Then we applied step indicators saturation for step indicators. Secondly, we applied both techniques (IIS + SIS) jointly for the identification of significant breaks in the series (impulse and step).

Table 3
Impulse and step indicator saturation

Indicators	Coefficients	T- Value	T- Prob.
I:1977	-5.816	-4.520	0.000
I:1998	2.430	3.220	0.003

I:2020	-5.306	-6.140	0.000
S1:2004	2.134	3.270	0.002
S1:2001	3.739	6.270	0.000
S1:2008	-2.263	-3.460	0.002
S1:1987	-3.217	-3.080	0.004
budget-deficit U	-0.003	-0.352	0.007
budget-deficit_1 U	-0.003	-3.380	0.002
Interest rate U	-0.356	-4.050	0.000
Interest rate_1 U	-0.191	-2.050	0.051
exchange rate U	-0.155	-2.790	0.010
exchange rate_1 U	0.238	3.810	0.001
private deficit U	-0.373	-5.930	0.000
private deficit_1U	0.418	6.430	0.000
Sigma	0.704	13.374	
log-likelihood	35.905		
no. of observations	43	No of parameters	15
mean (trade-deficit)	-6.555	3.851	

Table 3 shows the indicator saturation (IIS + SIS) model for triple deficits and generates significant impulse and step indicators with their magnitudes in their parentheses: 1977 (-58%) an impulse indicator captures the impact on trade-deficit due to the military dictatorship (dismissal of civil government by the military). 1998 (24%) captures the impact after the nuclear test, Pakistan was banned all aid and financial supports due to UN sanctions (Sarwar, 2012). In 2020 (-53%) Pakistan trade deficit has been increased from $2.7 billion in 2015 to $18.2 billion in 2020 (Pakistan economic survey 2019-2020). In 2001 (37%) a step indicator captures the impact on trade-deficit (due to the incident of September-9-2001, resulting in an American attack on Afghanistan) (Khanna, 2010). In 2004 (-21%) Pakistan entered the era of terrorism after the invasion of NATO on Afghanistan (Khanna, 2010). 2008 (-22%) Pakistan also suffered from the financial crises of 2007-08 and internal political instability (Rehman et al, 2015) and in 1987 (-32%) Pakistan's economy experienced public debt of Rs 521 billion. All independent variables are un-restricted (fixed) so, that all significant indicators have been retained by IIS and SIS. Sigma is 0.7 which is lower than previous models of IIS and SIS. All these indicators affect the trade-deficit during the time. Previous models could not capture all these effects.

Table 4
Diagnostic Test:

AR 1-2 test:	F (2,25) = 0.29949 [0.7438]
ARCH 1-1 test:	F (1,41) = 0.60554 [0.4409]
Normality test:	Chi^2(2) = 2.0173 [0.3647]
Hetero test:	F (21,17) = 1.4109 [0.2376]
RESET23 test:	F (2,25) = 0.42856 [0.6561]

The diagnostic check misspecification or diagnostic tests are used to guide the selection of congruent models, where the residuals which are not normally distributed at 5% level of significance but if we are wider the interval at 1% then they appear normally distributed. Fit vs actual much better than all other previous models used for trade-deficit. All effects are removed in this new indicator saturation model (IIS + SIS) model.

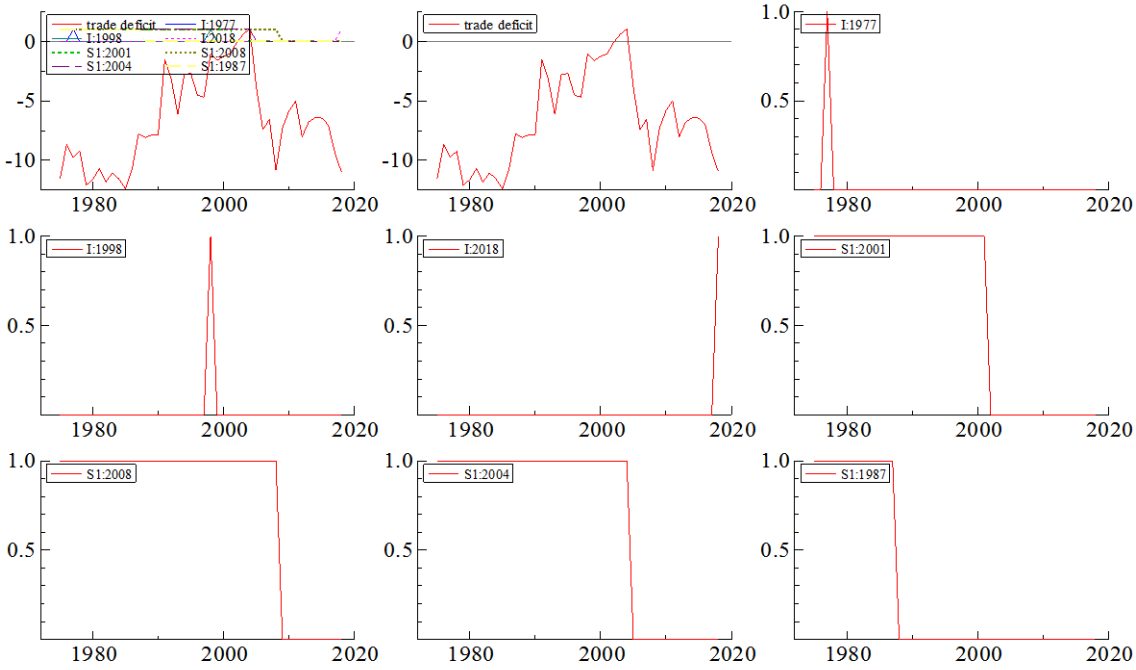

Figure 1: Graphical presentation of breakpoints

Figure 1 shows the significant impulse and step indicators of the triple deficits model graphically. The first two figures labeled with trade deficit showed a trade deficit graph with structural breaks. Three impulse indicators (I: 1977, I:1998, I:2020) and four-step indicators (S:1987, S:2001, S:2008, S:2004). These steps and impulse indicators significantly affect trade-deficit over time.

Cointegration

For cointegration analysis, we have applied the equilibrium correction model (EqCM) for short-run and long-run relationships. First, we employed a static equilibrium correction model for long-term cointegration to check whether the cointegration relationship among explained and explanatory variables exist or not. Secondly, we applied a dynamic equilibrium correction model for short-term and long-term analysis.

Static Equilibrium Correction Model

In cointegration analysis, we apply the static long-term equilibrium correction (EqCM) to check the cointegrating relationship among trade-deficit and its determinants in the existence of multiple breakpoints. A long-term relationship established between the fiscal and trade imbalance, private deficit, and other economic variables like exchange rate and interest rate.

Table 5
Static equilibrium correction model:

Indicators	Coefficients	T- Value	T- Prob.
budget-deficit	-2.163	-3.590	0.001
Interest rate	-2.262	-1.010	0.010
exchange rate	-1.288	-1.660	0.007
private deficit	-3.393	-0.685	0.008
I:1977	1.150	0.560	0.009
I:1998	3.342	1.670	0.005
I:2020	-1.542	-0.692	0.004
S1:2004	3.434	1.830	0.000

S1:2001	-2.440	-1.370	0.000
S1:2008	-2.380	-1.700	0.008
S1:1987	-7.072	-6.460	0.000
Long-run sigma		1.915	
WALD test		Chi^2(11) = 676.981[0.0000] **	

The underlying equation shows static long-term results.

$$TD_t = 2.16\, bd_t + 2.26\, Int_t + 1.28\, ex_t + 3.39\, pd_t - 1.14\, I{:}1977 - 3.34\, I{:}1998 + 1.54\, I{:}2020 - 3.43\, S1{:}2004 + 2.43\, S1{:}2001 + 2.37\, S1{:}2008 + 7.07\, S1{:}1987 \quad (\mathbf{3.1})$$

Table 5 shows that in the presence of multiple structural breaks the Keynesian theory of triple deficits is significant in the case of Pakistan as the static equation in equation 4.1 showed that the long-term relationship exists between the said variables. It has been observed that budget-deficit and private deficit have a significant and positive relation with trade-deficit in Pakistan, in a way that budget deficit influenced the trade imbalance by 2.16 percent. After the incorporation of multiple location shifts, we rejected the twin deviation. The private deficit also shows a significant and positive relationship with trade-imbalance, that the trade-imbalance will rise by 3.39 percent in the long run. Similarly, in the case of interest rate and exchange rate, the situation appears significant with current account-deficit as both interest rate and exchange rate enhances the trade-deficit by 2.26 and 1.28 percent respectively in the long run. In the static long run equilibrium correction model, multiple structural breaks significantly influenced the trade deficit.

Analysis of Lag Structure Coefficients:

Long-term equation results have been shown in the underlying table 6. Unit-root t-test = -2.33 for trade-deficit, -3.591 for budget-deficit and -1.01 for interest rate, -1.65 and -0.68 for the exchange rate and private deficit respectively, which suggests that trade-deficit and all independent variables were non- stationary series at level, integrated of order I(1) as the dynamic ARDL model suggest so, better to estimate the equation with equilibrium correction model (EqCM) to capture both short-term and long-term dynamics.

Table 6
Lag structure and significance test:

Analysis of Lag Structure Coefficients:			
Indicators	**Lag 0**	**Sum**	**SE (Sum)**
trade-deficit	-1	-1	0
budget-deficit	-2.163	-1.016	0.005
Interest rate	-2.262	-1.162	0.160
exchange rate	-1.288	-0.029	0.017
private deficit	-3.391	-0.103	0.151
Tests on the Significance of each Variables			
Variables	F- Test	Prob. Value	Unit Root, T- Test
trade-deficit	F (1,26)	12.407 [0.0016] **	-2.330
budget-deficit	F (1,33)	12.898 [0.0011] **	-3.591
Interest rate	F (1,33)	1.0204 [0.3198]	-1.010
exchange rate	F (1,33)	2.7539 [0.1065]	-1.660
private deficit	F (1,33)	0.46944 [0.4980]	-0.685

Dynamic long-term cointegration

To capture the long-term and short-term dynamic relationship among the trade imbalance, fiscal deficit, saving investment gape (private deficit), interest rate, and exchange rate in the occurrence of multiple structural breaks we have analyzed the dynamic equilibrium correction model.

Table 7
Dynamic long-term cointegration

Modeling Trade Deficit by OLS			
Indicators	**Coefficients**	**T- Value**	**T-Prob.**
trade-deficit_1	0.783	11.000	0.000
budget-deficit	0.410	-3.180	0.003
private deficit_1	0.342	4.560	0.000
EqCM_1	-0.307	-2.230	0.032
S1:2004	4.209	3.450	0.001
S1:2001	-2.281	-2.240	0.032
S1:2008	-4.521	-5.540	0.000
Sigma		1.512	
log-likelihood		-74.969	
RSS		82.290	
no. of observations		43	
no. of parameters		7	
Mean (TD)		-6.555	
SE (TD)		3.851	
AR 1-2 test:	F (2,33)	5.420	[0.0092] **
ARCH 1-1 test	F (1,41)	0.806	[0.3744]
Normality test	Chi^2 (2)	5.897	[0.0524]
Hetero test	F (13,29)	1.103	[0.3952]
Hetero-X test	F (23,19)	0.831	[0.6671]
RESET23 test	F (2,33)	0.645	[0.5311]

The following equation shows dynamic long-term coefficients.

$$TD_{\ t} = 0.78\ td_{\ t-1} + 0.41\ bd_{\ t} + 0.34\ pd_{\ t-1} - \ 0.306\ eqcm_{\ t-1} + 4.2\ S1{:}\,2001 - 2.2\ S1{:}\,2004 - 4.5\ S1{:}\,2008 \qquad (\mathbf{3.2})$$

In the previous table 6 dependent and all explanatory variables are non-stationary at level, so we regress trade-deficit on the lagged, current, and differenced values of dependent and independent variables. The dynamic equilibrium correction model (EqCM) in table 7 shows the significant variables i.e., 1st lag of trade-deficit td_{t-1}, budget-deficit (BD), 1st lag of private deficit (PD_{t-1}) and three-step indicators 2001, 2002, and 2008 which influence the current account imbalance in the long-term and short-term. While the exchange rate, interest rate, and lagged values are insignificant with trade-deficit and hence removed from the model, but the triple deficits hypothesis is still significant in the dynamic equilibrium correction model. The effect of the lag value of trade deficit (td_{t-1}) increases the inertia in trade-deficit, adding to rises as trade-deficit increases. Current account imbalance rises by 0.41 percent in the short run.

The trade-deficit has been influenced by 0.34 percent, due to changes occurred in private deficit. These variables have a significant and positive effect on trade-deficit both in the long-term and short-term. The equation (4.1) ($EqCM = 2.16\ bd_{\ t} + 2.26\ int_{\ t} + 1.28\ ex_{\ t} + 3.39\ pd_{\ t}$) the coefficient of this equation is -0.30, which is statistically significant, and it means 30% of that deviation from equilibrium is remove from each period. In the presence of three-step indicators S1:2001, S1:2004, and S1:2008, budget-deficit shows a significant relationship with trade-deficit. In 2001 Pakistan suffered political crises after the military takeover in 1999 (Khanna, 2010). As the military seized the civilian government.

After the incident of September-9-2001 war started in Afghanistan and the influx of Afghan refugees destabilized the economy of Pakistan. In 2004 Pakistan's economy faced energy, financial crises, and armed conflicts. Armed conflicts began in 2004 when tensions started in Waziristan (Khanna, 2010). In 2008 Pakistan also suffered from world financial crises (Rehman et al, 2015). The sigma is the same as the previous model, but the fit is better

as all previous models do not capture all these effects in both short-term and long-term dynamics.

Graphical statistics for the equilibrium correction trade-deficit model:

The graphical statistics of the model in underlying figure 2 shows that although the match of trade imbalance and budget imbalance seems best from the previous models. The fitted values track the outcomes least well for the changes in trade-deficit over that period. However, in the case of Pakistan trade-deficit and budget-deficit exist throughout history due to several external and internal shocks. As a result, graphical analysis shows that the residuals are non-normal and no autocorrelation.

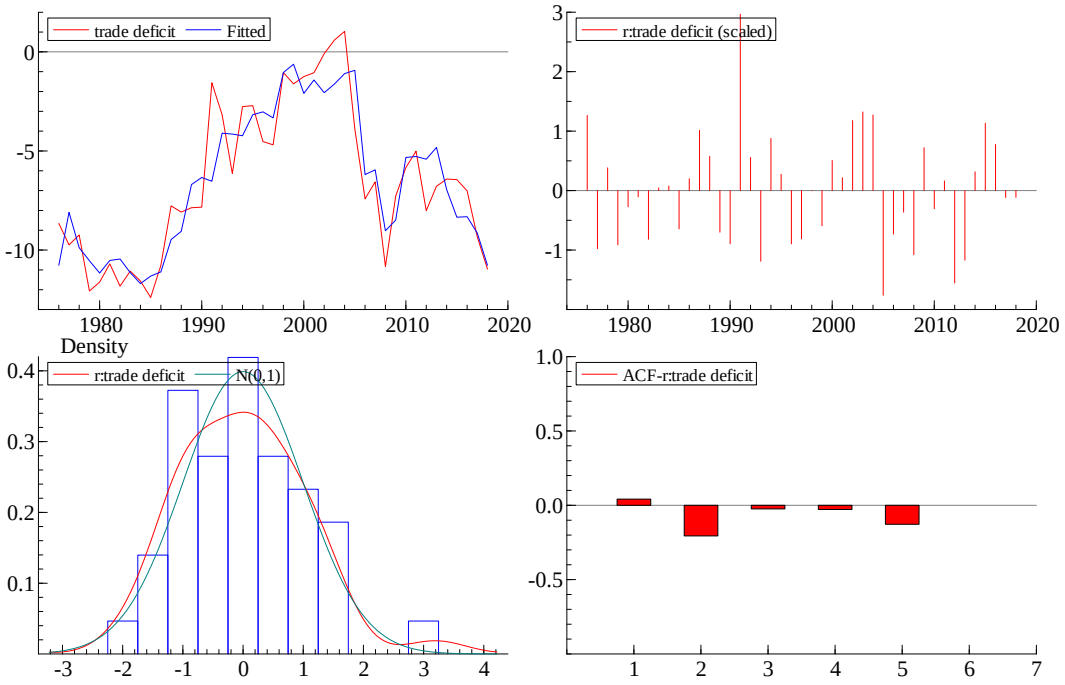

Figure 2: Graphical presentation of Equilibrium correction model

Stability Tests

In time series analysis there exists a problem of structural change in parameters therefore, it is necessary to check the stability diagnostic of parameters. For the diagnostic check, we have applied the ARCH effect, normality, and heteroscedasticity test.

ARCH Effect

In time series analysis the variance of the error term is stochastic (non-uniform over the time) and effected by the variance of one or more variables, that is the problem of autoregressive conditional heteroscedasticity (ARCH). Therefore, the ARCH effect is used to analyze the effects which are unexplained by econometric models.

Hypothesis

H_0: Model has no ARCH effect.

H_A: Model has an ARCH effect.

Table 8
ARCH Effect

Lag	Coefficient	Standard Error
1	0.10813	0.1543
RSS = 455.247	Sigma = 3.3322	
Testing for error ARCH from lags 1 to 1		
ARCH 1-1 test	F (1,41) = 0.49096 [0.4875]	

The ARCH test is used to check for the autoregressive conditional heteroscedasticity in time series data. Results show that the probability value of the F-test is 0.4 that's why we cannot reject our null hypothesis that there exists no ARCH effect.

Normality Test

In econometrics, normality tests are used to describe the data either it is well modeled by a normal distribution or not. To check the normality of the data we have applied the Jarque Bera test. Jarque Bera test is a goodness of fit test to examine whether the skewness and kurtosis of sample data are according to the normal distribution or not.

Hypothesis

H_0: Residuals are not normal.

H_A: Residuals are normal.

Table 9
Normality test for residuals

Observation	43
Mean	-0.060
Std. Dev	1.382
Skewness	0.687
Excess Kurtosis	1.094
Minimum	-2.517
Maximum	4.531
Median	0.061
Asymptotic test	**Chi^2(2) =** 5.530 [0.063]
Normality test	**Chi^2(2) =** 4.809 [0.090]

Results of Jacque Bera show that the values of skewness and excess kurtosis are not reliable because in Pakistan trade and budget deficits exist throughout history and the chi-square probability value is greater than 0.05 therefore, we cannot reject our null hypothesis.

Heteroscedasticity Test

Heteroscedasticity means unequal scatter of variance. In econometrics, the vector of stochastic variables is heteroscedastic if the consistency of a variable is unequal across the range of values of a second variable that predicts it.

Hypothesis

H_0: Data is homoscedastic.

There is no heteroscedasticity in the model.

H_A: There is heteroscedasticity in the model.

Table 10
Heteroscedasticity coefficients

Variables	Coefficients	t-value
trade-deficit_1	-1.840	-0.939
budget-deficit	-0.022	-0.528
private deficit_1	-0.309	-0.374
EqCM_1	0.073	0.047
S1:2004	-0.415	-0.126
S1:2001	1.971	0.636
S1:2008	1.049	0.258
trade-deficit_1^2	-0.167	-1.029
budget-deficit^2	0.000	-0.144
private deficit_1^2	-0.027	-0.471
EqCM_1^2	0.066	0.259
trade-deficit_1*budget-deficit	-0.003	-0.330
budget-deficit*private deficit_1	0.000	0.043
private deficit_1* EqCM_1	0.002	0.010
trade-deficit_1*private deficit_1	-0.060	-0.654
budget-deficit* EqCM_1	0.006	1.063
trade-deficit_1* EqCM_1	0.120	0.464
RSS = 289.018 **sigma =** 3.400	**effective no. of parameters =** 18	
Chi^2(17) = 16.435 [0.4932]	**F (17,25) =** 0.90981 [0.5718]	

For heteroscedasticity in table 10 white test was used to check the heteroscedasticity in the model. It obtains squared residuals from original and auxiliary regression on the set of explanatory variables, the square of the independent variable and their cross terms. Chi^2 probability test value is 0.49 so, we cannot reject the null hypothesis.

Equilibrium correction model without structural breaks:

We applied the equilibrium correction model (EqCM) on trade-deficit without incorporating the structural breaks. The results show that budget-deficit, interest rate, and private deficit are insignificant and the value of the EqCM term was -7.08 which is insignificant. As the graphical analysis also shows that model is insignificant and not normal.

Table 11
Equilibrium correction model without structural breaks

Variables	Coefficient	t-value	t-probability
Trade deicit_1	1.000	5.58E+15	0.000
Budget deficit	0.000	0.000	1.000
Interest rate	1.34E-16	0.799	0.430
Exchange rate	4.43E-17	2.670	0.011
EqCM	-7.08E-17	-0.488	0.628
D (trade deficit)	1.000	3.51E+15	0.000
Sigma	3.03E-15	RSS 3.3084395e-028	
Log Likelihood	+ infinity		
No of Obs	43	no. of parameters	7
Mean	-6.5552	S.E	3.85142
AR 1-2 test	F (2,34) = 0.429 [0.654]		
ARCH 1-1 test	F (1,41) = 0.000 [1.000]		
Normality test	Chi^2 (2) = [0.000] **		
Hetero test	F (13,26) = 6.668 [0.000] **		
RESET 23 tests	F (2,34) = 0.099 [0.905]		

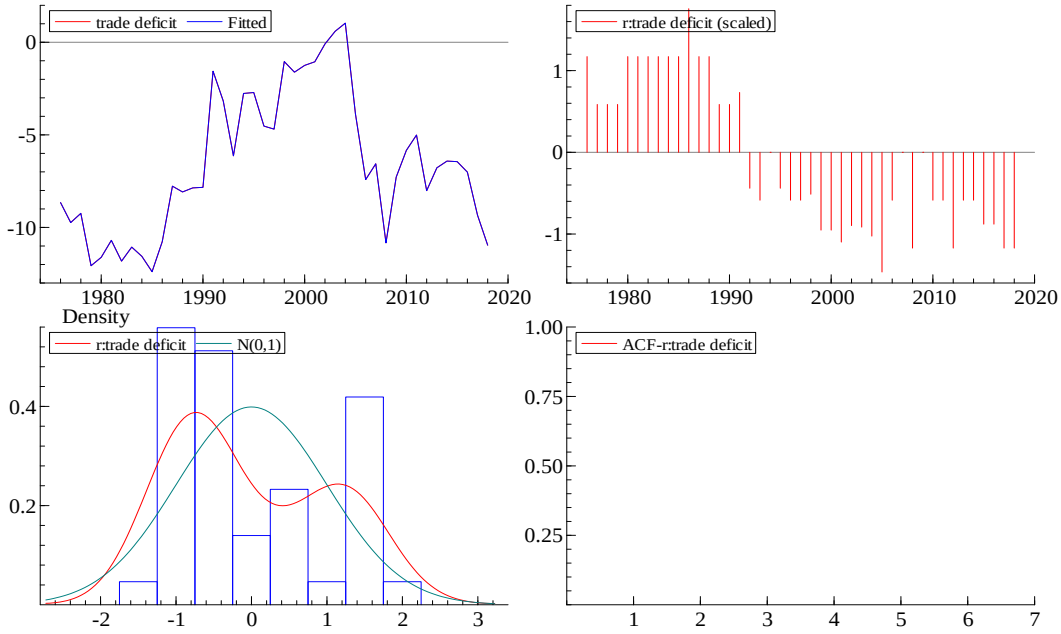

Figure 3: Graphical presentation of Equilibrium correction model without break points

Conclusion

Triple deficit theory is a put forward by expanding the twin deficit theory, to recognize the private deficit together with the trade deficit and budget deficit and to investigate the relationship among these under the Keynesian approach. Triple deficit describes the existence of an equilibrium condition within the disequilibrium where internal and external disequilibrium do coexist that puts forward the necessity of producing alternative policies. Since there exists a positive relationship among trade-deficit and budget-deficit under the equilibrium correction model with multiple structural breaks. For structural breaks, this study used step indicator saturation method and impulse indicator saturation to get the significant impulse and step indicators. The standard Indicator saturation method shows significant multiple indicators (I:1977, I:1998, I:2020, S:1987, S:2001, S:2004, and S:2008). These breaks are globally and domestically significant. We used annual data from 1975 to 2020. This study applied the equilibrium correction model (EqCM) on the triple deficits hypothesis as the standard Johansen cointegration and ECM did not capture the multiple breakpoints.

First, we analyze the Keynesian triple deficits hypothesis with a static equilibrium correction model in the presence of multiple breakpoints and concludes that in the long-term there exists a positive relationship between trade-deficit and budget-deficit. While other financial variables also show a positive and significant relationship with trade-deficit. Then we applied a dynamic equilibrium correction model in the presence of multiple breakpoints. we examine that in dynamic long-term and short-term budget-deficit, the private deficit has a positive relationship in the presence of three-step indicators (S1:2001, S1:2004, and S1:2008). In 2001 Pakistan suffered political crises after the military takeover in 1999. After the incident of September 11, 2009, the war started in Afghanistan and the influx of Afghan refugees destabilized the economy of Pakistan. In 2004 Pakistan's economy faced an energy crisis. Armed conflicts began in 2004 when tensions started in Waziristan. In 2008 Pakistan also suffered from world financial crises.

Recommendations

This research determines that while analyzing the triple deficits hypothesis, multiple breakpoints should be considered in the series otherwise we may end up with false results. Trade-deficit occurs when there exist structural breaks in the economy. Therefore, to control the deficits government should make such type of policies that mitigates the effects of structural breaks, and this will atomically reduce the adverse effects of shocks to the trade sector and financial sector.

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