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

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Abstract

This paper investigated the effect of terms of trade and its volatility on economic growth in sub-Saharan Africa. The study employed dynamic panel data models of difference and system Generalized Method of Moments (GMM), which could account for biases associated with endogeneity of explanatory variables and problems induced by unobserved country-specific characteristics. The study used both net barter terms of trade and income terms of trade as a measure of terms of trade for the analysis of the entire data for this paper. Using data from 1985 to 2014, the study found that the improvement in both net barter terms of trade and income terms of trade is growth-enhancing, whereas its deterioration is growth-retarding. As the majority of the sample countries are primary commodity exporters, their terms of trade shows deterioration through time and this adversely affects economic growth. Furthermore, the result proved that volatility of net barter terms of trade and income terms of trade has a negative and significant effect on economic growth. Finally, the use of alternative data set contributed to the result being robust.

Key Words: Terms of Trade, volatility, economic growth, Sub-Saharan Africa
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1. Introduction

There are two basic arguments about the effect of specialization on primary products. The first argument is the Prebisch-Singer (PS) hypothesis. This hypothesis, which was developed by Prebisch (1959) and Singer (1950), postulates that the price of primary commodities has a downward trend overtime as compared to the price of manufactured goods. Some of the explanations that have been offered for this decline include productivity differentials between countries, asymmetric market structure, and high income elasticity of demand for manufacturing goods relative to that of primary commodities. One corollary of these findings is that developing countries, to the degree that they export primary commodities and import manufactured goods, will be subject to a secular deterioration in their net barter terms of trade. The second argument is the Harberger-Laursen-Metzler (HLM) effect. This conjecture was offered by Laursen and Metzler (1950) and Harberger (1950). It proclaims that terms of trade (ToT) shock leads to greater instability of national income and aggregate savings. According to their argument, an adverse shock on ToT causes a rise in spending, a decline in savings, and a deficit in current account.

Various studies have consistently identified deterioration of ToT as a determinant of a country's macroeconomic performances. The deterioration of ToT, which is mainly due to a faster rise in import price than export price, worsens 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 consensus regarding the direction of its effect on growth. However, it is yet unclear whether volatility of ToT appears to play a role in explaining growth fluctuations. If volatility really matters for growth, then any exogenous shock that affects 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 whose target is to maintain growth.

Blattman *et al.* (2007); Jacks *et al.* (2011); and Cavalcanti *et al.* (2015) assert that the effects of terms of trade are asymmetric between primary commodity exporting countries and industrialized countries with diversified and broader export bases. They argue that volatility mattered little for the larger, diversified industrial nations, but it seems to have impacted primary commodity exporting nations adversely.

There are only a few papers on primary commodity exporting regions that try to look into the relationship between ToT volatility and growth. However, none of them convincingly tries to solve endogeneity problems, which are common in the majority of the existing literature on ToT. Some of them employ cross-country ordinary least squared (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 (growth/GDP) in almost all cases exhibits 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 into primary commodity exporting countries. It mainly investigates the effect of change in the volatility of ToT on economic growth in sub-Saharan Africa (SSA). To overcome all these problems discussed in the exiting literature, this paper uses recent dataset and employs dynamic panel data models of difference and system GMM that account for 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 trade (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[3] will become more unfavourable than ITT[4] as it does not show us whether the country would be better-off or worse-off in terms of exports as the capacity to

[3]NBTT = P_x/P_m, where P_x stands for export prices and P_m for import prices.
[4]ITT = $[P_x/P_m]Q_x$, where Q_x stands for quantity of exports

import. This 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 a 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 the 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 amount of literature that has examined 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 PS thesis, which states that the price of primary commodities has a 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), Hadass and Williamson (2003), and Cashin and McDermott (2002) have found evidence for the existence of secular deterioration. All these studies proclaim that there is a negative linear trend on commodity ToT.
Using the co-integration technique, Arize (1996) explores the effect of ToT on balance of trade and finds a significant positive long-term equilibrium relationship between ToT and trade balance. Similarly, Thirlwall (2003) added that the deterioration of ToT, which is mainly due to a faster rise in import price than export price, worsens the balance of payment at a given rate of growth. These findings have important implications for primary commodity exporting countries. The deterioration in ToT, which less developed countries are facing, leads to income and welfare losses (Prebisch, 1959). Furthermore, Kıpıcı (1996) analysed the existence of the HLM hypothesis, which states that when ToT improves, the real income level will rise and, consequently, the improvement in ToT boosts trade balance. Kıpıcı (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 inter-temporal elasticity of substitutions.

ToT volatility has been found to be a topic of recent literature. It was first spurred by the influential work of Ramey and Ramey (1995), which 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-term movements in ToT might be an important source of such volatility. According to Eichengreen (1998), both negative trends and volatility in ToT depressed export revenues and capital inflows for many developing countries.

Mendoza (1997), using the stochastic endogenous growth model, conducted an investigation on 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 is negatively affected by real exchange rate instability. Recently, Samimi *et al.* (2011) have made a closer look at 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 a negative impact of ToT volatility on growth.

Blattman *et al.* (2007) use a similar model with that ofMendoza (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 a diversified and broader export base. They argue that volatility mattered little for the larger, diversified industrial nations, but it seems to have impacted primary commodity exporting nations adversely.

Moreover, Cavalcanti *et al.* (2015) investigate the impact of the level and volatility of the commodity ToT on economic growth. Using a wider sample of 118 countries both annual data from 1970 to 2007 and five-year non-overlapping 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 countries where primary commodity is abundant contributes 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 indicates a significant positive effect of both ToT and its volatility on economic growth. Their finding for the effects of volatility contradicts with that of Mendoza (1997), Bleaney and Greenaway (2001) and Samimi *et al.* (2011), which proclaim the presence of a significant negative effect of ToT volatility on growth. Although Jawaid and Waheed (2011) claim the robustness of their initial result by performing a sensitivity analysis using different additional variables, sample sizes and various proxies of volatility variable, it would still be difficult to accept it as problems of identification and endogeneity have not yet been 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 the literature on this area is its choice of proxy for ToT. The majority of the literature on the area focuses on NBTT and not much emphasis has been given to 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 of the literature on ToT, particularly for that which examines 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 is the underlying assumption throughout such literature. However, industrialised countries that export mainly manufactured items and import primary products are not predominantly price takers in the international market. In such cases, the assumption of exogeneity of ToT made on most of the 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 in this case as SSA countries are mainly primary commodity exporters. More than 80 percent of the exports of sub-Saharan Africa are primary products, and intra-regional trade in the region is low(Keane *et al.* 2010) mainly due to the existence of non-tariff barriers (NTBs). 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 the 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"[5] of ToT is no more an issue in this case.

3. Data and Methodology

3.1 Data

To examine the effects of ToT growth and volatility on economic growth in SSA, this paper uses annual data covering the period from 1985 to 2014. The investigation covers 35 sub-Saharan African countries out of the total of 49 for which there is full data for the sample period. The data for real percapita gross domestic product, total labour force, NBTT, and ITT is taken from the United Nations Conference on Trade and Development (UNCTAD) statistics database. Additionally, the data for investment share of GDP is from Feenstra, Inklaar, and Timmer (2015), which is the latest version of the Pen World Table (PWT 9.0). Due to absence of data for investment share of GDP, the data used for

[5]This is a problem that occurs when terms of trade change helps one country and harms another.

this analysis is limited to the period up to2014. The detailed description of variables used in this paper follows.

As the prime motive of this study is to show the effect of the volatility of ToT, it is crucial to generate volatility 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 start with the following model:

$$y_{it} = \phi y_{it-1} + \beta' x_{it} + \mu_i + u_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \mathbf{(1)}$$
$$for\ i = 1,2,3,\ldots,N\ and\ t = 1,2,3,\ldots,T$$

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

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 Levin–Lin–Chu test and the Im, Pesaran and Shin (IPS) test. Both tests are based on the analysis of the equation:

$$\Delta y_{it} = \lambda_i y_{it-1} + Z'_{it}\gamma_i + u_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \mathbf{(2)}$$
$$for\ i = 1,2,3,\ldots,N\ and\ t = 1,2,3,\ldots,T$$

where:

$H_o: \lambda_i = 0\ \forall_i$

$H_A: \lambda_i < 0$ $(for$ Levin– Lin– Chu test$)$
$H_A: \lambda_i < 0\,, i = 1,2, \dots, N_1;\ \lambda_i = 0, i = N_1 + 1, N_1 + 2, \dots, N\ (for\ IPS\ test).$

The IPS test extends the Levin–Lin–Chu test framework to allow for heterogeneity in the value of $\lambda_i$under the alternative hypothesis. Under the null hypothesis, all series are non-stationary, whereas under the alternative hypothesis, a portion of the series is assumed to be stationary in the case of IPS.

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 a simple cross-sectional approach and the traditional static panel estimators like fixed effect and random effect settings are inconsistent in such cases. To overcome these problems, this paper uses the Arellano and Bond (1991) difference GMM estimator. 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 remove the country-specific characteristic μ_i as it does not vary with time. Assuming that the explanatory variables are weakly exogenous[6] but predetermined, and the error term is not serially correlated, the difference GMM estimator will have the following moment conditions:

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

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

Differenced GMM estimator may be exposed to a downward finite-sample bias (Blundell & 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, Hoeffler, & Temple, 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 takes care of the moment conditions as applying to a specific time period.

Table 1: Description of variables

S. No.	Variable	Type	Name	Description
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.
2	INV	Explanatory variable	Investment	Investment share of GDP per capita at constant 2005 U.S. dollars. It is used as a proxy for capital due to lack of data for capital stock in the region.
3	LAB	Explanatory variable	Labour force	Total labour force expressed in thousands
4	GNBTT	Explanatory variable	Growth of net barter terms of trade	Growth rate of net barter terms of trade
5	GITT	Explanatory variable	Growth of income terms of trade	Growth rate of income terms of trade
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
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
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 a smoothing parameter of 100.
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 a smoothing parameter of 100.

Since the validity of the instruments has an effect on the consistency of the GMM estimator, 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 proxies for volatility of ToT. This paper follows Basu and McLeod (1991), Blattman *et al.* (2007),Williamson (2008) and Furth (2010)to employ the Hodrick-Prescott (HP) filter to decompose ToT movements into trend and volatility.

4. Results and Discussion

4.1 Descriptive Statistics

Table 2: Summary statistics of growth and volatility of NBTT and ITT

Variable		Mean	Std. Dev.	Min	Max	Observations
Growth of	Overall	0.5389	14.26	-	101.62	N=1050
	Between		2.32	-4.06	7.46	n=35
	Within		14.07	-	94.7	T=30
Volatility of	Overall	16.99	17.72	0	111.91	N=1050
	Between		10.48	2.23	46.67	n=35
	Within		14.39	-	90.98	T=30
Growth of	Overall	7.65	35.1	-	432.58	N=1050
	Between		5.49	0.17	25.12	n=35
	Within		34.68	-	415.11	T=30
Volatility of	Overall	43.93	57.91	0.7	806.44	N=1050
	Between		27.03	8.11	141.38	n=35
	Within		51.41	-	708.99	T=30

Source: Estimation result

NBTT growth varied between -62 and 102 percent while ITT growth varied between -76 and 433percent. 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 variations in the NBTT growth, ITT growth, NBTT volatility, and ITT volatility 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.

4.2 Panel Unit Root Test

Table 3 presents the results of the Levin–Lin–Chuand IPS panel unit root tests. The optimum lag is selected using Akaike Information Criteria (AIC).

Table 3: Panel Unit Root Test

Variable	Deterministic	Levin–Lin–Chu		Im, Pesaran and Shin	
		Level	First difference	Level	First difference
Percapita GDP	Constant	2.9425	-13.8089*	4.6255	-15.9101*
	Constant + trend	-2.2721**	-15.0190*	2.0538	-16.5125*
Investment	Constant	-2.8997*	-26.9680*	-2.2523**	-26.0836*
	Constant + trend	-7.0414*	-23.6852*	-4.7110*	-23.6868*
Labour force	Constant	8.9063	-4.7815*	17.3976	-6.7297*
	Constant + trend	-6.7398*	-8.6190*	2.2773	-8.6065*
Growth of NBTT	Constant	-21.4451*	-35.3951*	-23.3977*	-37.8914*
	Constant + trend	-17.9194*	-29.2945*	-20.9178*	-34.0163*
Growth of ITT	Constant	-24.8054*	-33.8864*	-24.5374*	-35.1063*
	Constant + trend	-22.0127*	-28.5403*	-22.4899*	-31.8348*
Volatility of NBTT	Constant	-4.9623*	-16.3938*	-4.7141*	-15.5816*
	Constant + trend	-6.0310*	-14.4247*	-3.5521*	-12.8791*
Volatility of ITT	Constant	-18.0839*	-16.9352*	-11.5167*	-16.3625*
	Constant + trend	-15.9530*	-13.2355*	-9.4949*	-12.4610*

* 1% levels of significance
** 5% levels of significance
Source: Estimation result

The result shows that the null hypothesis of a panel unit root in the level of the series is rejected for all variables except for Percapita GDP and LAB. Both types of tests (with and without trend) significantly prove that the majority of the series strongly reject the null hypothesis that all series contain a unit root. Hence, there is no strong evidence that all the series are integrated of orders one.

4.3 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, the study uses NBTT and ITT interchangeably throughout this paper. The study uses variables in levels; then, the difference and system GMM estimator take the first differences in the regression. Therefore, coefficients reported hereafter belong to the first differences rather than levels of variables.

4.3.1 Net Barter Terms of Trade and Economic Growth

Table 4 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, excluding South Africa from the sample. Although South Africa is found in SSA, it is relatively industrialised and a middle-income country as compared to other sample countries. Hence, the study excluded South Africa in the second regression so as to see the difference on the result.

However, in both regressions, using all 35 countries and excluding South Africa, it is clearly observed that the coefficient for the growth of NBTT is positive and highly significant. This implies that improvements in ToT are growth-sustaining while deterioration in ToT becomes growth-retarding. As the majority of sample countries are primary commodity exporters, their ToT shows deterioration through time and this adversely affects economic growth. On the other hand, the coefficient of NBTT volatility is negative and highly significant.

Table 4: Difference GMM regression result using NBTT

Estimation Method	Differenced GMM	
Period	1985-2014	
Volatility measure	Standard Deviation of NBTT	
Dependent variable:	[1a]	[1b]
Percapita GDP	All Sample countries	Excluding South Africa
Independent Variables		
Lagged percapita GDP	0.9481*	0.9467*
	(0.0011)	(0.0011)
Investment	1.1117*	1.0337*
	(0.1066)	(0.0851)
Labour force	0.0153*	0.0085*
	(0.0005)	(0.0005)
Growth of NBTT	0.3367*	0.3486*
	(0.0067)	(0.0067)
Volatility of NBTT	-0.1786*	-0.2187*
	(0.0363)	(0.0405)
Number of countries	35	34
Specification Tests (p-values)		
Sargantest	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.

Source: Estimation result

Since differenced GMM may be subject to a large downward finite-sample bias, the study used system GMM estimator that has better finite sample properties. Table 5 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, excluding South Africa from the sample.

Table 5: System GMM regression result using NBTT

Estimation Method	**System GMM**	
Period	**1985-2014**	
Volatility measure	**Standard Deviation of NBTT**	
Dependent variable:	**[2a]**	**[2b]**
Percapita GDP	**All Sample countries**	**Excluding South Africa**
Independent Variables		
Lagged percapita GDP	0.9767*	0.9785*
	(0.0011)	(0.0016)
Investment	5.1035*	4.8957*
	(0.0898)	(0.0982)
Labour force	0.0027*	-0.0017*
	(0.0008)	(0.0003)
Growth of NBTT	0.3196*	0.2722*
	(0.0166)	(0.0276)
Volatility of NBTT	-0.5515*	-0.5067*
	(0.0399)	(0.0347)
Number of countries	35	34
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.
Source: Estimation result

In both regressions, it is observed that the coefficient for the growth of NBTT is positive and highly significant. However, the coefficient of NBTT volatility is growth-retarding and highly significant.

Although the coefficients 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 -0.5515in the case of system GMM regression. Therefore, it is evident that while an improvement of NBTT is growth-enhancing, deterioration of NBTT decelerates growth. Similarly, volatility of NBTT slows down growth for the full sample. This finding is in line with results of recent studies such as Samimi *et al.* (2011), Furth (2012), and Cavalcanti *et al.* (2012).

4.3.2 Income Terms of Trade and Economic Growth

Table 6: Difference GMM regression result using ITT

Estimation Method	**Differenced GMM**	
Period	**1985-2014**	
Volatility measure	**Standard Deviation of ITT**	
Dependent variable: Percapita GDP	**[3a] All Sample countries**	**[3b] Excluding South Africa**
Independent Variables		
Lagged percapita GDP	0.9480*	0.9457*
	(0.0012)	(0.0014)
Investment	1.1702*	1.0761*
	(0.0977)	(0.0836)
Labour force	0.0153*	0.0079*
	(0.0004)	(0.0007)
Growth of ITT	0.2671*	0.2531*
	(0.0068)	(0.0104)
Volatility of ITT	-0.0891*	-0.1179*
	(0.0085)	(0.0165)
Number of countries	35	34
Specification Tests *(p-values)*		
Sargan test	0.6235	0.6905
Serial Correlation		
First-order	0.0638	0.0503
Second-order	0.2849	0.2805

Figures presented in brackets are standard errors.

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

Source: Estimation result

Table 6 presents difference GMM regression results using ITT. The result, similar to the case of NBTT, shows that improvement in ITT is growth-sustaining while deterioration and volatility of ITT is growth-retarding.

The system GMM regression result presented in Table 4.6 also shows a 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 goes up to 0.3596 in the system GMM regression. When we see the coefficient of volatility of ITT, it has changed from -0.0891 to -0.1525. Therefore, the result confirms the importance of an underlying improvement in ITT in driving economic growth. Moreover, it is evident that deterioration in ITT and its volatility is an impediment for economic growth.

At the beginning of this paper, it was noted that there are familiar grounds for fearing that the NBTT will become more 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) used both NBTT and ITT for his empirical analysis and found 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 improvement in both NBTT and ITT has a positive and significant effect on economic growth while deterioration in both NBTT and ITT has a negative and significant effect. Even though there is similarity on the direction of the effects of growth and volatility of ToT on economic growth, there is a significant difference on the magnitude of the coefficients of ToT volatility when the study uses NBTT and ITT differently. In the difference GMM regressions, regressions [1a] and [3a], the coefficient for volatility changes by half when the study uses NBTT instead of ITT. Similarly, system GMM regression result shows that the difference in coefficients of NBTT and ITT is more than three-fold. Overall, volatility of ITT has a smaller effect on economic growth as compared to that of NBTT.

In all regressions, the control variables are statistically significant and have the expected sign except for the change in lagged percapita GDP in all regressions and for the change in labour 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.

Table 7: System GMM regression result using ITT

Estimation Method	**System GMM**	
Period	**1985-2014**	
Volatility measure	**Standard Deviation of ITT**	
Dependent variable:	**[4a]**	**[4b]**
Percapita GDP	**All Sample countries**	**Excluding South Africa**
Independent Variables		
Lagged percapita GDP	0.9745*	0.9745*
	(0.0009)	(0.0012)
Investment	5.3538*	5.1912*
	(0.0895)	(0.1189)
Labour force	0.0021*	-0.0018*
	(0.0004)	(0.0006)
Growth of ITT	0.3596*	0.3336*
	(0.0114)	(0.0100)
Volatility of ITT	-0.1525*	-0.1334*
	(0.0140)	(0.0158)
Number of countries	35	34
Specification Tests (p-values)		
Sargantest	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.

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

Source: Estimation result

4.4 Robustness Checks

The robustness of the result is checked using different dataset, by taking different proxies 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, the study followsBasu and McLeod (1991), Blattman *et al.* (2007),Williamson (2008), and Furth (2010) to employ the Hodrick-Prescott (HP) filter to decompose ToT movements into trend and volatility.

Table 8 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, the coefficient for growth of NBTT was found to be positive and statistically significant. This finding fits with the initial results from regression [1a] and [2a] in which the coefficient for the growth of NBTT is positive and significant.

The difference GMM regression result [5a] shows that volatility of NBTT has an insignificant effect. However, regression [5b] clearly shows volatility of NBTT has a 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.

Table 8: Regression result using NBTT

Estimation Method	**Difference and System GMM**	
Period	**1985-2014**	
Volatility measure	**Hodrick-Prescott (HP) filter**	
Dependent variable: Percapita GDP	**[5a] Difference GMM**	**[5b] System GMM**
Independent Variables		
Lagged percapita GDP	0.9482*	0.9766*
	(0.0004)	(0.0014)
Investment	1.1585*	5.2685*
	(0.0746)	(0.0847)
Labour force	0.0153*	0.0015*
	(0.0004)	(0.0003)
Growth of NBTT	0.3276*	0.3050*
	(0.0134)	(0.0207)
Volatility of NBTT	-0.0432	-0.3914*
	(0.0610)	(0.0708)
Number of countries	35	35
Specification Tests (p-values)		
Sargantest	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.
Source: Estimation result

Additionally, as this study did for NBTT, the robustness of the result for ITT is checked using a similar procedure. Table 9 presents difference and system GMM regression results using ITT.

Table 9 contains two regression results, i.e. regression [6a] for difference GMM and regression [6b] for system GMM. In both regression results, the coefficient for the growth of ITT was found to be positive and statistically significant. Regarding volatility of ITT, its coefficient was found to be negative and significant in regression [6b]. This finding fits with the initial results in which volatility of ITT has a negative significant effect on economic growth.

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

Table 9: Regression result using ITT

Estimation Method	**Difference and System GMM**	
Period	**1985-2014**	
Volatility measure	**Hodrick-Prescott (HP) filter**	
Dependent variable: **Percapita GDP**	**[6a]** **Difference GMM**	**[6b]** **System GMM**
Independent Variables		
Lagged percapita GDP	0.9486*	0.9745*
	(0.0009)	(0.0008)
Investment	1.1522*	5.3011*
	(0.0535)	(0.0682)
Labour force	0.0156*	0.0018*
	(0.0002)	(0.0004)
Growth of ITT	0.2624*	0.3373*
	(0.0099)	(0.0105)
Volatility of ITT	-0.0194	-0.1312*
	(0.0160)	(0.0276)
Number of countries	35	35
Specification Tests (p-values)		
Sargantest	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.
Source: Estimation result

In all regressions, the control variables are statistically significant and have the expected sign except for the change in lagged percapita GDP in all regressions. Therefore, similar to the 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 the results reported in Section 4.3.1 and 4.3.2 and provide evidence for a positive effect of an improvement in ToT and a negative effect of both deterioration and volatility of ToT on economic growth.

5. Conclusion

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

The regression result of difference and system GMM estimators shows that the growth of both NBTT and ITT has positive and significant coefficients. This implies that improvement in ToT is growth-enhancing whereas deterioration in ToT is growth-retarding. Furthermore, the result proved that volatility of NBTT and ITT has a negative and significant effect on economic growth. To make sure that the findings are not driven by the method with which volatility of ToT is measured, the study employed HP filter to measure volatility of ToT instead of using the moving window standard deviation of ToT growth rate. Finally, this result was found to be robust using the aforementioned alternative volatility measure as well.

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 affects 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

List of Countries Included in the Study

Benin	Chad	Senegal	Mali	Gambia
Botswana	Comoros	Ghana	Mauritania	South Africa
Burkina Faso	Togo	Sudan	Mauritius	Guinea-Bissau
Burundi	Congo, Rep.	Kenya	Zambia	Swaziland
Cameroon	Cote d'Ivoire	Lesotho	Niger	Congo, Dem. Rep.
Cape Verde	Ethiopia	Madagascar	Nigeria	Mozambique
Zimbabwe	Gabon	Malawi	Rwanda	Central African Republic

List of Countries Excluded from the Study

Angola	Liberia	Somalia
Djibouti	Namibia	South Sudan
Equatorial Guinea	Sao Tome and Principe	Uganda
Eritrea	Seychelles	Western Sahara
Guinea	Sierra Leone	