On trends and cyclical dynamics in the net barter terms of trade of sub-Saharan Africa's primary commodity exporters

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Abstract

This paper addresses terms of trade shocks in four commodity-exporting countries: Botswana, Cote d'Ivoire (Ivory Coast), Ghana and Zambia. We address both the short run cyclical fluctuations and the long run trends. The latter is important for importing countries with respect to the uncertainties associated with production and manufacturing. For exporting countries, it enables policy makers to cope with price risk in international markets. Using unobseved components models we showed that a shock to the terms of trade dissipate between 2 and 9 years, with the long run trend indicating the tendency for the net barter terms of trade to decline over time. In addition, we showed that the shorter the shocks to the terms of trade, and the longer the frequency of the shock, the more severe the accumulated long run loss in welfare and output. Hedging the downside risk of commodity price busts, commodity beneficiation among others are suggested as policy menus for smoothing the path of income and consumption.

Keywords: Terms of trade, sub-Saharan Africa, trends, cycles, unobserved components

JEL: C51, Q11, E32

1. Introduction

Primary commodities exhibit some stylized facts: they have grown above average over the past 60 years, and fallen much less so during the same period; slowing more with recessions, and rising faster with upturns. The short run fluctuations in primary commodity prices are noted to be demand driven, and sometimes display evidence of lagged supply response, while the long-term trend is supply driven and tend to follow advances in technology in primary, relative to manufactured industries(see Cashin and McDermott, 2002; Deaton and Laroque, 1992). The 2007/8 recession has brought renewed interest in these empirical facts of the evolution of primary commodity prices. While resource rich countries have not experienced the direct effects of the financial crisis, given their low exposure to international capital markets, adverse consequences have affected the real sectors of resource abundant economies, mainly because of their dependence on the extractive sector for generating fiscal revenues and export earnings. Commodity prices dipped at the beginning of the downturn. Oil prices decreased from $137 per barrel in July 2008 to $35 barrel by the end of that year; over the same period, copper prices fell from $4/lb to $3.1/lb. Yet the recent commodity price shocks have been relatively mild compared to previous recessions, and prices returned to 2007 levels by mid-2009. Because of the decline in commodity prices, windfall revenues also plummeted and both export volumes and earnings shrank, significantly dampening growth prospects. Countries with excessive dependence on the mineral sector faced an especially precarious situation because they had failed to diversify beyond the commodities market.

These dramatic events raise questions about the evolution of commodity prices, particularly, the long-run permanent trend, and the short-run cycles. The long-run evolution of commodity prices and their inter-relationships are important for both importing and exporting countries. For the former, it enables a more efficient planning at the production level and reduces the uncertainties that impede manufacturing activities. For the latter it enables to better cope with price risks in international markets and to limit interventions at the domestic level that may have

undesirable spill over effects. However, understanding the short run fluctuations and long run trends in the terms of trade for developing countries has been fraught with difficulties, particularly at the empirical level. Most studies, inter alia, Sproas (1980), Zanias (2005) take the view of some form of stationarity or the other of the time series properties of commodity prices, model the terms of trade for all developing countries, and find at most two structural breaks in the series. We depart from this line of research and make three main contributions to the literature.

First, estimating the change in the secular terms of trade inevitably faces serious statistical difficulties. For example, results are very sensitive to which years are taken as the beginning and end of the data series and the way the price indices of exports and imports are calculated. We propose unobserved components. We favour this model based as opposed to the model free procedures found in the literature as they capture the trend, cyclical and seasonal components of commodity prices, while at the same time treating the traditional approach as a special case. The components capture the salient features of the data that are useful in analysing and predicting the short run and long run behaviour of commodity terms of trade. Moreover, it is easy to incorporate changing patterns and to introduce additional features such as interventions.

Second, in contrast with previous studies that rely on cross-country evidence, we concentrate on individual commodity exporting countries. With cross-country studies a movement in the overall terms of trade of all developing countries does not have much relevance for individual developing nations. For example, a developing country exporting mainly beverages would have found its terms of trade rising very little between 1972 and 2001, while developing countries exporting primarily raw materials, metals and especially petroleum experienced a large increase in their terms of trade. Thus, what is important is the type of product in a nations exports and the change in the price of those products over time. We account for this by focusing on specific

commodity exporters for which movements in global demand and supply conditions would have implications for the terms of trade.

Third, we account for multiple structural breaks, an issue that has occupied researchers in the terms of trade debate but hardly settled, and hardly goes beyond two breaks in the series.

The rest of the paper is structured as follows: the next section reviews the literature on secular decline in the terms of trade and argues that whereas the theoretical paradigm put forward in the 1950s may still be valid, the empirical approach falls far short of current developments in applied econometrics. In section 3, we present unobserved components, focussing particularly on the specification and estimation. The properties of the data are discussed in section 4. We present and discuss our empirical findings in section 5.

2. Secular decline in the terms of trade: a review of the literature

Whereas a lot has been written about the behaviour of commodity markets, there are still many gaps in our knowledge concerning the short run cyclical fluctuations and long run trends. The literature on the behaviour of commodity prices, particularly, dealing with terms of trade shocks either begin and/or end with the work of Prebisch (1950) and Singer (1950). Independently developed in the late 1940s, the Prebisch-Singer Hypothesis (PSH for short) postulates that there is a secular decline in the terms of trade for primary commodities relative to manufactured goods. The driving force behind this, argued the PSH is the propensity for developing countries to export primary commodities and import manufactures, hence the productivity increases that take place in developed nations are passed onto their workers in the form of higher wages and income, while most or all of the productivity increases that take place in developing nations are reflected in lower prices. Moreover, markets for manufactured goods are noted to be imperfectly competitive compared with those for primary products, thus accounting for the wide gap

between the price of manufactured goods and their cost of production as compared with primary products.

However, the net barter terms of trade appear to be slightly outdated since the composition of global trade in recent time has raised questions about the validity of the PSH. There has been an upsurge of manufactured exports from developing Asia, while at the same time OECD countries such as Australia, New Zealand and Canada export primary products. Thus, the terms of trade for developing versus developed countries are no longer as closely related to the net barter terms of trade for primary and manufactured goods. However, the PSH is still relevant for sub-Saharan African countries that rely extensively on the export of primary commodities for their export revenues.

Tests for a secular deterioration in the terms of trade have followed two broad paths: the first group of studies involves models that assume deterministic trend and or impose stationarity on the data generation process (dgp), with most early empirical evidence favouring the position of a deterministic time trend. Spraos (1980) presents evidence of a stable declining commodity terms of trade and Sapsford (1985) collaborates this albeit with qualification on the stability of Sproas' study. Grilli and Yang (1988) found that the terms of trade between primary products and manufactures declined by about 0.6% per year over 1900-1986 periods and since 1953 when petroleum products were excluded. Reinhart and Wickham (1994) confirm these results for the 1900-1990 periods. Cashin and McDermott (2002) showed that real commodity prices deteriorated by about 1% per year over the 140 year period from 1962 to 1999. They also find evidence of rising amplitude of price fluctuations since the early 1900s and more frequent fluctuations since the early 1970s. Zanias (2005) find the price of primary commodities with respect to the price of manufactured goods dropped to nearly one-third from 1900 to 1998, but that this occurred during structural breaks (1915-1920 and 1975-1993) rather than generally over time. Santos-Paulino (2007) examined the dynamic relationship between terms of trade shocks

and the current account in selected small islands developing states. The findings show that the terms of trade explain a significant proportion of the variation in the current account balances. Also, the current account balances reflect a *J*-curve type reaction to terms of trade innovations. Real output also reacts negatively to changes in the terms of trade. Harvey et al (2010) in a recent paper employ a unique data set and new time-series techniques to re-examine the existence of trends in relative primary commodity prices. The data set comprises 25 commodities and provides a new historical perspective, spanning the seventeenth to the twenty-first centuries. New tests for the trend function, robust to the order of integration of the series, are applied to the data. Results show that eleven price series present a significant and downward trend over all or some fraction of the sample period. In the very long run, a secular, deteriorating trend is a relevant phenomenon for a significant proportion of primary commodities.

The second strand of models resort to detrending or filtering to decompose commodity series into their permanent and temporary components following a Beveridge and Nelson (1981) type decomposition based on ARIMA models and, or a Hodrick and Prescott (1980) type of filters. The BV decomposition does not, assume a priori, a deterministic trend; however, the fact that it is based on an ARIMA model is a major weakness because for such a structure it is quite frequent that more than one specification fit the same data, thus rendering the model selection somewhat arbitrary (see also Harvey, 1985). The HP filter imposes properties on the estimated cycle by construction, when in fact the properties of the cycle may be exactly what are in question. As Harvey and Jaeger (1993) argue the HP filter is only suited for US GDP, and can lead to the discovery of spurious cycles in other series. Recent extensions in Koopman and Lee (2008) focus on unobserved components with diffuse initial conditions, dropping linear additive specifications in favour of models which allow interactions between the trend cycle and the seasonal component, while Chen and Mills (2009) concentrate on business cycle applications.

3. Model set up--unobserved components

In this paper we propose structural time series models that typically consist of interpretable components such as trend, cycle, seasonal and irregular components. Each component is set up in such a way that the dynamic stochastic process depends on normally distributed disturbances. With regards to the terms of trade series, this seems to be the most plausible way of decomposing trends and cycles as opposed to the alternative analysis based on HP filter and BV decomposition. The deterministic trend is a limiting case in which the hyperparameters which allow the level and slope to change are equal to zero. This allows us to investigate the long-run and short-run dynamics of commodity prices, while modeling the observed and unobserved components associated with them. Following Harvey (1989), Harvey and Koopman (2000), the logarithm of the terms of trade index x_t can be represented with stochastic unobservable components as follows

$$x_t = \mu_t + \psi_t + \varepsilon_t \qquad t = 1, \dots, T \tag{1}$$

where μ_t is a trend component, $\psi_t$is a cycle component, and ε_t is an irregular component. We assume that the $\psi_t$is a stationary white noise process, ε_t is a white noise disturbance with variance σ^2 and the components are mutually uncorrelated. The linear trend can be written as

$$\mu_t = \mu_{t-1} + \beta_{t-1} + \eta_t \qquad t = 1, \dots, T \tag{2}$$

$$\beta_t = \beta_{t-1} + \xi_t \qquad t = 1, \dots, T \tag{3}$$

Where η_t and ξ_t are independent white noise processes with variances σ_η^2 and σ_ξ^2 respectively. The cyclical component can be modelled as

$$\begin{bmatrix}\psi_t \\ \psi_t^*\end{bmatrix} = \rho \begin{bmatrix} cos\lambda & sin\lambda \\ -sin\lambda & cos\lambda \end{bmatrix} \begin{bmatrix}\psi_{t-1} \\ \psi_{t-1}^*\end{bmatrix} + \begin{bmatrix}\omega_t \\ \omega_t^*\end{bmatrix} \dots 0 \le \lambda \le \pi, 0 \le \rho \le 1 \tag{4}$$

where ω_t and ω_t^* are uncorrelated white noise processes with variances σ_ω^2 and $\sigma_{\omega*}^2$ respectively (ψ_t^* appears by construction). Here λ can be thought of as the frequency of the cycle and ρ as a damping factor of the amplitude. Although this formulation appears rather peculiar, it allows for a great variety of processes. The cycle can be written as

$$(1 - 2\rho cos\ \lambda \mathbf{L} + \rho^2 \mathbf{L}^2)\psi_t = (1 - \rho cos\lambda \mathbf{L})\omega_t + (\rho sin\lambda \mathbf{L})\omega_t^* \qquad (5)$$

which is an ARMA (2, 1) ($\mathbf{L}$ is the lag operator). If $\sigma_\omega^2 = 0$, it reduces to an AR(2) with complex roots, whereas if either $\lambda = 0$ or $\lambda = \pi$, then the cycle is AR(1). We assume $\sigma_\omega^2 = \sigma_{\omega*}^2$.

Equations (1), (2), (4) and (5) can be cast in state space form. The parameters λ, ρ, σ_ω^2 σ_η^2 and σ^2 are estimated by maximizing the likelihood of the observed sample with respect to these parameters through the Kalman filter. A comparison of different non-tested models can be made either using the maximized likelihood function (L) or the prediction error variance (PEV), which is the steady-state variance of the one-step ahead prediction error.

Equations (1), (2), (4) and (5) also imply an ARMA representation of x_t

$$x_t = \frac{1}{\Delta^2}(\xi_{t-1} + \Delta\eta_t) + \frac{(1-\rho cos\lambda L + \rho sin\lambda L)\omega_t}{(1-\phi_1 L - \phi_2 L^2)} + \epsilon_t \qquad (6)$$

where $\Delta = (1 - \boldsymbol{L})$ is the first difference operator. Equation (5) shows that a structural time series model can be thought of as an unobserved component ARMA (2, 2, 4) with at most two unit roots. Thus, if $\sigma_\xi^2 = 0$, i.e the slope is constant, and $\sigma_\eta^2 > 0$, then x_t is stationary in first differences, whereas if $\sigma_\xi^2 = \sigma_\omega^2 = \sigma^2 = 0$ then x_t is difference stationary. Conversely, if $\sigma_\eta^2 = \sigma_\xi^2 = \sigma_\omega^2 = 0$, then x_t is trend stationary and all the variance is attributed to the irregular component. Here the trend is linear and deterministic and has a non-zero constant drift. If $\sigma_\omega^2 > 0$, x_t is still trend stationary with richer dynamics(it is an ARMA(2,2)) and all the variance is attributed to the cyclical and residual components.

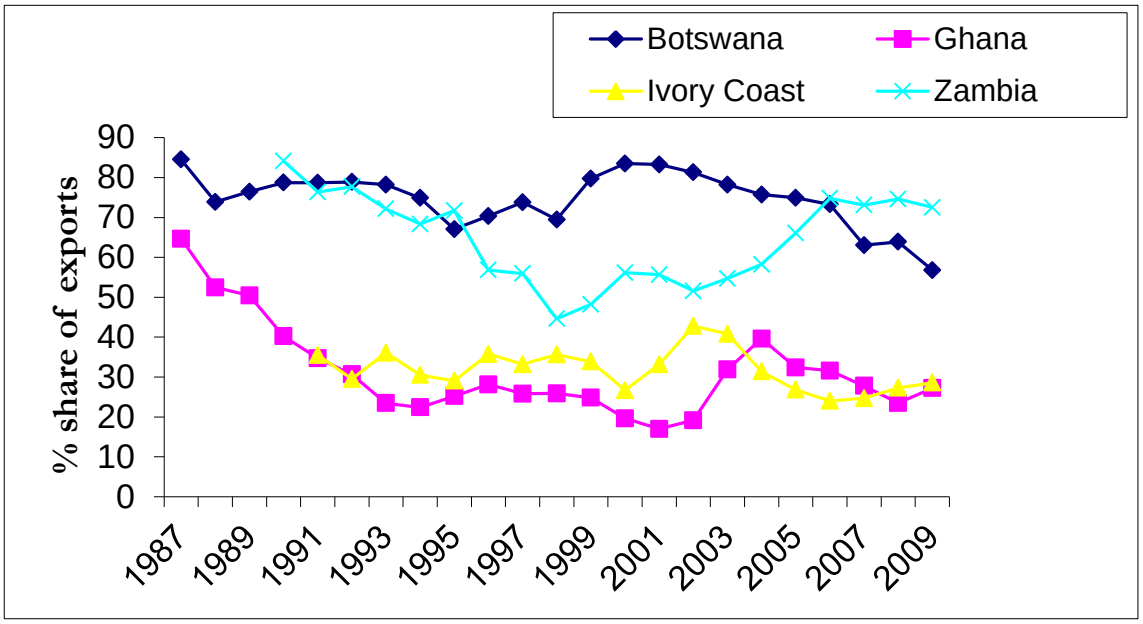
The most general model has stochastic trend, stochastic slope and a stationary ARMA cycle. Among the restricted versions of the basic structural model are the deterministic trend model with constant slope and the stochastic trend model with AR (1) cycle. In the former restrictions are $\sigma_\eta^2 = \sigma_\xi^2 = 0$ while in the latter $\lambda = 0$ or $\lambda = \pi$

4. The data set

The data employed is the terms of trade index for four countries: Ghana, Botswana, Zambia and Cote d'Ivoire (Ivory Coast). The terms of trade index is constructed as the average of the ratio of export prices to import prices. Export and import price indices are in turn deflated with each country's GDP to make the analysis consistent, and to capture changes in both the prices and the composition of each country's external trade. The source of the data is the Economist Intelligence Unit (EIU) terms of trade index, and ranges from 1987 to 2009 for the sampled countries. We chose the sample in such a way that the country involved exports goods that are of global importance and that the leading export commodity carries a big weight in the country's overall economic activity, i.e. in terms of contributing to employment, government revenues and foreign exchange earnings. This qualification is important in the present context since movements in the terms of trade would have huge implications for the country involved. To shed more light on this issue we plot the share of the dominant commodity in the export basket of each country in Figure 1, where Botswana depends largely on diamonds, Zambia is noted for copper exports, Ghana and Cote d'Ivoire are the world's leading exporters of cocoa.

The diamond industry has been Botswana's economic backbone since independence in 1966. Botswana supplies 25% of the world's diamonds and the industry has contributed to the country achieving record breaking economic growth rates over sustained periods to become the best performing, and best managed economy in sub-Saharan Africa.

Figure 1: Share of Main Exports



As Figure 1 indicates, although the share of diamonds in total exports is declining, down from about 85% in the late 1980s to about 60% in 2009, the economy remains highly dependent on the diamond industry and government efforts to diversify have not yet successfully lessened this dependence. Africa's contribution to world copper supply is led by Zambia, accounting for about 2% of global supply. Although minimal by global standards, copper is Zambia's sole export, implying that its economic pulse is directly linked to the world's economic fortune; thus, when global economic activity was buoyant and commodity prices strong in the 1960s, and the most recent period before the 2007 recession, Zambia's economy soared. As the cycle turned and the global economy began to sink to the trough of the business cycle, it dragged Zambia's economy with it. West Africa supplies over 50% of world cocoa, led by Cote d'Ivoire (37%) and Ghana (21%). Ghana's economic performance of recent years has largely been driven by investment in and the performances of the gold and cocoa industries. The evidence from Figure 1 shows that all countries are making effort to diversify away from dependence on a single export, with varying degrees of success. Cote d'Ivoire currently exports more non-cocoa based products such as fuels and semi-processed goods.

Apart from the fact that the countries in our sample are dependent on a single commodity for export earnings employment and government revenues, all countries are net importers of crude oil and fixed capital and intermediate goods. Thus, volatility in international commodity markets creates serious problems for these country's terms of trade.

5. Shocks to the terms of trade

In this section, we present results based on the unobserved model specified in section 3. We adopt a stochastic component approach for the trend and cycle. The faster the level and slope change, the more past observations are discounted. The deterministic trend is a limiting case. We put our model in state space form. The underlying processes that govern the unobserved state vector and variance parameters along with the loading matrices, the damping factor and the frequency of the cycle are jointly estimated by maximum likelihood using the Kalman filter technique. The computations are implemented using the STAMP package of Koopman et al (2007). We discuss the results for the terms of trade series below, where the linear unobserved components with trend and cycle components together with the usual white noise disturbance are presented in Table 1.

5.1. Short run fluctuations

The net barter terms of trade are a key indicator of macroeconomic performance and are highly correlated with output fluctuations. Disruptions to the terms of trade have implications for government revenues, and typically the response of policy makers to smooth income and consumption would depend on how large and how long the shocks are. We fit 3 cycles in the terms of trade series to pick out the short run cyclical fluctuations. The results are shown in Table 1.

Table 1: Cycles parameters

Parameter	Botswana	Ghana	Cote d'Ivoire	Zambia
σ_{ε}^2	0.01142	0.0498	0.00041	0.000032
σ_{ξ}^2	0.00222	0.0011	0.00044	0.00039
σ_{η}^2	3.7×10^{-6}	0.0001	0.00059	0.0154
σ_{ω}^2	0.00018	5.23×10^{-6}	9.26×10^{-5}	5.91×10^{-9}
$2\pi/\lambda$	2.1	7.7	5.1	9.2
λ	3.03	0.81	1.23	0.682
ρ	0.96	1.00	0.98	1.00
Amplitude	0.034	0.2	0.033	0.205

Notes: The parameters σ_{ω}^2 , σ_{η}^2 and σ_{ξ}^2 are the variance of the cycle, trend and slope respectively. $2\pi/\lambda$ is the number of years it takes the cycle to dissipate and λ is the frequency of the cycle while ρ is the damping factor, measuring the extent of persistence of the cycle.

As shown in Table 1 the cyclical variance are $\sigma_{\omega}^2 = 0.0114$ and $\sigma_{\omega}^2 = 0.05$ for Botswana and Ghana respectively. The variance for Cote d'Ivoire and Zambia are very small, implying that the slope and the trend component absorb most of the underlying dynamics of the series in both countries. The disturbances of the trend appear very small for Ghana $\sigma_{\eta=}^2\ 3.7\times10^{-6}$, and so it is for the other countries in Table 1. Not only is a single cycle enough to account for the observed fluctuations in the terms of trade series, but also the underlying data generating mechanism suggests that such a model fits the data well.

The lower panel of Table 1 gives more information on the short run fluctuations in the terms of trade. The number of years it takes for a shock to the terms of trade to dissipate ranges from 2 years in Botswana to 9 years for Zambia. The parameter $2\pi/\lambda$ shows that terms of trade shocks

in Cote d'Ivoire tend to follow a traditional business cycle, lasting approximately 5 years, whilst it takes almost 8 years for Ghana.

The frequency of the fluctuations is also very important as it indicates how often policy makers may respond to the short run fluctuations in the terms of trade. The evidence presented in Table 1 indicates that the longer the cycle, the shorter the frequency. This is true for Zambia whose cyclical frequency is only 0.7, compared to Botswana, where the shortest cycle of 2 years has a frequency of 3.03. Given that Africa's raw materials are consumed in advanced countries, there is no gain saying that cyclical fluctuations in commodity terms of trade might mimic macroeconomic cycles, and short run shocks are likely to be driven by booms and busts in global consumption. This allows us to ask whether sub-Saharan African countries experiencing downturns in the international prices of their commodity exports were subsequently more likely to see declines in economic prospects. Using indicators such as the government's budget balance as a percentage of GDP and GDP growth at purchasing power parity for the four countries under consideration we can see that in Figures 2 and 3, since the 1980s, GDP growth tended to decline with recessions and the budget gap widens in such periods.

Figure 2: GDP at PPP

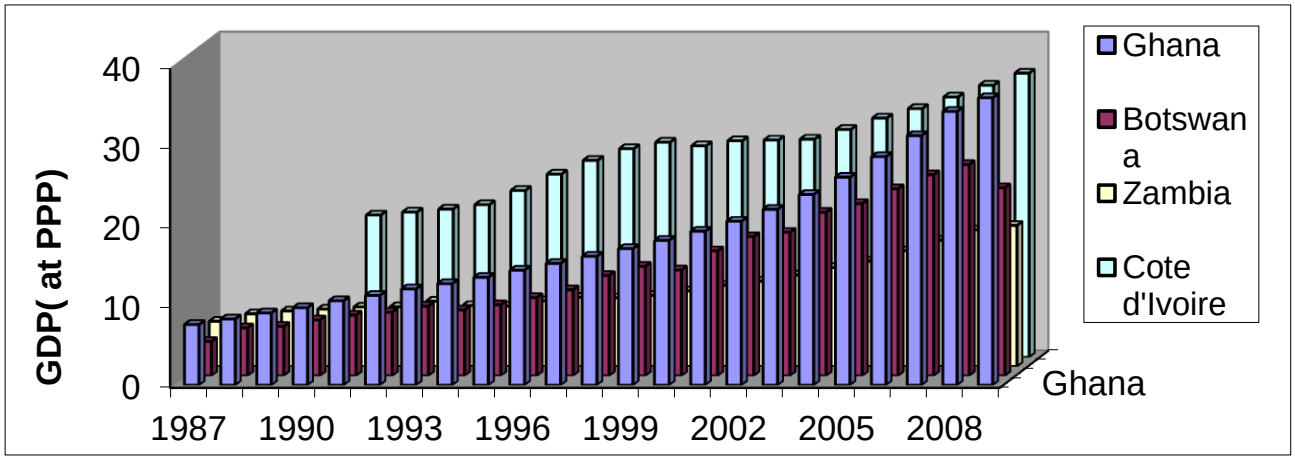
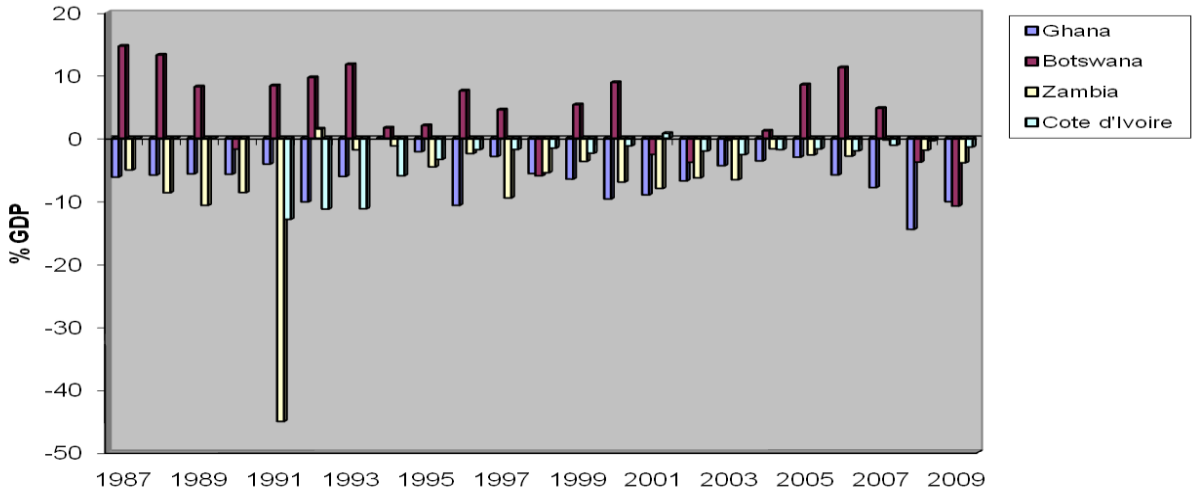


Figure 3: Budget balance(%GDP)



Other studies such as Brückner and Ciccone(2010) find that downturns in international commodity prices did make civil war onset more likely, and that this result is robust to accounting for cross-country differences in the probability of civil war; for country-specific time trends; and for common shocks to the likelihood of civil war across sub-Saharan Africa. For example, between 1981 and 2006, a 20% drop in a country's export price indices raised the probability of civil war outbreak by around 2.8 percentage points. To put this into perspective, the "background" probability of a civil war outbreak in sub-Saharan Africa over the 1981-2006 periods was about 2.8 %, and the probability of a drop in the export price index larger than 20% to about 10%. Hence, there was approximately a 10% chance of a drop in export prices that increased the probability of a civil war by 100% of the background probability.

5.2. The long run trend

Next, we address a topical issue in terms of trade shocks, which has dodged empirical analysis in the commodity price literature thus far. The long run evolution of the terms of trade of a country is as important as the short run fluctuations, as knowing this enables importing countries to cope with uncertainties associated with production and manufacturing, while helping

exporters to cope with price risk in international markets in the light of the appropriate domestic interventions. Numerous studies, *inter alia,* Cuddington and Urzua (1989), Powell (1991), Deaton and Laroque (1992) present conflicting results concerning the time series properties of commodity prices. Apart from the finding that real commodity prices exhibit a high degree of persistence and autocorrelation, there is little agreement whether commodity prices are stationary or are characterized by structural breaks. This surprising gap in the literature is attributed to the conventional weaknesses in the techniques employed. In contrast to previous research, we account for multiple structural breaks (the literature so far has examined two breaks; see Kellard and Wohar, 2006 and Zanias, 2005). From the outset, we introduce interventions to take account of outlying observations and structural breaks. The data irregularities may arise from a specific event, such as oil price shocks in the case of an outlier or a change in policy such as the signing of new international commodity agreements in the case of structural breaks. Failure to account for breaks and shifts in the series would result in poor fit and unreliable estimates. Table 2 shows the results.

Table 2: Interventions

Ghana	RMSE	Prob	**Cote d'Ivoire**	RMSE	Prob	**Zambia**	RMSE	Prob
Level break 1990	-1.292	-5.295*** [0.000]	Level break 1994	0.624	12.14*** [0.000]	Level break 1990	-0.579	-3.555*** [0.002]
Outlier 1993	-0.464	-2.894*** [0.009]	Outlier 2002	0.212	6.058*** [0.001]			
			Outlier 2000	-0.170	-4.845*** [0.000]			

Note: figure in [ ] are p-value. RMSE is the root mean square. *** indicates significance at the 1% level.

We introduce an impulse intervention, which takes the value of one at a particular time of the outlier and zero elsewhere. A break in the level of the series results in a shift up or down and is modelled as a step intervention variable, which are zero before the event and one thereafter. In line with our expectation, the terms of trade series is beset with outliers and breaks. For instance, there is a level break for Ghana in 1990, leading to a drop in the terms of trade by 1.3%. An outlier is picked up in 1993 resulting in another drop in the terms of trade, albeit lesser than the

1990 break. Interestingly these breaks are associated with significant changes in the Ghanaian economy, with the 1990 break associated with wide movements in cocoa prices and the 1993 outlier associated with the transition to democracy where the country experienced various shocks to economic activity. Two outliers are prominent in Cote d'Ivoire, 2002 and 2000, with the former more associated with the disruptions to cocoa production following the political upheavals. Finally, a level break is identified in 1990 and 1994 for Zambia and Cote d'Ivoire respectively.

Table 3 shows the diagnostics for all our estimations and the comparison of various non-nested models based on the predictive error variance. The diagnostic tests based on the one-step ahead prediction errors $f_t^{-1/2}v_t$,normality statistic and serial correlations test shows that the goodness of fit is fine. The lower end of Table 3 is the growth rate of the trend. To get a clearer picture of the evolution of the terms of trade series we plot the trend in Figure 4, where the red line depicts the long run trend with accompanying standard errors.

Table 3: Evolution of terms of trade shocks

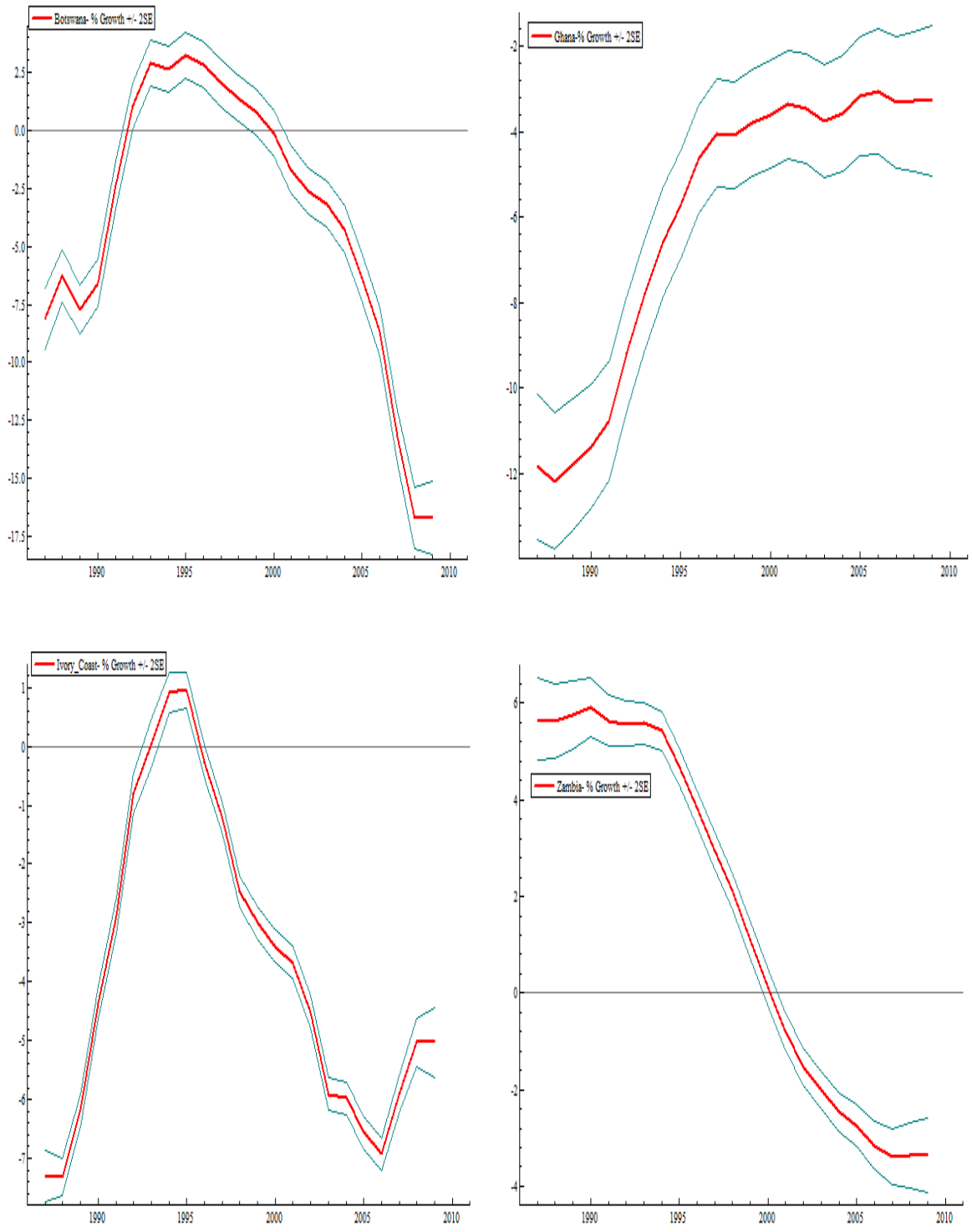
	Botswana	Ghana	Cote d'Ivoire	Zambia
LogL	39.18	24.57	48.24	32.02
$N(\chi^2_2)$	3.155	0.393	1.305	3.639
$H_7(F_{7,7})$	0.513	0.322	0.822	0.285
DW	1.31	1.55	1.984	2.117
$Q_8(\chi^2_5)$	2.911[0.405]	8.589[0.000]	3.3763[0.337]	5.3926[0.145]
R^2	0.122	0.768	0.917	0.671
PEV	0.0204	0.0474	0.0027	0.0237
trend (%growth)	-16.7	-3.278	-5.031	-3.3642

Note: Figure in [ ] are p-values. **N** is a normality statistic based on the third and fourth moments, $\mathbf{H_m}$ a heteroscedasticity statistic based on the ratio of the sample for the first one third of the prediction errors, $\mathbf{Q_l}$ is the Box-Ljung serial correlation statistic up to 12 lags

As shown in Figure 4 the long run evolution of the terms trade behave differently for different countries with different export composition. For copper exporting Zambia, the evidence from Figure 5 indicates that after the collapse of copper prices in the early 1980s with subsequent recession and rise in poverty, the country's terms of trade improved when for most of the 1990s when copper prices returns to their 1960 levels. However, there are indications that the mid 2000s also saw poor performance of copper prices with attendant effect on the terms of trade. Ghana's terms of trade deteriorated throughout the sample, worsening more in the most recent period. The evidence for Cote d'Ivoire and Botswana shows deterioration, recovery and subsequent deterioration. The outlook of the terms of trade for all countries during the period under consideration is summarised in the lower panel of Table 3, where over all, the terms of trade had declined between 3% for Ghana and 16% for Botswana. These results also indicated

that the shorter the shocks to the terms of trade, and the longer the frequency of the shock, the more severe the accumulated long run loss in terms of welfare and output.

Figure 4: long run trend



This is important not least because policies required to deal with the permanent component are patently different from those that focus on the temporary component. False reading of trends, or even inability to uncover structural breaks might engineer unwarranted policies that could further compound the problems associated with commodity price fluctuations.

6. Concluding Remarks

This paper examined both the short run cyclical fluctuations and the long run trends in the net barter terms of trade of four leading commodity exporting countries in sub-Saharan Africa—Botswana, Cote d'Ivoire, Ghana, and Zambia. The net barter terms of trade are a key indicator of macroeconomic performance and are highly correlated with output fluctuations. Whether it is Zambia's copper booms and crash (1964-80); or Cote d'Ivoire's cocoa shocks in the early 2000s—disruptions to revenues and investment would warrant domestic policy response. We showed that the period for a shock to the terms of trade to dissipate ranges from 2 years in Botswana and 9 years for Zambia. We also showed that over all, the terms of trade had declined between 3% for Ghana and 16% for Botswana. These results indicated that the shorter the shocks to the terms of trade, and the longer the frequency of the shock, the more severe the accumulated long run loss in output and welfare.

The existence and persistence of these cycles thus raises important policy questions about the stabilization and consumption and income of both producing and consuming nations alike, given that these short-run fluctuations may produce hysteresis type effect with attendant consequences such as hastening recessions or even making them more severe. The role of stabilization funds, agricultural boards and international commodity agreements as intervention measures for the cyclical fluctuations in agricultural produce have been discussed in Reinhart and Wickham (1994). For mineral exporters such as Zambia and Botswana these cyclical patterns suggest a strategy to smooth the path of income and consumption over the commodity cycle as a way of

sustaining the mining industry. In particular, processing a significant proportion of metals domestically for export may reduce dependence on external markets, while at the same time managing export receipts to serve as a buffer in stormy times may well smooth the unfavourable swings in incomes and revenues that results from terms of trade shocks. Moreover, the timing of investments in new projects could be designed to take advantage of the cyclical upturns and thus improve project profitability. Our results also point to the possibility of hedging the downside risk of shocks which tend to occur anywhere between 2 to 9 years. For countries such as Cote d'Ivoire and Ghana that rely on cocoa exports, commodity beneficiation may be useful. In theory, controlling world supply could even prove a much viable policy in the long run. However, evidence shows that while international commodity agreements may have worked for cartels such as OPEC, such agreements in the past for coffee and cocoa have not been successful in controlling output and hence world market prices. We therefore argue that commodity cartels may be neither necessary nor sufficient for a successful raw material based economy. In its place, a more radical policy that commodity exporting countries could adopt is the creation and broadening of existing regional trading blocs. To date, Africa's contribution to global trade is less than 1%, while inter regional trade in sub-Saharan Africa lags far behind the EU and Asean. Thus strong regional trade could generate the necessary critical mass for Africa's exports while reducing vulnerability. This in itself is a function of a host of policy reforms, including but not limited to harmonizing trade and economic policies, eliminating currency conversion bottlenecks and inefficient infrastructure and dismantling bureaucracy and corruption at the borders. Importantly too, sub-Saharan African countries could do better by lessening the adverse impact of trade shocks by properly managing export receipts during good times. This is not least trivial since a sound diversification policy rests on how sound the receipts from past exports are disposed off. This in turn requires strong political and economic institutions that would curtail waste and wanton dissipation of scarce resources. Finally, it is perhaps fair to argue

that strong investment in commodity producing infrastructure is key to sustaining Africa's comparative advantage in this sector.

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