Terms of Trade Volatility and Economic Growth in Sub-Saharan Africa

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August 2012

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August, 2012

Abstract

This paper investigated the effect of terms of trade growth and its volatility on economic growth in Sub-Saharan Africa. I employed dynamic panel data models of difference and system GMM that could account biases associated with endogeneity of explanatory variables and problems induced by unobserved country specific characteristics. I used both net barter terms of trade and income terms of trade as a measure of terms of trade for the entire analysis of this paper. Using data from 1985 to 2010, I found that the net barter terms of trade and income terms of trade growth has positive and significant effect on economic growth. Furthermore, the result proved that volatility of net barter terms of trade and income terms of trade have negative and significant effect on economic growth. Finally, this result is found to be robust using alternative volatility measures.

Keywords: Economic Growth, Terms of Trade, Volatility, Sub-Saharan Africa

JEL Code: F00, F10, F43

1. Introduction

Various studies have consistently identified deterioration of terms of trade (ToT) as determinants of country's macroeconomic performances. The deterioration of ToT, which is mainly due to a rise in import price faster than export price, worsen the balance of payment and leads to income and welfare losses. Terms of trade shocks also appear to play a role in explaining growth fluctuations although there is no common consensus regarding the direction of its effect on growth. However, it is yet unclear whether ToT volatility appears to play a role in explaining growth fluctuations. If volatility really matters for growth then any exogenous shock that affect volatility can also affect growth. Therefore, it is important to clearly identify the effect of ToT volatility on growth so as to show the clear-cut direction for various policy interventions that target maintaining growth.

Blattman el al (2007), Jacks et al (2009) and Cavalcanti et al (2012) assert that the terms of trade effects are asymmetric between primary commodity exporting countries and industrialized countries with diversified and broader export base. They argue that volatility mattered little for the larger, diversified industrial nations, but volatility seems to have impacted primary commodity exporting nations adversely.

To date, to the best of my knowledge, there are only few papers on primary commodity exporting regions that try to look the relationship between ToT volatility and growth. However, none of them convincingly try to solve endogeneity problems which are common for the majority of existing literatures on ToT. Some of them employ cross country OLS regression using average data. This approach neither solves the problem of endogeneity nor shows the true effect of ToT on growth. It completely eliminates the time series nature of the data and will make it difficult to learn about the effect of growth and shock of ToT over time. Others use the fixed effects and IV estimation. Such methods might be feasible as long as instruments used are strong. In addition, the dependent variable (percapita GDP) in almost all cases exhibit dependence. As a result, the lag-dependent variable appears as regressor and this will raise the problem of autocorrelation.

Inspired by all these facts, this paper attempts to shed some light on the issue by making a closer look towards primary commodity exporting countries. It mainly investigates the effect of a change in the growth and volatility of ToT on economic growth in Sub-Saharan Africa (SSA). To overcome all aforementioned problems in the exiting literature, this paper uses recent dataset and employs dynamic panel data models of difference and system GMM that account biases associated with joint endogeneity of explanatory variables and problems induced by unobserved country specific effects.

This paper has another feature that distinguishes it from other papers done on ToT. Unlike most papers which focus solely on net barter terms of (NBTT), this paper uses both NBTT and income terms of trade (ITT) for its entire analysis. There are familiar grounds for fearing that the NBTT[1] will become unfavourable than ITT[2] as it does not show us whether the country would be better-off or worse-off in terms of exports as the capacity to import. It is due to the fact that the formulation does not include the variable of the actual amount of exports. If, for example, we increase our export price, the NBTT will undoubtedly increase for given level of import price. However, an increase in our export price might induce the world demand for our export to decline and we might end up with lower export receipts than ever before. These problems can be resolved by using ITT which is obtained by weighting the NBTT by quantity of exports. ITT explicitly takes into account the actual export volume and it will also change with the change in price of exports.

2. Literature Review

This paper is not the first to emphasize the consequence of ToT shock on economic growth. There is a large literature that has deemed the effects of movements in ToT. The major focus of previous literature has been movements in ToT and its influence on balance of payments. Following the Prebisch-Singer (PS) thesis which states the price of primary commodities has downward trend overtime as compared to the price of manufactures, various papers including those by Sapsford (1985), Sarkar (1986), Grilli and Yang (1988), Lutz (1999), Haddas and Williamson (2001) and Cashin and

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[1] NBTT = P_x/P_m, where P_x stands for export prices and P_m for import prices

[2] ITT = $[P_x/P_m]Q_x$, where Q_x stands for quantity of exports

McDermott (2002) have found an evidence for the existence of secular deterioration. All these studies proclaim that there is negative linear trend on commodity ToT.

Using cointegration technique, Arize (1996) explores the effect of ToT on balance of trade and finds significant positive long run equilibrium relationship between ToT and trade balance. Similarly, Thirlwall (2003) added that the deterioration of ToT, which is mainly due to a rise in import price faster than export price, worsen the balance of payment at a given rate of growth. These findings have important implication for primary commodity exporting countries. The deterioration in ToT facing less developed countries leads to income and welfare losses (Prebish 1959). Furthermore, Kipici (1996) analysed the existence of the Harberger-Laursen-Metzler (HLM) hypothesis which states that when ToT improves the real income level will rise and, consequently, the improvement in ToT boosts trade balance. Kipici (1996) asserts that the relation between ToT and trade balance depends on the significance of consumption-smoothing and consumption-tilting intentions that are directed by the intertemporal elasticity of substitutions.

ToT volatility has been found to be a topic of recent literature. It was first spurred by the influential work of Ramsey and Ramsey (1995) that explains the existence of negative correlation between output volatility and growth. Their finding implies that exogenous shocks that influence volatility can also have an effect on growth. Short-run movements in ToT might be an important source of such volatility. According to Eichengreen (1996), both negative trends and volatility in ToT depressed export revenues and capital inflows for many developing countries.

Mendoza (1997), using stochastic endogenous growth model, conducts an investigation of the growth effect of ToT uncertainty on a panel of 40 countries between 1970 and 1991. His empirical analysis provides robust evidence that terms of trade variability has a large adverse effect on economic growth. Similarly, for their investigation in Sub-Saharan Africa, Bleaney and Greenaway (2001) use a sample of 14 countries from 1980 to 1995 and show that growth is negatively affected by ToT volatility while investment by real exchange rate instability. Recently, Samimi et al (2011) make closer look towards the effect of ToT volatility on 20 oil exporting countries. They use data from

1980 to 2005 for their investigation and find the existence of negative impact of ToT volatility on growth.

Blattman et al (2007) use a similar model with Mendoza (1997) to estimate the impact of ToT volatility on income using new panel data for 35 countries from 1870 to 1939. They find volatility to be much more vital for growth than was declining in trend of ToT and accounts for a significant amount of the divergence in incomes among the sample of small and commodity dependent nations. They added that ToT effects are asymmetric between primary commodity exporting countries and industrialized countries with diversified and broader export base. They argue that volatility mattered little for the larger, diversified industrial nations, but volatility seems to have impacted primary commodity exporting nations adversely.

Moreover, Cavalcanti et al (2012) investigate the impact of the level and volatility of the commodity ToT on economic growth. Using wider sample of 118 countries both annual data from 1970 to 2007 and five-year nonoverlapping observations, they find that while commodity ToT growth enhances real output per capita, volatility exerts a negative impact on economic growth. Following this result, they argue that the negative growth effects of commodity ToT volatility offset the positive impact of commodity booms, and hence, export diversification in primary commodity abundant countries contribute to faster growth. Additionally, they share the idea of Blattman et al (2007) which claims the asymmetric effects of ToT volatility between primary commodity exporting countries and industrialized countries.

Using data from 2004 to 2008, Jawaid and Waheed (2011) show the effect of ToT and its volatility on economic growth for a sample of 94 developed and developing countries. Their cross country ordinary least square estimation indicate significant positive effect of both ToT and its volatility on economic growth. Their finding for the effects of volatility contradicts with Mendoza (1997), Bleaney and Greenaway (2001) and Samimi et al (2011) which proclaim the presence of significant negative effect of ToT volatility on growth. Although Jawaid and Waheed (2011) claim the robustness of their initial result by performing sensitivity analysis using different additional variables, sample size and various proxies of volatility variable, it would still be difficult to accept it as problems of identification and endogeneity not yet resolved.

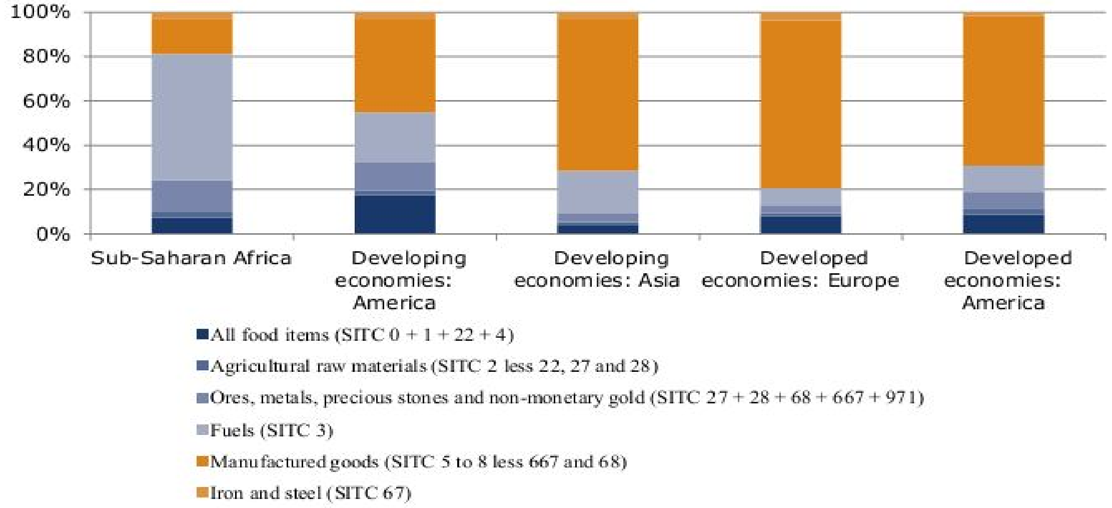
Very importantly, they set a direction for further research describing the need for further investigation on the issue using long time series data.

The problem for almost all literatures on this area is their choice of proxy for ToT. Majority of the literature on the area focus on NBTT and not much emphasis has been given for ITT. Lutz (1994) uses both NBTT and ITT for his empirical analysis between ToT and economic growth. He uses pooled cross-section and time series data for 91 countries from 1968 to 1988 and finds a significant negative growth effect of ITT volatility. However, the estimated coefficients on the degree of volatility in the NBTT turned out to be either insignificant or positive.

The other problem for most literatures on ToT, particularly for those which make cross-country regressions on both primary commodity exporting and industrialized countries, is the issue of endogeneity. Exogeneity of short-term volatility and long-term growth of ToT are the underlying assumptions throughout these literatures. However, industrialised countries which export mainly manufactures and import primary products are not predominantly price takers in international market. In such cases, the assumption of exogeneity of ToT made on most of cross-country regressions will be very strong.

However, short-term volatility and even long-term growth of ToT might be exogenous for primary commodity exporting small open economies since these countries are price takers in the international market. Therefore, it might be reasonable to consider ToT as exogenous, specifically in this paper, as countries in SSA are mainly primary commodity exporters. As shown in (figure 1) more than 80 percent of Sub-Saharan Africa's export is primary products (Keane et al 2010).

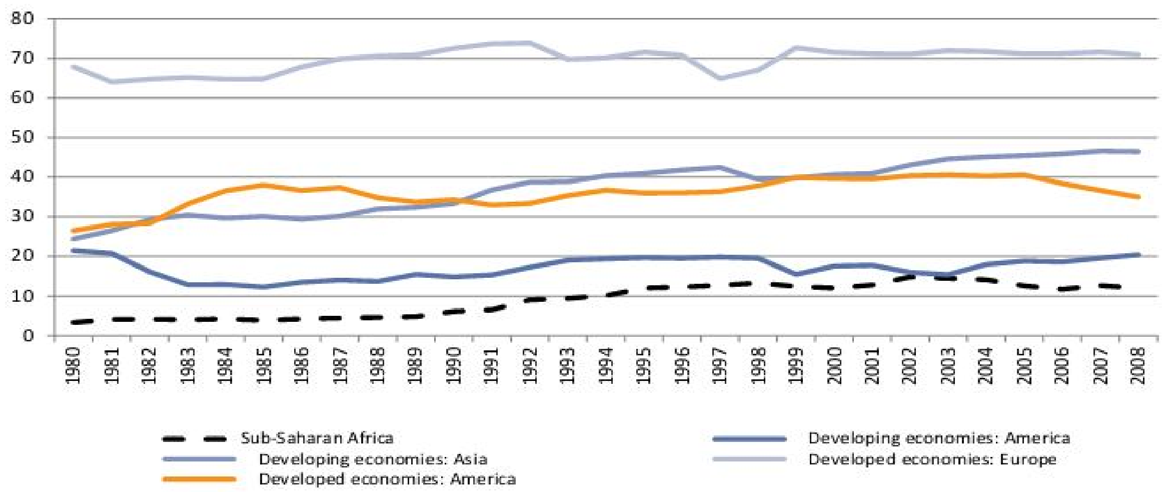
Figure 1: Composition of World Export by Region, 2008



Source: Keane et al (2010)

Intra-regional trade in Sub-Saharan Africa is low (Keane et al 2010) mainly due to existence of non-tariff barriers (NTBs). This fact is shown in (figure 2) below. Therefore, the ToT data of individual countries in this region is mainly with the rest of the world. This lower intra-regional trade implies that ToT of member countries does not highly depend on the capacity and reaction of individual economies in the region; rather it depends on the capacity and reaction of the rest of the world. As a result, "transfer problem"[3] of ToT is no more an issue in this case.

Figure 2: Intra-Regional Exports as a Proportion of Total Exports, 1980-2008 (%)



Source: Keane et al (2010)

[3] It is a problem that occurs when terms of trade change helps one country and harms the other.

3. Data and Methodology

3.1 Data

To examine the effects of growth and volatility of ToT on economic growth in SSA, this paper uses annual data covering the period 1985 to 2010. The investigation covers 35 sub-Saharan African countries out of the total of 48 for which there is full data for the sample period. The data for real percapita gross domestic product, total labor force, NBTT and ITT is from United Nations Conference on Trade and Development (UNCTAD) statistics database. Additionally, the data for investment share of GDP is from Heston et al (2012) which is the latest version of the Pen World Table (PWT 7.1). Due absence of data for investment share of GDP, the data used for this analysis is limited till 2010. The detail description of variables, the sources of data and list of countries included in are listed in the appendix.

As the prime motive of this study is to show the effect of the growth and volatility of ToT, it is crucial to generate volatility of ToT for every year under consideration. Numerous studies, including Mendoza (1997), Rodrik (1998), Jansen (2004), Dungey (2004) and Kim (2007) use terms of trade growth rate and the standard deviation of the growth rate. As a result, this paper follows Mendoza (1997), Rodrik (1998), Jansen (2004), Dungey (2004) and Kim (2007) to employ the standard deviation of the growth rate of NBTT and ITT as a measure of volatility. This paper uses a moving window standard deviation in order to generate time varying standard deviation for every year.

3.2 Methodology

This section introduces the dynamic panel models of difference and system GMM to be applied in this paper. Most empirical works of economic growth from cross-sectional simple regression to the static and dynamic panel data techniques starts with the following model:

$$y_{it} = \phi y_{it-1} + \beta' x_{it} + \mu_i + \delta_t + u_{it} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$for\ i = 1,2,3,\ldots,N\ and\ t = 1,2,3,\ldots,T$$

Where y_{it} is the dependant variable, y_{it-1} is the lagged dependent variable, x_{it} is a vector of explanatory variables, μ_i is unobserved country specific characteristics, δ_t is time-specific effect and u_{it} is the error term.

A number of econometric problems may happen from estimating equation (1). The lagged dependent variable, y_{it-1}which enters the model as a regressor gives rise to autocorrelation. Moreover, since causality may run in both directions, regressors in the right hand side are assumed to be endogenous and these regressors may be correlated with the error term. Furthermore, time-invariant country specific characteristics might be correlated with the explanatory variables.

Using simple cross-sectional approach and the traditional static panel estimators like fixed effect and random effect settings are inconsistent in such cases. To overcome aforementioned problems, this paper uses the Arellano-Bond (1991) difference GMM estimator. The difference GMM uses first-differences to transform equation (1) and the equations estimated in this paper take the following form:

$$\Delta PGDP_{it} = \alpha_1 \Delta PGDP_{it-1} + \alpha_2 \Delta INV_{it} + \alpha_3 \Delta LAB_{it} + \alpha_4 \Delta GNBTT_{it} + \alpha_5 \Delta VNBTT_{it} + \Delta u_{it} \ldots (2)$$

$$\Delta PGDP_{it} = \beta_1 \Delta PGDP_{it-1} + \beta_2 \Delta INV_{it} + \beta_3 \Delta LAB_{it} + \beta_4 \Delta GITT_{it} + \beta_5 \Delta VITT_{it} + \Delta \mathcal{E}_{it} \ldots\ldots (3)$$

Where,

- ✓ *PGDP - per capita gross domestic product*
- ✓ *INV - investment share of GDP*
- ✓ *LAB- labour force*
- ✓ *GNBTT- growth of net barter terms of trade*
- ✓ *GITT- growth of income terms of trade*
- ✓ *VNBTT- volatility of net barter terms of trade*
- ✓ *VITT- volatility of income terms of trade*

The first-differenced lagged dependent variable is instrumented with its past levels. Lagged levels of the endogenous regressors are also used as an instrument. This makes the endogenous variables predetermined and not correlated with the disturbance term. The first-differences also removes country specific characteristic μ_i as it does not vary with time. Assuming that the explanatory variables are weakly exogenous[4] but predetermined, and the error term is not serially correlated, the difference GMM estimator will have the following moment conditions:

$$E(y_{it-s,}\, \Delta u_{it}) = 0 \qquad for\ t = 3, \dots, T\ and\ s \geq 2$$

$$E\left(x_{it-s,}\, \Delta u_{it}\right) = 0 \qquad for\ t = 3, \dots, T\ and\ s \geq 2$$

Differenced GMM estimator may be exposed to downward finite-sample bias (Blundell and Bond 1998). This suggests that some care may be necessary before relying on this technique to estimate autoregressive models for time series data like per capita GDP (Bond et al 2001). Therefore, this paper considers one more estimator that has superior finite sample properties and follows Arellano and Bover (1995), Blundell and Bond (1998) and Bond et al (2001) in employing a system GMM estimator. This method includes variables in levels with the lagged differences of the endogenous variables as instruments. Thus the variables in levels are instrumented with their own first differences. As a result, the additional moment conditions for the regression in levels will be:

$$E\left(\Delta y_{it-s,}\mu_i + u_{it}\right) = 0 \qquad for\ s = 1,$$

$$E\left(\Delta x_{it-s,}\mu_i + u_{it}\right) = 0 \qquad for\ s = 1$$

This paper uses the standard two-step method that controls for heteroskedasticity. The variance for a given moment condition might not be the same across time and this grants for a more flexible variance-covariance structure since the system GMM estimator take care of the moment conditions as applying to specific time period.

Testing for panel unit root is an important step to test if the dependent and independent variables are stationary or not. Therefore, this study first undertakes the Im, Pesaran and Shin (IPS) test. The IPS test extends the Levin–Lin–Chu test framework to allow for heterogeneity in the value of λ_i under the alternative hypothesis. This test is based on the analysis of the equation:

[4] Variables are weakly exogenous means they can be influenced by past and current realizations of the growth rate but not upcoming realizations of the error term.

$$\Delta y_{it} = \lambda_i y_{it-1} + Z'_{it}\gamma_i + u_{it} \quad \ldots\ldots(4)$$

$$for\ i = 1,2,3,\ldots,N\ and\ t = 1,2,3,\ldots,T$$

Where:

$H_o: \lambda_i = 0\ \forall_i$

$H_A: \lambda_i < 0\ , i = 1,2,\ldots,N_1;\ \lambda_i = 0, i = N_1 + 1, N_1 + 2,\ldots,N$

Under the null, all series are non-stationary where as under the alternative a portion of the series is assumed to be stationary.

Furthermore, the validity of the instruments has an effect on the consistency of the GMM estimator. So as to address this issue, this paper considers two specification tests. The first test is the Sargan test, the test of over-identifying restrictions which tests the overall validity of instruments. The second test examines the hypothesis that the error term is not serially correlated.

Finally, the robustness of the result is checked using different dataset, by taking different proxy for volatility of ToT. This paper follows Basu and McLeod (1991), Blattman et al (2007), Williamson (2008) and Furth (2012) to employ the Hodrick-Prescott (HP) filter to decompose ToT movements into trend and volatility.

4. Results and Discussion

4.1 Descriptive Statistics

Growth of NBTT varied between -62 and 102 while growth of ITT varied between -76 and 433. Volatility of NBTT varied between 0 and 112 while volatility of ITT varied between 0.69 and 806. Average growth of NBTT and ITT for each country in the sample varied between -4 and 7, and 0.17 and 25, respectively.

The reported standard deviations indicate that the variation in growth of NBTT, growth of ITT, volatility of NBTT and volatility of ITT during the sample period across countries are significantly different from that observed within a country over time. The larger figure of the within standard deviation shows the greater variability of variables.

Table 1: Summary statistics of growth and volatility of NBTT and ITT

Variable		Mean	Std. Dev.	Min	Max	Observations
GNBTT	overall	.5389203	14.2566	-62.28739	101.619	N = 875
	between		2.323867	-4.059319	7.4621	n = 35
	within		14.0712	-58.3242	94.69587	T = 25
VNBTT	overall	16.98717	17.72127	0	111.9054	N = 875
	between		10.48245	2.22756	46.65998	n = 35
	within		14.39371	-22.20244	90.97665	T = 25
GITT	overall	7.647908	35.0999	-75.90037	432.5815	N = 875
	between		5.486461	.1744243	25.12159	n = 35
	within		34.68037	-90.40171	415.1078	T = 25
VITT	overall	43.927	57.91229	.6954814	806.4374	N = 875
	between		27.02714	8.110334	141.3785	n = 35
	within		51.41426	-70.90243	708.9859	T = 25

Panel Unit Root Test

Table 4.2 presents the results of the IPS panel unit root test. The optimum lag is selected using Alkaline Information Criteria (AIC). The result shows that the null hypothesis of a panel unit root in the level of the series is rejected for all variables except PGDP and LAB. The test (in both with and without trend) significantly prove that majority of the series strongly reject the null that all series contain a unit root. Hence, there no strong evidence that all the series are integrated of orders one.

Table 4.2: Panel Unit Root Test (IPS)

Variable	Level		First difference	
	Without trend	With trend	Without trend	With trend
PGDP	4.6255	2.0538	-15.9101*	-16.5125*
INV	-2.2523**	-4.7110*	-26.0836*	-23.6868*
LAB	17.3976	2.2773	-6.7297*	-8.6065*
GNBTT	-23.3977*	-20.9178*	-37.8914*	-34.0163*
GITT	-24.5374*	-22.4899*	-35.1063*	-31.8348*
VNBTT	-4.7141*	-3.5521*	-15.5816*	-12.8791*
VITT	-11.5167*	-9.4949*	-16.3625*	-12.4610*

* 1% levels of significance

** 5% levels of significance

Empirical Results

This section presents the difference and system GMM estimation results of the effect of growth and volatility of NBTT and ITT. As clearly stated in earlier sections, I use NBTT and ITT interchangeably throughout this paper.

4.1.1 Net Barter Terms of Trade and Economic Growth

Table 4.3 presents difference GMM regression results using NBTT. It contains two regression results, i.e. regression [1a] using all 35 sample countries and regression [1b] using 34 countries by excluding South Africa from the sample. I excluded South Africa in our second regression so as to see the difference on the result.

Table 4.3: Difference GMM regression result using NBTT

Estimation Method	Differenced GMM	
Period	1985-2010	
Volatility Measure	Standard Deviation of NBTT	
Dependent variable: Percapita GDP	[1a] All Sample countries	[1b] Excluding South Africa
Independent Variables		
$\mathbf{PGDP_{t-1}}$	0.9481* (0.0011)	0.9467* (0.0011)
Investment (% of GDP)	1.1117* (0.1066)	1.0337* (0.0851)
Labor Force	0.0153* (0.0005)	0.0085* (0.0005)
Growth of NBTT	0.3367* (0.0067)	0.3486* (0.0067)
Volatility of NBTT	-0.1786* (0.0363)	-0.2187* (0.0405)
Number of Countries	35	34
Number of Observations	805	805
Specification Tests *(p-values)*		
Sargan Test	0.6203	0.6684
Serial Correlation		
First-order	0.0679	0.0656
Second-order	0.2836	0.2787

Figures presented in brackets are standard errors

Symbols *, **, and *** represent significance at 1%, 5% and 10% respectively.

Despite South Africa is found in SSA, it is relatively industrialised and middle income country as compared to other sample countries. However, in both regressions using all 35 countries and by excluding South Africa, we clearly observe that growth of NBTT is both growth sustaining and highly significant. On the other hand, volatility NBTT is negative and highly significant.

Since differenced GMM may be subject to a large downward finite-sample bias, I used system GMM estimator that has better finite sample properties. Table 4.4 presents system GMM regression results using NBTT. It contains two regression results, i.e. regression [2a] using all 35 sample countries and regression [2b] using 34 countries by excluding South Africa from the sample.

Table 4.4: System GMM regression result using NBTT

Estimation Method	System GMM	
Period	1985-2010	
Volatility Measure	Standard Deviation of NBTT	
Dependent variable: Percapita GDP	[2a] All Sample countries	[2b] Excluding South Africa
Independent Variables		
$\mathbf{PGDP_{t-1}}$	0.9767* (0.0011)	0.9785* (0.0016)
Investment (% of GDP)	5.1035* (0.0898)	4.8957* (0.0982)
Labor Force	0.0027* (0.0008)	-0.0017* (0.0003)
Growth of NBTT	0.3196* (0.0166)	0.2722* (0.0276)
Volatility of NBTT	-0.5515* (0.0399)	-0.5067* (0.0347)
Number of Countries	35	34
Number of Observations	840	840
Specification Tests *(p-values)*		
Sargan Test	0.5854	0.6332
Serial Correlation		
First-order	0.0398	0.0561
Second-order	0.2774	0.2744

Figures presented in brackets are standard errors

Symbols *, **, and *** represent significance at 1%, 5% and 10% respectively.

In both regressions, we observe that Growth of NBTT is both growth sustaining and highly significant. However, Volatility NBTT is growth retarding and highly significant. Despite the coefficient of growth of NBTT are of comparable magnitude in both estimators' regressions, volatility of NBTT exhibit large differences in their coefficients. While the coefficient for volatility of NBTT in difference GMM regression is -0.1786, it changes to -0.5515 in the case of system GMM regression. Therefore, it is evidence that while growth of NBTT is growth enhancing, volatility of NBTT decelerates growth for the full sample. This finding is in line with results of recent studies such as Samimi et al (2011), Furth S. B., (2012) and Cavalcanti et al (2012).

4.1.2 Income Terms of Trade and Economic Growth

Table 4.5 presents difference GMM regression results using ITT. The result, similar to in the case of NBTT, shows that growth of ITT is growth sustaining while volatility of ITT is growth retarding.

Table 4.5: Difference GMM regression result using ITT

Estimation Method	Difference GMM	
Period	1985-2010	
Volatility Measure	Standard Deviation of ITT	
Dependent variable: Percapita GDP	[3a] All Sample countries	[3b] Excluding South Africa
Independent Variables		
$\mathbf{PGDP_{t-1}}$	0.9480* (0.0012)	0.9457* (0.0014)
Investment (% of GDP)	1.1702* (0.0977)	1.0761* (0.0836)
Labor Force	0.0153* (0.0004)	0.0079* (0.0007)
Growth of ITT	0.2671* (0.0068)	0.2531* (0.0104)
Volatility of ITT	-0.0891* (0.0085)	-0.1179* (0.0165)
Number of Countries	35	34
Number of Observations	805	805
Specification Tests *(p-values)*		
Sargan Test	0.6235	0.6905
Serial Correlation		
First-order	0.0638	0.0503
Second-order	0.2849	0.2805

Symbols *, **, and *** represent significance at 1%, 5% and 10% respectively.

The system GMM regression result presented in Table 4.6 also shows similar direction although there is some difference on the magnitude of the coefficients of growth and volatility of ITT. The coefficient for growth of ITT in difference GMM regression is 0.2671, but it increases to 0.3596 in the system GMM regression. When we see the coefficient of volatility of ITT, it is changed from -0.0891 to -0.1525. Therefore, the result confirms the importance of underlying growth of ITT in driving economic growth. Moreover, it is evidence that volatility is an impediment for economic growth.

Table 4.6: System GMM regression result using ITT

Estimation Method	System GMM	
Period	1985-2010	
Volatility Measure	Standard Deviation of ITT	
Dependent variable: Percapita GDP	[4a] All Sample countries	[4b] Excluding South Africa
Independent Variables		
$\mathbf{PGDP_{t-1}}$	0.9745* (0.0009)	0.9745* (0.0012)
Investment (% of GDP)	5.3538* (0.0895)	5.1912* (0.1189)
Labor Force	0.0021* (0.0004)	-0.0018* (0.0006)
Growth of ITT	0.3596* (0.0114)	0.3336* (0.0100)
Volatility of ITT	-0.1525* (0.0140)	-0.1334* (0.0158)
Number of Countries	35	34
Number of Observations	840	840
Specification Tests *(p-values)*		
Sargan Test	0.5332	0.6039
Serial Correlation		
First-order	0.0381	0.0520
Second-order	0.2782	0.2754

Figures presented in brackets are standard errors, * represent significance at 1%.

At the beginning of this paper, I noted that there are familiar grounds for fearing that the NBTT will become unfavourable than ITT for the analysis of the effect of ToT on economic growth. However, the result does not reveal notable difference on both types of ToT as shown in Lutz (1994). Lutz (1994) uses both NBTT and ITT for his empirical analysis and finds a significant negative growth effect of ITT volatility. Nevertheless, his estimated coefficients on the degree of volatility in the NBTT turned out to be positive but insignificant.

However, this paper confirms negative and significant growth effect of both NBTT and ITT volatility. Additionally, the result confirms that the growth of both NBTT and ITT have positive and significant effect on economic growth. Even though there is similarity on the direction of the effects of growth and volatility of ToT on economic growth, there is significant difference on the magnitude of the coefficients of ToT volatility when we use NBTT and ITT differently. In the difference GMM regressions, regressions [1a] and [3a], the coefficient for volatility changes by half when we use NBTT instead of ITT. Similarly, system GMM regression result shows that the difference in coefficients of NBTT and ITT is more than three-fold. Over all, volatility of ITT has smaller effect on economic growth as compared to NBTT.

In all regressions, the control variables are statistically significant and have the expected sign except for lagged percapita GDP in all regressions and for labor force in regression [2b] and [4b]. Therefore, income convergence is either very slow or non-existent across sample countries since the coefficient of lagged dependent variable is positive and significant. Finally, in almost all regressions, the second-order serial correlation and the Sargan test statistics are beyond the conventional significance levels.

4.2 Robustness Checks

The robustness of the result is checked using different proxy for volatility of ToT. It is mainly to make sure that the findings are not driven by the method in which volatility of ToT is measured. Instead of using the moving window standard deviation of ToT growth rate, in this section, I follow Basu and McLeod (1991), Blattman et al (2007), Williamson (2008) and Furth (2012) to employ the Hodrick-Prescott (HP) filter to decompose ToT movements into trend and volatility.

Table 4.7: Regression result using NBTT

Estimation Method	Difference and System GMM	
Period	1985-2010	
Volatility Measure	Hodrick-Prescott (HP) filter	
Dependent variable: Percapita GDP	[5a] Difference GMM	[5b] System GMM
Independent Variables		
$\mathbf{PGDP_{t-1}}$	0.9482* (0.0004)	0.9766* (0.0014)
Investment (% of GDP)	1.1585* (0.0746)	5.2685* (0.0847)
Labor Force	0.0153* (0.0004)	0.0015* (0.0003)
Growth of NBTT	0.3276* (0.0134)	0.3050* (0.0207)
Volatility of NBTT	-0.0432 (0.0610)	-0.3914* (0.0708)
Number of Countries	35	35
Number of Observations	805	840
Specification Tests *(p-values)*		
Sargan Test	0.5884	0.4695
Serial Correlation		
First-order	0.0617	0.0471
Second-order	0.2832	0.2755

Figures presented in brackets are standard errors

Symbols *, **, and *** represent significance at 1%, 5% and 10% respectively.

Table 4.7 presents difference and system GMM regression results using NBTT. It contains two regression results, i.e. regression [5a] for difference GMM and regression [5b] for system GMM. In both regression results, growth of NBTT found to be positive and statistically significant. This finding fits with the initial results from regression [1a] and [2a] in which growth of NBTT has positive significant effect on economic growth. The difference GMM regression result [5a] shows that volatility of NBTT has insignificant effect. However, regression [5b] clearly shows volatility of NBTT has negative and significant effect on economic growth. As a result, it is better to rely on the result of system GMM as differenced GMM may be subject to finite-sample bias. Therefore, it seems safe to conclude that our result is robust and volatility of NBTT harms economic growth.

Additionally, as I did for NBTT, the robustness of the result for ITT is checked using similar procedure. Table 4.8 presents difference and system GMM regression results using ITT. It contains two regression results, i.e. regression [6a] for difference GMM and regression [6b] for system GMM. In both regression results, growth of ITT found to be positive and statistically significant. Regarding volatility of ITT, its coefficient found to be negative and significant in regression [6b]. This finding fits with the initial results in which volatility of ITT has negative significant effect on economic growth.

Table 4.8: Regression result using ITT

Estimation Method	Difference and System GMM	
Period	1985-2010	
Volatility Measure	Hodrick-Prescott (HP) filter	
Dependent variable: Percapita GDP	[6a] Difference GMM	[6b] System GMM
Independent Variables		
$\mathbf{PGDP_{t-1}}$	0.9486* (0.0009)	0.9745* (0.0008)
Investment (% of GDP)	1.1522* (0.0535)	5.3011* (0.0682)
Labor Force	0.0156* (0.0002)	0.0018* (0.0004)
Growth of ITT	0.2624* (0.0099)	0.3373* (0.0105)
Volatility of ITT	-0.0194 (0.0160)	-0.1312* (0.0276)
Number of Countries	35	35
Number of Observations	805	840
Specification Tests *(p-values)*		
Sargan Test	0.5023	0.4258
Serial Correlation		
First-order	0.0672	0.0423
Second-order	0.2843	0.2781

Figures presented in brackets are standard errors

Symbols *, **, and *** represent significance at 1%, 5% and 10% respectively.

In addition, I tried to include growth and volatility of NBTT and ITT separately in all regressions so as to see if this affects my results. In all cases, neither the sign nor the significance of coefficients of growth and volatility of NBTT and ITT is changed.

In all regressions, the control variables are statistically significant and have the expected sign except for lagged percapita GDP in all regressions. Therefore, similar to my initial findings, income convergence is either very slow or non-existent across sample countries since the coefficient of lagged dependent variable is positive and significant. Finally, in all regressions, the second-order serial correlation and Sargan test statistics are beyond the conventional significance levels. Hence, the findings obtained using different volatility measures confirm the robustness of my result reported in Section 4.3.1 and 4.3.2, and provide evidence for positive effect of growth of ToT and negative effect of volatility of ToT on economic growth.

5. Conclusion

This paper investigated the effect of growth and volatility of ToT on economic growth in Sub-Saharan Africa. I employed dynamic panel data models of difference and system GMM that could account biases associated with endogeneity of explanatory variables and problems induced by unobserved country specific characteristics. I used both net barter terms of trade and income terms of trade as a measure of ToT for entire analysis of this paper. In order to measure volatility of ToT, I used the moving window standard deviation of ToT growth rate.

This paper found that the growth of NBTT and ITT has positive and significant effect on economic growth. Furthermore, the result proved that volatility of NBTT and ITT have negative and significant effect on economic growth. To make sure that the findings are not driven by the method in which volatility of ToT is measured, I employed HP filter to measure volatility of ToT instead of using the moving window standard deviation of ToT growth rate. Finally, this result is found to be robust using the aforementioned alternative volatility measure.

This result suggests that countries can promote their growth using interventions that enhance and improve their ToT over time. In addition, this finding confirms that ToT volatility matters for economic growth. As a result, any exogenous shock that affect ToT volatility can also affect growth. Therefore, it is possible to sustain growth through various policy interventions that target reducing ToT volatility.

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Appendix

Table 1: Description of variables and the list of countries included in the study.

SN	VARIABLE	TYPE	NAME	DESCRIPTION	SOURCE
1	PGDP	Dependent variable	Per capita gross domestic product	It is per capita gross domestic product converted to international dollars using purchasing power parity rates. Data are in constant 2005 international dollars.	UNCTAD
2	INV	Explanatory variable	Investment	Investment share of GDP per capita at constant 2005 U.S. dollars. It is used as proxy for capital due to lack of data for capital stock in the region	PWT 7.0
3	LAB	Explanatory variable	Labor force	Total labour force expressed in thousands	UNCTAD
4	GNBTT	Explanatory variable	Growth of net barter terms of trade	Growth rate of net barter terms of trade	UNCTAD
5	GITT	Explanatory variable	Growth of income terms of trade	Growth rate of income terms of trade	UNCTAD
6	VNBTT	Explanatory variable	Volatility of net barter terms of trade(1)	Obtained by using the moving window standard deviation of net barter terms of trade growth rate	Own calculation
7	VITT	Explanatory variable	Volatility of income terms of trade(1)	Obtained by using the moving window standard deviation of income terms of trade growth rate	Own calculation
6	V2NBTT	Explanatory variable	Volatility of net barter terms of trade(2)	By decomposing net barter terms of trade movements into trend and volatility using the HP filter with smoothing parameter of 100.	Own calculation
7	V2ITT	Explanatory variable	Volatility of income terms of trade(2)	By decomposing income terms of trade movements into trend and volatility using the HP filter with smoothing parameter of 100.	Own calculation
Countries in included in the study are: Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo, Dem. Rep., Congo Rep., Cote d'Ivoire, Ethiopia, Gabon, Gambia, Ghana, Guinea-Bissau, Kenya, Lesotho, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Niger, Nigeria, Rwanda, Senegal, South Africa, Sudan, Swaziland, Togo, Zambia, and Zimbabwe					