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Fiscal Policy Reaction Function for Kenya

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Abstract
This article investigates how the Kenyan government responds to debt portfolio disturbances by estimating Kenya's fiscal reaction function. The empirical estimation uses monthly data sets from the seventh month of 2000 (2000:07) to the third month of 2014 (2014:03). The empirical results indicates that, the Kenya government faces difficulties in responding to short term positive debt shocks, given its fiscal policy reaction is contradictory to theory expectation, hence a severe fiscal adjustment may be inevitable in the future.
Keywords: Kenya's fiscal reaction function, Quantile Regression, ARDL Model

1 Introduction

Fiscal policy is poised for a comeback, mainly due to the low interest environment (Krugman, Paul, 2005). The main objectives of fiscal policy entails efficient resource allocation, income redistribution and stabilizing economic activity. Governments use fiscal policies as an economic stabilizing instrument via "discretionary fiscal fine-tuning or effects of automatic fiscal stabilizers" or a combination of both (Swanepoel, 2004). The effectiveness of fiscal policy largely depends on, instruments, institutions and environment under which these instruments are applied. The government budget plays a crucial role in either stabilizing or destabilizing the economy, with a persistent budget deficit seen as destabilizing. The governments' structure of expenditures and revenues, and the macroeconomic stability are interlinked. Unlike monetary, fiscal discretionary policy had been less preferred due to; crowding-out effects, irreversibility, inflexibility, political constraints, longer lags, problems in measurements, timing issues et cetera, all compounding the challenges' fiscal policy faces in stabilizing the economy. However, Nguyen, Truong (2013) observed that, whereas monetary policy was the key thing in the 1970s and 80s, fiscal policy is gaining currency after numerous crises in economic policy macro model implementation. While the empirical investigation of fiscal reaction functions is not new, available literature is mainly for developed economics. Literature focusing on developing economies including Kenya is scanty.

The approach by Bohn, Henning (1998) grounded on the primary fiscal balance response to the public debt variation caused by economic shocks. Bohn (1998) noted that a sustainable fiscal policy is the one in which government reacts systematically by adjusting primary fiscal balance inline to public debt changes such that public debt remains fiscally sustainable. The rationale behind this finding is that, the governments' systematic failure to react to debt changes, during shocks violates the no-Ponzi condition and the public debt may explode as opposed to converging to zero over time. Therefore, an increased debt-to-GDP ratio has to be marched with a primary balance-to-GDP ratio increase to be fiscally sustainable in the long-run.

Kenya's economy through the famous Sessional Paper No. 1 of 1986 turned its back on its post-Independence *dirigisme*, and set herself towards economic liberalism mainly due to the sequence of events that accelerated the reforms' pace. The turning point for the Kenyan economy appears to be the early 1990s. After the general hardening of donor attitudes and a standoff with the IMF in 1992 that lent to a substantial tightening of the external budget supplement, prompting government to quickly institute fiscal controls, elimination of *de jure* capital controls and agree to a floating exchange rate.

The main anchors of fiscal policy are fiscal deficits or surplus, which emanates from the revenue and planned expenditure difference, and previous debts. Analyzing these variables therefore, leads to the exposition of the prudency of Kenya's fiscal strategy. The Kenyan government has a 5% fiscal deficit policy but data shows that it has consistently been defied since 2009 (see figure 1). We investigate how the Kenyan government responds to debt portfolio disturbances, by estimating Kenya's fiscal reaction function. To establish whether the policies are fiscally sustainable, various techniques, namely Quantile Regression (QREG), OLS, Generalized Methods of Moments (GMM), two-stage least squares (2SLS) and Autoregressive Distributed Lag (ARDL) Model were employed in establishing the debt levels, the output gap and the primary balance relationship in Kenya. This is the first attempt to consider Kenya's fiscal debt sustainability using Bohn's approach based on available literature.

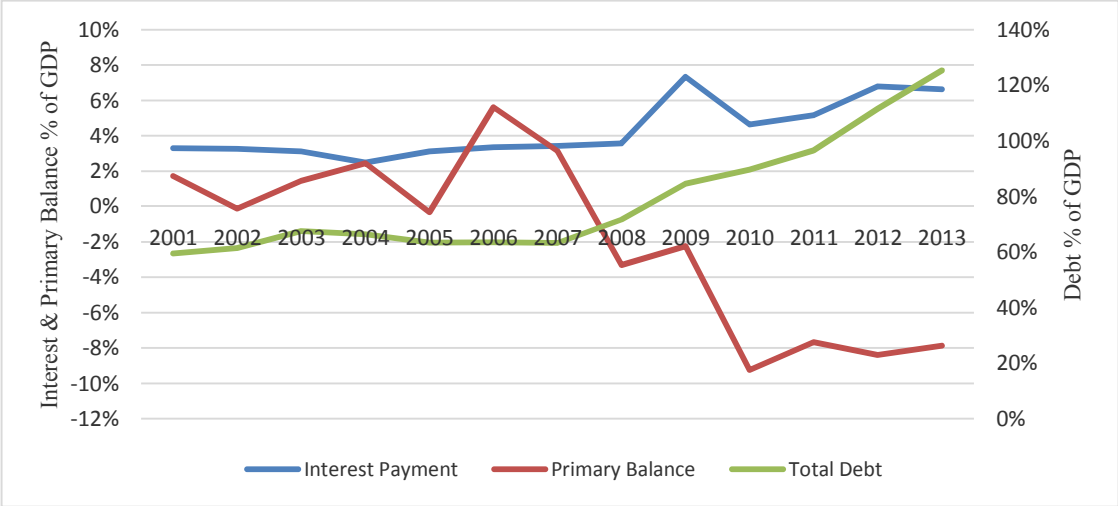


Figure 1 Debt interest payments, Primary Balance & Debt as a percentage of GDP

2 Theoretical Background of Fiscal Sustainability

Research has shown that, consistent forecasting of output gap is rather difficult, if not impossible, and hence many empirical studies instead of point targets proposes a target band for the structural and overall budget deficit (Burger, Philippe & Marina Marinkov, 2012). This band stipulates the adjustments required in the deficit by acting as a negative feedback rule whenever the actual debt is not within the stipulated band hence ensuring fiscal sustainability. However, Stoian, Andreea & Emilia Câmpeanu (2010) noted that for many economies, fiscal sustainability in the long-run requires severe fiscal adjustments given that many have no capacity to run a primary surplus in the short-run coupled with an opposite response to public debt shocks. Governments react strongly via the primary budget surplus target adjustment to changes in indebtedness (Baldi & Staehr, 2013; Nguyen, 2013; Mello, 2008). In addition to the usual debt and output gap as key fiscal policy variables, Nguyen (2013) added interest rate into the model, and keenly observed that, 'apart from debt and the output gap, which were mentioned in other papers, the interest rate is the new element in the function and should be important in any borrowing action'.

Baldi, Guido, & Karsten Staehr (2013) noted the reinforced EU fiscal performance importance after the 2008 global crises and the subsequent debt crisis (European), resulting from the problems faced by EU member states in accessing both capital markets and private loans. Accordingly, interest rates on government debt in the most EU member states shot up, while in others the debt markets simply dried up (Baldi & Staehr, 2013). Therefore, to assess any country's fiscal stance, fiscal reaction function plays a key role. Baldi & Staehr (2013) noted that, based on empirical literature, fiscal reaction function seems to differ amongst the developed and emerging economies; typically developed economies have a counter-cyclical fiscal policy while emerging are mainly pro-cyclical.

A consistent past legislative activity leads to sustainable fiscal forecasts as opposed to other fiscal policy variants consistent with literature (Mello, 2008; and Bull, Nicholas & Timothy Dowd, 2005), an indication that before implementation of fiscal policy functions in macroeconomic models prior work is required. Mello (2008) found that expenditures strongly affect changes in revenue, an indication of a spend-and-tax government policy. Weichenrieder, Alfons & Jochen Zimmer (2014) showed that joining Euro area reduces individual country's responsiveness to debt shocks, while Baldi & Staehr (2013) showed that after the 2008 financial crisis, responsiveness in the EU changed drastically with post-crisis estimation, showing a much more debt stock feedback and less counter-cyclicality, mostly for the EU governments that experienced serious debt financing problems.

The most common regression techniques used to analyze the fiscal reaction functions are GMM (Burger & Marinkov, 2012); OLS (Mello, 2008; Burger, Stuart, Jooste & Cuevas, 2012; and Stoian & Câmpeanu, 2010); VECM (Burger, Stuart, Jooste & Cuevas, 2012; and Stoian & Câmpeanu, 2010); n2SLS (Plodt & Reicher, 2015).

3 Estimating the Reaction Function

The fiscal reaction functions are mainly useful in estimating how governments react to public debt changes. Empirical research underscores that, governments' fiscal policy is run sustainably by either increasing (decreasing) the primary surplus (deficit) in response to rising debt (Burger, Stuart, Jooste & Cuevas, 2012, and

Mello, Luiz, 2008). The fiscal reaction function typically reflects on the response of the primary balance[1], expenditure or revenue to changes in lagged debt (all variables are ratios of GDP). The main reasoning is rooted in the inter-temporal government budget constraint expressed as;-

$$D_t = (1 + i_t) D_{t-1} - S_t \quad (1)$$

where S_t denotes primary balance (+ surplus; - deficit), D_t is debt (public), and i_t is the nominal interest rate on the debt.

Further, we normalize equation 1 to GDP and derive the following equation

$$\Delta\left(\frac{D_t}{Y_t}\right) = \left(\frac{r_t - g_t}{1 + g_t}\right)\left(\frac{D_{t-1}}{Y_{t-1}}\right) - \left(\frac{S_t}{Y_t}\right) \quad (2)$$

where Y is output (GDP), r is the interest rate (real), g is the growth rate (real)

Setting $\Delta(D_t / Y_t) = 0$, the equation 2 reduces to a well-known primary balance expression that ensures the public debt remains unchanged.

$$\left(\frac{S_t}{Y_t}\right) = \left(\frac{r - g}{1 + g}\right)\left(\frac{D_{t-1}}{Y_{t-1}}\right) = \alpha\left(\frac{D_{t-1}}{Y_{t-1}}\right) \quad (3)$$

where $\alpha = (r - g) / (1 + g)$

Starting from an acceptable debt level position, equation 3 is the fiscal rule that defines the primary balance necessary to keep to such debt target. Therefore, rational government behavior that intents to have a stable public debt can be estimated using a fiscal reaction function as shown below;

$$\left(\frac{S_t}{Y_t}\right) = \alpha\left(\frac{D_{t-1}}{Y_{t-1}}\right) + \varepsilon_t \quad (4)$$

Mello (2008) expanded equation 4 to allow for government inertia behavior by adding a lag of primary balance/GDP. Further, other studies include a constant to allow for a non-zero (implicit/explicit) debt-to-GDP ratio target, while others add an output gap, as a control variable for short-run demand stabilization. Many studies including Burger, Philippe & Marina Marinkov (2012) following Bohn's specification, prefer to substitute the primary balance with its components mainly the expenditure and revenue, in turn. As long as $\alpha \succ 0$ in equation 4 above, the fiscal policy is sustainable, a condition only feasible if $r \succ g$. Conversely, if $r \prec g$, the debt-to-GDP ratio moves towards infinity, hence technically the debt becoming un-sustainable.

The multi-period budget constrains analogues to the equation 2 and subject to $r \neq g$ takes the form

$$\frac{D_t}{Y_t} = \left(\frac{1+g}{r-g}\right)\left(\frac{1+r}{1+g}\right)^t \frac{S_o}{Y_o} - \left(\frac{1+g}{r-g}\right)\frac{S_o}{Y_0} + \left(\frac{1+r}{1+g}\right)^t \frac{D_o}{Y_0} \quad (5)$$

It is clear from equation 5 that, the Debt-to-GDP ratio explodes whenever, $r \succ g$ and $t \to \infty$, unless the budget balance is set such that, the first and third terms on the right hand site are equal and with opposite signs. However, setting $r \prec g$ and $t \to \infty$, the equation converges to a stable ratio as shown below. Therefore, governments need not react to the debt/GDP ratio whenever $r \prec g$

$$\frac{D_t}{Y_t} = -\left(\frac{1+g}{r-g}\right)\frac{S_o}{Y_o} \quad (6)$$

Equation 4 is the most common and simplest linear equation between the primary surplus and inherited debt level at time t. According to Bohn (2008), ε_t is bounded and represents other influences of the primary surplus, while $\alpha \succ 0$ satisfies the no-Ponzi condition and economy's inter-temporal budget constraints. Weichenrieder & Zimmer (2014) notes that a statistically significant and positive reaction coefficient ($\alpha \succ 0$) is not a 'sufficient condition' for a sustainable debt whenever the primary budget surplus is upper bounded.

In view of the above and following Weichenrieder & Zimmer (2014) version of the 'Bohn's (1998) approach', we focus on a simple linear model to estimate Kenya's fiscal reaction function – based on how primary balance

[1] Primary balance is the difference between government revenue (including non-tax revenues) and government expenditures (excluding interest payments, but includes transfers and capital expenditures)

reacts to variations in public debt - as below;

$$\left(\frac{S_t}{Y_t}\right) = c + \alpha\left(\frac{D_{t-1}}{Y_{t-1}}\right) + V_t + \varepsilon_t \quad (7)$$

where V_t includes different relevant regressors according to literature (Bohn 1998; Weichenrieder & Zimmer, 2014), while the use of lagged debt to GDP is to avoid simultaneity problems, c is constant to allow for a non-zero debt-to-GDP ratio target.

4 Data and Methods

The empirical estimation uses monthly data sets from the seventh month of 2000 (2000:07) to the third month of 2014 (2014:03) for the Kenyan economy, obtained from the CBK and the KNBS databases. The following variables were used; - the output (GDP), public debt/GDP (GDP is a flow while debt is a stock variable, we multiplied GDP by twelve to attain an annualized measure) and primary balance. The monthly budgets' data sets were seasonally adjusted. HP filters ($\lambda = 14,400$) was used to generate the potential values of output and output gap computed as follows;

$$\hat{y}_t = \frac{y_t - \overline{y_t}}{y_t} * 100 \quad (8)$$

where y_t indicates the log of the actual output and $\overline{y_t}$ indicates the log of potential output

Quantile Regression

Quantile regression method is gaining popularity due to the following attractive properties; its regression estimators are more efficient and less sensitive to outliers, unlike OLS and GMM estimators. Quantile regression can apply in investigating how the dependent variables respond to the explanatory variables at different points along the distribution (Chevapatrakul & Paez-Farrell, 2014). Therefore, quantile regression generates better estimates, than other linear estimation techniques (OLS, IV & GMM among others) and hence most preferred for the Taylor type rules. Unlike other estimation techniques (OLS, IV & GMM) whose response is based on the mean value of the dependent variable – mean is highly affected by extreme values – and their results can be misleading; quantile regression allows the estimation of responses to be measured at different points, hence been applicable even during "abnormal" periods to make key policy decisions. Employing quantile regression therefore, allows for a wider measurement of primary surplus response to public debt and any other control variable in the economy.

We estimate equation 7 via quantile regression, as follows;-

$$q_\theta\left(\frac{S_t}{Y_t} \mid \frac{D_{t-1}}{Y_{t-1}}, V_t\right) = c + \beta_\theta E\left(\frac{D_{t-1}}{Y_{t-1}} \mid \Omega_t\right) + \delta_\theta V_t + \varepsilon_t$$

The parameters $\hat{\alpha}_\theta$, $\hat{\beta}_\theta$ *and* δ_θ are solutions to the above regression equation, and their interpretation is similar to OLS regression coefficients.

The regressions with $\theta = 0.05,\ 0.1,\ 0.2,\ 0.3,\ 0.4,\ 0.5,\ 0.6,\ 0.7,\ 0.8,\ 0.9$ & 0.95 were estimated. For statistically robust inference results, we apply "heteroscedastic bootstrap" method to calculate the standard errors of the quantile regression estimates as used by Chevapatrakul & Paez-Farrell (2014).

ARDL Regression

We further employ the ARDL to estimate the long-run equation, given its flexibility of application when the variables are either "mutually co-integrated" or are of different integration order, that is, $I(1)$ or $I(0)$, but not appropriate when integrated at order two ($I(2)$) or higher (Pesaran & Pesaran, 2009). However, the ARDL model is applicable given all variables as reported in the table1 are $I(1)$ or $I(0)$. Laurenceson & Chai (2003) noted "ARDL takes sufficient numbers of lags to capture the data generating process in a general-to-specific modeling framework". Moreover, according to Banerjee and others (1993), ARDL is easily convertible to ECM, via a simple linear transformation. The ECM integrates the long-run equilibrium with the short run dynamics without losing long-run information.

The ARDL model estimating the equation 7;-

$$\left(\frac{S}{Y}\right)_t = c + \beta E\left(\frac{D_{t-1}}{Y_{t-1}} \mid \Omega_t\right) + \delta V_t + \sum_{j=1}^{n}\left(\varphi_{1,j}\Delta\left(\frac{S}{Y}\right)_{t-j}\right) + \sum_{j=1}^{n}\left(\varphi_{2,n}\Delta V_{t-j}\right) + \varepsilon_t$$

5 Estimation Results

Before estimating fiscal reaction functions, we first perform the various test to investigate the order of integration of each variable. Results (table 1) indicate that, output gap/GDP and primary balance/GDP are stationary (I(0)), while debt/GDP ratio is non-stationary (I(1)) but is difference stationary.

Table 1 Stationarity Test Results

Series	Model	ADF	DF GLS	PP	Conclusion
Primary/GDP	τ_t	-14.909***	-13.345***	-14.908***	Stationary
	τ_u	-13.517***	-12.696***	-13.769***	
	τ	-13.368***		-13.692***	
Debt/GDP	τ_t	-0.936	-1.255	-1.324	Non-Stationary
	τ_u	-1.301	-1.304	-1.613	
	τ	0.081		-0.011	
Δ Debt/GDP	τ_t	-9.744***	-9.704***	-9.923***	Stationary
	τ_u	-9.692***	-8.895***	-9.931***	
	τ	-9.713***		-9.962***	
Gap/GDP	τ_t	-4.162***	-4.172***	-3.530**	Stationary
	τ_u	-4.172***	-4.082***	-3.539***	
	τ	-4.155***		-3.526***	

Notes: *(**) *** denotes 10(5)1 percent level

τ_u, τ_t, τ, indicates the model includes "intercept, trend & intercept, or none" respectively

We estimate our fiscal reaction function using several techniques, namely Autoregressive Distributed Lag (ARDL), OLS, two-stage least squares (2SLS), GMM – "Generalized Methods of Moments" and Quantile Regression (QREG). To handle the issue of endogeneity in n2SLS and GMM, we follow Plodt, Martin & Claire Reicher (2015); and use two lags of debt ratio, output gap growth $\langle (gap_t - gap_{t-1}) / gap_{t-1} \rangle$ and lagged output gap as instruments. Plodt & Reicher (2015) noted that even though standard in empirical literature, future shocks will always affect filtered values of past variables and hence the instrumental variables approach, cannot fully control for the possible endogeneity of past trend output or potential output in response to fiscal policy. We produce five sets of fiscal reaction functions as shown in the table 2, using ARDL, OLS, 2SLS, GMM and QREG models.

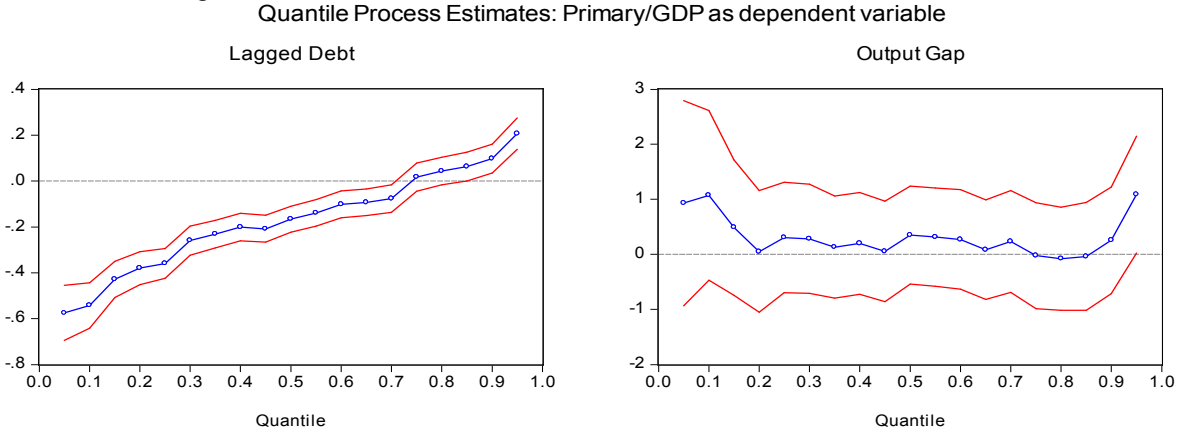
Table 2 Regression Results with Primary/GDP as dependent variable

	ARDL	OLS	2SLS	GMM	QREG
$Debt_{t-1}$/GDP	-0.164645***	-0.145391***	-0.149758***	-0.149758**	-0.166650***
	(-3.5063)	(-3.4032)	(-3.4765)	(-1.9727)	(-4.7830)
Gap/GDP	0.217867	0.174405	0.033928	0.033928	0.351520
	(0.3395)	(0.26297)	(0.0442)	(0.0723)	(0.6499)

Notes: *(**) *** denotes 10(5)1 percent level; () denotes t-values

ARDL adjustment coefficient (ECT) -1.04225*** (-12.493), lags (1, 3, 0) & bound test of 38.511***

Quantile regression estimated at median



All regressions used a lagged debt and output deviations as explanatory variables while the primary surplus is the explained variable (all variables are ratios of GDP). The parameter α that captures the behavior

of the reaction function is statistically significant but negative in all regression models against theory expectation of it been positive. That is, a one percent increase in public debt results in a 15-percent decrease in primary surplus or a 15-percent increase in deficit. An indication that the government cannot run a surplus (or reduce deficit) in the short-run. Therefore, the fiscal policy cannot absorb a positive debt shock given its response is contrary to theory expectation. Fiscal sustainability maybe comprised, and in the long run necessitate bitter fiscal adjustments to cure the current situation. Further, the response of the primary surplus to control variable (output gap), though positive as expected is statistically insignificant. Over the period 2001–2008, Kenya had a primary surplus or low primary deficit and a low public debt (less than 70% of GDP). However, after 2009, both deficits and debt increased rapidly (see figure 1). The debt interest payment increased from 3.6% to 7.3% within one year (2008 to 2009), while total debt increased from 71% to 85% over the same period. This can be partially, explained by the fact that Kenya had a president who was on his second and final term (2008-2013) during that period, hence loose fiscal policy. Such a situation is not sustainable in the long run. Replacing the primary surplus with either expenditure or revenue, yield results that have no long run relationship as reported by ARDL bounds testing (see tables 3 & 4 in appendix).

6 Conclusion

Fiscal sustainability and more so in developing economies is an issue of great concern mainly due to controversy and much debate on this concept of fiscal sustainability. We shed some light on Kenya's long run fiscal debt sustainability by employing recent techniques mainly quantile regression and ARDL models. Our main findings similar to Stoian & Câmpeanu (2010) is that, Kenya's government faces difficulties in responding to short term positive debt shocks, given its fiscal policy reaction is contradictory to theory expectation, hence a severe fiscal adjustment may be inevitable in the future.

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Appendix

Table 3 Regression results with Revenue/GDP as dependent variable

	ARDL	OLS	2SLS	GMM	QREG
$Debt_{t-1}$/GDP	0.561109***	0.541787***	0.543364***	0.547847***	0.569573***
	(5.0571)	(17.886)	(17.780)	(15.405)	(20.432)
Gap/GDP	0.723044	0.562040	0.879893	0.878483	1.132451**
	(0.4220)	(1.1952)	(1.6163)	(1.2149)	(2.4708)

Notes: *(**) *** denotes 10(5)1 percent level; () denotes t-values
ARDL adjustment coefficient (ECT) is -0.2428*** (-2.6197), lags of (4, 0, 0) and bound test of 1.71
Quantile regression estimated at median

Table 4 Regression results with Expenditure/GDP as dependent variable

	ARDL	OLS	2SLS	GMM	QREG
$Debt_{t-1}$/GDP	0.604589***	0.687178***	0.692783***	0.753213***	0.738433***
	(3.8298)	(14.623)	(14.624)	(9.6369)	(8.2404)
Gap/GDP	0.241646	0.387635	0.833123	1.035645	0.084609
	(0.1104)	(0.5314)	(0.9872)	(1.2091)	(0.1468)

Notes: *(**) *** denotes 10(5)1 percent level; () denotes t-values
ARDL adjustment coefficient (ECT) is -0.3162*** (-2.6835), lags of (4, 2, 0) and bound test of 1.804
Quantile regression estimated at median