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**Article**

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## ECONOMIC METHODOLOGY, PHILOSOPHY & HISTORY | RESEARCH ARTICLE

# External debt and current account adjustments: The role of trade openness

Oyakhilome Wallace Ibhagui<sup>1\*</sup>

**Abstract:** In this paper, we examine the various links among external debt, trade openness and current account in Sub-Saharan Africa, utilizing an approach that highlights current account from the perspective of saving and investment. We explore whether external debt aids the subsequent adjustment process of current account deficits in SSA. We also examine the role of openness in the adjustment process. Empirical analysis using large panel data samples of Sub-Saharan African countries between 1985 and 2013 shows that external debt mostly sets the tone for the subsequent adjustment of current account deficits in SSA. However, the current account deficits of countries with high openness expand significantly from increases in external debt. The results are robust to different time periods and econometric estimation techniques, the inclusion of other current account determinants as control variables and consideration of endogeneity.

**Subjects:** Statistics & Probability; Economics; Finance

**Keywords:** external debt; trade openness; current account balance; endogeneity

**JEL classifications:** F30; F32; F40

### ABOUT THE AUTHORS

Oyakhilome Wallace Ibhagui am rounding off the correction of my PhD thesis at the University of Kent where I registered as a student in the fall of 2014. I am a student member of the macroeconomic research group of the School of Economics, University of Kent. My research activities involve doing empirical and theoretical research in international finance and financial economics. In international finance, I look at exchange rate, capital flows and their impact on African economies. In financial economics, I analyse the drivers of different asset classes such as equities and fixed income and the interrelationships of global financial markets.

The research reported in this paper relates to providing a view on the ongoing debate regarding whether Africa countries should expand their external debt levels, the effect on the adjustments in current account and the role of trade openness in the adjustment process. The contribution of this research is primarily to provide an empirical-based perspective to the African countries that are looking to become more or less open to international trade and the global economy.

### PUBLIC INTEREST STATEMENT

In the last few decades, current account, defined as the record of a nation's transactions with other countries has attracted considerable interest. This paper investigates the relationship among external debt, trade openness and current account in Sub-Saharan Africa. Specifically, this study examines the role external debt and openness plays in the adjustment process and behaviour of current account deficits in SSA.

To address these issues, the study employed large panel data samples of SSA countries between 1985 and 2013. The empirical analysis utilized fixed effects, generalized methods of moments, pooled mean group and dynamic fixed effects models.

Several findings emerge from our analysis. First, it is shown that external debt plays a significant role in the behaviour and adjustment process of current account deficits. Second, for countries with high degree of openness, current account deficits expand considerably from increases in external debt. The use of different econometric estimation techniques, time periods and the inclusion of other control variables did not invalidate these results.

## 1. Introduction

The past decades were marked by efforts to arrive at an understanding of the macroeconomic factors that determine current account balances, both in developed and developing countries. Arriving at this understanding is crucial because it provides a clear idea of helpful strategies for effective policy-making. Over time, several potential current account determinants have been studied in the literature in a bid to uncover the specific macroeconomic variables that determine the behaviour of current account. A number of theoretical models on the behaviour of current account have thus resulted from these studies (see Buiters, 1981; Glick & Rogoff, 1995; Sachs, 1981). However, majority of the models provide predictions of current account determinants which, when tested, yield inconsistent magnitude and direction of the relationships that current account bears with the identified determinants, Calderon, Chong, and Loayza (1999). This inconsistency in the theoretical models forced researchers to gravitate towards empirical analysis for definitive answers.

The earliest empirical studies on current account determinants focused more on developed economies and much less on the developing economies of Africa, Asia and South America due to data constraints. Moreover, until recently, previous empirical studies mainly emphasized the analysis of the responses of current account balances to shocks in a specific macroeconomic determinant. This emphasis can be seen in several studies that deals with terms of trade shocks or fiscal policy shocks on current account balances using econometric techniques as in Marquez and McNeilly (1988), Rose and Yellen (1989) and Marquez (1990). The problem has also been studied in the context of real business cycle (RBC) models for both developed and developing countries as in Backus et al. (1994), Mendoza (1995) and Senhadji (1998). Also, the problem has been evaluated with impulse-response functions using dynamic stochastic general equilibrium (DSGE) models as in Leiderman and Razin (1991) and Frenkel, Razin, and Yuen (1996) and with techniques such as VAR and panel data analysis as in Glick and Rogoff (1995). Despite the significant contributions made by these studies to the existing current account literature, comprehensive cross-country empirical studies on current account determinants are still limited. Even where available, results often conflict and diverge. Furthermore, studies on current account adjustments and the factors that accelerate these adjustments are still relatively scarce. In addition to the limited literature on the drivers of current account in SSA, we believe research on current account adjustments in SSA is pressingly required and worth doing because the state of current account is a major indicator used to gauge the health, external position and future behaviour of SSA economies; it aids the decision-making process of policy-makers and partly forms the basis of the outlook and sovereign ratings ascribed to SSA countries.

In a bid to empirically ascertain current account determinants, Debelle and Faruquee (1996) use a panel of 21 industrial countries over 1971–1993 and an expanded cross-sectional data-set that includes 34 industrial and developing countries to explain long-run variations and short-run dynamics of current account. They find that relative income, government debt and demographic factors play a significant role on the long-run variation of current account in the cross section, whereas reverse is the case for fiscal surplus, terms of trade and capital controls. Their investigation of the short-run effects further revealed that real exchange rate, business cycle and terms of trade are significant short-run determinants of current account. Calderon et al. (1999) provide a generalized characterization of the empirical linkages between current account deficits and an expanded set of macroeconomic variables for a panel of 44 developing countries over the period 1966–1995. Their main findings are that current account deficits in developing countries are persistent, albeit moderately. However, their results for the effects of external debt on current account are not robust and do not yield a statistically significant coefficient in the cross-country analysis. This highlights the divide on the effects of external debt on current account balances.

Chinn and Prasad (2003) adopt a structural approach, which includes the roles of the fundamental macroeconomic determinants of savings and investment to investigate the medium-term determinants of current account using data samples for 18 industrial and 71 developing countries covering the period 1971–1995. They find that the initial stock of net foreign assets and government budget balances each has positive effects on current account balances. Shortly after the ASEAN financial

crises of 1997, the current account surpluses in affected Asian countries have grown in leaps and bounds, largely as a war chest to prevent the situation that triggered the crisis from reoccurring and as a hedge or safety-net against sudden reversals. Chinn and Ito (2007, 2008) provide an empirical explanation for the surge in current account surpluses in some Asian countries, mainly from deficits in 1997 to surpluses in subsequent years. They propose that standard current account determinants as in Chinn and Prasad (2003) cannot explain the surge in current account surpluses. Given this, they introduce indicators of financial development and legal environment likely to affect savings, investment and economic growth. Their results show that the interaction of legal environment with financial development plays a significant role in explaining capital outflows from Asia. Thus, their results suggest that lack of investment opportunities, rather than excess savings is responsible for the surge in current account surpluses in Asia, following the 1997 ASEAN financial crises and this leads them to reject the savings glut hypothesis.

Calderon, Chong, and Zanforlin (2007) analyse the behaviour of current account deficits in developing countries. With respect to African countries, they find that there is not much persistence in current account deficits as is the case in the full sample of developing countries. However, their results show that external debt does not have a significant impact on current account deficits. This again, nicely summarizes the problem that exists in the literature: whereas some studies provide a strong basis for expecting external debt to impact current account deficits significantly, others show that the empirical evidence is fragile, to say the least. This ambiguous effect of external debt on current account is one of the areas explored in this paper and forms part of the motivation for this research.

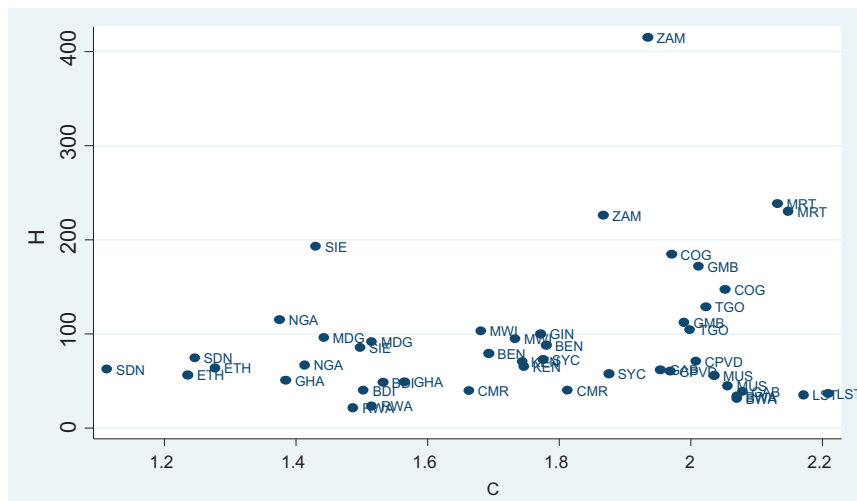
Although the highlighted previous studies have looked at the determinants of current account balances, none of them investigated or analysed the adjustments of current account balances in Sub-Saharan Africa. While it may seem natural to argue that high external debt shrinks surpluses and worsens current account deficits, a country's capacity to understand its current account adjustment process and curtail the unfavourable impact of external debt on its current account might be enhanced or limited by its degree of openness. In an effort to examine the effects of external debt on current account adjustment in Sub-Saharan Africa, our research takes its cue from a lack of theoretical foundation to justify if, why and how external debt is involved in current account adjustment and also the little or no emphasis on the role openness plays in the adjustment process. In particular, we reproduce Bulut (2011) theoretical model that provides some guidance on how external debt functions in the current account adjustment process; we also emphasize how high openness to trade, despite its economic benefits might hinder the current account adjustment tendencies of external debt. The preceding arguments illustrate the role of openness in unlocking the current account adjustment properties of external debt. Despite this role of openness, the literature on current account adjustment appears to have ignored its indirect importance altogether.

Figure 1 which shows data on external debt and trade openness provides some motivation for our view on openness. The aims of Figure 1 is to show that openness and external debt can be related so that relationships involving external debt could be plausibly altered or enhanced by openness. We use external debt as a share of GDP alongside a standard measure of openness, as used in the literature for the period 1985–2013. As the scatter plot in Figure 1 suggests, there is a positive relationship between the two variables. However, it is also apparent that a wide variation exists in both variables given their interaction with one another. Indeed, if the extent of openness plays an important role in influencing the effects of external debt on current account in SSA, one can expect countries with the same levels of external debt but different degree of openness to in fact have very different outcomes in terms of the adjustments of their current account balances.

Our empirical analysis of current account adjustments is based on the saving–investment approach. In this paper, we argue that external debt is a significant reason why high capital mobility has not influenced current account in recent years. Our position is that previously high external debt is responsible for the narrowing of current account imbalances in sub-Saharan Africa. External debt

**Figure 1. External Debt and Openness (1985–2013).**

Note: Countries in this plot are the 30 SSA countries for which data are available. They constitute the data samples whose summary statistics are presented in Tables 2a and 2b. In accordance with the literature, openness enters into the model in logs. H denotes External Debt while C denotes openness. A more detailed graphical illustration of each variable is provided in Appendix 1.



results in current account adjustments and increases correlation between savings and investment because high external debt forces SSA countries to look inwards and prune down the accumulation of further debt to finance domestic investments, and instead rely increasingly on domestic savings to finance domestic investment leading investment to depend on, and hence correlate with domestic savings. We thus show theoretically and empirically that external debt has a role to play in the behaviour and adjustments of current account in SSA. In the empirical analysis, a negative coefficient on external debt in current account regressions implies that external debt reduces current account imbalances in SSA either via a reduction in investment or an increased dependence of investment on domestic savings. This narrows the saving–investment gap, reduces the current account deficits and gradually results in current account adjustments.

Our approach, which follows Bulut (2011), suggests that running high current account deficits increases the effective interest rate for countries, thus, SSA countries with high external debt face a positive spread over world real interest rate making it cost-ineffective for heavily indebted SSA countries reputed for low credit rating to run consistent current account deficits due to high costs associated with the accumulated debt to finance the deficits. We argue that the high costs lead to a decline in external debt accumulation which either slows down investment or increases correlation between investment and saving, resulting in a decline in current account deficits and causing current account deficits to gradually adjust upwards from the negative terrain towards the origin. This adjustment comes with a decrease in the persistence of current account deficits as foreign investors reduce their inflows for fear of debt default. However, the persistence begins to rise again as soon as considerable adjustments have been achieved and favourable domestic conditions—lower debt levels following perhaps deleveraging or debt forgiveness and better growth prospects—prompt foreign investors to view SSA markets as less risky, more attractive or less prone to a default. This leads to an increase in foreign inflows making it possible for SSA countries to finance deficits, fund new investments and thus run benign and expansive current account deficits.

In our theoretical framework, our approach assumes a small open economy and that SSA countries can borrow externally to fund shortfalls in total income. Finances available to the representative agent thus come from total income generated from domestic goods and services and external debt. Furthermore, we assume that external debt, in addition to the usual interest costs, incurs transaction-related convex adjustment costs. The representative agent uses the external debt and total income to cover all expenses—interest and non-interest costs, including consumption and investment related costs. In this regard, our work differs from existing research which provides no theoretical motivation on current account determinants in Sub-Saharan Africa.

Summarily, in this paper, we tackle two main problems. First, we investigate one implication of our theoretical model which predicts that external debt adjusts current account deficits in SSA. Second, we examine whether the external debt of more open SSA countries significantly reverses the current account adjustment process. To do this, we interact openness with external debt and study the impact of the resulting variable on current account adjustments. In specifying our empirical model, we draw on current account determinants implied in our theoretical model and we also follow Calderon et al. (1999, 2002), Bulut (2011) and to some extent, Chinn and Prasad (2003). This ensures our regressions include a comprehensive, but not exhaustive list of control variables identified in the literature as current account determinants.

Our major results are in two fold. First, we find that external debt mostly plays an important role in the adjustment process of current account deficits in Sub-Saharan Africa. Second, openness to trade, despite its benefits, reverses results significantly. In particular, countries with high openness experience current account deficit expansions following a rise in external debt. We find that this result holds true for different time periods and after controlling for other current account determinants and also after addressing concerns regarding joint endogeneity of explanatory variables and after using different techniques of estimation inclusive of fixed effects, generalized methods of moments, pooled mean group and dynamic fixed effects models.

The rest of the paper is organized as follows—theoretical background that introduces the convex costs of external debt into the incomplete small open economy models are provided in Section 2; data samples are defined in Section 3; empirical results are presented and discussed in Section 4 while Section 5 presents the conclusion.

## 2. The model

The model presented in this section fully follows Bulut (2011). Although we utilize this model as a guidance for understanding and interpreting our results, our objective in this paper is not to test the implications or predictions of the variables in the model or any other model for that matter as no existing single theoretical model can capture the entire range of variables and relationships that constitute our focus in this paper. Instead, we are primarily more keen on providing an empirical characterization of the current account adjustment process in SSA which could set the stage for building more structured and testable models of current account adjustments to aid subsequent theoretical, empirical and policy related work. Consider an incomplete small open economy (SOE) that produces goods and has a representative infinitely-lived household that consumes goods according to established preferences represented by a utility function  $U(C_t)$  defined on consumption  $C_t$ . The economy generates income  $Y_t$  from domestic production and finances consumption  $C_t$  and investment  $I_t$  with no government intervention in the decision-making. Suppose the economy can borrow with minimal restrictions via issuing bonds in the global financial markets. The economy has an external debt stock or issued bonds outstanding whose cumulative value at current time  $t$  is  $B_t$ . The non-time varying interest on the outstanding debt is  $r$ , so that the interest cost of servicing the debt becomes  $rB_t$ . In instances, where the income  $Y_t$  does not fully finance all of consumption  $C_t$ , investment  $I_t$ , and interest cost  $rB_t$  on outstanding debt, the economy approaches the global market and issues bonds which raise the value of its external debt stock to  $B_{t+1}$  by the start of the next period. Suppose, in addition, the economy now attracts a convex external debt holding cost  $\left(\frac{\omega}{2}\right)B_{t+1}^2$  on its external debt which is interpreted as the cost of holding external debt or convex external debt holding cost, where  $\omega > 0$  shows credit worthiness effects and represents external debt holding cost parameter, then the total expenditure the economy incurs is the sum of expenditures on consumption, investment, interest on debt and convex cost. This is given by

$$\phi = C_t + I_t + rB_t + \left(\frac{\omega}{2}\right)B_{t+1}^2 \quad (1.1)$$

If income  $Y_t$  generated from production fully covers all costs, then  $Y_t \geq C_t + I_t + rB_t + \left(\frac{\omega}{2}\right)B_{t+1}^2$  and we are done. However, in our case, there is need to borrow because the income generated does not cover the costs in full, so  $Y_t < \phi$  or  $\phi = Y_t + \delta$ , for some  $\delta > 0$ , where  $\delta$  is the additional cost not

covered by  $Y_t$ . We argue that  $\delta$  is financed by the flow of debt which increases the external stock from  $B_t$  to  $B_{t+1}$ . Thus,  $\delta$  must equal  $B_{t+1} - B_t$ , and the intertemporal budget constraint of the representative agent who borrows internationally becomes

$$\delta = B_{t+1} - B_t = \phi - Y_t = C_t + I_t + rB_t + \left(\frac{\omega}{2}\right)B_{t+1}^2 - Y_t \quad (1.2)$$

where  $C_t + I_t + rB_t + \left(\frac{\omega}{2}\right)B_{t+1}^2 - Y_t > 0$

The infinitely-lived household receives utility from consumption  $C_t$ . The lifetime utility function is expressed as

$$\sum_{t=0}^{\infty} \beta^t U(C_t), \quad 0 < \beta < 1 \quad (1.3)$$

The intertemporal maximization problem of the infinitely-lived household is to choose a consumption path that maximizes lifetime expected utility. Thus, the household solves

$$\max_{C_t} E_0 \sum_{t=0}^{\infty} \beta^t U(C_t), \quad 0 < \beta < 1$$

$$\text{s.t } C_t = B_{t+1} + Y_t - I_t - (1+r)B_t - \left(\frac{\omega}{2}\right)B_{t+1}^2 \quad (1.4)$$

Following Bulut (2011), we assume there is an aggregate production function  $F$  that represents constant returns to scale technology  $F(AK_t) = AF(K_t)$  with the standard capital accumulation  $K_t$ , is homogenous to degree one, with given labour and total factor productivity  $A > 0$  parameters and zero depreciation  $\delta = 0$  of capital stock. Thus,

$$Y_t = AF(K_t), \quad K_{t+1} = K_t + (1 - \delta)I_t \quad (1.5)$$

Under this assumption, the intertemporal maximization problem for  $0 < \beta < 1$  becomes

$$\max_{C_t} E_0 \sum_{t=0}^{\infty} \beta^t U\left(AF(K_t) + B_{t+1} - K_{t+1} + K_t - (1+r)B_t - \left(\frac{\omega}{2}\right)B_{t+1}^2\right) \quad (1.6)$$

Now suppose the infinitely-lived household continues to derive utility from consumption  $C_t$  but now experiences disutility from the given labour  $L$  supplied within the economy. To introduce openness into the model, we take a cue from Lane and Milesi-Ferretti (2004) and assume the lifetime objective function of the infinitely-lived household, which is to be maximized, is modelled as

$$E_0 \sum_{t=0}^{\infty} \beta^t \left[ \frac{\sigma}{\sigma-1} C_t^{\frac{\sigma-1}{\sigma}} - \frac{\vartheta}{1+\varphi} L_t^{1+\varphi} \right], \quad 0 < \beta < 1 \text{ and } \sigma, \vartheta, \varphi > 0 \quad (1.7)$$

and that the aggregate consumption index  $C_t$  is a composite of traded  $C_{Tt}$  and nontraded  $C_{Nt}$  goods, defined as

$$C_t = \left[ \mu^{\frac{1}{\rho}} C_{Tt}^{\frac{\rho-1}{\rho}} + (1-\mu)^{\frac{1}{\rho}} C_{Nt}^{\frac{\rho-1}{\rho}} \right]^{\frac{\rho}{\rho-1}}, \quad \rho > 0 \quad (1.8)$$

where  $\rho$  measures the constant elasticity of substitution between traded ( $C_{Tt}$ ) and nontraded ( $C_{Nt}$ ) goods, and  $\mu$  is the share of tradable goods in the domestic consumption basket, labour is mainly supplied to the nontraded sector,  $\sigma$  is the constant relative risk aversion parameter and  $\beta$  is the household's discount factor. All parameters are positive and the last term in Equation (1.8) captures the disutility, in terms of reduced leisure of supplying labour. Specifically, the last term is the disutility of work effort, where  $\varphi > 0$  represents the inverse of the Frisch elasticity of labour supply with

respect to real wage. Meanwhile, the price index corresponding to the consumption index is the consumption price index  $P_t$  given by

$$P_t = \left[ \mu + (1 - \mu)P_{Nt}^{1-\rho} \right]^{\frac{1}{1-\rho}}, \quad (1.9)$$

where  $P_{Nt}$  is the price of nontradable goods.

From (1.8) and (1.9), the demand for traded and nontraded goods as a function of the consumption index is given by

$$C_{Tt} = \mu \left( \frac{1}{P_t} \right)^{-\rho} C_t, \quad C_{Nt} = (1 - \mu) \left( \frac{P_{Nt}}{P_t} \right)^{-\rho} C_t, \quad (2.0)$$

### 2.1. Optimality conditions under the assumptions of no economic uncertainty

To simplify the model and obtain tractable optimality conditions, we first assume the economy faces no uncertainty, which makes for a deterministic case. Then we obtain the optimality conditions under this assumption. To achieve this, we derive the capital, bond and consumption Euler equations associated with the optimization problem using the value function approach which relies on Bellman dynamic optimization.

#### Capital-Euler Equation

The Bellman equation, or value function, associated with the optimization problem in (1.3)–(1.6) can be written as

$$V(K_t, B_t) = \max_{\{B_{t+1}, K_{t+1}\}} \{U(C_t) + \beta \mathbb{E}_t[V(K_{t+1}, B_{t+1})]\} \quad (2.1)$$

Under the assumption of no uncertainty in the economy, we have

$$\begin{cases} U'(C_t) = \beta(AF'(K_{t+1}) + 1)U'(C_{t+1}) \\ U'(C_{t-1}) = \beta(AF'(K_t) + 1)U'(C_t) \end{cases} \quad (2.2)$$

#### Bond-Euler Equation

Differentiating the right and left hand side of the value function with respect to  $B_{t+1}$  and  $B_t$  respectively gives the bond equation and envelope condition as

$$(1 - \omega B_{t+1})(AF'(K_{t+1}) + 1)U'(C_{t+1}) + \mathbb{E}_t \left[ \frac{\partial V(K_{t+1}, B_{t+1})}{\partial B_{t+1}} \right] = 0 \quad (2.3)$$

$$\frac{\partial V(K_{t+1}, B_{t+1})}{\partial B_{t+1}} = -(1 + r)U'(C_{t+1}) \quad (2.4)$$

Plugging the envelope condition into the bond equation yields the Bond-Euler equation

$$AF'(K_{t+1}) + 1 = \frac{(1 + r)\mathbb{E}_t[U'(C_{t+1})]}{(1 - \omega B_{t+1})U'(C_{t+1})} \quad (2.5)$$

We assume the economy has a perfect foresight, so variables are deterministic. This implies  $\mathbb{E}_t[U'(C_{t+1})] = U'(C_{t+1})$ . Thus, the Bond-Euler equation, in the current period, becomes

$$AF'(K_t) + 1 = \frac{(1 + r)}{(1 - \omega B_t)}$$



and

$$\frac{\partial AF'(K_t)}{\partial B_t} = \frac{\omega(1+r)}{(1-\omega B_t)^2} > 0, \omega > 0 \quad (2.6)$$

In the Bond-Euler equation,  $AF'(K_t)$  represents the marginal productivity of domestic physical capital which essentially equates effective domestic interest rate. When external holding cost  $\omega$  is zero, so that decisions on household investment and holdings of domestic physical capital is dictated by the exogenous world interest rate, then we have that  $AF'(K_t) + 1 = 1 + r$  or  $AF'(K_t) = r$  which refers to the standard steady state. In this case, the effective domestic real interest rate equates the prevailing world real interest rate. Thus, Equation (2.6) implies that, with non-zero external holding cost, the economy deviates from steady state, and externally indebted SSA countries face an effective interest rate higher than the prevailing world real interest rate. As countries increase external debt, the value of the external convex cost  $\omega B_t$  increases and so  $1 - \omega B_t$  shrinks. For a given level of world interest rate  $r$ , this increases the domestic effective interest rate  $AF'(K_t)$ , and raises the overall cost of capital. Thus, the domestic effective interest rate increases as countries become increasingly indebted externally and incur non-zero convex costs of external debt, since  $\frac{\partial AF'(K_t)}{\partial B_t} > 0$ .

As effective interest rate increases, it becomes more and more expensive to service external debt and this decreases the demand for external debt. A decrease in demand for external debt, *ceteris paribus*, reduces investment and consumption incentives. For a given level of output, the decline in consumption increases savings. Together with a reduction in investment, the increase in savings adjusts current account deficits upwards, towards the origin, from the negative domain, thereby narrowing the current account deficits and achieving some degree of balance or adjustment. The empirical analysis tests the implications of the predictions of this model.

From (2.2) and (2.6), we have

$$\begin{cases} (1 - \omega B_{t+1})U'(C_t) = \beta(1+r)U'(C_{t+1}) \\ (1 - \omega B_t)U'(C_{t-1}) = \beta(1+r)U'(C_t) \end{cases} \quad (2.7)$$

which represents how the introduction of external convex holding costs alters the relationship between current and future marginal utility of consumption.

For convenience, and as a first pass, we follow the literature and assume, without recourse to the two sectors of the economy, a logarithmic utility function  $U(C_t) = \ln C_t$ , i.e. limit of (2.7) as  $\sigma \rightarrow 1$ , and a constant discount factor,  $\beta(1+r) = 1$ , so that the representative agent maximizes a logarithmic utility function and the desire to borrow and lend in the steady state is ruled out. Thus, in the case where variables are deterministic, the Euler equation in (2.7) becomes

$$\frac{C_t}{C_{t-1}} = \frac{\beta(1+r)}{(1-\omega B_t)}$$

and

$$\Delta C_t = \omega B_t \quad (2.8)$$

where  $\Delta C_t = \ln C_t - \ln C_{t-1}$ ,  $\ln \beta(1+r) = 0$  and  $\ln(1 - \omega B_t) = -\omega B_t$  for  $0 < (1 - \omega B_t) \leq 1$ .

Equation (2.8) generates some sort of consumption tilting effect for externally indebted SSA countries. It predicts consumption growth increases intertemporally when external debt increases.

The optimality conditions characterizing our theoretical model are summarized below as

$$\left\{ \begin{array}{l} U'(C_t) = \beta(AF'(K_{t+1}) + 1)U'(C_t) \\ (1 - \omega B_{t+1})U'(C_t) = \beta(1 + r)U'(C_{t+1}) \\ AF'(K_t) + 1 = \frac{(1+r)}{(1-\omega B_t)} \\ C_t = \omega B_t \end{array} \right. \quad (2.9)$$

Our model provides theoretical arguments which demonstrate how external debt influences saving and investment decisions. Our final note on the above theoretical formulation is that if external debt influences investment and saving, and current account is the difference between saving and investment, then external debt should affect current account. In particular, we expect external debt to bear some relationships with current account adjustments in SSA. In the same way, other known determinants of saving and investment decisions besides external debt, though not captured in the model, should also impact current account. These determinants come from the empirical literature.

Finally, combining (2.0), (2.2) and (2.5) which incorporates the two sectors of economy, gives

$$\left\{ \begin{array}{l} \frac{C_{Tt+1}}{C_{Tt}} = \frac{1}{(1-\omega B_{t+1})^\sigma} \left( \frac{P_t}{P_{t+1}} \right)^{\sigma-\rho} \\ \frac{C_{Nt}}{C_{Tt}} = \frac{(1-\mu)}{\mu} (P_{Nt})^{-\rho} \end{array} \right. \quad (3.0)$$

The first equation in (3.0) is the dynamic evolution of consumption under perfect foresight and convex cost in a 2-sector economy. It suggests that consumption of traded goods grows at a rate proportional not only to relative aggregate prices but also to the adjustment cost. In particular, if aggregate price level is currently below its future value, this induces increases in present consumption of traded goods relative to future consumption due to lower consumption-based real interest rate. However, the new intuition our model provides is that increases in present or future consumption of traded goods can be dampened when agents face a high adjustment cost in the period. The second equation in (3.0) links consumption of traded and nontraded goods to the relative price of nontraded goods and the intratemporal elasticity of substitution. Suppose the relative price of nontraded goods is constant or normalized to unity. Equation (3.0) suggests that (1) the relative consumption of traded goods would increase the greater the value of  $\mu$ , as  $\frac{\partial C_{Tt}}{\partial \mu} = \frac{C_{Nt}}{(1-\mu)^2} > 0$ , where  $\mu$  represents the size of the traded goods sector, and (2) the relative consumption of nontraded goods decreases as the size of the traded goods sector increases and increases as the size of the traded goods sector reduces, since  $\frac{\partial C_{Nt}}{\partial \mu} = -\frac{C_{Tt}}{\mu^2} < 0$ . Following, Lane and Milesi-Ferretti (2004), the relative size of the traded goods sector  $\mu$  captures, to a considerable extent, a country's openness to trade, so that a high  $\mu$  implies high openness and vice versa. We note, from the preceding argument, that consumption of traded goods is increasing in openness. Since Lane and Milesi-Ferretti (2004) model assumes there is no domestic consumption of export goods in the small open economy, it follows that domestic consumption is attributed to either nontraded goods or traded import goods. Therefore, from the foregoing, an increase in the size of the traded goods sector  $\mu$ , which is an increase in openness, expands import goods which then widen current account deficits especially when households have access to external debt to finance imports. This is the intuition behind introducing openness into the empirical model. We empirically test this prediction using SSA data.

## 2.2. Consumption, investment and external debt holding cost

Here, we briefly present the implication of a non-zero external debt holding cost on consumption and investment decisions. From Equation (1.5), we see that consumption growth responds to external debt holding when the cost of external debt holding is different from zero. Thus, even though we have ruled out consumption tilting motive via the assumption  $\beta(1 + r) = 1$ , external debt holding cost nonetheless generates a form of consumption tilting effects in which countries with huge external debt liability positions, relative to external debt asset, as it the case with SSA, tilt consumption downward perhaps to be more able to lessen the debt burden in subsequently. For domestic investment decisions, the implications of a convex holding cost of external debt contrast sharply from

those in a frictionless market where there is no holding cost. We have argued above that in the case of a frictionless market where external debt holding cost is absent, investment behaviour is decided based on the exogenous world interest rate since it equates the marginal product of domestic capital. Thus, investment in domestic physical capital yields  $AF'(K_t) + 1 = 1 + r$ , where  $AF'(K_t) + 1$  is the gross real return on domestic physical capital.

With friction, however, and letting the marginal productivity of domestic capital equal the real domestic interest rate, i.e.  $AF'(K_t) = r^*$ , the gross real return on domestic physical capital becomes, from Equation (2.3),  $(r^* + 1) = \frac{(1+r)}{(1-\omega B_t)}$ , which shows that the actual real return on the domestic physical capital is dependent on not only the exogenous world real interest rate but also on the external debt holding costs. For SSA countries known to be mostly debt burdened, with net external debt that is highly positive and almost equivalent to external debt liabilities,  $B_t > 0$  and  $\frac{1}{(1-\omega B_t)} > 1$ , so that  $(r^* + 1) = \frac{(1+r)}{(1-\omega B_t)} > (1 + r)$  and  $r^* > r$ . For these indebted SSA countries, external debt holding cost further raises the real domestic interest rate above previous levels with no external holding cost. This in turn increases the cost of capital, weakens domestic investment in physical capital and ultimately raises the marginal product of domestic physical capital. Thus, the model predicts that external debt should weaken investment and tilt consumption downwards in debtor countries.

### 3. Data and empirical strategy

#### 3.1. Data

Data samples were obtained from three major sources—The World Bank (2015), International Financial Statistics of the International Monetary Fund and Davas (2012) database of real effective exchange rates. External debt data samples come entirely from the World Bank Database. In our specification, it enters the empirical analysis as a fraction of GDP. We would like to emphasize that the choice of countries is based on the availability of data. We use gross external debt as a proxy for net external debt in the empirical estimations because, for most SSA countries, external asset holding is negligible. No claim is made that this holds true for all countries as, for instance, the situation is likely different in Asia where countries hold significant amounts of external assets which are often the same size as or larger than external debt liabilities. Given the non-availability of data samples for real effective exchange rate (REER) from the World Bank and International Monetary Fund for our list of Sub-Saharan African countries, we turn to estimates provided in Davas (2012). These estimates are good because where actual REER data are available from the World Bank, they match the estimates contained in Davas (2012) almost perfectly. Meanwhile, current account data are taken mostly from the World Bank and International Monetary Fund databases.

To capture openness, we use the ratio of the sum of exports plus imports to total output (GDP) as is customary in the open economy macroeconomics literature. The samples, as well as those of other current account determinants which we have used as control variables in this empirical analysis, come entirely from the World Bank Database. There are 30 SSA countries in the sample. A much detailed description of the data-set is included in Appendices 2 and 3.

#### 3.2. Empirical strategy

Our empirical strategy follows the investment-saving approach which defines current account balance as the gap between saving and investment. Based on this definition, it allows determinants of saving and investment to explain adjustments in current account balance towards the origin. As earlier motivated, our focus in this paper is to obtain empirical evidence on the role of external debt in the adjustment of current account in SSA. Although we try to highlight other determinants of current account in SSA, we must state that our aim is not to extrapolate all possible factors that alter current account adjustments in SSA. No single empirical or theoretical work can achieve this as there are a plethora of variables directly or indirectly impacting current account. Our attention instead focuses on how external debt determines current account adjustment in SSA.

Following available literature on current account determinants in developing countries, we estimate regression equations to uncover the relationships between external debt position and current account as well as the relationships between current account and its other determinants in the case of Sub-Saharan Africa. The other current account determinants are taken as control variables—our focus is on the effects of external debt on the adjustment process of current account deficits in SSA countries. As motivated in the theoretical part, when convex external debt holding costs are introduced, external debt positions create an effective interest rate which alters investment and saving decisions. Thus, the expected relationship, at least based on theoretical motivations, is that an increase in external debt raises the effective interest rate when there are convex external debt holding costs and this decreases the appetite for external debt, which in turn decreases domestic investment and consumption. The decrease in consumption improves national savings and, alongside the decline in investment, narrows the current account deficit, pushing it towards the origin. Therefore, we expect a negative relationship between current account and external debt positions in SSA.

Drawing from the theoretical analysis, we see that external debt position and real interest rate are determinants of saving and investment so, they should impact current account. The other determinants of savings and investment, and hence current account, have no theoretical backing in our model and are drawn from the empirical literature. We do not claim they represent an exhaustive list of current account determinants in SSA. In our specification, these variables include openness, productivity growth, age dependency, relative income, government consumption, openness, real effective exchange rate and international aid flow.

There are three sets of data samples. The first, second and third data sets include 30 SSA countries for the periods 1985–2013, 1990–2013 and 1985–2008, respectively. The second and third data sets are equal numbered because it is our intention to have two periods of equal length capturing important economic events in SSA. The year 1990 is chosen as the initial year of the third data-set (Sample 3) because it was roughly around this time, allowing for a lead or lag of two years, that many of the SSA countries in our samples either significantly reduced trade barriers and thus adopted trade liberalization or, for some of the countries, completely eliminated barriers to trade and embraced free trade agreements. (See IMF Sub-Saharan Africa Regional Economic Outlook, 2004 and Kassim, 2013). All of these have important consequences on the openness of these countries. Meanwhile, the year 2008 is associated with the global economic meltdown and remains an important year for the global economy.

Table 1 presents descriptive statistics for external debt, current account balance and trade openness for the periods under consideration. There is considerable variation in the share of external debt in GDP across countries, ranging from 2 to 518% in each of the three periods. The current account variables also range extensively, mostly within the negative (deficits) territory, from –6.003% to 0.632% in the period 1985–2013 and 1990–2013 and from –5.434 to 0.632% in the period 1985–2008. The openness variables also range extensively across time, from 10.748 to 217.305% in the period 1985–2013, 10.748 to 209.891% in the period 1985–2008, and from 1.031 to 217.305% in the period 1990 – 2013. Finally, economic growth in SSA has been rapid, ranging from –50.248 to 35.224% in each of all the three periods.

### **3.3 External debt and current account adjustment**

The purposes of our empirical analysis are to test for the relevance of external debt in the adjustment of current account deficits in Sub-Saharan Africa and examine the trade openness channel through which external debt impacts the adjustment process of current account deficits in sub-Saharan Africa. Following leads from our theoretical model, and three influential papers—Bulut (2011), Chinn and Prasad (2003) and Calderon et al. (1999, 2002), we derive an empirical specification based on the assumption that external debt has either present or lagged impact or both on current account balances. Further, to ensure comparability, we include as controls a number of current account determinants common to these influential papers. As a starting exercise, we look at the direct

**Table 1. Descriptive statistics**

	Mean	Standard deviation	Minimum	Maximum
<i>Sample 1: (1985–2013)</i>				
CA/GDP	-0.110	0.490	-6.003	0.632
ED/GDP	81.927	70.362	2.000	581.207
Openness	67.023	1.715	10.748	217.305
Relative income	0.000	4.942	0.000	0.035
Growth	3.929	5.468	-50.248	35.224
<i>Sample 2: (1985–2008)</i>				
CA/GDP	-0.087	0.421	-5.434	0.632
ED/GDP	95.799	83.138	2.000	581.207
Openness	63.096	1.727	10.748	209.891
Relative income	0.000	4.696	0.000	0.022
Growth	3.836	5.809	-50.248	35.224
<i>Sample 3: (1990–2013)</i>				
CA/GDP	-0.122	0.522	-6.004	0.632
ED/GDP	83.977	80.171	2.000	581.207
Openness	68.783	1.676	1.031	217.305
Relative income	0.000	4.777	0.000	0.035
Growth	3.983	5.514	-50.248	35.224

effect of contemporaneous and lagged external debt (*ED*) on current account (*CA*) and estimate the following equation:

$$CA_{it} = \alpha_i + \beta_1 ED_{it} + \beta_2 ED_{it-1} + \beta_3 CONTROLS + \varepsilon \tag{3.1}$$

To select our control variables, we follow both existing theoretical and empirical literatures as no single theoretical model can capture the entire range of relationships between current account and its determinants. Tables 2a and 2b presents results based on regressions for the three samples that we have (the larger sample is for the period 1985–2013 and the smaller samples are for the periods 1985–2008 and 1990–2013). Columns (1) (2) and (3) of Tables 2a and 2b show results for a selection of control variables that include relative income, real effective exchange rate, openness, domestic economic growth, international aid flows, government consumption, terms of trade, age dependency and world real interest rate. Table 2a presents the random effects (RE) results while Table 2b presents the fixed effects (FE) results. The Hausman test in Table 2b indicates that the null hypothesis of random effects is rejected, so fixed effects estimation technique gives the appropriate estimation of the regression.

Although not the focus of this paper, one interesting result that is significant on all fronts based on the regression in (3.1) is the relative income level of SSA countries. Following the established procedure in the literature, our proxy for relative income level, which captures relative stages of development, is the log of the ratio of real domestic output of a country to US real domestic output being the largest in the world. As in the literature, this ratio is expressed in logs to smooth-out any non-linear effects. As the three columns of Table 2b show, we do find a negative and significant effect of relative income on current account deficits for all time periods considered. The negative and significant effect shows that the stages of development hypothesis holds in SSA. That is, SSA countries whose income levels are farther from more developed countries tend to run large current account deficits. However, the size of the current account deficits decreases progressively as countries develop in relation to the most developed economy in the world. According to this hypothesis, SSA countries run current account deficits because their limited savings cannot cover investment requirements,

**Table 2a. Current account balance and external debt—random effects (RE) estimator**

	(1)	(2)	(3)
Period	1985–2013	1985–2008	1990–2013
Observations	748	632	629
ED/GDP	0.0002 (0.38)	0.0000 (0.03)	0.0004 (0.55)
L.ED/GDP	-0.00003 (0.06)	0.0004 (0.005)	-0.0003 (0.38)
Relative Income	0.0148 (0.24)	0.0460 (0.70)	0.0543 (0.83)
REER	-0.2961** (2.50)	-0.2727** (2.10)	-0.4457*** (2.81)
Openness	-0.2927*** (2.60)	-0.255** (2.10)	-0.3775*** (2.81)
Domestic growth	0.0021 (0.87)	0.001 (0.27)	0.006* (1.66)
Int. aid flows	-0.38384*** (3.29)	-0.4125*** (3.31)	-0.4144*** (2.67)
Terms of trade	-0.0629 (0.54)	0.01972 (0.15)	-0.1255 (0.87)
Government consumption	0.01576** (2.08)	0.0046 (1.32)	0.0059* (1.66)
Age dependency	-0.01302 (0.72)	-0.00798 (0.41)	-0.00051 (0.03)
World real interest rate	0.01576** (2.08)	0.0122 (1.33)	0.01539* (1.80)
R <sup>2</sup>	0.1715	0.1918	0.1672
F-stat (p-value)	0.0006	0.0007	0.0007

Notes: All regressions have a constant term; t-values are in parentheses and estimation is by random effects method but fixed effects method is shown to be the appropriate method, as in the Hausman test in 2b. Dropping the lagged external debt does not change the coefficient of contemporaneous external debt.

\*Indicate both statistical significance at 10% significance level and  $p < 0.1$ .

\*\*Indicate both statistical significance at 5% significance level and  $p < 0.05$ .

\*\*\*Indicate both statistical significance at 1% significance level and  $p < 0.01$ .

but as they develop, they amass increased savings, so they decrease external financing. This then frees up large amounts of resources to be devoted towards paying back previously accumulated external debt.

Another important result suggested in this preliminary analysis is that the coefficient of government expenditure is positive and significant in all time periods considered. This suggests that higher government expenditure leads to significant deterioration in current account deficits of SSA countries. This result is consistent with Yi (1993) who showed that higher government purchases played a role in the deterioration of the US trade balance and hence current account during the 1970s and 1980s.

Meanwhile, there is no consistently significant evidence of the impact of other control variables on current account deficits in SSA in each of the sample periods. This is at variance with existing studies and could be due to the fact that we employed vastly different time periods from what is available

**Table 2b. Current account balance and external debt—Fixed effects (FE) estimator**

	(1)	(2)	(3)
Period	1985–2013	1985–2008	1990–2013
Observations	748	632	629
ED/GDP	–0.001 (0.99)	–0.001** (2.03)	–0.001 (1.16)
L.ED/GDP	0.0000 (0.01)	0.0003 (0.64)	–0.0001 (0.16)
Relative Income	–0.259** (2.38)	–0.425*** (2.96)	–0.318** (2.34)
REER	–0.238* (1.93)	–0.276* (1.96)	–0.323* (1.93)
Openness	–0.272** (2.11)	–0.275* (1.91)	–0.356** (2.15)
Domestic growth	0.002 (1.00)	0.003 (1.11)	0.002 (0.80)
Int. aid flows	–0.227* (1.78)	–0.169 (1.19)	–0.057 (0.33)
Terms of trade	–0.019 (0.16)	0.077 (0.54)	–0.074 (0.47)
Government consumption	0.008** (2.52)	0.009** (2.23)	0.01** (2.60)
Age dependency	–0.012 (0.05)	0.017 (0.47)	0.0186 (0.54)
World real interest rate		0.006 0.361	0.005 (0.58)
R <sup>2</sup>	0.015	0.056	0.046
F-stat [p-value]	0.0006	0.0081	0.0028
Hausman [p-value]	0.0043	0.0010	0.0011

Notes: All regressions have a constant term; t-values are in parentheses and estimation is by random effects method but fixed effects method is shown to be the appropriate method, as in the Hausman test in 2b. Dropping the lagged external debt does not change the coefficient of contemporaneous external debt.

\*Indicate both statistical significance at 10% significance level and  $p < 0.1$ .

\*\*Indicate both statistical significance at 5% significance level and  $p < 0.05$ .

\*\*\*Indicate both statistical significance at 1% significance level and  $p < 0.001$ .

in the literature that studies the impact of macroeconomic determinants on current account balances. It could also be because our preliminary estimation uses fixed effects techniques and does not factor in potential joint endogeneity of control variables, whereas available studies in existing literature do.

More importantly, however, we shall restrict our analysis to the crux of this paper—our main focus in this paper is to analyse how external debt results in current account adjustments and the trade openness channel through which these adjustments occur. A look at the results presented in Table 2b shows that external debt adjusts current account deficits in all periods for the sample of countries, but this outcome is significant for the sample period 1985–2008, at the 5% level. In column (3), we slightly alter the time period to 1990–2013 and retain our expanded set of control variables. In all cases, the external debt share is not significant in the lagged form.

Bulut (2011) argues that the final effect of high debt on current account balance takes time, such as one period before, to be realized. This informs why we have included the lagged value of external debt in our regression. According to our regression, we find no such significance of lagged external debt on current account. Instead, we find that the contemporaneous impact of external debt on current account deficits completely captures all the external debt effects, given that the coefficient of lagged external debt is not only small and economically meaningless but is also insignificant. We next look at the openness channel through which external debt adjusts current account deficits. The regressions in Table 3 examine the adjustment properties of external debt on current account balance through the trade openness channel. We interact external debt with openness and use the resulting variable as a regressor to test for the significance of trade openness in the current account adjustment process associated with external debt. To ensure the interactive term between external debt and openness does not proxy for either external debt or trade openness, both variables were included in the regression independently. Thus, we perform the following regression:

$$CA_{it} = \begin{cases} \delta_i + \vartheta_1 ED_{it} + \vartheta_2 ED_{it-1} + \vartheta_3 (ED_{it} \times TO_{it}) \\ + \\ \vartheta_5 TO_{it} + \vartheta_5 CONTROLS + \varepsilon_{it} \end{cases} \quad (3.2)$$

As shown in Table 3, the Hausman test continues to signify that fixed effects technique is the more appropriate estimation for the regression. This yields an interactive term that turns out positive and significant in all columns and for all time periods for results obtained via fixed effects and reported in columns (1F), (2F) and (3F). Each regression uses a slightly different time period and hence, data samples differ slightly in observation from one regression to another. Column (1F)/(1R) uses the full sample, i.e., 1980–2013, column (2F)/(2R) uses partial samples, i.e. 1985–2008, while column (3F)/(3R) uses partial samples spanning 1990–2013.

Our main result in this section is that the interactive term is significant at the 5% level for the entire range of time periods and control variables used. External debt is now conditionally significant in all time periods, albeit at varying levels of significance, and continues to adjust current account deficits in SSA. The significance of the interactive term may in part be due to its capturing an indirect burden of external debt on current account balance in Sub-Saharan Africa—external debt could trigger current account adjustments, but the adjustment process could be impaired in the presence of high openness, leading instead to a widening of current account deficits in Sub-Saharan Africa. Interestingly, the coefficient of external debt displays considerable variation in its level of significance even within the same sample of countries and control variables as the time period changes—clearly supporting our decision for looking at a range of different time periods rather than just one time period.

Table 2b also reports (a) the joint significance test of openness with the interaction term and (b) the joint significance test of external debt with the interaction term. For all of the time periods considered, the tests confirm the importance of trade openness and external debt as well as the control variables. In particular, the hypothesis that the coefficient of external debt and the interaction term is zero is rejected, further supporting the finding that external debt is an important factor in the adjustment process and, in the presence of high openness, the adjustment of current account deficits could well be reversed. Also, the hypothesis that the coefficient of openness and the interaction term is zero is rejected. Both rejections are at the 5% level. The rejections would appear to be stronger for the period 1985–2008 given that the coefficients of the interactive terms in these regressions also report the highest t-statistics compared with the counterparts in the other columns. In all of these, the interaction between external debt and openness remains robust.



**Table 3. Current account balance and external debt: The role of trade openness: fixed effects (F) and random effects (R)**

	(1)F	(2)F	(3)F	(1)R	(2)R	(3)R
Period	1985–2013	1985–2008	1990–2013	1985–2013	1985–2008	1990–2013
Observations	741	635	628	741	635	628
ED/GDP	-0.007* (1.73)	-0.0060** (2.25)	-0.0081* (1.78)	-0.0065 (1.60)	-0.0432* (1.76)	-0.008* (1.75)
ED/GDP × Openness	0.00446** (2.04)	0.0365** (2.47)	0.00506** (2.06)	0.0045** (2.04)	0.0319** (2.30)	0.0548** (2.19)
L.ED/GDP	0.004 (1.06)	-0.0020 (0.51)	0.0053 (-1.19)	0.0045 (1.12)	-0.00366 (0.91)	0.005864 (1.31)
L.ED/GDP × Openness	-0.0022	0.0011 (0.52)	-0.0028 (1.20)	-0.0024 (1.12)	.0021341 (1.00)	-0.0032 (1.35)
Rel. income	-0.241** (2.09)	-0.4394*** (2.95)	-0.3412** (2.39)	0.0422 (0.74)	0.0482 (0.80)	0.0705 (1.20)
REER	-0.2842** (2.09)	-0.3120** (2.25)	-0.3800** (2.29)	-0.327** (2.72)	-0.3051** (2.35)	-0.4836*** (3.12)
Openness	-0.4991** (2.59)	-0.7044*** (3.18)	-0.5856** (2.44)	-0.4834*** (2.89)	-0.5694*** (3.03)	-0.5701*** (2.92)
Domestic growth	-0.026 (1.10)	0.0022 (0.84)	0.00273 (0.95)	0.0021 (0.86)	0.0079 (0.29)	0.0018 (0.61)
Int. aid flows	-0.1401 (1.07)	-0.0928 (0.64)	0.0203 (0.12)	-0.4057*** (3.52)	-0.4079** (3.33)	-0.4669019** (3.18)
Terms of trade	0.0073 (0.06)	0.1344 (0.94)	-0.0676*** (4.42)	-0.02935 (0.25)	0.0607 (0.45)	-0.0958 (0.67)
Government consumption	0.02160*** (4.03)	0.0236*** (3.52)	0.0263*** (4.13)	0.0138*** (2.98)	0.01265** (2.34)	0.0142*** (2.77)
Age dependency	-0.0044 (0.17)	0.0184 (0.50)	0.0105 (0.30)	-0.0126 (0.76)	-0.0083 (0.46)	-0.0001 (0.04)
World interest rate	0.0055 (0.65)	0.0028 (0.29)	0.0046 (0.49)	0.01597** (2.10)	0.0109 (1.19)	0.0142* (1.66)
R <sup>2</sup>	0.0139	0.0465	0.0313	0.1925	0.2014	0.1962
F-stat [p-value]	0.0000	0.0005	0.0002			0.0000
Hausman [p-value]	0.0000	0.0000	0.0000			0.0000

\*Indicate both statistical significance at 10% significance level and  $p < 0.1$ .

\*\*Indicate both statistical significance at 5% significance level and  $p < 0.05$ .

\*\*\*Indicate both statistical significance at 1% significance level and  $p < 0.01$ .

### 3.4. Endogeneity issues

In the empirical analysis performed thus far, there has been no discussion on the possibility of problems arising from joint endogeneity. Empirically, it is likely and plausible that the current account determinants considered are jointly endogenous in the sense of being correlated with the error term and the presence of reverse causality. This potentially could lead to overstatements of the effects of each of external debt and openness as well as their interaction on current account balance. Therefore, following Calderon et al. (2001), we specify a dynamic panel regression model that (1) allows for joint endogeneity of variables; (2) includes an unobserved country-specific factor that correlates with the hypothesized current account determinants and (3) contains lagged values of the

dependent variable, being lagged current account. In this instance, the Generalized Method of Moments (GMM) estimator for dynamic models of panel data is employed for the econometric analysis. This estimation technique not only allows for the use of instruments to deal with issues of endogeneity of explanatory variables and unwanted correlations of error terms and differenced lagged dependent variables, it also aids in analysing persistence of the dependent variable as well as in estimating long- and short-run effects of specific variables on the dependent variable. Furthermore, in this paper, it provides a means to ascertain whether results obtained thus far are robust to different estimation techniques. For identification, we follow Anderson and Hsiao (1982), Arellano and Bond (1991) and use as instruments the lags of potential endogenous and exogenous regressors because they are expected to satisfy the exclusion restriction hypothesis—they are correlated with the potential endogenous regressors but uncorrelated with the error term, so that their impact on current account, wherever they occur, can only operate through the variables that they are instrumenting. The validity of these instruments is further accentuated by the fact that the requirement of no second order serial correlation in the error term of the differenced equation, as in Arellano and Bover (1995), is satisfied.

We specify two dynamic panel regression models—one without the interaction term, wherein the openness (*TO*) variable is contained in the set of controls, and the other with an interaction term in which the openness variable is spelt out. Both regressions are specified below as

$$CA_{it} = \alpha_i + \vartheta_1 CA_{it-1} + \vartheta_2 ED_{it} + ED_{it-1} + \vartheta_3 \text{CONTROLS} + \varepsilon_{it} \quad (3.3)$$

$$CA_{it} = \alpha_i + \vartheta_1 CA_{it-1} + \vartheta_2 ED_{it} + ED_{it-1} + \vartheta_3 (ED_{it} \times TO_{it}) + \vartheta_4 TO_{it} + \vartheta_5 \text{CONTROLS} + \varepsilon_{it} \quad (3.4)$$

where  $CA_{it-1}$  is the lagged current account variable,  $\alpha_i$  is the fixed effect while  $\varepsilon_{it}$  is the idiosyncratic error term. The regressors are as defined in the previous section. Long-run effects of regressors on current account is then calculated as  $\frac{\theta}{1-\theta}$ ,  $i \in \mathbb{N}$ .

Following Calderon et al. (1999, 2002), Arellano and Bond (1991) and Arellano and Bover (1995), we employ a Generalized Method of Moments (GMM) procedure to generate consistent and efficient estimates of the coefficients of our variables of interest. The consistency of GMM estimator relies on the validity of lagged values of the explanatory variables as appropriate instruments in the current account regressions presented in (3.3 and 3.4). In order to address this issue of instrument validity, two core specification tests are considered.

The first is the Sargan test of over-identifying restrictions, which tests the overall validity of instruments. The null hypothesis for this test is that the instruments are valid and over-identifying restrictions exist. Thus, failure to reject the null hypothesis (large *p*-values) gives support to the model and implies that the number of instruments used in the estimation is appropriate for the model. The second test is a test for serial autocorrelation. The null hypothesis in this case is that the error term is not serially correlated. Non-rejection of the null hypothesis (high *p*-values) implies that serial correlation does not exist, and this holds true whether in first, second or third order. When the test fails to reject the null hypothesis of the absence of second-order serial correlation, we conclude that the original error term is serially uncorrelated and continue with the GMM estimation. Tables 4a and 4b report the GMM results obtained through this procedure, as shown below. As shown in Table 4a, we find that after controlling for endogeneity, external debt becomes even more strongly significant in most of the sample periods and we continue to find a negative relationship between external debt positions and current account deficits in SSA. The effect of world interest rate on current account deficits displays the expected ambiguity in direction. In particular, we find that world real interest rate bears a positive relationship with current account deficits in the second sample period, 1985–2008, but the relationship becomes negative when the sample period is altered to 1990–2013. The negative relationship suggests that an increase in world interest rate impacts savings and investment in a way that leads to a decline in current account deficits; a positive relationship implies current account deficits expanded following a rise in world real interest rate.

**Table 4a. Current account balance adjustment and external debt—GMM**

	(1)	(2)	(3)
Period	1985–2013	1985–2008	1990–2013
Observations	687	580	571
I.CA	0.7662*** (114.92)	0.0119*** (3.23)	0.7080*** (103.02)
ED/GDP	-0.0003*** (3.24)	-0.0008*** (7.45)	-0.0001 (0.55)
Relative income	-0.1054*** (3.93)	-0.2305*** (7.15)	-0.0758** (1.99)
REER	-0.1834*** (5.34)	-0.2170*** (5.20)	-0.1839*** (3.66)
Openness	-0.2712*** (6.36)	-0.3073*** (10.80)	-0.3147*** (5.49)
Domestic growth	0.0029*** (4.12)	0.0029*** (3.01)	0.0036*** (3.65)
Int. aid flows	0.0299 (1.25)	0.1213** (2.35)	-0.0164 (0.56)
Terms of trade	0.1015** (2.18)	0.04187 (0.83)	0.2075*** (4.02)
Government consumption	0.0026*** (2.69)	0.0051*** (10.85)	0.001 (0.89)
Age dependency	-0.0148 (1.62)	-0.0022 (0.13)	-0.0144 (1.37)
World real interest rate	-0.0016 (1.11)	0.0051*** (3.63)	-0.0044** (2.58)
LR impact of ED on CA	-0.0013	-0.001	-0.0003
LR impact of Openness on CA	-1.1791	-0.3110	-1.0490

\*Indicate statistical significance at 10% significance level;  $p < 0.1$ .

\*\*Indicate statistical significance at 5% significance level;  $p < 0.05$ .

\*\*\*Indicate statistical significance at 1% significance level;  $p < 0.001$ .

In all sample periods, we find that the significant relationship between real effective exchange rate (*REER*) and current account deficits is not consistent with the predictions of the Mundell-Fleming model. Our results suggest that a fall in the real effective exchange rate has the effect of expanding current account deficits. In particular, a 10 per cent depreciation of the real exchange rate leads to an average increase in current account deficits of 1.95 percentage points across the three sample periods. Thus, we continue to obtain some evidence in support of the J-curve hypothesis. For terms of trade, we find a positive and significant relationship between terms of trade and current account deficits in most sample periods, a result which again is at variance with the Harberger-Larsen-Metzler effect which proposes that terms of trade bear a negative relationship with current account deficits. Where significant, our results suggest that a 10 percentage point increase in terms of trade heightens current account deficits by about 1.56 percentage points. The hypothesis of stages of development continues to receive support even after controlling for endogeneity. The results in Table 4a show that relative income has a negative and significant effect on current account deficits. That is, a country's current account deficits decrease as the country becomes relatively developed and its per capita income approaches that of more developed economies. This finding is significant, economically and statistically, across all time periods of samples considered which gives complete support to the stages of development hypothesis is SSA.

**Table 4b. Current account balance and external debt: The role of trade openness—GMM**

	(1)	(2)	(3)
Period	1985–2013	1985–2008	1990–2013
Observations	687	580	571
I.CA	0.7270*** (14.62)	0.8931*** (12.94)	0.6819*** (110.21)
ED/GDP	-0.0070*** (3.43)	-0.0041** (2.88)	-0.0052** (2.84)
ED/GDP × Openness	0.0038*** (3.55)	0.0021** (2.78)	0.0031*** (3.23)
Rel. income	-0.1659*** (4.01)	-0.2187*** (4.25)	-0.1712*** (2.22)
REER	-0.2060** (2.09)	-0.0707 (0.44)	-0.1713*** (3.12)
Openness	-0.5507*** (4.15)	-0.4795** (3.26)	-0.4748*** (3.62)
Domestic growth	0.0035 (1.87)	0.0019 (1.52)	0.0040* (2.81)
Int. aid flows	0.0681 (1.18)	0.1162* (1.87)	-0.0343 (0.07)
Terms of trade	0.1165 (1.45)	0.09295* (1.94)	0.2230 (1.45)
Government consumption	0.0063** (2.78)	0.0082** (2.41)	0.0788*** (4.24)
Age dependency	0.0132 (0.52)	0.0083 (0.22)	-0.0126 (0.62)
World real interest rate	-0.0321 (1.54)	0.0005 (0.21)	-0.0327 (1.27)
LR impact of ED on CA	0.0096	-0.0051	-0.0081
LR impact of openness on CA	-0.7575	-0.5390	-0.696
LR impact of ED/GDP × Openness on CA	0.0052	0.0020	0.0045
Wald test	0.0000	0.0000	0.0000
1st-order serial correlation	0.0829	0.1693	0.0967
2nd-order serial correlation	0.2509	0.2198	0.2252
Sargan test	>0.10	>0.10	>0.10

Notes: In columns (1)–(3), the variables which are taken as current account determinants are instrumented and this reduces the sample size in relation to the previous sample size which ignored the possibility of joint endogeneity of the independent variables. Lagged external debt, as external debt variable, remains insignificant in all preceding regressions, so we drop it henceforth.

\*Indicate both statistical significance at 10% significance level and  $p < 0.1$ .

\*\*Indicate both statistical significance at 5% significance level and  $p < 0.05$ .

\*\*\*Indicate both statistical significance at 1% significance level and  $p < 0.01$ .

As before, we assess the relevance of demographics on current account deficits using age dependency ratio. Despite obtaining consistently negative estimated coefficients in all sample periods as shown in Table 4a, we find that these coefficients are not statistically significant. Thus, we conclude that changes in demographics do not significantly accelerate changes in current account deficits, though their effects on savings are well-established in the literature. Again, the degree of

openness appears to be associated with reduced current account deficits among SSA countries and this tends to suggest that SSA countries are largely consumption rather than investment-based, and a significant amount of their imports are consumer goods for consumption rather than investment or capital goods.

Meanwhile, for income per capita growth, we find that increases lead to an enlargement in current account deficits and this relationship is significant across all time periods. Again, the results indicate that although increases in growth may be associated with a rise in savings, it appears the correlation of growth with investment is somewhat larger, leading to an expansion in current account deficits. The coefficient of growth is robust since it is positive and significant across all sample periods. Although significant, the size of this estimated coefficient seems to be unchanged even after controlling for endogeneity. Thus, the strong positive relationship between these variables is consistent with the observation that SSA countries that recorded relatively high growth rates over the last decades have generally demanded investment capital from other economies.

Table 4b shows results obtained when external debt is interacted with openness and the interaction term included as a regressor. As expected, the coefficient of lagged current account deficit (as a fraction of GDP) is positive and highly significant (at 5% level) in each of the three sample periods, and demonstrates moderate persistence, with an estimated median persistence of about 0.68 across the three sample periods, slightly higher than that obtained in previous studies. The median size of this coefficient reveals moderate persistence of transitory shocks, implying that the half-life of these shocks on the current account deficit is about 1.79 years. Thus, despite occurrences of current account reversals in some SSA countries, in general current account deficits in SSA is moderately persistent. Compared to Calderon et al. (2001), our results suggest that the level of persistence is somewhat higher in SSA, and this likely points to more benign levels of external debt in SSA, following the HIPC and MDRI debt forgiveness programmes. The benign debt levels supported growth in the region in the last decades, decreased the risk profiles of affected countries and increased their attractiveness to foreign investors. This combination has spurred some capital inflows into the region to maintain moderate persistence of current account deficits. To be clear, SSA countries have become less precariously indebted externally and have enjoyed a significant amount of economic growth in the last decades. The decline in external debt over the years through the various debt support programmes has encouraged the inflows of funds which make it possible to fund the deficits, thus the moderate increase in persistence.

During years of high debt, heavily indebted countries' growth and external debt position could not justify persistence in current account deficits as foreign investors gradually held back their funds. This made it difficult to increasingly finance the deficit, which led to a reduction in the persistence of deficit. This explains why our median coefficient of current account persistence is about six times larger than that obtained in Calderon et al. (2001) in their analysis of the determinants of current account deficits in SSA for the period 1975–1995, a period where the levels of external debt in most African countries were at all-time high levels while the region's economic growth was at an all-time low and persistence of current account deficit was much lower given the unwillingness foreign investors to export capital to the region, resulting in low persistence in current account deficits.

For domestic growth, when estimation is done using GMM, we find that exogenous increases in domestic growth enlarge current account deficits and this conclusion holds across all samples and time periods. This improves on the fixed effects estimation which finds no significant relationship between growth and current account deficits. The positive and significant coefficient is consistent with a situation where domestic absorption rises faster than exports. Again, although an increase in growth may well spur exports and be associated with a rise in savings, the results suggest that the correlation of growth with investment is somewhat larger, which in turn triggers an expansion in current account deficits, based on the savings-investment framework. Moreover, where significant, the size of the estimated coefficient of domestic growth now appears larger when we control for endogeneity. Neglecting the possibility of endogeneity as in fixed effects, the coefficient shrinks and

is insignificant in all the three time periods. As noted in Calderon et al. (2001), a smaller growth coefficient may result from negative reverse causation; this negative causation is corrected via GMM estimators. Although we find a significant relationship between real exchange rate and current account deficits, contrary to predictions of the standard open economy Mundell-Flemings model we find that the coefficient of REER is negative. That is, a fall in the real effective exchange rate (i.e. a depreciation of the domestic currency) expands current account deficits where significant and according to the GMM estimation, a 1 per cent depreciation of the real exchange rate increases current account deficit by about 0.20 percentage points.

A possible explanation for this is that the demand for SSA exports is exchange rate inelastic and foreign demand is weakly responsive to changes in domestic exchange rate. Thus, depreciation worsens the current account deficits in SSA and we obtain some evidence in support of the J-curve hypothesis as it applies to yearly data. This is consistent with the fact that most SSA countries that export usually export globally traded commodities whose prices in the international market are entirely expressed in a standard currency, i.e. the US\$, different from the domestic currency. So, a depreciation of the domestic currency will not change the price of the commodities expressed in US\$, except of course it will make it more expensive for those who hold this domestic currency to purchase commodities as they would have to pay more due to the currency depreciation, thus raising import costs and increasing current account deficits. The exchange rate depreciation does not necessarily affect the price that other buyers of the commodities would pay in the international market. It is the appreciation or depreciation of the standard currency in which the commodities are traded that determines the relative cost of commodities to buyers and hence the quantity they would demand of the commodities. This is what partly determines the degree of elasticity of demand for the commodities—the appreciation or depreciation in the currency in which they are traded.

In most of the regressions performed, we find that international aid flows, represented as the ratio of effective assistance to GDP and age dependency ratio do not have significant effects on current account deficits in SSA. Terms of trade, on the other hand, appears to bear a negative and significant relationship with current account deficits only for the sample period 1990–2013 and this is consistent with the Harberger–Laursen–Metzler effect. The results in the case of fixed effects suggest that a 10 percentage point increase in terms of trade reduces current account deficit by 0.67 percentage point. When, however, the possibility of endogeneity is controlled for, the result either changes in direction or the significance vanishes for most of the time period considered. In particular, results in Table 3 show that for the period 1985–2008, a 10 percentage point increase in terms of trade significantly increases current account deficit by 0.90 percentage point while the results are insignificant for other time periods. Contrary to results obtained in the case of developing countries, we find statistically insignificant relationship between world real interest rate and current account deficits in SSA, with varying direction of coefficients across the three samples. This implies that there is no significant empirical evidence that an increase in world real interest rate lessens current account deficits in SSA or that reductions in international real interest rate widen SSA demand for international capital which leads to an expansion in current account deficits.

Among the most consistent results is the hypothesis of the relative stages of development. In all regressions, we continue to get evidence for the relative stages of development hypothesis, even after accounting for endogeneity. Thus, we find evidence that the size of the current account deficits of SSA countries is likely to decline as SSA countries become increasingly developed and narrow the wide gap that exists between them and developed economies. On a more important note, external debt continues to bear a negative relationship with current account deficits, providing an evidence that external debt accelerates current account adjustments in SSA. Moreover, the interaction between external debt and openness continues to bear a positive relationship with current account deficits, which implies that high openness hampers or dampens the current account adjustments potential of external debt. The result shows that the interaction term worsens current account deficits by 0.21 percentage of GDP in the short-run with this figure increasing to 0.31 percentage of GDP in the long-run. Meanwhile, the correlation tests show that error terms are serially uncorrelated

while the Sargan test shows that instruments are valid. All columns suggest that the coefficients of the interactive term remain positive and significant and results are similar, in many ways, to the fixed effects results, especially for the interaction term, except that external debt has now become significant, albeit conditionally. All of the columns also report the test statistic for no over identifying restrictions to confirm the validity of the instruments. Columns (1)–(3) control for the joint endogeneity of the indicators of current account determinants. In all of these, the results continue to support the finding that external debt yields adjustments in current account deficits and high openness significantly reverses the current account adjustment process initiated by external debt. The coefficients and levels of significance, however, changed considerably in values compared with the earlier fixed effects results in Table 2b.

At this juncture, it is imperative to state that while GMM is the favoured method in the empirical literature for addressing endogeneity issues, it is not the only technique that deals with endogeneity. There are other instrumental variables estimators that are also suitable to tackle endogeneity. In this section, we re-estimate the preceding model using IV-2SLS and limited information maximum likelihood (LIML) estimators to further confirm the robustness of our main finding. GMM, IV-2SLS and LIML estimators all provide consistent estimates when endogenous variables are present among regressors, but of the three endogeneity-consistent estimators, GMM often has the dual advantages of consistency and efficiency under homoscedasticity and heteroscedasticity. IV-2SLS which, to a considerable extent, is an offshoot of GMM is consistent and efficient, without an external robust correction, only in the presence of homoscedasticity, something that cannot always be guaranteed in SSA data, while LIML has no mean and variance in finite samples, has moment issues, and thus often not efficient, and its quantiles to some extent deviate substantially from the true value of the parameter of interest. Meanwhile, we also test whether endogeneity is an issue in our empirical analysis. As with the GMM estimation, and since it is not always easy to obtain external instruments that are convincing and acceptable, our identification strategy is such that we utilize lagged values as appropriate instruments for the potential endogenous regressors. The results obtained for each estimator are detailed in Tables 5a and 5b.

The purpose of these re-estimations in our empirical analysis is to examine whether our central finding that the current account deficits of SSA countries with high openness expand significantly from increases in external debt, are robust to different specifications and estimators that are endogeneity-consistent. As a first pass in the re-estimation, we assess whether our earlier results are invariant to different time periods and estimation technique adopted. To do this, we use two additional estimators: IV-2SLS estimator and LIML. Then, we ask whether or not addressing the effects of endogeneity is necessary in our empirical analysis. This we do by carrying out formal tests of exogeneity of our independent variables. As before, we interact external debt with openness and use this as the regressor whose behaviour we want to test its robustness. We also include separately in the regression each variable in the interaction term to ensure that the interaction term does not proxy for external debt or openness.

Tables 5a and 5b presents results obtained from IV-2SLS and LIML respectively. As seen in both tables, the interaction term continues to be significant in the three sample periods, albeit at a lower level compared to previous estimations, even when most variables have lost their significance. These results thus provide an overwhelming support that confirms the robustness of our main finding. This relationship between the interaction term and current account is one of the few consistent results to have emerged from the myriad of regressions performed in this paper and surprisingly one that had been overlooked in the literature. In the nadir rows of Tables 5a and 5b, we report results of over identifying restrictions and exogeneity of explanatory variables to confirm the validity of our instruments and justify the use of estimation techniques that address endogeneity. The results continue to side with the finding that instruments utilized are valid and, more importantly, not all explanatory variables in our regressions are exogenous, confirming that the use of endogeneity-consistent estimators is very well justified.

**Table 5a. Current account balance and external debt: The role of trade openness—IV-2SLS**

	(1)	(2)	(3)
Period	1985–2013	1985–2008	1990–2013
Observations	702	599	571
I.CA	0.8012*** (5.73)	1.000*** (13.07)	0.7762*** (5.41)
ED/GDP	-0.0173* (1.92)	-0.0168** (2.00)	-0.0145* (1.72)
ED/GDP × Openness	0.0092* (1.94)	0.0088** (2.01)	0.0075* (1.73)
Rel. income	0.0096 (0.40)	-0.0243 (1.29)	-0.0073 (0.31)
REER	0.2623 (0.62)	-0.0620 (0.79)	-0.1079 (1.02)
Openness	-0.9216 (1.61)	-0.9647** (2.18)	-0.8490 (1.88)
Int.aid flows	0.0129 (0.08)	0.0972 (1.19)	-0.0265 (0.66)
Terms of trade	0.0157 (0.22)	0.1111 (1.02)	-0.0478 (0.97)
Government consumption	-0.0003 (0.09)	-0.0001 (0.04)	-0.0018 (0.66)
Age dependency	0.0021 (0.23)	0.0112* (1.87)	0.0959 (1.29)
World real interest rate	0.0005 (0.07)	0.0030 (0.68)	0.0057 (1.07)
R <sup>2</sup>	0.7189	0.7949	0.7544
Wald test	0.0000	0.0000	0.0000
Endogeneity test $\chi^2(6)$	14.9398	14.7109	23.1222
p-value	0.0207	0.0226	0.0008
Endogeneity test F(6, X)	2.9811	4.088	4.874
p-value	0.007	0.0005	0.0001
Sargan test	0.3252	0.3804	0.6284
Bassman test	0.3294	0.3879	0.6348
Score test	0.3788	0.5210	0.7359

Notes: In columns (1)–(3), the endogeneity test is a core and regression tests which confirm all of the variables are not exogenous and at least one variable is endogenous and it is appropriate to address endogeneity issues, as we have done. For the robust regression F test, the value of X are 684, 581 and 574 for sample 1985–2013, 1985–2008 and 1990–2013 respectively. We have dropped the variable growth which remains insignificant in all these regressions. Standard errors are robust standard errors to accommodate any presence of heteroscedasticity as one can never count on homoscedasticity.

\*Indicate both statistical significance at 10% significance level and  $p < 0.1$ .

\*\*Indicate both statistical significance at 5% significance level and  $p < 0.05$ .

\*\*\*Indicate both statistical significance at 1% significance level and  $p < 0.01$ .

One could argue that the reason the interaction term remains “stubbornly” significant and sign invariant in the above analysis is because the moderately large time dimensions in our panels and the likelihood that the panel vectors are integrated have not been addressed. To address these



**Table 5b. Current account balance and external debt: The role of trade openness—LIML**

	(1)	(2)	(3)
Period	1985–2013	1985–2008	1990–2013
Observations	702	599	592
I.CA	0.8031*** (5.72)	0.9923*** (12.35)	0.7749*** (5.40)
ED/GDP	-0.0192* (1.79)	-0.0199* (1.82)	-0.0159* (1.64)
ED/GDP × Openness	0.0102* (1.81)	0.0104* (1.82)	0.0083* (1.65)
Rel. income	0.0101 (0.40)	-0.0283 (1.24)	-0.0098 (0.39)
REER	0.3340 (0.70)	-0.0771 (0.81)	-0.1122 (1.00)
Openness	-1.0298 (1.53)	-1.1206** (1.98)	-0.9209 (1.80)
Int.aid flows	0.0395 (0.22)	0.1184 (1.30)	-0.0097 (0.07)
Terms of trade	0.0202 (0.26)	0.1420 (1.06)	-0.04497 (0.84)
Government consumption	-0.0001 (0.04)	-0.0005 (0.24)	-0.0015 (0.72)
Age dependency	0.0019 (0.20)	0.0124* (1.83)	0.0103 (1.30)
World real interest rate	-0.0004 (0.04)	0.0026 (0.54)	0.0061 (1.08)
R <sup>2</sup>	0.6948	0.7629	0.7352
Wald test	0.0000	0.0000	0.0000
<i>Over identifying restrictions tests</i>			
Anderson-Rubin test $\chi^2(2)$	0.9320	1.8104	0.9132
p-value	0.3343	0.4045	0.6334
Basman test $F(2, X)$	0.9147	0.8840	0.4458
p-value	0.3392	0.4137	0.6405

Note: In columns (1)–(3), the null hypothesis for the over identifying restrictions is that there is over identifying restrictions and the instruments used are valid. A P-value greater than 0.10 means the null cannot be rejection which implies the model is well specified. This conclusion is well supported by both Anderson-Rubin and Basman tests for over identifying restrictions presented in the table. For the Basman  $F$  test, the value of  $X$  are 689, 585 and 578 for sample 1985–2013, 1985–2008 and 1990–2013, respectively. We have dropped the variable growth which remains insignificant in all these regressions.

\*Indicate both statistical significance at 10% significance level and  $p < 0.1$ .

\*\*Indicate both statistical significance at 5% significance level and  $p < 0.05$ .

\*\*\*Indicate both statistical significance at 1% significance level and  $p < 0.01$ .

issues, we turn to the PMG/MG estimation techniques in the next section. We adopt these techniques because it is well know that in instances where panel vectors are integrated, and the time dimension has observations large enough for each country within the panel to be studied separately, then the pooled mean group (PMG) and the mean group (MG) estimators due to Pesaran, Shin, and Smith (1999) and Pesaran and Smith (1995) are two appropriate estimation techniques for estimating model coefficients.

### 3.5. The mean group and pooled mean group estimation

In another attempt to check for robustness of our main results, we draw from the PMG/MG estimation technique which is suitable in instances, where  $T$  is large so much so that regression analysis can be separately implemented across time for each of the countries  $i = 1, \dots, N$ . In our set up, although  $N > T$ , the data samples are such that  $T \rightarrow \infty$  as  $N \rightarrow \infty$ , lending support to either MG or PMG model. In other words, this estimation technique can be implemented because our dynamic panel data is such that the cross-sectional observations ( $N$ ) and the number of time-series observations ( $T$ ) are both large. This specification implies that the assumption of homogeneity of slope parameters is often inappropriate.

The PMG and MG estimates of the coefficient of interaction between external debt and openness are found in Table 6. They show the role that openness plays in explaining the impact of external debt on current account balance in SSA. For each time period considered, the  $p$ -value of the result of the Hausman test is reported. The long-run effects we are interested in are the ones that external debt, openness as well as the interaction between external debt and openness has on current account balance, so only these are reported. The pooled mean group and mean group estimation techniques are described in more details in Appendix 4.

Table 6 presents results obtained using PMG and MG estimation techniques. Unlike the MG estimator, the PMG estimator constrains the long-run relationships to be equal across all panels. This yields efficient and consistent estimates across countries when the restrictions are true and slope homogeneity is valid. If the true model is in fact heterogeneous, the PMG estimates become inconsistent while the MG estimates become consistent. To ascertain the validity of the restrictions, and empirically test the hypothesis of slope homogeneity, we perform a Hausman test of the difference in the PMG and MG model. Results of the test are presented in Table 6. The large  $p$ -values of the Hausman test suggest that the null hypothesis that the PMG estimator is more appropriate for the model cannot be rejected, at the 5% level. Thus, under the null hypothesis, the PMG estimator is the preferred efficient estimator.

In columns (1) PMG, (2) PMG and (3) PMG, the model is estimated with the control variables, in varying proportions. As expected, the speed of adjustment is negative and highly significant, at the 5% per cent level and this implies that indeed long-run relationships exist among the variables. Furthermore, the speed of adjustment estimates for the three samples range from 39 to 47 per cent, implying that the dynamics are not significantly dispersed. Precisely, the value of the speed of adjustment coefficient indicates that between 39 and 47 per cent of the system readjusts to equilibrium and the readjustment from disequilibrium to equilibrium is achieved in one year. In all columns, the impact of the interaction of openness and external debt on current account balance continues to remain significant. Most columns once again show the impact of external debt on the adjustment process of current account deficits. The results of the interactive term suggests that the coefficients of the interactive term remain positive and closely match previous results in similarity and continue to support the idea and major finding that the interaction between external debt and openness worsens the adjustment of current account deficits in Sub-Saharan Africa in the long-run. In Table 7, we present the short-run coefficients and speed of adjustments for individual countries to get a sense of the dynamics of the relationships among the variables in each country.

From the country-specific short-run regressions (see Appendix, Table 7 for results), the speed of adjustment coefficients for eight, thirteen and ten countries turned out insignificant for the period 1985–2013, 1985–2008 and 1990–2013, respectively. This suggests no long-run relationships exist among the variables in the short-run regressions. For the interactive terms, the results suggest that its coefficients are significant only in three, six and two countries for the period 1985–2013, 1985–2008 and 1990–2013, respectively. Where significant, the results show a mixed relationship between the interactive term and current account deficits on country-specific level. To be clear, the coefficient of the interactive term is positive for Botswana and negative for Benin and Malawi for the

**Table 6. Current account balance and external debt: the role of trade openness—PMG**

Period	1985–2013	1985–2008	1990–2013	1985–2013	1985–2008	1990–2013
Observations	736	676	642	736	676	642
	(1) PMG	(2) PMG	(3) PMG	(1) MG	(2) MG	(3) MG
Speed of adjustment (ec)	-0.4689*** (4.85)	-0.3899*** (7.54)	-0.4702*** (8.85)	-0.6206*** (7.70)	-0.5664*** (9.17)	-0.8326*** (4.07)
<i>Long-run coefficients of interest</i>						
ED/GDP	-0.0418*** (6.77)	0.0027*** (5.48)	-0.0033*** (4.87)	-0.4854 (1.10)	-9.6056 (0.98)	0.1440 (0.68)
Openness	-0.3974*** (7.81)	-0.4225*** (7.41)	-0.3688*** (6.96)	-4.5912 (0.94)	-103.1143 (0.99)	2.0275 (0.88)
ED/GDP × Openness	0.0026*** (7.42)	0.0027*** (6.23)	0.0211*** (5.31)	0.2322 (1.10)	4.5187 (0.98)	-0.0668 (0.68)
<i>Average short-run coefficients</i>						
ED/GDP	0.0624 (0.95)	0.0391 (1.12)	0.0529 (0.93)	0.1807 (0.94)	0.0650 (0.76)	0.0484 (1.28)
ED/GDP × Openness	-0.0302 (0.98)	0.0181 (1.10)	-0.0246 (0.97)	-0.0853 (0.94)	-0.0301 (0.74)	-0.0228 (1.35)
Rel. income	-0.776* (1.76)	0.2603* (2.13)	-0.3711 (1.52)	-0.69265 (1.43)	0.08648 (0.65)	-0.4097* (1.88)
REER	-1.5231 (1.13)	-0.6998 (0.97)	-0.6431 (0.76)	-0.281471 (0.41)	-0.1436274 (0.72)	-1.06233 (0.99)
Openness	0.2719 (0.90)	0.0213 (0.06)	0.5611 (1.01)	1.42389 (0.99)	0.953543 (1.08)	1.41279 (1.44)
Age dependency	-0.1464 (0.26)		-0.4805 (1.45)	0.243156 (0.67)		-0.20304 (0.51)
World real interest	-		-0.0055 (0.59)			-0.00854 (1.16)
Domestic growth	0.0091 (1.34)			0.0045* (1.71)		
Government consumption	0.0112 (1.27)			0.000003 (0.02)		
Hasman test (p-value)	(0.4115)	(0.7593)	(0.6933)	(0.4115)	(0.7593)	(0.6933)

Note: Following the decline in domestic savings, surge in external debt and sluggish economic growth recorded in SSA in the early 1980s to mid-1990s, SSA countries reduced their appetite for external debt through domestic and external support via debt forgiveness. (1) PMG is controlled with the whole control variables, (2) and (3) use less control variables.

\*Indicate both statistical significance at 10% significance level and  $p < 0.1$ .

\*\*Indicate both statistical significance at 5% significance level and  $p < 0.05$ .

\*\*\*Indicate both statistical significance at 1% significance level and  $p < 0.01$ .

larger sample period of 1985–2013. For the smaller sample periods, the results show that the coefficient of the interactive term is positive for Benin, Congo and Sudan and negative for Kenya, Malawi and South Africa in the sample period 1985–2008 while it is negative for Malawi and Tanzania and positive for no country in the sample period 1990 – 2013. Thus, in instances where the coefficient of the interactive term is positive, the results suggest that external debt significantly worsens the adjustment of current account deficits at country-specific level in the presence of high openness;

**Table 7. Short-run results of individual countries**

	1985–2013					1985–2008					1990–2013							
	Speed of adj.	ED/GDP	Openness	ED/GDP* openness	Rel. income	REER	Speed of adj.	ED/GDP	Openness	ED/GDP* openness	Rel. income	REER	Speed of adj.	ED/GDP	Openness	ED/GDP* openness	Rel. income	REER
Angola	-1.0192*** (4.87)	0.008 (-0.22)	0.9809** (0.05)	-0.0015 (0.91)	0.333 (1.49)	-0.3351 (1.61)	-0.3110** (2.35)	-0.0003 (0.08)	0.144 (0.44)	-0.00028 (0.02)	0.0379 (0.36)	0.0531 (0.29)	-0.2592 (1.44)	0.0014 (0.30)	0.5267 (1.48)	-0.0007 (0.34)	0.277 (1.00)	0.0932 (0.49)
Burundi	-0.7145*** (4.20)	-0.0057* (1.71)	-0.3232 (1.29)	0.0027 (1.37)	-0.5639** (2.77)	0.0802 (0.42)	-0.8659*** (4.39)	-0.00209 (0.52)	0.0115 (0.03)	-0.0001 (0.04)	-0.5608* (1.90)	-0.7743 (0.41)	-0.4505** (2.74)	-0.0761* (1.83)	-0.4249 (1.36)	0.0036 (1.47)	-0.7858** (2.86)	0.1064 (0.42)
Benin	-0.8855*** (4.28)	0.01341 (1.61)	0.6257** (2.00)	-0.0087* (1.79)	-0.2945 (1.60)	0.3187** (2.34)	-0.6208*** (3.87)	-0.0301** (2.60)	-1.6848*** (3.78)	0.01782** (2.57)	0.1342 (0.78)	0.0373 (0.31)	-0.8436 (5.19)	0.0132 (1.22)	0.5824* (1.92)	-0.091 (1.46)	-0.5007** (2.66)	0.5829*** (3.72)
Botswana	-0.3036* (1.81)	-0.3534*** (3.17)	-1.8056** (2.03)	0.1764*** (3.15)	0.2639 (0.81)	-1.1133 (1.41)	-0.6744** (2.77)	-0.1709 (1.33)	-0.7048 (0.73)	0.0886 (1.41)	0.5868 (1.49)	-1.0222 (1.21)	-0.3447* (2.23)	-0.1325 (0.64)	-0.4157 (0.31)	0.0623 (0.59)	0.0569 (0.15)	-1.1501 (1.67)
Cape Verde	-0.2688** (2.32)	0.0021 (0.48)	0.1699 (1.46)	-0.0114 (0.38)	-0.1047 (0.76)	0.1368 (1.02)	-0.8695*** (4.82)	0.0014 (0.30)	0.2593 (1.69)	-0.0005 (0.18)	0.1195 (0.87)	0.0202 (0.17)	-0.1087 (1.22)	0.001 (0.19)	0.1664 (1.19)	-0.005 (0.16)	-0.0844 (0.51)	0.1237 (0.82)
Cameroon	-0.2630** (2.11)	0.0057 (1.18)	0.3393 (0.46)	-0.00278 (1.16)	0.08631 (0.27)	0.1501 (0.09)	-0.1832 (1.27)	0.0054 (1.02)	0.24111 (0.28)	-0.0026 (0.99)	0.13256 (0.34)	0.3027 (0.17)	-0.19213 (1.46)	0.0483 (0.91)	0.1383 (0.16)	-0.023 (0.86)	-0.0939 (0.26)	0.4342 (0.17)
Congo Rep	-0.4805*** (3.09)	-0.0637 (1.68)	-1.6159** (1.97)	0.0325 (1.66)	-0.0249 (0.06)	-1.0714 (0.82)	-0.5513** (2.91)	-0.0928* (1.98)	-2.3590** (2.20)	0.0489* (1.95)	-0.0506 (0.10)	-0.4488 (0.29)	-0.5489 (2.55)	-0.0517 (1.12)	-1.278 (1.26)	0.0237 (0.99)	-0.5043 (0.96)	-1.7423 (1.27)
Ethiopia	-0.3973** (2.25)	-0.0001 (0.05)	0.1114 (0.53)	0.0003 (0.16)	0.1809 (1.27)	-0.2594 (1.29)	0.4866* (1.91)	0.0001 (0.03)	0.0578 (0.25)	0.0001 (0.05)	0.3191** (2.06)	0.0822 (0.22)	-0.7611 (2.67)	0.0035 (1.01)	-0.1327 (0.53)	0.024 (1.05)	-0.1857 (0.88)	-0.0744 (0.27)
Gabon	-0.6061*** (3.42)	0.02835 (0.90)	2.6504** (2.27)	-0.0152 (0.98)	0.2701 (0.63)	0.1031 (0.29)	-0.5280*** (3.16)	0.0279 (0.85)	2.7236** (2.26)	-0.0152 (0.94)	0.2001 (0.44)	0.0711 (0.20)	-0.5265 (2.01)	0.07616 (1.29)	6.905 (2.34)	-0.0423 (1.39)	-0.78388 (1.04)	0.6367 (1.03)
Ghana	-0.3652** (2.48)	0.0346 (0.72)	-0.0017 (0.01)	-0.0018 (0.71)	0.17611 (0.98)	-0.1977 (1.38)	-0.3715** (2.41)	0.0014 (0.25)	-0.1143 (0.49)	-0.0003 (0.09)	0.3712 (1.66)	-0.1455 (0.94)	-0.3386 (2.05)	-0.0018 (0.28)	-0.2009 (0.76)	0.00101 (0.30)	0.0001 (0.00)	0.0659 (0.26)
Guinea	-0.1985 (1.02)	-0.0524 (0.40)	-0.3171 (0.58)	0.0022 (0.33)	-0.6080* (1.95)	0.088 (0.78)	-0.4062 (1.74)	-0.0017 (0.15)	-0.0189 (0.03)	0.0006 (0.09)	-0.3354 (1.23)	0.0328 (0.34)	-0.1592 (0.98)	-0.00715 (0.51)	-0.4579 (0.79)	0.0029 (0.42)	-0.6652 (1.59)	-0.0267 (0.01)
Gambia	-0.3299** (2.52)	0.0063 (1.66)	0.3436 (1.68)	-0.0028 (1.36)	0.3005 (1.31)	-0.0083 (0.03)	-0.7019*** (3.40)	0.0027 (0.62)	0.2421 (1.04)	-0.0009 (0.40)	0.3675 (1.52)	0.0222 (0.09)	-0.5412 (3.96)	0.0083 (1.41)	0.37336 (1.22)	-0.0041 (1.16)	0.0095 (0.03)	-0.1681 (0.65)
Madagascar	-0.2493* (1.86)	0.0154 (0.77)	0.5859 (0.81)	-0.0088 (0.84)	0.6726 (1.56)	0.268 (2.68)	-0.2552 (1.60)	0.0332 (1.31)	1.5267 (1.47)	-0.0179 (1.34)	0.9884** (2.07)	-1.3049** (2.67)	-0.29326 (1.71)	0.0247 (0.85)	0.7107 (0.81)	-0.01347 (0.91)	0.6224 (1.28)	-1.2434 (2.40)
MSM	-0.1946** (2.34)	-0.082 (1.10)	-1.3336 (0.83)	0.0331 (1.00)	-2.7833 (1.71)	-0.4762 (1.72)	-0.07 (0.77)	-0.1001 (1.28)	-2.27 (1.29)	0.04341 (1.24)	-0.9152 (0.52)	-0.2824 (0.94)	-0.2344 (2.37)	-0.0398 (0.47)	-0.0643 (0.03)	0.0142 (0.38)	-3.9872 (1.90)	-0.4658 (1.67)
Kenya	-0.5749*** (3.41)	0.0046 (1.14)	0.3367 (1.39)	-0.026 (1.12)	-0.0088 (0.07)	0.0704 (1.19)	-1.2098*** (5.56)	0.0055* (1.81)	0.4228** (2.18)	-0.0034* (1.91)	0.135 (1.31)	0.0321 (0.84)	-0.784467 (4.02)	0.0018 (0.30)	0.2813 (0.83)	-0.012 (0.36)	-0.0391 (0.31)	0.026689 (0.24)

(Continued)

**Table 7. (Continued)**

	1985-2013					1985-2008					1990-2013							
	Speed of adj.	ED/GDP	Openness	ED/GDP* openness	Rel. income	REER	Speed of adj.	ED/GDP	Openness	ED/GDP* openness	Rel. income	REER	Speed of adj.	ED/GDP	Openness	ED/GDP* openness	Rel. income	REER
Seychelles	-0.0526 (0.54)	-0.2228 (1.26)	0.2525 (0.64)	0.000 (0.02)	-0.2228 (1.26)	0.0167 (0.09)	-0.1959 (1.45)	0.0014 (0.31)	0.3623 (0.91)	-0.001 (0.41)	-0.211 (1.15)	0.019 (0.08)	0.0575 (0.84)	-0.0039 (1.09)	-0.1701 (0.52)	0.0023 (1.21)	-0.08241 (1.05)	0.0437 (0.53)
Sierra Leone	-0.1554* (1.90)	-0.0242 (1.21)	-0.2083 (0.81)	0.0116 (1.21)	-0.1205 (1.64)	0.039214 (0.47)	-0.4481** (2.54)	-0.0005 (0.02)	0.0852 (0.28)	0.0014 (0.12)	-0.0157 (0.19)	0.0802 (0.74)	-0.1924 (2.18)	-0.0197 (0.84)	-0.1765 (0.66)	0.0094 (0.84)	-0.0824 (1.05)	0.0437 (0.53)
South Africa	-0.0803 (0.79)	0.0007 (0.30)	-0.4587 (1.65)	-0.0007 (0.30)	-0.3068 (1.65)	-0.25401 (1.21)	0.0133 (0.11)	0.0147** (2.64)	0.5619 (1.46)	-0.0086*** (2.83)	-0.4008** (2.26)	-0.2716 (1.50)	-0.2345 (2.04)	0.0004 (0.09)	-0.5728 (2.17)	-0.0005 (0.25)	-0.498 (2.77)	-0.0943 (0.45)
Mauritania	-0.3136 (1.64)	0.0444 (1.09)	0.3428 (0.76)	-0.02169 (1.07)	0.1571 (0.74)	-0.3487 (0.60)	-0.3039 (0.89)	-0.0196 (0.19)	-0.3084 (0.30)	0.0111 (0.21)	0.1138 (0.47)	-0.3981 (0.30)	-0.3566 (1.66)	0.0587 (1.44)	0.4932 (1.02)	-0.02878 (1.43)	0.16135 (0.76)	-0.4613 (0.77)
Mauritius	-0.4997*** (2.94)	0.0052 (1.40)	0.4273 (1.67)	-0.0029 (1.45)	0.1649 (0.91)	-0.0588 (0.46)	-0.3399 (1.59)	0.0014 (0.28)	-0.0108 (0.03)	0.0001 (0.03)	0.7534** (2.06)	-0.0421 (0.25)	-0.3507 (2.33)	0.0046 (1.08)	0.3415 (1.11)	-0.0028 (1.16)	-0.01939 (0.09)	0.0054 (0.02)
Malawi	-0.1701** (2.45)	0.0192*** (6.32)	0.3330** (2.19)	-0.1259*** (6.78)	0.2705** (2.21)	-0.0367 (0.26)	-0.1497** (2.59)	0.0193*** (6.52)	0.3387** (2.18)	-0.0127*** (7.02)	0.2814** (2.37)	-0.0657 (0.47)	-0.1214 (1.50)	0.0187 (5.19)	0.1906 (0.90)	-0.01227 (5.53)	0.1769 (1.38)	-0.03929 (0.25)
Namibia	-0.5799*** (3.23)	0.0016 (0.96)	0.1441 (0.74)	-0.0014 (1.10)	-0.0269 (0.13)	-0.5486** (0.42)	0.0715 (2.66)	-0.0637 (0.44)	0.000 (0.32)	-0.0773 (0.01)	-0.0773 (0.33)	-0.4836 (1.25)	0.0015 (2.75)	0.0834 (0.73)	0.0834 (0.25)	0.0108 (0.63)	0.04193 (0.03)	0.04193 (0.107)
Sudan	-0.1784 (1.39)	-0.0007 (0.38)	-0.2676 (1.26)	0.0009 (0.79)	0.1443 (0.79)	0.0366 (0.37)	-0.4004*** (3.24)	-0.0045** (2.03)	-0.6305** (2.59)	0.0029** (2.19)	-0.0792 (0.42)	-0.0763 (0.82)	-0.4685 (3.19)	0.0021 (1.12)	-0.1495 (0.82)	-0.0008 (0.65)	0.1511 (0.88)	0.107 (0.77)
Nigeria	-0.1622 (1.53)	1.6264 (0.90)	20.481 (1.45)	-0.6927 (0.83)	7.3044 (1.32)	-27.216** (2.09)	0.0631 (0.61)	-1.0275 (0.91)	-8.7267 (0.78)	0.4798 (0.94)	4.1669 (1.43)	-21.41*** (3.15)	-0.1607 (1.53)	1.6272 (0.90)	20.4697 (1.45)	-0.6931 (0.83)	7.2822 (1.31)	-27.2398 (2.09)
Rwanda	-0.4511** (2.64)	0.0435 (1.45)	1.074 (1.00)	-0.0217 (1.66)	-1.9001 (1.01)	5.54** (2.01)	0.1197 (0.70)	0.0391 (1.77)	1.1316 (1.60)	-0.0191 (1.76)	1.2194 (1.23)	3.6992** (2.54)	-0.3838 (2.07)	0.0734 (1.60)	1.3018 (1.01)	-0.0345 (1.78)	-4.808 (1.78)	5.7646 (1.73)
Swaziland	-0.1583** (2.12)	0.0026 (0.78)	0.1217 (0.70)	-0.0015 (0.81)	0.3287** (2.44)	-0.1503 (0.80)	0.1053 (1.56)	0.0812 (0.15)	-0.0007 (0.24)	0.31553 (0.27)	-0.0007 (2.17)	-0.0389 (0.50)	-0.5654 (4.37)	0.0008 (0.30)	-0.5654 (0.93)	0.0008 (0.37)	-0.00055 (3.32)	0.0447 (0.87)
Tanzania	-0.1072 (1.15)	0.0084 (1.61)	0.5261* (1.82)	-0.0464 (1.68)	-0.0385 (0.41)	-0.0499 (0.42)	-0.1032 (0.78)	0.009 (1.61)	0.5679 (1.76)	-0.0051 (1.69)	-0.0641 (0.55)	-0.0919 (0.70)	-0.2177 (1.47)	0.0166 (1.88)	0.693 (1.99)	-0.00634 (1.95)	0.0139 (0.13)	-0.0184 (0.17)
Togo	-0.4869 (1.63)	0.0064 (0.60)	-1.6837* (1.84)	-0.0319 (0.59)	-0.3353 (0.53)	0.3866 (0.23)	-1.1222*** (4.84)	0.039 (1.60)	5.5048 (1.35)	-0.0224 (1.65)	0.132 (0.41)	0.635 (0.71)	-0.5207 (2.65)	-0.0036 (0.49)	-2.4194 (2.85)	-0.0022 (0.57)	-0.1539 (0.69)	-0.2285 (0.33)
Zambia	-0.3054* (1.84)	0.0212 (0.95)	0.2267 (0.70)	-0.0122 (0.96)	-0.024 (0.27)	-0.1421 (0.72)	0.0015 (1.28)	-0.1718 (0.11)	0.000 (0.83)	-0.0742 (0.01)	-0.0205 (1.04)	-0.1234 (0.16)	0.00645 (1.38)	-0.1234 (0.45)	0.00645 (0.09)	-0.0947 (0.47)	-0.0151 (1.02)	-0.0908 (0.10)
Lesotho	-0.7789*** (3.81)	-0.0004 (0.11)	-0.0894 (0.27)	0.0002 (0.11)	0.1777 (0.92)	0.2528 (1.04)	-0.6841*** (3.04)	-0.0004 (0.08)	-0.0494 (0.12)	0.0002 (0.08)	0.2747 (0.93)	0.1996 (0.67)	-0.8204 (5.14)	0.00004 (0.01)	-0.0132 (0.04)	-0.0003 (0.17)	0.06171 (0.35)	-0.0908 (0.41)

\*Indicate statistical significance at 10% significance level;  $p < 0.1$ .

\*\*Indicate statistical significance at 5% significance level;  $p < 0.05$ .

\*\*\*Indicate statistical significance at 1% significance level;  $p < 0.01$ .

where the coefficient of the interactive term is negative, the results imply that external debt significantly improves the adjustment process of current account deficits of the concerned SSA countries through high openness. On the whole, the results are significant in less than 21% of the SSA countries considered in each of the time periods, suggesting that the short-run impact of external debt through openness is not of great significance at country-specific level across Sub-Saharan Africa and this could provide an idea for why the problem has not been considerably studied at country-specific level. The reason for this could be justified by the reasoning that the mechanism by which external debt influences current account through openness does not operate in the short term but takes a longer term for its full impact to be seen.

### **3.6. Dynamic fixed effects**

As a final check on the validity and robustness of our main results (which is our discovery that external debt aids the adjustment of current account deficits but worsens current account adjustments through high trade openness), we estimate the current account models using a dynamic fixed effects estimator. Like the PMG estimator, the dynamic FE estimator restricts the coefficients of the cointegrating vector to be identical across all countries in the long run. However, it differs from the PMG estimator since, in the spirit of the FE model, it additionally restricts the speed of adjustment and short-run coefficients to be equal. Furthermore, it addresses the problem of endogeneity of the explanatory variables and country-specific error term via mean differencing. One notable feature of this estimation technique is its dependence on large  $T$  which ensures that, after performing mean differencing, any bias and endogeneity problem generated by the lagged dependent variable dwindles provided  $T$  remains sufficiently large, a condition which is satisfied in our data samples. A test for the presence of cross-sectional dependency in the spirit of Pesaran (2004) is also performed. Results obtained using the dynamic fixed effects estimator, alongside the cross-sectional dependency test, are presented in Table 8.

In all columns, DFE (I), DFE (II) and DFE (III), the coefficients of external debt and the interactive term yield results which are significant and similar in magnitude and direction to results obtained from earlier estimations. The results thus continue to support our key finding that external debt supports the adjustment process of current account deficits but worsens the adjustment process of current account deficits when the degree of openness is high. The relationship continues to be statistically significant. The test for the presence of cross-sectional dependency yields an average absolute residual correlation which ranges from 0.215 to 0.232 for the three sample periods considered. These values suggest that there is no significant evidence of cross-sectional dependence of the error terms. The results show that the findings of the role of openness on the impact of external debt on current account balance in SSA are robust to all of the different estimation techniques we have employed.

### **4. Conclusion**

Following the decline in domestic savings, surge in external debt and sluggish economic growth recorded in SSA in the early 1980s to mid-1990s, the result was a high debt burden in SSA which subsequently led to a reduction in the persistence of current account deficit and started the dispensation of current account adjustments, especially as these countries were heavily debt burdened and their growth rates in these periods were suboptimal and unattractive to encourage sustained inflows of capital to finance the deficits. In recent empirical literature, some effort has been made to examine the effects of several key macroeconomic variables on the current accounts of developing countries. However, only limited attention has been specifically given to the effect external debt plays in the adjustment process of current account deficits in Sub-Saharan Africa. Furthermore, to the best of our knowledge, no previous studies have attempted to explore the role of openness in the adjustment process of current account deficit via external debt, whether in developed or developing countries, and this creates a gap in the literature. The present paper tries to fill this gap.

We build upon the work in previously cited studies and, in particular, extend the work of Debelles and Faruqee (1996) and Calderon et al. (1999) by focusing our analysis on Sub-Saharan Africa, rather than the broader developing countries, and by exploring a wider range of empirical specifications.

**Table 8. Current account balance and external debt: The role of trade openness-dynamic fixed-effects**

	1985–2013	1985–2008	1990–2013
	DFE(1)	DFE(2)	DFE(3)
I.CA/GDP	0.8259*** (37.97)	0.1721*** (3.99)	0.8235*** (34.61)
ED/GDP	-0.0271** (2.03)	-0.0245** (2.11)	-0.0302* (1.95)
ED/GDP × Openness	0.0014** (2.03)	0.0012* (1.80)	0.0015* (1.94)
Relative Income	-0.1002 (1.46)	-0.1596* (1.82)	-0.1095 (1.35)
REER	-0.0762 (1.02)	-0.0606 (0.82)	-0.0654 (0.67)
Openness	-0.3327*** (3.10)	-0.3093*** (2.69)	-0.3806*** (2.93)
Domestic growth	0.0024 (1.66)	0.0040*** (3.29)	0.0025 (1.45)
Int. aid flows	-0.0006 (0.01)	0.0698 (0.84)	0.0173 (0.17)
Terms of trade	0.0509 (0.70)	0.0324 (0.43)	0.0612 (0.65)
Government consumption	0.0013 (0.66)	0.0036* (1.69)	0.0018 (0.78)
Age dependency	0.0106 (0.66)	0.0460 (0.24)	0.0129 (0.65)
World real interest rate	-0.0030 (0.62)	0.0029 (0.64)	-0.0033 (0.60)
LR impact of interactive	0.0080	0.0015	0.008
No of observations	727	543	620
R <sup>2</sup>	0.7740	0.0211	0.6898
F-test	0.0000	0.0001	0.0000
Cross-sec dep test	0.215	0.230	0.219

Note: Coefficients are rounded to 4 decimal places. First-differenced dependent variable in the second column to ensure stationary. We also added gross savings to the regression—coefficient turned out insignificant & not reported. Absolute values of the t-statistic are in parenthesis (). Following Pesaran (2004), we performed a cross sectional dependency test to check for the existence of cross sectional dependence of error terms. Results suggest no significant evidence of cross sectional dependence at the conventional significance levels, i.e. 5%. In all, the magnitude and direction of coefficients of the interactive term are of most importance as we check for their robustness.

\*Indicate both statistical significance at 10% significance level and  $p < 0.1$ .

\*\*Indicate both statistical significance at 5% significance level and  $p < 0.05$ .

\*\*\*Indicate both statistical significance at 1% significance level and  $p < 0.01$ .

Although we develop a small open-economy model with external debt to part-provide a theoretical justification for our empirical specifications, we do not completely dwell on testing this model or its predictions. Our objective in this paper is primarily empirical: to provide empirical evidence, supported by theoretical characterizations, of current account adjustments and determinants in Sub-Saharan Africa with emphasis on external debt. Our work is similar in some respects to existing research, especially Bulut (2011), Debelle and Faruqee (1996) and Calderon et al. (1999), but the

**Table 9. Coefficients of the interactive term for different methods of estimation**

	1985–2013	1985–2008	1990–2013
Fixed effects (FE)	0.0045**	0.0037**	0.0051**
Generalized method of moments (GMM)	0.0038***	0.0021***	0.0031***
IV-two stage least squares (IV-2SLS)	0.0092*	0.0088**	0.0075*
Limited info maximum likelihood (LIML)	0.0102*	0.0104*	0.0083*
Pooled mean group (PMG)	0.0026***	0.0027***	0.0021***
Dynamic fixed effects (DFE)	0.0014**	0.0012*	0.0015*
Average	0.0053	0.0048	0.0046
Median	0.0038	0.0027	0.0031

Note: The random effects (RE) and mean group (MG) estimators are not reported here because the Hausman test performed in each case suggests the use of fixed effects (FE) and pooled mean group (PMG) respectively.

\* $p < 0.1$ .

\*\* $p < 0.05$ .

\*\*\* $p < 0.01$ .

justification of our empirical specifications as well as the broad variety of econometric techniques adopted, distinguishes this paper from existing research.

We have focused in particular on how external debt enhances current account adjustment and the role of openness in the current account adjustment process in SSA. Contained in the paper is also a study on the empirical relationship between current account and some variables proposed in the literature as determinants of current account balance. This provides an opportunity for us to obtain a number of stylized facts on the effects of a variety of economic variables on current account deficits for a sample of SSA countries selected based on data availability.

By controlling for the possibility of joint endogeneity of regressors in the spirit of Calderon et al. (2001) and employing two additional estimation techniques—PMG and DFE—our final empirical evidence in line with our theoretical model suggests that external debt aids in the current account adjustment process in SSA. However, after interacting external debt with openness, we find that high openness reverses the current account adjustment process of external debt. That is, external debt significantly expands current account deficits when openness is high. Our results are robust to the inclusion of lagged levels of external debt, different time periods, the addition of other determinants of current account, consideration of endogeneity and the use of different estimation techniques inclusive of the pooled mean group and dynamic fixed effects methods of estimation. Our results suggest that openness plays a role in the current account adjustment process of external debt. To the best of our knowledge, this has not been shown before and thus constitutes an important contribution.

Thus, we have provided empirical evidence, part-supported by theory, that previous high external debt aided the resulting subsequent adjustment of current account deficits in SSA and that high openness, when interacted with external debt, reverses the current account adjustment process. In other words, external debt expands current account deficits when countries have high openness to trade, with the direction of trade tilting more towards imports. The results in this paper suggest that SSA countries should put the right openness policies in place before amassing large external debt-capital to finance projects that would improve local and external conditions. These two policies need not be incompatible. Better domestic policies on openness to trade that not only encourage trade, but also emphasize the right kind of trades that unlock the benefits of external debt on current account should be pursued. We do not rule out the possibility that our work can be helpful for constructing more formal theoretical models of current account determinants. We leave this as an area to be explored for future research.



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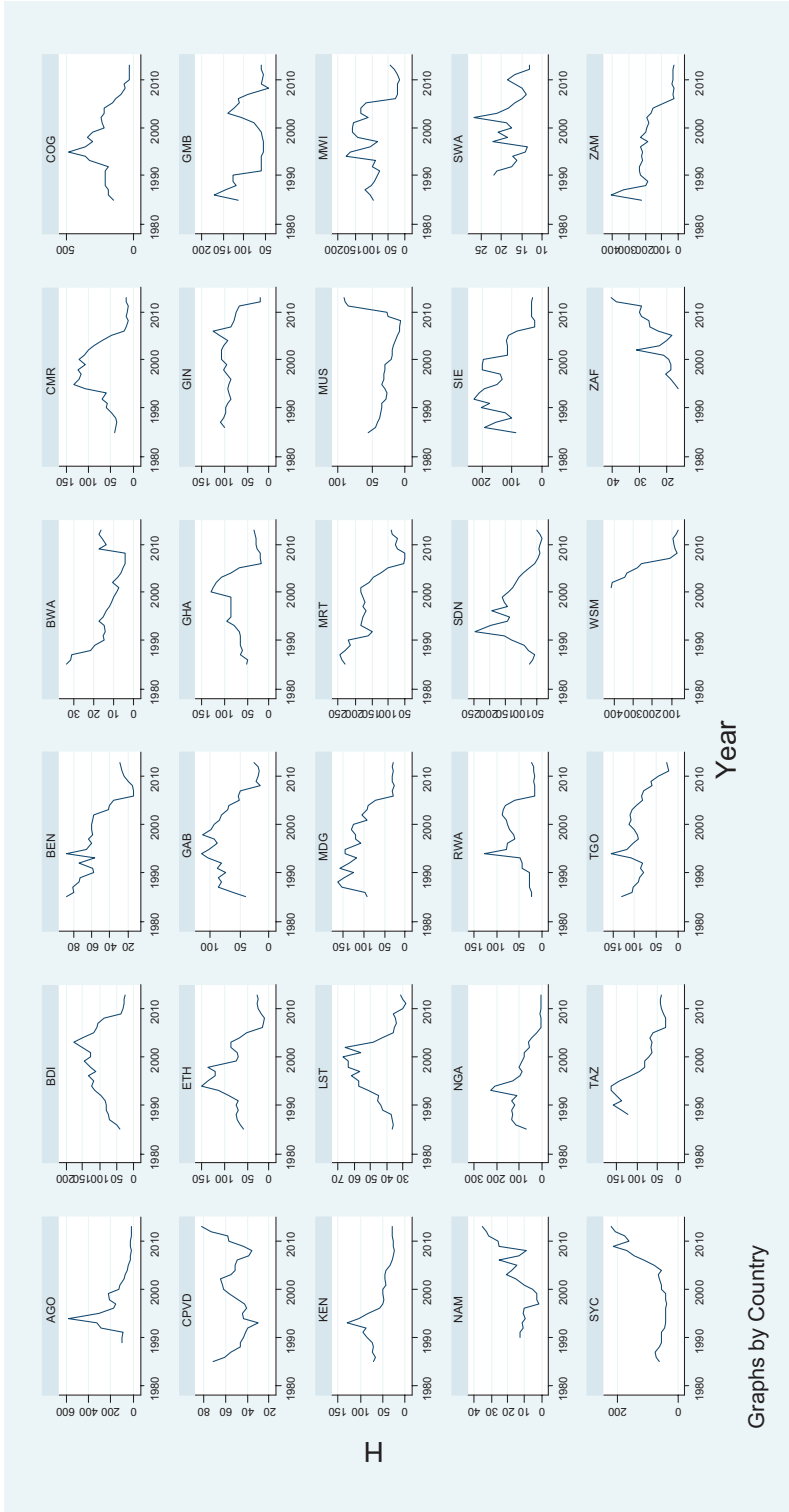
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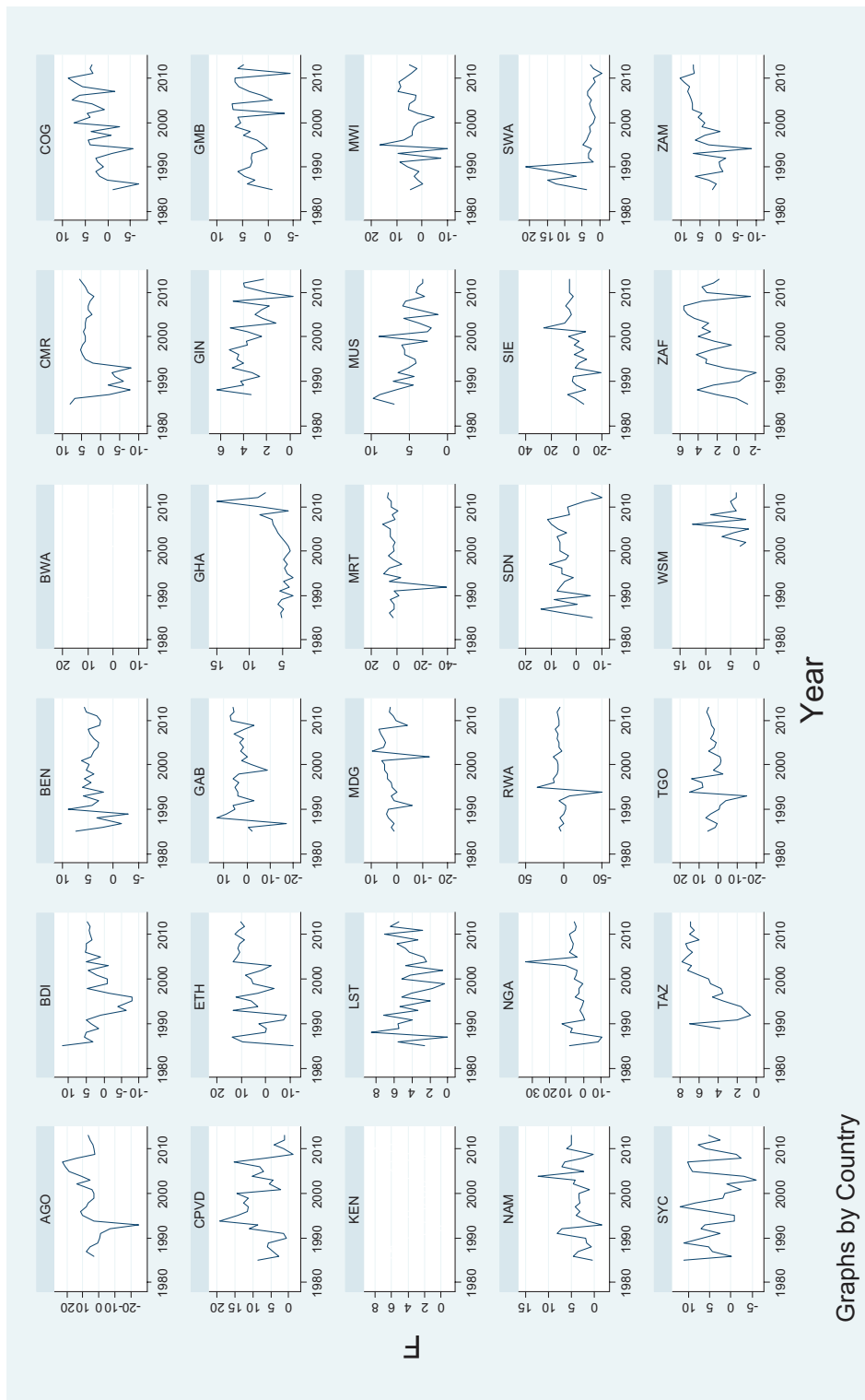
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Appendix 1

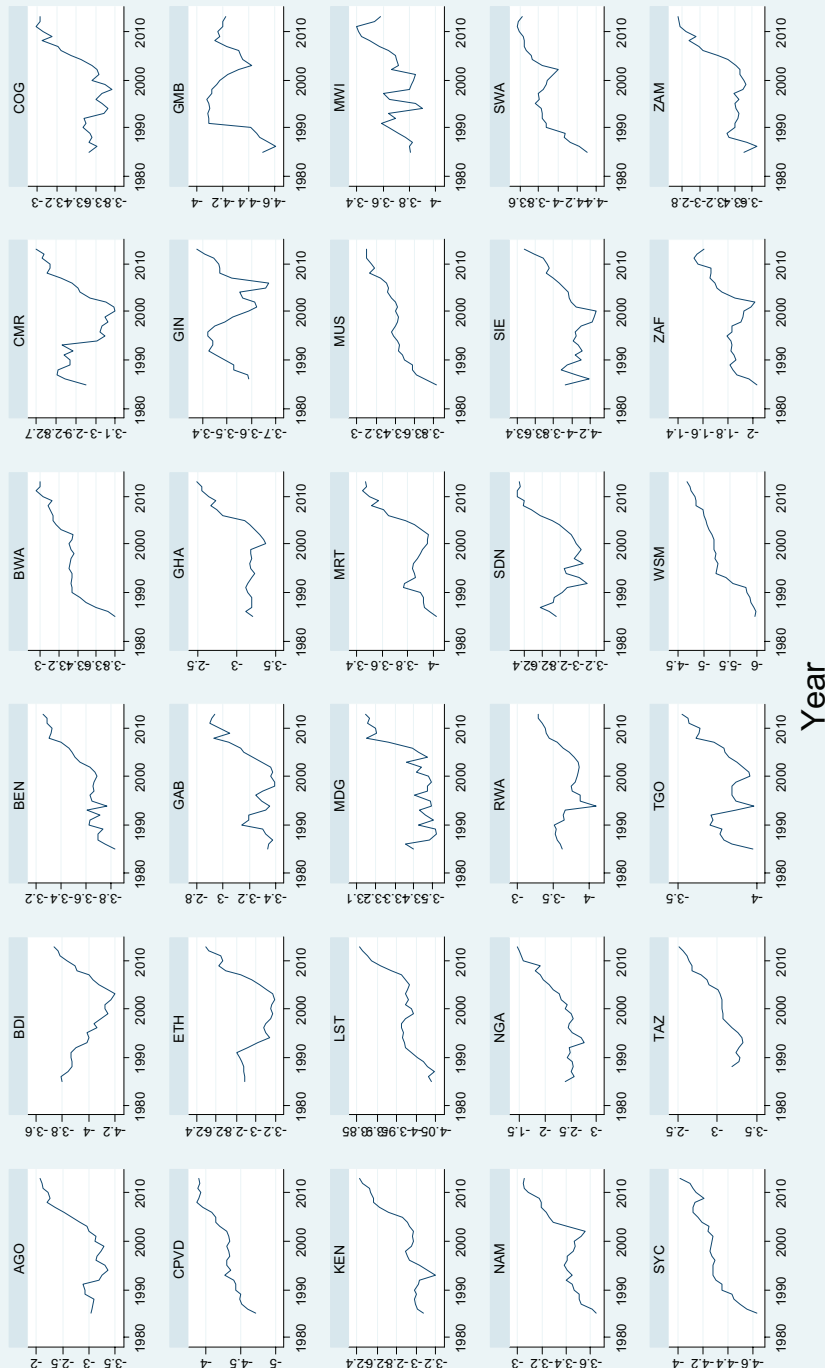
I. External Debt as a percentage of GDP (H)



## II. Domestic Output Growth ( Year-on-year) (F)

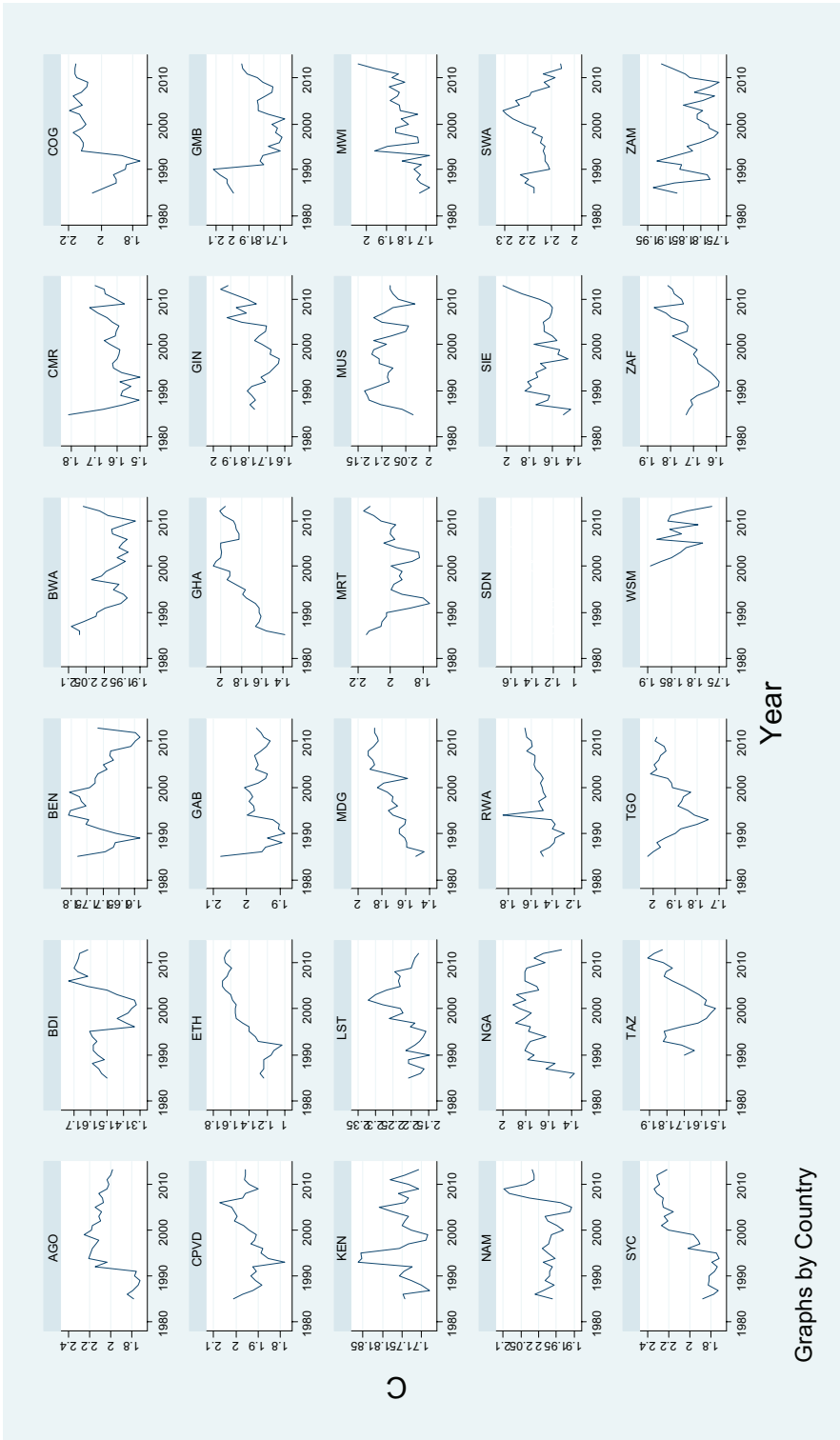


### III. Relative Stages of Development (A)



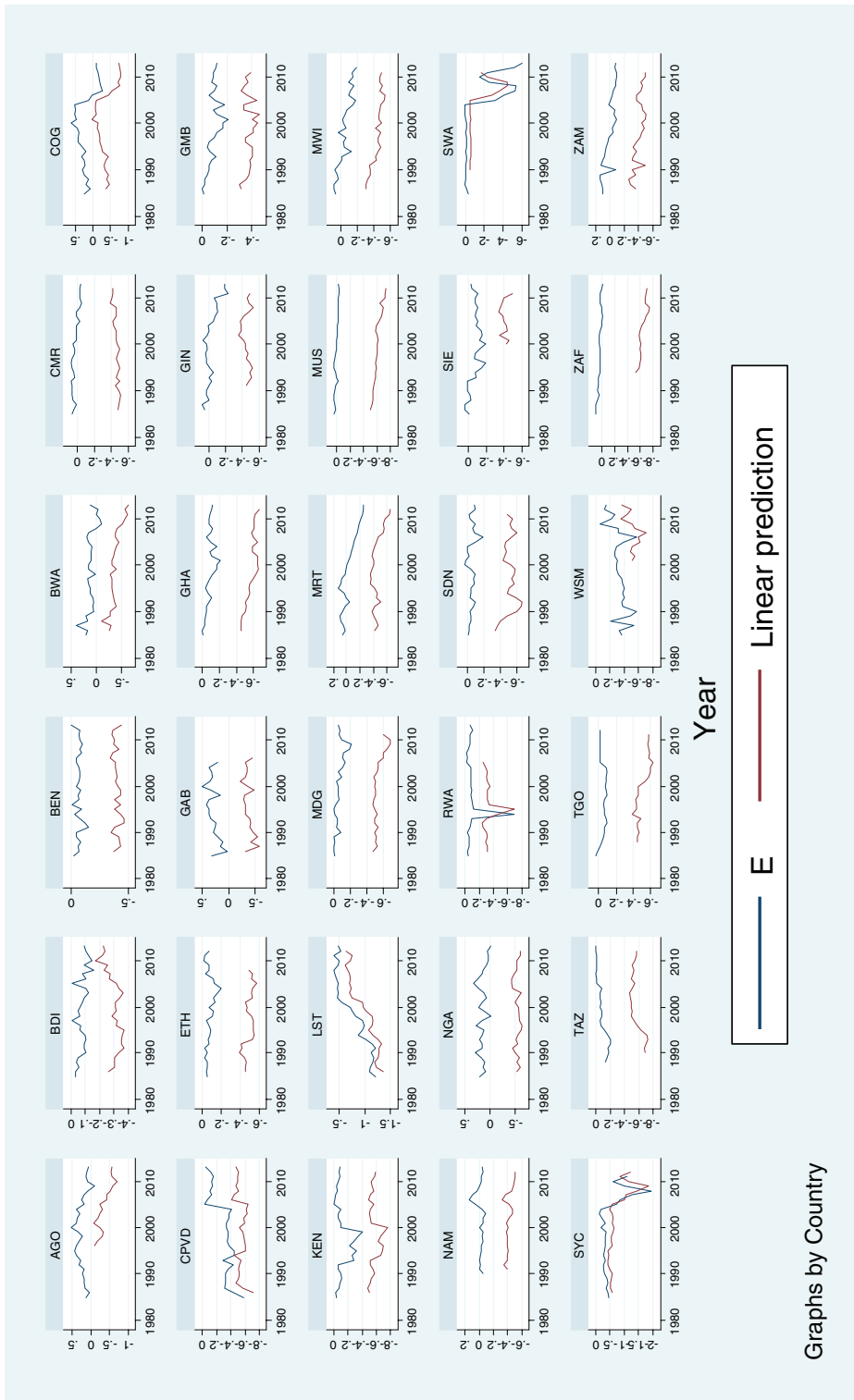
Graphs by Country

IV. Trade Openness ( $\frac{X+M}{Y}$ )

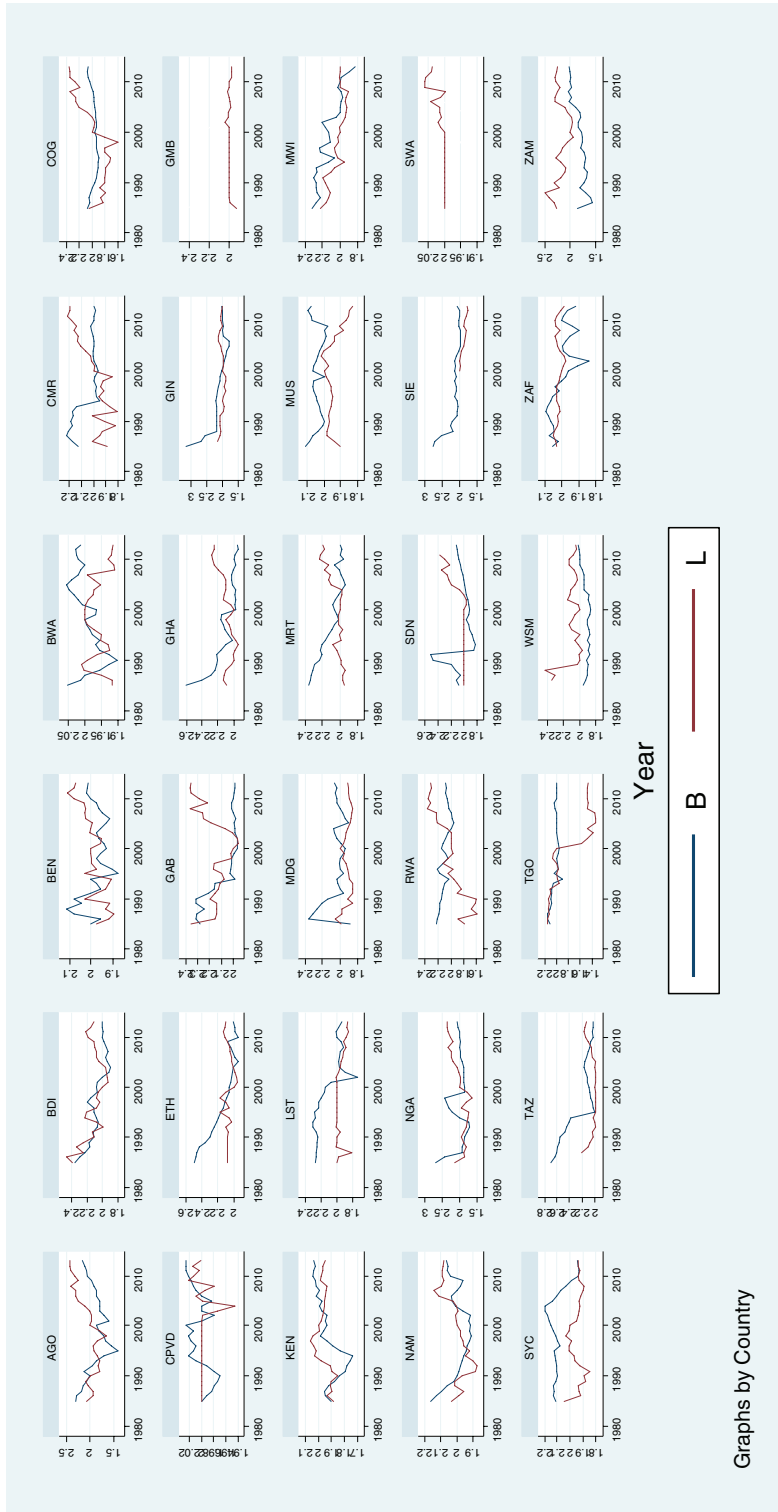


c

V. Current Account Balance (E) (as a percentage of GDP)



**VI. Real Effective Exchange Rate (B) and Terms of Trade (L)**



## Appendix 2

### Sub-Saharan African countries in the sample

Code	Country	SSA Region	GDP/ capita (US\$)	Code	Country	SSA Region	GDP/capita (US\$)
AGO	Angola	Southern Africa	3,679	MRT	Mauritania	SSA/Maghreb	1,084
BDI	Burundi	East Africa	199	MUS	Mauritius	East Africa	1,084
BEN	Benin	West Africa	682	MWI	Malawi	Southern Africa	1,084
BWA	Botswana	Southern Africa	6,051	NAM	Namibia	Southern Africa	4,595
COM	Comoros	East Africa	741	NGA	Nigeria	West Africa	1,802
COG	Congo, Rep	Central Africa	2,633	RWA	Rwanda	East Africa	498
CPVD	Cape Verde	West Africa	3,147	SDN	Sudan	North/East Africa	1,261
ETH	Ethiopia	East Africa	334	SIE	Sierra Leone	West Africa	491
GAB	Gabon	Central Africa	9,030	SWA	Swaziland	Southern Africa	2,711
GHA	Ghana	West Africa	1,194	SYC	Seychelles	East Africa	12,105
GIN	Guinea	West Africa	426	TAZ	Tanzania	East Africa	671
GMB	Gambia	West Africa	495	TGO	Togo	West Africa	499
KEN	Kenya	East Africa	503	WSM	Sao Tome Principe	West Africa	1,198
LST	Lesotho	Southern Africa	919	ZAF	South Africa	Southern Africa	6,391
MDG	Madagascar	Southern Africa	392	ZAM	Zambia	Southern Africa	1,285

Note: The GDP/capita in US\$ is the 10 year average real per capita income of each of the countries in the sample.

## Appendix 3

### Description data, variables and sources

Variable	Sources	Description
Current account balance (CA)	World Bank and IMF IFS	Current account deficit as a percentage of GDP
Real effective	Zsolt/World Bank Exchange Rate	REER represents the multilateral real exchange rate, in logarithm
Terms of trade (TOT)	World Bank	Terms of trade is calculated as the ratio of export prices to import prices (base 2000 = 100), in logarithm
International aid	World Bank	International aid is the ratio of the effective development assistance (EDA) to GDP. It measures the aggregate aid flows combining total grants and the grant component of all official loans
External debt (ED)	World Bank	External debt is measured as the ratio of a country's total external debt to GDP
World real interest rate	World Bank	Taken as the real interest rate of the US—which is the annualized nominal interest rate less average annual inflation rate
Trade openness	World Bank	Calculated as the sum of exports and imports as a fraction of GDP, in logarithm
Domestic relative income level	World Bank	Ratio of domestic output to the US output, expressed in logarithm
Domestic growth dependency ratio	World Bank	Yearly percentage growth in per capita GDP

Note: Definitions used are from the World Bank.



## Appendix 4

### The pooled mean group and mean group estimator

Here, we explain in some detail the PMG/MG estimation technique which is suitable in instances where  $T$  is large so much so that regression analysis can be separately implemented across time for each of the countries  $i = 1, \dots, N$ . In our set up, we have  $T = 29$ ,  $N = 30$ , lending support to either MG/PMG model. In other words, this estimation model has been implemented because our dynamic panel data is such that the cross-sectional observations ( $N$ ) are below the number of time-series observations ( $T$ ). This specification implies some departure from the assumptions of slope homogeneity, meaning each country's long run coefficients are not forced or constrained to equate.

An additional requirement for this specification is that the model to be estimated constitutes variables that are non-stationarity. This can be a major concern when suitable methods of handling nonstationary variables are non-existent. Pesaran et al. (1997) and Pesaran et al. (1999) address this downside by proposing techniques to estimate nonstationary dynamic panels that allow slope parameters to be heterogeneous across groups. These techniques are the aforementioned mean-group (MG) and pooled mean-group (PMG) estimators. The MG estimator due to Pesaran and Smith (1995) involves estimating  $N$  time-series regressions and averaging the coefficients; the PMG estimator (see Pesaran et al., 1997, 1999), on the other hand, combines pooling and averaging of coefficients. We provide a brief formulation of these approaches below as has been used in our scenario.

Suppose a general panel regression specification as

$$y_{it} = \mu_i + \delta' X_{it} + \varepsilon_{it}, \quad (1)$$

where  $X_{it}$  is a vector of  $K$  regressors. The generalized autoregressive distributive lag (ARDL) ( $p, q_1, \dots, q_k$ ) dynamic panel specification associated with this equation can be written as

$$y_{it} = \sum_{j=1}^p \tau_{ij} y_{i,t-j} + \sum_{j=0}^q \delta'_{ij} X_{i,t-j} + \mu_i + \varepsilon_{it}, \quad (2)$$

where  $i = 1, 2, \dots, N$  is the number of countries,  $t = 1, 2, \dots, T$  is the number of time periods and  $X_{it}$  is a  $k \times 1$  vector of explanatory variables.  $\delta_{ij}$  are the  $k \times 1$  coefficient vectors,  $\tau_{ij}$  are scalars while  $\mu_i$  is the usual country-specific effect and  $T$  is sufficiently large to ensure the model can be fitted for each country. If the variables are  $I(1)$  and cointegrated, then the error term is a  $I(0)$  process for all  $i$ . This feature implies an error correction model in which the short-run dynamics are influenced by the deviation from equilibrium. Thus, the error correction equation associated with the generalized autoregressive distributive lag is

$$y_{it} = \varphi_i (y_{i,t-1} - \theta_i' X_{it}) + \sum_{j=1}^{p-1} \tau_{ij}^* \Delta y_{i,t-1} + \sum_{j=0}^{q-1} \delta'_{ij} \Delta X_{i,t-j} + \mu_i + \varepsilon_{it}, \quad (3)$$

where

$$\varphi_i = - \left( 1 - \sum_{j=1}^p \tau_{ij} \right), \theta_i = \frac{\sum_{j=0}^q \delta_{ij}}{1 - \sum_k \tau_{ik}}, \tau_{ij}^* = - \sum_{m=j+1}^p \tau_{im}, \delta_{ij}^* = \sum_{m=j+1}^q \delta_{im} \quad (4)$$

and  $1 \leq j \leq p-1$  and  $1 \leq j \leq q-1$ .

The parameter  $\phi_i$  represents the error-correcting speed of adjustment. If  $\phi_i = 0$ , then no evidence exists for long-run relationships. Thus, this parameter is expected to be negative and significant under the assumption that variables show a return to long-run equilibrium.

In estimating the error correction equation, Pesaran and Smith (1995) suggest that the model could be estimated separately for each country  $i$  and a simple arithmetic mean of the estimated coefficients taken. This is the mean group estimator. Under this estimator, the intercepts, slope coefficients and error variances are allowed to be distinct across countries. Pesaran et al. (1997, 1999) proposed a PMG estimator that combines both pooling and averaging. Like the MG estimator, the PMG estimator allows intercept, short-run coefficients, and error variances to differ across countries. However, in much similarity to fixed effects estimator, it constrains long-run coefficients to be equal across countries. The parameters are estimated using maximum likelihood estimation method. The log likelihood associated with the error correction function can be written as

$$l_T(\theta', \sigma') = -\frac{T}{2} \sum_{i=1}^N \ln(2\pi\sigma_i^2) - \frac{1}{2} \sum_{i=1}^N \frac{1}{\sigma_i^2} (\Delta y_{it} - \varphi_i \omega_i(\theta))' H_i (\Delta y_{it} - \varphi_i \omega_i(\theta)) \quad (5)$$

for  $i = 1, \dots, N$ , where  $\omega_i(\theta) = y_{i,t-1} - X_i \theta$ ,  $H_i = I_T - W_i (W_i' W_i)^{-1} W_i'$ ,  $I_T$  is the usual identity matrix of order  $T \times T$ , and  $W_i = (y_{i,t-1}, \dots, y_{i,t-p+1}, X_i, X_{i,t-1}, \dots, X_{i,t-q+1})$ .

An initial estimate of the long-run coefficient vector,  $\hat{\theta}$ , is obtained and the short-run coefficients and group-specific speed of adjustment terms are estimated by performing a regression of  $\Delta y_i$  on  $(\hat{\omega}, W_i)$ . These conditional estimates are in turn used to update the estimate of  $\theta$ . The process is iterated until convergence is achieved.

As an illustration of the scenario presented in this paper, we have a panel model specification that has two regressors—relative money supply and relative real output—denoted by the vector  $X_{it} = (X_{1it}, X_{2it})$ , and one regressand—nominal exchange rate—denoted by scalar  $y_{it}$ . In the instance when the lag order selection criterion implies that a maximum of one lag is appropriate, the associated ARDL becomes ARDL (1,1,1) dynamic panel specification which is given by

$$y_{it} = \delta_{10i} X_{1it} + \delta_{11i} X_{1it-1} + \delta_{20i} X_{2it} + \delta_{21i} X_{2it-1} + \tau_i y_{it-1} + \mu_i + \varepsilon_{it}, \quad (6)$$

where ARDL (1,1,1) implies that the dependent variable is lagged once and each of the two independent variables is lagged one—thus, we have ARDL (1,1,1).

The error correction reparameterization of the ARDL (1,1,1) dynamic panel is then given by

$$\Delta y_{it} = \varphi_i (y_{i,t-1} - \theta_{0i} - \theta_{1i} X_{1it} - \theta_{2i} \Delta X_{2it}) + \delta_{11i} \Delta X_{1it} + \delta_{21i} \Delta X_{2it} + \varepsilon_{it} \quad (7)$$

where

$$\varphi_i = -(1 - \tau_i), \theta_{0i} = \frac{\mu_i}{1 - \tau_i}, \theta_{1i} = \frac{\delta_{10i} + \delta_{11i}}{1 - \tau_i}, \theta_{2i} = \frac{\delta_{20i} + \delta_{21i}}{1 - \tau_i} \quad (8)$$

The error-correction speed of adjustment parameter,  $\phi_p$  and the long-run coefficients  $\theta_{1i}$  and  $\theta_{2i}$  are of primary interest. With the inclusion of  $\theta_{0i}$ , a nonzero mean of the cointegrating relationship is allowed.

The above illustration motivates our set-up for the estimation of the parameters of the exchange rate determinants in our regression. If we set  $p = q = 1$  so that we impose a one period lag on all variables, we can transform the regression equation into an ARDL dynamic panel specification. In our specification, besides exchange rate, which is the dependent variable, there are two regressors—relative money supply and real output. Thus, the ARDL ( $p, q_1, \dots, q_k$ ) is obtained by setting  $p = q = 1$  and  $k = 2$  in the generalized ARDL. This gives

$$y_{it} = \tau_i y_{i,t-1} + \delta'_{i0} X_{i,t} + \delta'_{i1} X_{i,t-1} + \mu_i + \varepsilon_{it} \quad (9)$$

and the subsequent error correction model is given by

$$\Delta y_{it} = \varphi_i (y_{i,t-1} - \theta'_i X_{i,t}) + \delta'_{i1} \Delta X_{i,t} + \mu_i + \varepsilon_{it},$$

where

$$\varphi_i = -(1 - \tau_i), \theta_{0i} = \frac{\mu_i}{1 - \tau_i}, \theta_{ki} = \frac{\delta_{ki0} + \delta_{ki1}}{1 - \tau_i}, k = 1, 2 \quad (11)$$

and  $p = q = 1$  and  $X_{it}$  is a  $2 \times 1$  vector of explanatory variables, each having coefficient  $\theta_{ki}$  - as in,  $\theta'_i$  is a vector that stacks  $\theta_{ki}$  for  $k = 1, 2$  while  $\delta'_{i1}$  and  $\delta'_{i0}$  stack  $\delta_{ki1}$  and  $\delta_{ki0}$ , respectively. Both MG and PMG techniques provide similar estimated coefficients that are supportive of the monetary model in sign and significance, though for both estimators, the estimated coefficient of money supply elasticity continues to be less than unity.



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