Original Research Article

Efficiency Estimation of the Stabilizing Error Correction Model in the Presence of Explosiveness

Comment [a1]: The use of the title is quite good, but it is necessary to consider the use of the words policy and stability so that the research model is more applicable to real conditions. example of "Policy or Transformation Implications".

ABSTRACT

In this paper, we proposed a new model to stabilize the explosiveness in an Error Correction model that is explosive in nature, called the stabilizing Error Correction Mechanism. We derived the mathematical methodology for obtaining the estimate of the model using the Ordinal Least Square method. We also discussed and obtained the Error Correction model and compared the result with the Stabilizing Error Correction Mechanism using root mean square error. A Monte-Carlo simulation was performed, and the stimulation results showed that the error correction model exhibited some explosiveness, and the damping coefficient of the stabilizing model exerted a stabilizing effect on the error correction mechanism, thereby reducing the overshooting in the error correction model. Our proposed model contributed to a smoother and more stable response to deviations from the long-run equilibrium. The root mean square error of the stabilizing Error Correction model was observed to be smaller than the adjustment model in the Error Correction model. Therefore, the Stabilizing Error Correction model performs better than the Error Correction model.

Comment [a2]: The choice of words in the abstract needs to be reviewed to provide a concise general overview and provide conclusions that include an applicable summary.

Keywords: Autoregressive Distributed Lag, Error Correction model, Long-run model, and Stabilizing Error correction model

1. INTRODUCTION

Economictheory generally deals with long-run equilibrium relationships generated by market forces and behavioural rules (Iyeli et al., [1] .However, most empirical econometric studies involving time series can be interpreted as attempts to evaluate such relationships in a dynamic framework, and integrated variables are a specific class of non-stationary variables with important economic and statistical properties. In many economic models, a unit root is implied. Examples include exchange rates, money supply, stock prices, inflation rate, Gross Domestic Product (GDP), and unemployment rate (Mustafa [2], Celina [3], Ayodeji and Oluwole [4], Ibrahim [5] Charles et al. [6], Elem-Uche et al. ([7]. Box and Jenkins [8] had advocated successive differencing of integrated time series before modelization, but Sargan [9], Hendry and Mizon [10], and Davidson et al. [11] criticized the specification of dynamic models in terms of differenced variables only, arguing that omitting the former would entail a misspecification error. However, Granger [12] solved the puzzle by pointing out that linear combinations could be stationary in levels. Engle and Granger [13] formalized the idea of cointegration, which is used in a variety of economic models (Iyeli et al.,[1]. In recent years, the cointegration method has been developed to address the issue of non-stationarity in time-series data. Over the past forty years, it has established itself as a standard tool in econometrics and provides evidence for the presence of a real long-term economic relationship. Applying the real economic data to the cointegration test gives a formal and practical foundation for evaluating the short- and long-term models. When two or more economic variables are cointegrated, short-term deviations from equilibrium have an effect

Comment [a3]: Economic phenomena are not explained in a fundamental way, giving rise to confusion in reviewing the estimation results.

on the other variables, which in turn influences a shift in the direction of the long-run equilibrium. The cointegration of the two variables suggests that an adjustment mechanism is in place to keep the long-run relationship's errors from increasing. The Error Correction model is used to measure the correction from the disequilibrium of the previous period, which has a very good economic implication; it eliminates trends from the variables involved and thereby resolves the problem of spurious regressions. Muritala et al. [14], Albdulaziz and Basmah [15], and Wasanthi [16] observed some explosiveness in the adjustment term.

The purpose of this paper is to investigate some explosiveness in the Error correction model and to propose a model to adjust for the explosiveness in the model. The plan of the paper is as follows: Section 2 provides the methods to be applied, which include the ARDL, the cointegration, and the Error Correction Mechanism Section 3 adjusts for explosiveness in the model. Section 4 presents the Monte-Carlo simulation results for the model, and Section 5 is on some concluding remarks

Comment [a4]: In the objectives it is necessary to add research limitations so that the estimation model cannot deviate from the path to be achieved.

2. MATERIAL AND METHODS

2.1 The Autoregressive Distributed Lag (ARDL) model

The ARDL model by Pesaran and Shin [17] is given as:

$$\alpha(L)Y_t = \mu + \beta(L)X_t + \mu_t \qquad (1)$$

Where,

X_t is explanatory variable, Y_t is the dependent variable, and μ_t is the stationary error term,

$\beta(L)$ and $\alpha(L)$ are the lag polynomials such that;

$\alpha(L)= 1- \alpha_1 L- \alpha_2 L^2 -\ldots- \alpha_p L^p$

$\beta(L)= 1-\beta_1 L- \beta_2 L^2 -\ldots- \beta_q L^q$

We assume that X_t is vector of a random variable and

$$X_t=X_{t-1} +e_t \qquad (2)$$

Where X_{t-1} is the lag of Xt, e_t is stationary and equation (2.2) implies that X_t is integrated of I(1) or 1(0) and Y_t is also of Order I(1), Y_t and X_t are cointegrated, allowing for the $Cov(u_t,e_t) \neq 0$ in which X_t is said to be endogenous

2.2: Cointegration Model

Equation (1) can be rewritten as

$$\alpha(1)Y_t = \mu + [\beta(1) + \beta'(L) - \beta(1)]X_t + [\alpha(1) - \alpha(L)]Y_t + \mu_t$$

$$Y_t = \frac{\mu}{\alpha(1)} + \frac{\beta(1)'}{\alpha(1)} X_t + \frac{[\beta(L) - \beta(1)]'(1-L)}{\alpha(1)(1-L)} X_t + \frac{[\alpha(1) - \alpha(L)](1-L)}{\alpha(1)(1-L)} Y_t + \frac{\mu_t}{\alpha(1)}$$

$$Y_t = \lambda_1 + \lambda_2' X_t + \gamma_2'(L)\Delta X_t + \gamma_1(L)\Delta Y_t + v_t \quad (3)$$

Where

$\lambda_1 = \frac{\mu}{\alpha(1)}$, $\lambda_2 = \frac{\beta(1)'}{\alpha(1)}$

$\gamma_2' = \frac{[\beta(L)-\beta(1)]'}{\alpha(1)(1-L)}$, $\gamma_1 = \frac{[\alpha(1)-\alpha(L)]}{\alpha(1)(1-L)}$ and $v_t = \frac{\mu_t}{\alpha(1)}$

Equation (3) is the cointegration model and λ_2 measures the long-run impact of X on Y. Stock [18], and Engle and Granger [13] estimated equation (3) using OLS estimator since Y_t and X_t are of order I(1) and ΔY_t and ΔX_t are of order I(0).

2.3: Error Correction Model

Using (ARDL (1,1)), we have:

$$Y_t = \alpha_o + \alpha_1 Y_{t-1} + \beta_0 x_t + \beta_1 x_{t-1} + \varepsilon_t \quad (4)$$

$$Y_t - \alpha_1 Y_{t-1} = \alpha_o + \beta_0 x_t + \beta_1 x_{t-1} + \varepsilon_t \quad (5)$$

$$Y_t(1 - \alpha_1) = \alpha_o + (\beta_0 + \beta_1) x_t + \varepsilon_t \quad (.6)$$

$$Y_t = \frac{\alpha_o}{(1-\alpha_1)} + \frac{(\beta_0+\beta_1)x_t}{(1-\alpha_1)} + \frac{\varepsilon_t}{(1-\alpha_1)} \quad (7)$$

$$Y_t = \alpha_0^* + \beta^* x_t + \varepsilon_t \quad (8)$$

Equation (8) is the long-run multiplier.

Re-parameterizing the ARDL model using the technique of Perasan and Shin [19], is done by adding and subtracting $Y_{t-1}$and $\beta_0 x_{t-1}$ into equation 4, we have

$$Y_t = \alpha_o + \alpha_1 Y_{t-1} + Y_{t-1} - Y_{t-1} + \beta_0 x_t + \beta_0 x_{t-1} - \beta_0 x_{t-1} + \beta_1 x_{t-1} + \varepsilon_t \quad (9)$$

Rearranging we have,

$$Y_t - Y_{t-1} = \alpha_o + \alpha_1 Y_{t-1} - Y_{t-1} + \beta_0 x_t - \beta_0 x_{t-1} + \beta_0 x_{t-1} + \beta_1 x_{t-1} + \varepsilon_t \quad (10)$$

$$\Delta Y_t = \alpha_o + Y_{t-1}(\alpha_1 - 1) + \beta_0 \Delta x_t + (\beta_0 + \beta_1) x_{t-1} + \varepsilon_t \quad (11)$$

$$\Delta Y_t = -(1 - \alpha_1)\left[Y_{t-1} - \frac{\alpha_o}{(1-\alpha_1)} - \frac{(\beta_0+\beta_1)}{(1-\alpha_1)} x_{t-1}\right] + \beta_0 \Delta x_t + \varepsilon_t \quad (12)$$

The interpretation of the error correction model relies on a long run equilibrium relationship $y = \beta' x$.

The error correction mechanism is the adjustment of y_t through a(1) to equilibrium deviation in the previous period, in equation (8). The equation is rewritten as follows.

$$\Delta y_t = \lambda ECM_{t-1} + \beta_0 \Delta x_t + \varepsilon_t \qquad (13)$$

Where $ECM_{t-1} = \left[Y_{t-1} - \frac{\alpha_o}{(1-\alpha_1)} - \frac{(\beta_0+\beta_1)}{(1-\alpha_1)} x_{t-1}\right]$ and $\lambda = -(1-\alpha_1)$

Where $-1 < \lambda < 0$

$$\lambda = \begin{pmatrix} > 0, \text{the disequilibrium expands} \\ = 0, \text{there is no error correction} \\ -1 < \lambda < 0, \text{a quick equilibrium} \\ = -1, \text{Full error correction in one point} \\ < -1, \text{over shooting: oscillatory adjustment} \end{pmatrix}$$

3.0: Explosiveness in the Error Correction model

In the figure below, the blue line represents the long-run equilibrium relationship between Y and X, and the red line represents the actual values of Y. The green arrows show the direction of adjustment of Y in each period. When $\lambda$is the coefficient of the error correction term (ECT) which is expected to be between -1 and 0. The negative indicate the degree of correction. The magnitude of the correction suggests a fairly high speed of adjustment in the aftermath of a shock. When λ is greater than 1, the adjustment of Y is too large and overshoots the equilibrium, creating a divergent pattern. This is in contrast to the case when λ is between 0 and 1, where the adjustment of Y is gradual and convergent, and the red line eventually approaches the blue line. To correct the problem of explosiveness in the short run model a stabilizing error correction mechanism is proposed which is given as:

Stabilizing Error Correction Mechanism.

$$\Delta Y_t = \sum_{i=1}^{p} \beta_i \, \Delta Y_{t-i} + \sum_{j=0}^{q} \beta_j \, \Delta X_{t-j} + \lambda ECT_{t-1} + \theta SECM + e_t \qquad (14)$$

SECM is called the Stabilization error correction mechanism by damping the speed of correction. It measures the change in the error correction term from one period to the next. It helps to slow down the correction process. By introducing SECM, we allow the model to adjust the speed of correction dynamically based on past adjustments.

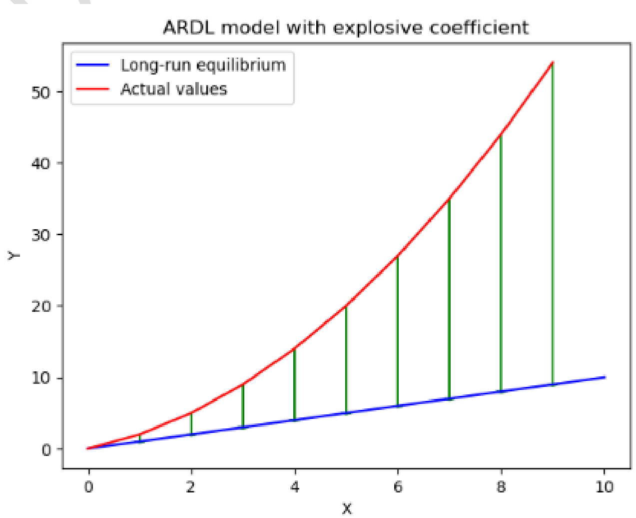

Figure 1: Illustration of explosiveness

In Matrix form equation (14) can be represented as:

$$y_t = hd_t + \theta SECM_t + e_t \quad (15)$$

$$y_t = [y_1, y_2, \dots, y_n]'$$

$$y_{t-1} = [y_0, y_1, \dots, y_{n-1}]'$$

$$e_t = [e_{1,} e_2, \dots, e_n]$$

$$d_t = [\Delta Y_t \Delta X_t ECM_t]$$

$$g = [\beta, \quad \theta]$$

$$set$$

$$H_{dt} = [d_T, SECM_t]$$

$$G = [g, \lambda]$$

Using OLS, the estimator G is denoted by G_t

$$G_t = [H_{dt}{}' H_{dt}]^{-1}[H_{dt}{}' y_t] \quad (16)$$

$$V(d) = \sigma_u^2 [H_{dt}{}' H_{dt}]^{-1} \quad (17)$$

And $\sigma_u^2 = N^{-1}\left(y - H_{dt}{}'\widehat{G_t}\right)'\left(y - H_{dt}{}'\widehat{G_t}\right)$ (18)

The t- statistic for the parameter estimate is given as

$$t = \frac{G_t - \widehat{G_t}}{S.E(\widehat{G_t})} \quad (19)$$

$$S.E\left(\widehat{G_t}\right) = \sqrt{var(G_t)} \quad (20)$$

4.0: Monte-carlo simulation

In this section, we will perform a detailed Monte Carlo analysis to illustrate the impact of the shock. The sample size considered is 50.

4.1 Data Generating Process

The parameters are selected arbitrarily.

$$y_t = \alpha + \beta_0 x_t + \beta_1 x_{t-1} + \phi y_{t-1} + u_t \quad (21)$$

where $x_t = \rho_1 x_{t-1} + v_t$
(22)

$\eta_{1t} \sim N(0,1)$

u_t and v_t are generated by the processes;

$u_{1t} = p_{11}\,\eta_{1t}$
(23)

$v_{1t} = p_{21}\,\eta_{1t} + p_{22}\,\eta_{2t} + p_{23}\,\eta_{1t-1}$
(24)

The initial values are: $x_0 = 1,\ y_0 = 1,\ \alpha = 0$

$(\beta_0, \beta_1, \phi) = B_1 = (1, 0, 0),\ B_2 = (0.6, 0, 0.4),\ B_3 = (0.6, 0.4, 0),\ B_4 = (0.6, 0.4, 0.4)$

$p_{11} = 0.95,\ 1.0$

$(p_{21}, p_{22}, p_{23}) = P_1 = (0, 1, 0), P_2 = (0.5, 0.866, 0),$
$P_3 = (0.5, 0.866, 0.5), P_4 = (0.5, 0.9, 0.9), P_5 = (0.9, 0.5, 0.5), P_6 = (0.9, 0.9, 0.9)$

η_{1t} and η_{2t} are independently and identically distributed standard normal variables

The various combinations of P_{2i} allow for correlation between the u_t and v_t and hence the endogeneity of X_t and for some serial correlation in v_t.

The various combinations of P_{2i} allow for correlation between the u_t and v_t and hence the endogeneity of X_t and for some serial correlation in v_t.

4.2 Results And Discussion

Tables 1 and 2 present results of the persistence of the estimation of the short-run model at P_{11}= 0.95 and 1.0 We observed the following:

i. The short-run model yielded an explosive behaviour when ϕ = 0, it seems that the adjustment of Y is too large and overshoots the equilibrium, creating a divergent pattern.
ii. When P_{22}, P_{23} = 0.9 and ϕ = 0.4 we observed that the adjustment of Y is too large and overshoots the equilibrium, creating a divergent pattern.
iii. When $\phi \neq 0$, the adjustment of Y is gradual and convergent, and long-run will eventually approaches the equilibrium point
iv. The influence of the lag of the independent variable on the current value of the dependent variable continues to decrease across all β_0, β_1, ϕ,
v. For all β_0, β_1, ϕ, the influence of the current independent variable on the current dependent variable increases for a while and then decreases

Table 1. Persistence at P11=1.0 when the sample size is 50

-	N=50, P11= 1.0												
		$(\beta_0, \beta_1, \phi) = (1, 0, 0)$			(β_0, β_1, ϕ) =(0.6, 0, 0.4)			(β_0, β_1, ϕ) =(0.6, 0.4, 0)			(β_0, β_1, ϕ) = (0.6, 0.4, 0.4)		
	ESTIMATOR	**COEFF**	**ST.ERR**	***P*-VALUE**	**COEFF**	**ST.ERR**	***P*-VALUE**	**COEFF**	**ST.ERR**	***P*-VALUE**	**COEFF**	**ST.ERR**	**PVALUE**
P21,P22,P23 (0,1,0)	$D(Y_{t-1})$	-	-	-	-	-	-	-	-	-	-	-	-
	$D(X_t)$	-	-	-	-	-	-	0.7269	0.1650	0.000	0.7206	0.1631	0.000
	$D(X_{t-1})$	-	-	-	-	-	-	-	-	-	-	-	-
	λ	**-1.106**	**1.1244**	**0.000**	**-0.737**	**0.1092**	**0.000**	**-1.123**	**0.1429**	**0.000**	**-0.744**	**0.1106**	**0.000**
P21,P22,P23 (0.5, 0.866, 0)	$D(Y_{t-1})$	0.1203	0.1185	0.316	-	-	-	0.1239	0.117	0.299	-	-	-
	$D(X_t)$	1.0452	0.1235	0.000	0.6463	0.1231	0.000	0.6409	0.1233	0.000	0.6471	0.1239	0.000
	$D(X_{t-1})$	0.5088	0.1684	0.004	0.5594	0.1314	0.000	0.4377	0.1860	0.023	0.4158	0.1943	0.038
	λ	**-1.2634**	**0.1767**	**0.000**	**-0.767**	**0.1267**	**0.000**	**-1.295**	**0.1973**	**0.000**	**-0.802**	**0.1439**	**0.000**
P21,P22,P23 (0.5, 0.866, 0.5)	$D(Y_{t-1})$	-	-	-	-	-	-	0.2569	0.0759	0.002	-	-	-
	$D(X_t)$	1.3223	0.1039	0.000	0.9412	0.1017	0.000	0.9503	0.1019	0.000	0.9351	0.0985	0.000
	$D(X_{t-1})$	0.5106	0.1194	0.000	0.3209	0.1012	0.003	-	-	-	-	-	-
	λ	**-1.3908**	**0.1267**	**0.000**	**-1.055**	**0.1353**	**0.000**	**-1.729**	**0.1679**	**0.000**	**-1.069**	**0.0983**	**0.000**
P21,P22,P23 (0.5, 0.9, 0.9)	$D(Y_{t-1})$	-	-	-	0.0781	0.0499	0.125	0.1571	0.0615	0.012	-	-	-
	$D(X_t)$	1.4107	0.0771	0.000	-	-	-	1.0094	0.0757	0.000	1.0039	0.0760	0.000
	$D(X_{t-1})$	0.3542	0.1071	0.002	-	-	-	-	-	-	-0.191	0.1182	0.113
	λ	**-1.4379**	**0.1407**	**0.000**	**-1.040**	**0.0548**	**0.000**	**-1.647**	**0.1785**	**0.000**	**-1.149**	**0.1500**	**0.000**
P21,P22,P23 (0.9, 0.5, 0.5)	$D(Y_{t-1})$	-	-	-	-	-	-	-	-	-	-	-	-
	$D(X_t)$	1.0524	0.0577	0.000	0.6804	0.0576	0.000	0.6524	0.0577	0.000	0.6578	0.058	0.000
	$D(X_{t-1})$	0.8466	0.0634	0.000	0.5915	0.0571	0.000	0.6504	0.0563	0.000	0.2389	0.1367	0.088
	λ	**-1.4907**	**0.0688**	**0.000**	**-1.164**	**0.0799**	**0.000**	**-1.491**	**0.0689**	**0.000**	**-1.163**	**0.1288**	**0.000**
P21,P22,P23 (0.9, 0.9, 0.9)	$D(Y_{t-1})$	-	-	-	-	-	-	0.2276	0.0459	0.000	-	-	-
	$D(X_t)$	1.1762	0.0625	0.000	0.7918	0.0604	0.000	0.7844	0.0614	0.000	0.7754	0.0613	0.000
	$D(X_{t-1})$	0.5146	0.0771	0.000	0.2304	0.0583	0.000	-	-	-	-0.156	0.1227	0.211
	λ	**-1.5627**	**0.1123**	**0.000**	**-1.272**	**0.1277**	**0.000**	**-1.894**	**0.1342**	**0.000**	-1.241	0.1338	0.000

Comment [a5]: It is highly recommended that it not be displayed. Just give the code and include it in the results attachment.

Table 2: Persistence at P11=0.95 when the sample size is 50 -

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-	N=50, P11= 0.95												
		$(\beta_0, \beta_1, \phi) = (1, 0, 0)$			(β_0, β_1, ϕ) =(0.6, 0, 0.4)			(β_0, β_1, ϕ) =(0.6, 0.4, 0)			(β_0, β_1, ϕ) = (0.6, 0.4, 0.4)		
	ESTIMATOR	**COEFF**	**ST.ERR**	***P*-VALUE**	**COEFF**	**ST.ERR**	***P*-VALUE**	**COEFF**	**ST.ERR**	***P*-VALUE**	**COEFF**	**ST.ERR**	***P*-VALUE**
P21,P22,P23 (0,1,0)	$D(Y_{t-1})$	-	-	-	-	-	-	-	-	-	-	-	-
	$D(X_t)$	-	-	-	-	-	-	0.7678	0.1536	0.000	0.7512	0.1523	0.000
	$D(X_{t-1})$	-	-	-	-	-	-	-	-	-	-	-	-
	λ	**-1.088**	**0.1077**	**0.000**	**-0.7131**	**0.1013**	**0.000**	**-1.1239**	**0.1408**	**0.000**	**-0.723**	**0.1032**	**0.000**
P21,P22,P23 (0.5, 0.866, 0)	$D(Y_{t-1})$	0.1416	0.1203	0.246	-	-	-	0.2779	0.0781	0.000	-	-	-
	$D(X_t)$	1.0553	0.1139	0.0000	0.6549	0.1137	0.000	0.7002	0.1150	0.000	0.7022	0.1123	0.000
	$D(X_{t-1})$	0.3986	0.1674	0.023	0.4584	0.1279	0.000	-	-	-	-	-	-
	λ	**-1.3075**	**0.1829**	**0.000**	**-0.8002**	**0.1326**	**0.000**	**-1.5929**	**0.1323**	**0.000**	**-1.0019**	**0.0816**	**0.000**
P21,P22,P23 (0.5, 0.866, 0.5)	$D(Y_{t-1})$	0.14163	0.1109	0.209	-	-	-	0.2209	0.0683	0.002	-	-	-
	$D(X_t)$	1.3189	0.0952	0.000	0.9301	0.0932	0.000	0.9248	0.0932	0.000	0.9182	0.0958	0.000
	$D(X_{t-1})$	0.3017	0.153	0.055	0.2361	0.0937	0.016	-	-	-	-0.0605	0.1549	0.699
	λ	**-1.5663**	**0.1811**	**0.000**	**-1.0896**	**0.1387**	**0.000**	**-1.7054**	**0.1573**	**0.000**	-1.0907	0.1452	0.000
P21,P22,P23 (0.5, 0.9, 0.9)	$D(Y_{t-1})$	0.2150	0.0705	0.004	-	-	-	0.1209	0.0541	0.031	-	-	-
	$D(X_t)$	1.4328	0.0679	0.000	-	-	-	0.9888	0.0696	0.000	0.9861	0.0695	0.000
	$D(X_{t-1})$	-	-	-	-	-	-	-	-	-	-0.2515	0.1206	0.043
	λ	**-1.609**	**0.1847**	**0.000**	**-0.9812**	**0.0486**	**0.000**	**-1.6152**	**0.1677**	**0.000**	**-1.1542**	**0.1452**	**0.000**
P21,P22,P23 (0.9, 0.5, 0.5)	$D(Y_{t-1})$	0.0827	0.0624	0.192	-	-	-	0.1060	0.0809	0.197	-	-	-
	$D(X_t)$	1.0623	0.0533	0.000	0.6814	0.0524	0.000	0.6604	0.0532	0.000	0.6671	0.0533	0.000
	$D(X_{t-1})$	0.6665	0.0879	0.000	0.47526	0.0536	0.000	0.4209	0.1162	0.001	0.15145	0.1358	0.271
	λ	**-1.5878**	**0.0973**	**0.000**	**-1.2091**	**0.0832**	**0.000**	**-1.6556**	**0.1396**	**0.000**	**-1.1522**	**0.1231**	**0.000**
P21,P22,P23 (0.9, 0.9, 0.9)	$D(Y_{t-1})$	0.1217	0.0871	0.170	-	-	-	0.1811	0.0409	0.000	-	-	-
	$D(X_t)$	1.1769	0.0570	0.000	0.7855	0.0553	0.000	0.7737	0.0564	0.000	0.7694	0.0565	0.000
	$D(X_{t-1})$	0.3302	0.1116	0.005	0.1483	0.0556	0.0108	-	-	-	-0.2064	0.1228	0.100
	λ	**-1.7079**	**0.1494**	**0.000**	**-1.3112**	**0.1315**	**0.000**	**-1.8439**	**0.1251**	**0.000**	**-1.2239**	**0.1287**	**0.000**

Tables 3 and 4 present results of the stabilizing error correction model, we observed the following

i. 1. The adjustment term was within -1<λ<0 which implies that there was a gradual and convergent and the long run will eventually approach the equilibrium.
ii. There were a few cases of disequilibrium where the coefficient of the stabilizing model was seem to be very close to 1.
iii. The values of the coefficient of the stabilizing model was observed to be very high which implies that stabilising model is exerting a stabilizing effect on the error correction mechanism in our model, thereby reducing the overshooting in the error correction model.
iv. The coefficient of the stabilizing model was observed to be consistently positive which implies that it contributes to a smoother and more stable response to deviations from the long run equilibrium.

4.4 Adjustment for Explosiveness

Table 3: Persistence at P11=1.0 when the sample size is 50

-	**N=50, P11= 0.95**												
		$(\beta_0,\beta_1,\phi)=(1,0,0)$			(β_0,β_1,ϕ) =(0.6, 0, 0.4)			(β_0,β_1,ϕ) =(0.6, 0.4, 0)			(β_0,β_1,ϕ) = (0.6, 0.4, 0.4)		
	ESTIMATOR	**COEFF**	**ST.ERR**	**PVALUE**	**COEFF**	**ST.ERR**	**PVALUE**	**COEFF**	**ST.ERR**	**PVALUE**	**COEFF**	**ST.ERR**	**PVALUE**
P21,P22,P23 (0,1,0)	$D(Y_{t-1})$	-	-	-				-	-	-			
	$D(X_T)$	1.0804	0.0251	0.000				0.7134	0.0240	0.000			
	$D(X_{t-1})$	-	-	-				0.3019	0.0239	0.000			
	λ	**-0.124**	**0.0313**	**0.000**				**-0.136**	**0.030**	**0.000**			
	Θ	**0.9814**	**0.0219**	**0.000**				**0.9861**	**0.021**	**0.000**			
P21,P22,P23 (0.5, 0.866, 0)	$D(Y_{t-1})$	-	-	-				-0.036	0.0182	0.058			
	$D(X_T)$	1.0581	0.0219	0.000				0.6715	0.0219	0.000			
	$D(X_{t-1})$	0.6493	0.0214	0.000				1.0651	0.0237	0.000			
	λ	**-0.117**	**0.0373**	**0.003**				**-0.118**	**0.0414**	**0.007**			
	$\Theta 0$	**1.0234**	**0.0265**	**0.000**				**1.0169**	**0.0266**	**0.000**			
P21,P22,P23 (0.5, 0.866, 0.5)	$D(Y_{t-1})$	-	-	-	-	-	-	-0.293	0.0547	0.000	-	-	-
	$D(X_T)$	1.3418	0.070	0.000	1.0652	0.0768	0.000	1.0600	0.064	0.000	0.9493	0.011	0.000
	$D(X_{t-1})$	0.0322	0.0717	0.666	0.2249	0.0755	0.005	0.5457	0.0916	0.000	0.7942	0.011	0.000
	λ	**-0.481**	**0.1425**	**0.002**	**-0.399**	**0.1503**	**0.011**	**-0.181**	**0.1336**	**0.182**	**-0.058**	**0.023**	**0.015**
	Θ	**0.906**	**0.0980**	**0.000**	**1.063**	**0.1083**	**0.000**	**0.986**	**0.0913**	**0.000**	**1.008**	**0.016**	**0.000**
P21,P22,P23 (0.5, 0.9, 0.9)	$D(Y_{t-1})$	-	-	-	-	-	-	-	-	-	-	-	-
	$D(X_t)$	1.454	0.0538	0.000	1.099	0.0077	0.00	1.112	0.0509	0.000	1.023	0.014	0.000
	$D(X_{t-1})$	-0.332	0.0536	0.000	-	-	-	-0.002	0.0486	0.9614	0.5764	0.013	0.000

Comment [a7]: It is highly recommended that it not be displayed. Just give the code and include it in the results attachment.

	λ	**-0.486**	**0.1513**	**0.003**	**0.052 2**	**0.0244**	**0.038**	**-0.431**	**0.1443**	**0.005**	**-0.154**	**0.0379**	**0.000**
	Θ	**0.924**	**0.1019**	**0.000**	**1.007**	**0.0158**	**0.000**	**0.996**	**0.0998**	**0.000**	**0.983**	**0.0268**	**0.000**
P21,P22,P23 (0.9, 0.5, 0.5)	$D(Y_{t-1})$	-	-	-	-	-	-	-	-	-	-	-	-
	$D(X_t)$	1.117	0.0631	0.000	0.711	0.020	0.000	0.738	0.0949	0.000	0.680	0.0130	0.000
	$D(X_{t-1})$	0.682	0.0663	0.000	0.956	0.0214	0.000	1.013	0.0977	0.000	1.411	0.0138	0.000
	λ	**-0.615**	**0.2287**	**0.010**	**-0.101**	**0.0705**	**0.160**	**-0.690**	**0.3441**	**0.051**	**-0.173**	**0.0473**	**0.001**
	Θ	**0.761**	**0.1592**	**0.000**	**1.069**	**0.0525**	**0.000**	**0.768**	**0.2417**	**0.003**	**0.985**	**0.0343**	**0.000**
P21,P22,P23 (0.9, 0.9, 0.9)	$D(Y_{t-1})$	-	-	-	-	-	-	-0.532	0.0615	0.000	-	-	-
	$D(X_T)$	1.258	0.0684	0.000	0.838	0.0243	0.000	0.878	0.0539	0.000	0.811	0.0208	0.000
	$D(X_{t-1})$	0.090	0.0710	0.211	0.455	0.0254	0.000	0.894	0.0913	0.000	0.918	0.0219	0.000
	λ	**-0.689**	**0.2331**	**0.005**	**-0.232**	**0.0814**	**0.007**	**-0.101**	**0.1825**	**0.583**	**-0.245**	**0.0737**	**0.002**
	Θ	**0.774**	**0.1599**	**0.000**	**1.020**	**0.0591**	**0.000**	**0.992**	**0.1287**	**0.000**	**0.976**	**0.0516**	**0.000**

Table 4: Persistence at P11=0.95 when the sample size is 50

-	**N=50, P11= 0.95**												
		$(\beta_0, \beta_1, \phi) = (1, 0, 0)$			(β_0, β_1, ϕ) **=(0.6, 0, 0.4)**			(β_0, β_1, ϕ) **=(0.6, 0.4, 0)**			(β_0, β_1, ϕ) **= (0.6, 0.4, 0.4)**		
	ESTIMATOR	**COEFF**	**ST.ERR**	**PVALUE**	**COEFF**	**ST.ERR**	**PVALUE**	**COEFF**	**ST.ERR**	**PVALUE**	**COEFF**	**ST.ERR**	**PVALUE**
P21,P22,P23 (0,1,0)	$D(Y_{t-1})$	-	-	-				-	-	-			
	$D(X_T)$	1.171	0.0202	0.000				0.762	0.0230	0.000			
	$D(X_{t-1})$	-	-	-				0.368	0.0228	0.000			
	λ	**-0.101**	**0.0277**	**0.0007**				**-0.138**	**0.0312**	**0.0001**			
	Θ	**0.987**	**0.0191**	**0.000**				**0.986**	**0.0218**	**0.000**			
P21,P22,P23 (0.5, 0.866, 0)	$D(Y_{t-1})$	-	-	-				-	-	-	-	-	-
	$D(X_T)$	1.071	0.0237	0.000				0.757	0.069	0.000	0.703	0.0004	0.000
	$D(X_{t-1})$	0.614	0.0231	0.000				0.864	0.0068	0.000	1.138	0.0004	0.000
	λ	**-0.142**	**0.0436**	**0.0023**				**-0.255**	**0.115**	**0.0324**	**-0.002**	**0.0007**	**0.006**
	Θ0	**1.022**	**0.0312**	**0.000**				**1.083**	**0.0883**	**0.000**	**0.999**	**0.0005**	**0.000**
P21,P22,P23 (0.5, 0.866, 0.5)	$D(Y_{t-1})$	-	-	-	-	-	-	-	-	-	-	-	-
	$D(X_T)$	1.369	0.0568	0.000	0.942	0.0102	0.000	1.036	0.0764	0.000	0.934	0.0103	0.000
	$D(X_{t-1})$	0.044	0.0582	0.451	0.434	0.0105	0.000	0.286	0.0748	0.0004	0.881	0.0102	0.000
	λ	**-0.402**	**0.125**	**0.003**	**-0.091**	**0.0222**	**0.000**	**-0.428**	**0.1641**	**0.013**	**-0.103**	**0.0222**	**0.000**
	Θ	**1.007**	**0.0879**	**0.000**	**0.996**	**0.0158**	**0.000**	**1.042**	**0.1172**	**0.000**	**0.985**	**0.0158**	**0.000**

P21,P22,P	$D(Y_{t-1})$	-	-	-				-0.054	0.0319	0.0965	-	-	-
23	$D(X_t)$	1.527	0.0425	0.000				1.119	0.0466	0.00	1.005	0.0132	0.000
(0.5, 0.9,	$D(X_{t-1})$	-0.406	0.0409	0.000				-	-	-	0.603	0.0131	0.000
0.9)	λ	**-0.326**	**0.134**	**0.019**				**-0.377**	**0.1536**	**0.0182**	**-0.159**	**0.0405**	**0.000**
	Θ	**1.014**	**0.0902**	**0.000**				**0.983**	**0.1025**	**0.000**	**0.982**	**0.0284**	**0.000**
P21,P22,P	$D(Y_{t-1})$	-0.445	0.0096	0.000	-	-	-	-0.443	0.0097	0.000	-	-	-
23	$D(X_t)$	1.076	0.0114	0.000	0.718	0.0244	0.000	0.681	0.0114	0.000	0.677	0.0116	0.000
(0.9, 0.5,	$D(X_{t-1})$	1.196	0.0175	0.000	0.916	0.0249	0.000	1.411	0.0149	0.000	1.381	0.0122	0.000
0.5)	λ	**-0.039**	**0.0449**	**0.394**	**-0.161**	**0.0903**	**0.082**	**-0.095**	**0.0444**	**0.039**	**-0.163**	**0.0467**	**0.001**
	Θ	**1.016**	**0.0031**	**0.000**	**1.054**	**0.0677**	**0.000**	**1.006**	**0.0316**	**0.000**	**0.986**	**0.0332**	**0.000**
P21,P22,P	$D(Y_{t-1})$	-	-	-	-	-	-	-0.574	0.0509	0.000	-	-	-
23	$D(X_T)$	1.327	0.0523	0.000	0.837	0.0256	0.000	0.844	0.0426	0.000	0.801	0.0184	0.000
(0.9, 0.9,	$D(X_{t-1})$	-0.639	0.1009	0.000	0.441	0.0267	0.000	0.972	0.0732	0.000	0.918	0.0192	0.000
0.9)	λ	**-0.466**	**0.2155**	**0.0362**	**-0.293**	**0.0936**	**0.0032**	**-0.019**	**0.1583**	**0.9054**	**-0.225**	**0.0715**	**0.0031**
	Θ	**1.029**	**0.1509**	**0.000**	**0.995**	**0.0684**	**0.000**	**1.036**	**0.1096**	**0.000**	**0.980**	**0.0493**	**0.000**

4.5: Comparison between Error Correction model and Adjustment for explosives

Table 5 shows the comparison between error correction model and the adjustment for explosiveness. It was discovered that the adjustment value from the error correction model was explosive but it became stabilized and ranges –from 0.5 to 0.5 in the stabilizing error correction model. Furthermore, the Sum of Square of regression for the stabilizing error correction model was observed to be smaller than the Sum of square of regression of the error correction model.

Table 5 Comparison between Error Correction Model and Stabilizing Error Correction Model

Comment [a8]: It is highly recommended that it not be displayed. Just give the code and include it in the results attachment.

P11=1.0, N=50							
	Adjustment term (λ) of ECM	SSR of ECM	Adjustment term (λ) of SECM	θ ofSECM	*P*-Value of $\lambda$of SECM	*P*-value of θ ofSECM	SSR of θ of SECM
B1P1	-1.10655	60.6888	-0.12440	0.98137	0.000	0.000	1.30663
B1P2	-1.26337	35.5929	-0.11647	1.02339	0.003	0.000	1.04553
B1P3	-1.3908	31.5238	-0.48134	0.90574	0.002	0.000	12.55786
B1P4	-1.437906	24.31958	-0.48642	0.92381	0.003	0.000	10.49876
B1P5	-1.490685	10.14827	-0.615326	0.476059	0.010	0.000	10.0034
B1P6	-1.56265	19.76874	-0.68851	0.774112	0.005	0.000	19.41545
B2P3	-1.054627	30.55614	-0.05275	1.000434	0.000	0.000	0.116955
B2P4	-1.040132	24.24044	0.052218	1.00697	0.038	0.000	0.255406
B2P5	-1.16411	10.32825	-0.100937	1.06846	0.159	0.000	1.172805
B2P6	-1.271669	19.0875	-0.231787	1.02035	0.007	0.000	2.76766
B3P1	-1.12293	60.0683	-0.135836	0.986107	0.000	0.000	1.1716
B3P2	-1.295019	36.51251	-0.118448	1.016958	0.007	0.000	1.02564
B3P3	-1.72957	31.37935	-0.39903	1.062714	0.011	0.000	15.12816
B3P4	-1.64704	23.79466	-0.431338	0.99639	0.005	0.000	10.18373
B3P5	-1.490685	10.14827	-0.690228	0.76807	0.051	0.003	24.27447
B3P6	-1.8940	19.4337	-0.10106	0.99155	0.583	0.000	13.29955
B4P3	-1.068969	30.86852	-0.05828	1.00814	0.015	0.000	0.3488
B4P4	-1.149705	21.95608	-0.15423	0.983161	0.000	0.000	0.61719
B4P5	-1.16268	9.29939	-0.17327	0.98506	0.001	0.000	0.43112
B4P6	-1.240767	17.48065	-0.24517	0.97566	0.002	0.000	1.851388
P11=0.95 and N=50							
	Adjustment term (λ) of ECM	SSR of ECM	Adjustment term (λ) of SECM	θ ofSECM	*P*-Value of $\lambda$of SECM	*P*-value of θ ofSECM	SSR of θ of SECM
B1P1	-1.08815	54.14689	-0.10133	0.98666	0.001	0.000	0.87679
B1P2	-1.30745	32.56275	-0.14165	1.02145	0.002	0.000	1.27827
B1P3	-1.5663	27.25855	-0.40192	1.006948	0.003	0.000	8.72927
B1P4	-1.60915	21.91993	-0.32638	1.013603	0.019	0.000	7.50795
B1P5	-1.58782	8.79073	-0.0387	1.01632	0.394	0.000	0.3462
B1P6	-1.7079	16.99948	-0.46628	1.028523	0.036	0.000	16.05396
B2P3	-1.08961	27.00202	-0.09139	0.99576	0.000	0.000	0.28104
B2P5	-1.20909	8.9427	-0.16071	1.053848	0.082	0.000	1.67437
B2P6	-1.31123	16.86052	-0.29248	0.99493	0.003	0.000	3.21218
B3P1	-1.12398	53.77957	-0.137669	0.985928	0.000	0.000	1.108223
B3P2	-1.59286	34.5018	-0.2550	1.08251	0.032	0.000	10.42417
B3P3	-1.70537	27.43358	-0.4275	1.042278	0.013	0.000	15.6464
B3P4	-1.61517	21.17412	-0.37719	0.98297	0.018	0.000	9.54722

B3P5	-1.65556	8.79209	0.09494	1.006336	0.004	0.000	0.35042
B3P6	-1.84399	17.14969	-0.01894	1.03599	0.905	0.000	8.571186
B4P2	-1.001949	34.5340	-0.001997	0.99999	0.006	0.000	0.00041
B4P3	-1.09065	25.52617	-0.10264	0.98456	0.000	0.000	0.24994
B4P4	-1.15423	19.3038	-0.15957	0.98158	0.000	0.000	0.61537
B4P5	-1.15222	8.12881	-0.16291	0.98564	0.001	0.000	0.355688
B4P6	-1.22386	15.51496	-0.22498	0.980316	0.003	0.000	1.4984

Conclusion Remark:

In Modelling the short run relationship, some of the adjustment terms were observed to be explosive thereby creating an over-correction and it also implies an oscillatory convergence. To correct the problem of explosiveness in the short run model, a stabilizing error correction mechanism was proposed. The coefficient of the stabilizing error correction model was observed to be consistently positive with values greater than 0 in all cases, which means that the damping coefficient exerted a stabilizing effect on the error correction mechanism in the model, thereby reducing the overshooting in the error correction model. It also implies that the adjustment mechanism responds to deviation from the long-run equilibrium in a way that prevents rapid and excessive corrections. It contributes to a smoother and more stable response to deviations from the long run equilibrium. The root mean square error of the stabilizing Error Correction model is observed to be smaller than the adjustment model in the Error correction model. Stabilizing error correction model perform better than the Error correction model.

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Comment [a9]: The use of references in research in an econometric journal must use 80% of references from journals of economics and applied sciences as well as economic policy that refer to econometric analysis. The year the journal is published plays a big role in the quality of the estimation results contained in it.

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