The Role of Foreign Exchange Rates in Sub-Saharan Countries: Empirical Comparison with Non-Euro OECD Countries Using Panel Data

Elias Sanidas and Fetene Bogale Hunegnaw

The effect of devaluations on economies is one of the most controversial macroeconomic policies in Sub-Saharan Africa (SSA), both theoretically and empirically. This study uses panel data from 1995-2013 for 17 SSA countries and 17 non-Euro OECD economies. The main conclusion is that exchange rates devaluations and revaluations are an effective policy instrument in improving trade balances and boosting real output in both regions. There are some similarities in the results between the two groups of nations but also many differences, which are indicated in detail in the text. For example, regarding the estimation of trade balances directly, the income effects (own GDP and foreign GDP) and the exchange rates effect seem to be more important in the case of SSA group than in the case of the OECD group. There are also some policy implications. Thus, governments in SSA nations are encouraged to further pursue both exchange rates and monetary or fiscal policies; and as they develop their industries, they may rely more and more on floating exchange rates.

Keywords: Exchange Rates, GDP, Trade balance, Exports, Imports, Panel data, Sub Saharan and OECD countries

JEL Classification: F14, F31, F43

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I. Introduction

Exchange rates are the necessary link between domestic economies and foreign economies. They play a very important role in contributing to the determination of exports, imports, trade balances, and GDP of all countries. This role is well documented in the relevant literature (both theoretically and empirically) and needs no evidence in this paper (although indirectly we talk about this issue as seen in the paragraphs which follow below). However, this role is not clear cut; it depends on several factors such as stage of economic development, import or export substitution, and so on.

In this paper, we want to examine a particular region of the world, the Sub Saharan Africa (SSA), which is still one of the poorest areas. We want to see the role of exchange rates in the economic development of this region through foreign trade for five main reasons. First as we will see in the next section there is a theoretical controversy regarding the effectiveness of devaluations/depreciations on trade balances and outputs. Hence strong empirical evidence might provide us a more definite theoretical answer to this controversy. Second, only a few studies have been conducted for this region (SSA) in this respect, and the conclusions have not been clear cut.

Third, we want to use four econometric models of panel data for providing rigorous empirical evidence; this is also a novelty of our paper which will add more robust conclusions in the existing literature for developing countries such as the SSA ones. Fourth, we will examine both trade balances directly and indirectly through exports and imports separately (another novelty). Finally, another important contribution of our paper is the econometric comparison between the SSA nations and a good sample of the non-Euro OECD developed countries. With this comparison we might be able to discern eventual differences in the effect of devaluations between developing and developed nations; these differences will in turn elucidate some theoretical considerations. All these five contributions make our paper a substantial addition to the existing relevant literature.

Developing countries such as the SSA ones face continuous problems regarding trade deficits and often low growth rates. These SSA nations have been using the policy tool of exchange rates to boost exports or to curtail imports and to accelerate their economic growth. In particular they often devalue their currency in order to boost exports and grow

faster. This devaluation takes place mainly under the regime of highly managed floating rates (IMF 2004 classification) and hence we will use the term depreciation only for the freely floating rates of developed countries as this term is established in the literature.[1]

Did these devaluations succeed? Did they improve trade balances? Were they the right policy? Did they have expansionary effects on output? For example, under the flag of liberalization for the last three decades in SSA countries their trade balances worsened (Agbeyegbe *et al.* 2004; Freund, and Rocha 2011), although their GDP was growing. International organizations such as the World Bank (WB) and International Monetary Fund (IMF) suggested more reforms including further devaluations of domestic currencies. Were these suggestions correct? Our paper will attempt to provide some answers to these questions.

Consequently, we will test the following specific hypotheses:

i) Exchange rates have a definite positive effect increasing real and nominal output; increasing exports and reducing imports; and reducing trade balance deficits in SSA countries;
ii) This effect is much stronger for non-Euro Zone OECD countries than SSA countries.

The remaining paper is as follows. In section II we summarize some theoretical and empirical articles in the literature. In section III we present the data, equations to be estimated, and the econometric models to use. In section IV we present our empirical results with relevant comments and discussion. Finally in section V we conclude.

[1] Changes in exchanges rates are given various names depending on the kind of exchange regimes prevailing. Under the floating regime system, a fall in the market price of a currency (vis-a-vis the US$) is called depreciation while a rise in market value of the currency is called appreciation. We refer to a discrete official reduction in the otherwise fixed par value of the currency as devaluation; revaluation is the antonym describing discrete rising of official par value. In any case for our study, when our exchange rate variable goes up (*e.g.* from 100 to 140 units of national currency per one US$) it shows devaluation or depreciation.

II. Literature review

There are three main theories (Abbas *et al.* 2014) that discuss the effect of devaluations on trade balances and output. First, the elasticities approach is embodied in a Keynesian model where output is assumed to be demand determined and related to unutilized production; then the impact of nominal devaluations on output and employment is positive. A country will improve its current account deficit by devaluing its currency provided that the sum (in absolute value) of the elasticities of demand for its exports and imports is greater than one.[2]

Second, according to the absorption approach, the effectiveness of nominal devaluations will depend on the economy's ability to generate expenditure switching (direction of a country's expenditure between foreign goods and domestic goods) and expenditure reducing (based on taxation measures). If nominal devaluations induce expenditure switching, then they will affect relative prices and thus, the (real or nominal) exchange rate changes increase real or nominal output and thus generate improvements in the current account.

Finally, the monetary approach focuses on the interaction between the external sectors and the monetary side of the economy. In this setting, if domestic credit is kept constant, devaluations will have a temporary effect on the trade balances. The trade balances will improve to the extent that the real balances effect will depress absorption and, through price increases, will reduce the real value of household wealth.

Based on these interrelated theories, economists and policy makers view depreciation or devaluation as the conventional tool for improving trade balances and output, although several authors have challenged this tool. Thus, the relationship between exchange rate depreciation/devaluation and output in developing countries has been debated and the issue is not settled. Most of the counter-arguments come from pessimists about elasticities effectiveness as well as from aggregate supply and cost considerations. Accordingly, proponents of the view that devaluations may have adverse real effects regarding semi-industrialized and developing countries are based on the presumption that trade flows are relatively insensitive to price and exchange rate

[2] As we shall see further below, our empirical results show that this approach seems to be correct.

changes in these countries. Following the footsteps of Hirschman (1949), Alejandro (1963) was among the first scholars to raise this possibility. He shows that devaluations may lead to reductions in real income using a model with relative price inelastic exports. Krugman, and Taylor (1978), have extended and formalized this view. They argue that devaluations can be contractionary to the extent that they generate, through their effects on the price level, a negative real balances effect. This, in turn, will result in lower aggregate demand and under some circumstances, lower output. In our present paper we show that we disagree with these pessimist scholars.

The channels through which real depreciation affect domestic production are many, and they are usually summarized by referring to the aggregate demand and aggregate supply models. Depreciation raises the cost of imported inputs and thus the cost of production, leading to a decrease in the aggregate supply. In addition, this could stimulate net exports, resulting in an increase in aggregate demand. This increase in aggregate demand is more than the decline in aggregate supply, and hence depreciation is expansionary. In our study we are interested in the impact of exchange rates changes mainly on aggregate output and trade balances. Thus, we are not interested in all the pros and cons of *e.g.* devaluations in the economy (empirically); that would be a huge task and hence out of the scope of our paper. However, we can briefly mention here the advantages and disadvantages of devaluations at least in theory:

Advantages

(i) Exports become cheaper and more competitive in relation to foreign nations, thus providing a boost for domestic demand and hence leading to more employment.
(ii) Higher level of exports lead to an improvement in the current account deficit and competitiveness.
(iii) Higher exports and aggregate demand can lead to higher rates of economic growth.

Disadvantages

(i) Can cause inflation through imports becoming more expensive and increases in aggregate demand without increases in local production
(ii) Decline in incentives for local producers to be efficient and thus

generate lower productivity
(iii) Reduces the purchasing power of national citizens going abroad
(iv) Speculation

In addition, when assessing the impact of devaluations, we must briefly examine some factors which influence this impact (and hence can be used as control variables in our empirical work). Thus, both government spending and broad money supply have expansionary effects on the gross domestic product (GDP). The effect of government spending is understood if we notice that this spending might enhance national infrastructure and employment opportunities, especially in the developing countries; and hence more imports might be necessary in developing countries of high technology and machinery products to build this infrastructure. The volume of money is often regarded as a complement to the exchange rate policy mainly because it becomes a cushion to inflationary or deflationary tendencies in the economy. Foreign direct investment (FDI) can also affect national output through the impact of imports on the economy, especially in the developing nations; FDI can also increase imports because FDI might mean that new factories produce local low technology products that necessitate high technology and machinery imports. Finally, another price variable that might affect the economy is the commodity prices index because developing nations export many commodities such as coffee, tea, *etc.* substantially.

Despite all these issues regarding the effectiveness of devaluations to adjust macroeconomic performances, the SSA nations have made maximum use of currency devaluations in recent years with the intention to change the direction of their economies. This implies that they are more inclined to have faith in the merits of devaluation to promote important macroeconomic goals and generate rapid economic growth. However, unlike for Asia and Latin America, the literature on the effect of devaluations in Africa is very scanty. Such neglect is unfortunate especially when the effect of devaluations in these countries has been characterized as one of the most controversial macroeconomic policies, see Sahn (1996). Empirical results of some studies (see Table 1) conducted for selected SSA countries are mixed, thus confirming the theoretical and quantitative controversy. Also in Table 1 we included several other articles for various other countries and regions of the world where we can see the effects of exchange rates

Table 1
Summary of Literature Review

Author	Region	Methodology	Effects
The effect of exchange rate on output			
Morley (1992)	LDC	2SLS	Contractionary
Kamin, and Rogers (2000)	Mexico	VAR	Contractionary
Upadhyaya, Dhakal, and Mixon (2000)	Turkey	VECM	No effect
Y. Kim, and Ying (2007)	Some East Asia	VAR	Contractionary
Edwards (1989b)	LDC	Simultaneous	Contractionary
Nunnenkamp, and Schweickert (1990)	Developing countries	OLS	Contractionary
Christopoulos (2004)	Asian Countries	FOLS	Expansionary
Nusair (2014)	16 East European countries	Cointegration	Expansionary for 7
Nusair (2014)	16 East European countries	Cointegration	Contractionary for 8
Nusair (2014)	India	Cointegration	Expansionary
Domac (1997)	Turkey	3SLS	Expansionary
Kalyoncu *et al.* (2008)	Finland, Ger/any, Sweden	VECM	Expansionary
Bahmani-Oskooee, and Kutan (2008)	Eastern Europe	VECM	Contractionary
Bahmani-Oskooee (1991)	LDCS	VECM	Expansionary
The effect of Exchange rates on Trade balances			
Miles (1979)	Latin American countries	OLS	No effect
Upadhyaya (1999)	Cyprus, Greece, Morocco	DL	Negative
Wilson, P. (2000)	South Korea	VECM	No effect
Wilson, P. (2000)	South Korea	OLS	positive
Y.-Y. Kim (2012)	South Korea	VAR	No effect
Himarios (1985)	Developing countries	Open eco/my model	positive

Table 1
(Continued)

Author	Region	Methodology	Effects
Baharumshah (2001)	Malaysia and Thailand	Cointegration	Positive
Lal, and Lowinger (2002)	Asia	OLS	Positive
Onafowora (2003)	East Asia	VECM	Positive
For African Countries in particular			
The effect of exchange rate on output			
Taye (1999)	Ethiopia	Simultaneous	Expansionary
Yiheyis (2006)	20 SSA	OLS	Contractionary
Genye (2010)	Ethiopia	OLS	Expansionary
Galebotswe, and Andrias (2011)	Botswana	VECM	Expansionary
Upadhyaya, Rainish, and Phelan (2009)	Kenya, Tanzania, Uganda	Panel OLS	Expansionary
El-Ramly, and Abdel-Haleim (2008)	Egypt	VAR	Expansionary
The effect of Exchange rates on Trade balances			
Yol, and Baharumshah (2007)	Tanzania	FMOLS	Positive
Yol, and Baharumshah (2007)	Ghana, Morroco, Senegal	FMOLS	No Effect
Eita (2013)	Namibia	VAR	Positive
Yol, and Baharumshah (2007)	10African countries	FMOLS	Positive for 6
Kwalingana *et al.* (2012)	Malawi	VECM	Not effect
Gebeyehu (2014)	Ethiopia	ARDL	Positive
Loto (2011)	Nigeria	OLS	Not effect
Ogbonna (2013)	Nigeria	VECM	Positive
Arabi, and Abdalla (2014)	Sudan	VECM	Positive
Bahmani-Oskooee, and Gelan, A. (2012)	9 Sub-Saharan Countries	VECM	Positive for 4
Agbola (2004)	Ghana	DOLS	No effect

Source: Authors' research

on output and trade balances.

III. Data and Empirical Methodology

The series of data examined in this study are the gross domestic product (GDP), exports, imports, exchange rate, money supply, government expenditure, foreign direct investment, and commodity prices which are collected from IMF, World Bank, and UNCTAD (United Nation Conference on Trade and Development). Our study uses panel data from 1995-2013 for 17 SSA countries in one group and 17 non-Euro OECD economies in the other group .The SSA countries included in the sample are Botswana, Burkina Faso, Burundi, Cameron, Cote D'Ivoire, Ethiopia, Ghana, Kenya, Malawi, Mali, Mauritius, Mozambique, Nigeria, Niger, Senegal, South Africa, and Uganda. The OECD sample includes Australia, Canada, Chile, Denmark, Hungary, Iceland, Israel, Japan, South Korea, Mexico, New Zealand, Norway, Poland, Sweden, Switzerland, Turkey, and the United Kingdom.

All variables are expressed in terms of growth rates (*e.g.* natural log of X_t – natural log of X_{t-1} or ln (X_t) – ln (X_{t-1}). In this way we achieve two prerequisites for a good empirical analysis. First, we achieve as much as possible stationarity hence we eliminate the possibility of spurious results. Second, we achieve a standardized expression of all variables, thus making comparison between regressions possible.

An exchange rate is the price of the home nation's currency in terms of another nation's currency, in our case in terms of the US$. With this definition, when the exchange rate increases it signifies depreciation of the national currency's exchange rate. The real exchange is calculated based on the consumer price index of domestic countries and the USA; it is calculated as $RER_{ij} = NER_{ij}*(CPI_{usa}/CPI_i)$ (see also Thapa 2002); where, NER is the nominal exchange rate against the USA; CPI_i is consumer price index of domestic country '*i*'; CPI_{usa} is consumer price index of USA.

In our empirical analysis the impact of exchange rates fluctuations on trade balances is estimated both indirectly through the impact on exports and imports separately; and directly through the impact on trade balances. Usually, the latter are defined as the difference of exports and imports values. In this study, we measure trade balances by the ratio of imports values to exports values. This ratio is widely used in many relevant emprical investigations such as those by

Bahmani-Oskooee, and Brooks (1999), Lal, and Lowinger (2002) and Onafowora (2003). This ratio is preferable because it is not sensitive to currency units and can be interpreted as nominal or real trade balances (Bahmani-Oskooee (1991)). Thus, a decrease in this ratio implies trade balances improvement while an increase in the ratio shows worsening of trade balances.

Regarding the equations to be estimated econometrically, as we have already mentioned, the impact of exchange rates on trade balances and output is not theoretically clear cut and hence we can arrive at some useful and more definite conclusions about this impact only empirically. To determine these equations, we use models that have been already used by many scholars who conducted empirical estimations; these models have also been suggested in various theoretical forms by scholars such as Dornbusch (1980) or Meese, and Rose (1990). It is also important to emphasize that it is customary that salient articles in relevant literature use the reduced-form equations /models. Thus, Bahmani-Oskooee *et al.* (2002, p. 71) say: "Since methodology is based on Johansen's (1998) cointegration analysis, we must rely on a reduced-form model. Following our previous research, the following model is adopted: $Y_t = f$ (…)…" Also, Edwards (1986, p. 503) used the fixed effect approach on a reduced form: "The reduced-form equation for real output considered in this paper is …" Lal, and Lowinger (2002, p. 374) very simply said: "We postulate the following model of the trade balance: …" And so on. All these authors did not use any structural-form equations in their methodology.

Thus, similarly we follow in particular Siregar, and Rajan (2004, pp. 224, 226) who said in relation to the export and import demand functions: "There are two primary determinants of export and import demand (Dornbusch 1980; Hooper, and Marquez 1993). First, is the foreign income variable which measures the economic activity and the purchasing power of the trading partner country ("income effect"). Second, is the relative price of the terms of trade variable ("price effect")…" We therefore also postulate theoretically (according to the existing literature) that the exports (X) and imports (M) equations should include the prices effect represented by exchange rates (E) and the income effects represented by domestic income or GDP (Yd) and foreign income (Yf); they can also include other relevant variables such as money sypply (M2), government expenditure (GE), foreign direct investment (FDI), commodity prices index ($COPI$), and so on. Note

that foreign income (*Yf*) is defined in our analysis as the top 20 trade partners' real GDP for the SSA region and the top nine partners for the OECD region.

$$X = f(E, Yd, Yf, \text{other variables}) \quad (1)$$
$$M = f(E, Yd, Yf, \text{other variables}) \quad (2)$$

It is important to emphasize that our main interest is the relationship between the dependent variables and the exchange rate *E*; hence the other variables can be considered as the control variables in the estimation process; in particular the income or output variables *Yd*, and *Yf* are necessary in order to include the income effect of the demand or supply concepts.

Similarly for the trade balances, the equation for estimation purposes is

$$(M/X) = f(E, Yd, Yf, \text{other variables}) \quad (3)$$

As already mentioned earlier, trade balances are defined as the ratio of imports to exports (*M*/*X*); a couple of extra references on this partial equilibrium equation[3] are Bahmani-Oskooee, and Niroomand (1998), Bahmani-Oskooee, and Alse (1994).

Finally, regarding the impact of exchange rates on output, a common practice in the literature is to relate total output not only to real or nominal exchange rate but also to measures of monetary and fiscal policies. The general model adopted here closely follows the one developed by Edwards (1989a), Bahmani-Oskooee, and Kutan (2008), Bahmani-Oskooee, and Kandil (2009), Ratha (2010) and takes the following form.[4]

[3] All these equations to be estimated econometrically are partial equilibrium based and hence we do not deal with structural-form equations modeling which would involve simultaneous equations with all dependent variables being endogenous. It is out of the scope of this paper to estimate structural-form equations although our GMM can bridge this gap substantially (GMM is used in our study).

[4] We will also test the same Equation (4) in nominal terms thus in this way we will be able to check on the importance of inflation indirectly.

$$RGDP = f\,(RE,\ RM2,\ RGE,\ \text{other variables}) \tag{4}$$

In our study we use panel data which means a combination of time series and cross section data as already mentioned above. We will apply four models for panel data: fixed effects (FE), random effects (RE), seemingly unrelated regressions (SUR), and generalized method of moments (GMM). These panel data models have been popularized recently with good empirical results; for a theoretical treatment of these models see Baltagi (2013). Out of these four models the FE and RE are simpler than the other two. The FE and RE models assist in controlling for unobserved heterogeneity when this heterogeneity is constant over time. This constant can be removed from the data through differencing, for example by taking a first difference. The RE assumption is that the individual specific effect is uncorrelated with the independent variables. The FE assumption is that the individual specific effect is correlated with the independent variables. In general, as Judson, and Owen (1997) argue, the FE model is more suitable than the RE model when dealing with macroeconomic data and with small sample size. Regarding the SUR model, initially Zellner (1962) introduced this model for a set of equations whose residuals of each equation may be correlated with the residuals of the other equations in the set; thus in this way the set of estimated equations may take into account the simultaneous effect of other common factors on all equations not explicitly considered in the separately estimated equations. This model was subsequently extended in the panel data case.

The problem of an omitted variable bias can be alleviated when an FE panel estimation is employed. Nevertheless, this approach cannot control time-varying country effects and endogeneity. Taking these issues into account, Caselli *et al.* (1996) and Bond *et al.* (2001) applied the GMM to correct for unobserved country heterogeneity, omitted variable bias, measurement error, and potential endogeneity. In particular, a system GMM, developed by Arellano, and Bover (1995) and Blundell, and Bond (1998), was found to reduce a small sample bias that characterizes the first-differenced GMM used by Caselli *et al.* (1996). In general, a GMM approach uses instrumental variables, lags, strictly exogenous (*e.g.* dummies representing omitted variables for each year), and endogenous variables (*e.g.* the dependent variable). Thus, we use the GMM approach in our study and we consider the relevant results as the most appropriate in our empirical work, although the

other three approaches to panel data can be confirmatory. Note that following the relevant literature, we use the following two criteria for model specification tests: first the Hansen test of over-identification, and second the test for second-order serial correlation AR (2) in first-differences that detect autocorrelation in levels. The AR (2) test also provides for further checks on the specification of the model, and on the legitimacy of variables as instruments in the differenced equation; a value of more than 0.05 in both test confirms the legitimacy of GMM results.

In general we will estimate the following GMM:

$$Y_{it} = X_{it}\beta_1 + W_{it}\beta_2 + \upsilon_{it} \qquad (5)$$
$$\upsilon_{it} = u_i + \varepsilon_{it}$$

where X_{it} includes strictly exogenous regressors, W_{it} are predetermined regressors (which may include lags of Y, which in our case is exports, GDP *etc.*) and endogenous regressors, all of which may be correlated with u_i, the unobserved individual effect (countries in our case); the error ε_{it} is idiosyncratic. First-differencing the Equation (5) removes the error u_i and its associated omitted-variable bias. Note that in our estimations both first differencing and levels of data is used (a useful option of the software STATA). Finally it is important to emphasize that the FE and other models are sub-categories of GMM.[5]

IV. Empirical Results

As we have already established so far, our paper attempts to empirically determine the impact of exchange rates on trade balances and output since theoretically scholars have not arrived at a clear cut conclusion regarding this impact. Thus, the results presented in this section are some of the best results we obtained out of various estimations based on the above Equations (1) to (4). This means that for example lags of some independent variables such as FDI are determined empirically. Also please note that for the GMM approach we usually include yearly dummy variables as strictly exogenous (thus taking into account macroeconomic shocks). Finally, we want to emphasize

[5] Of course it is out of the scope of this paper to present a systematic analysis of GMM and other models we use in our study.

that we attempted several models, for example having exactly the same variables (with no lags) for both exports and imports; however we preferred to present the results shown in the Tables below. Despite space limitations, nonetheless, we present some extra results based on the FE procedure shown in Appendix (where we added a yearly dummy variable for shocks).

Let us start with the exports response to exchange rates. Table 2 shows that the elasticities[6] of exports to exchange rate, own income and trade partner's income for both groups have positive and significant effects. We will mainly use the GMM results[7] as we believe they are more credible due to the inclusion of endogeneity issues as represented by adequate lags and instrumental variables. The coefficient for the exchange rate is positive and less than one as expected. It is rather larger for the SSA group than for the other group of countries probably because the former group has experienced larger fluctuations in exchange rates.[8] When we compare the own income elasticity in relation to exports between the two regions, the elasticity for the OECD countries is much higher than for the SSA countries; the opposite is true for the foreign income elasticity in relation to exports, thus indicating the stronger dependence of SSA on foreign demand (as expected since this region is still developing). Furthermore, for the SSA group only, FDI lagged 3 years and the price indexes of commodities have a positive effect on exports as expected.[9] This FDI lag was found to be the best lag empirically; it is not unreasonable since it takes some time before FDI has an impact on exports supply. Also note that the SUR results do not differ from the FE and RE results, thus indicating a relative independence between the estimated equations (hence the likely non-simultaneous nature of equations (1) to (4)).

Next, we will examine the imports. As we see in Table 3, the exchange

[6] As we have variables expressed as growth rates, the coefficients of these variables are equal to elasticities.

[7] The instrumental variables used for each model in this paper can be provided upon request.

[8] The OECD group has more freely floating exchange rates than the SSA group.

[9] The variable broad money supply M2 is not included in the above regressions. However, in other regressions not shown here, M2 as a monetary policy instrument is sometimes found to be effective in affecting exports values in both SSA and OECD countries (see for example our extra results in Appendix).

TABLE 2
EXPORTS RESPONSE

Variables	SSA countries				Non-Euro OECD Countries			
	RE	FE	SUR	GMM	RE	FE	SUR	GMM
	Coef.	Coef	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
E	0.12*	0.17**	0.12*	0.57**	0.20***	0.29***	0.20***	0.47***
	(0.08)	(0.05)	(0.08)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
Yd	0.50***	0.49***	0.50***	0.51***	0.82***	0.91***	0.83***	1.15***
	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
Yf	0.39	0.37	0.39	0.81*	0.44***	0.46***	0.44***	0.40***
	(0.33)	(0.36)	(0.32)	(0.08)	(0.00)	(0.00)	(0.00)	(0.00)
GE	0.09	0.13*	0.0873	0.25***				
	(0.15)	(0.06)	(0.14)	(0.00)				
FDI (-3)	0.03*	0.03	0.03*	0.03**				
	(0.10)	(0.11)	(0.09)	(0.04)				
COPI	0.26***	0.27***	0.261***	0.24***				
	(0.00)	(0.00)	(0.00)	(0.00)				
Const.	-0.01	-0.02	-0.01	-0.08**	0.67***	0.51***	0.01	-0.02***
	(0.60)	(0.48)	(0.60)	(0.02)	(0.00)	(0.00)	(0.51)	(0.00)
R2-within	0.35	0.35			0.63	0.63		
R2-b/n	0.32	0.26			0.58	0.56		0.56
R2-Ov.all	0.35	0.35			0.63	0.62		0.62
Pr > chi2	0.00	0.00		0.00	0.00	0.00		0.00
No. Obs.	249	249	249	247	306	306	306	306
No. of countries	17	17	17	17	17	17	17	17
No. instru				26				24
Arellano-Bond t. for AR(2) in the first diff:				0.41				0.42
Hansen test of over. restrictions:				0.72				0.72

Notes: (i) RE, FE SUR, GMM stand for random effect, fixed effect, seemingly unrelated regression and general method of moments.

(ii) P-values in parentheses; ***, **, * denote 1 percent, 5 percent, and 10 percent level of significance respectively.

(iii) E stands for exchange rates; Yd stands for national GDP; Yf stands for foreign GDP (total of 20 nations for the SSA, and 9 for the OECD group); GE stands for government expenditure, FDI stands for foreign direct investment; COPI stands for commodity prices index. All these variables are expressed as growth rates (using the logarithmic formula).

Table 3
Imports Response

Var.	SSA countries				NonEuro OECD Countries			
	RE	FE	SUR	GMM	RE	FE	SUR	GMM
	Coef.	Coef	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
E	-0.30***	-0.38***	-0.30***	-0.60***	-0.96***	-0.98***	-0.96***	-1.20***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Yd (–1)	0.17**	0.14*	0.17**	0.14***	0.08	0.07	0.08	0.16***
	(0.02)	(0.06)	(0.02)	(0.00)	0.17	(0.20)	(0.17)	(0.00)
GE	0.10	0.06	0.09	0.27	0.45***	0.22	0.45***	0.27***
	(0.11)	(0.44)	(0.10)	(0.18)	(0.00)	(0.11)	(0.00)	(0.00)
FDI (–1).	0.06***	0.07***	0.06***	0.06***				0.05***
	(0.01)	(0.00)	(0.00)	(0.00)				
Const.	0.08***	0.09***	0.01	0.08***	0.05***	0.06***	0.06***	(0.00)
	(0.00)	(0.00)	(0.51)	(0.01)	(0.00)	(0.00)	(0.00)	
R2-with.	0.17	0.17			0.50	0.50		
R2-b/n	0.00	0.00			0.19	0.00		
R2-O.rall	0.16	0.15			0.49	0.48		
Pr > chi2	0.00	0.00		0.00	0.00	0.00		0.00
No. Obs.	282	282	282	280	279	279	279	272
No. of countries	17	17	17	17	17	17	17	17
No. instru				25				
Arellano-Bond t. for AR (2) in first diff:				0.56				0.31
Hansen test of overid. restrictions:				0.75				0.72

Notes: (i) RE, FE SUR, GMM stand for random effect, fixed effect, seemingly unrelated regression and general method of moments.
(ii) P-values in parentheses; ***, **, * denote 1 percent, 5 percent, and 10 percent level of significance respectively.
(iii) For definitions of variables see notes of Table 2.

rate's effect on imports has the correct sign (–)[10] and is significant for

[10] It is expected that devaluations increase import prices relative to domestic prices and hence they will reduce imports; thus resulting in a negative import price elasticity.

both groups of countries; in addition, its coefficient is much larger for the OECD countries than for the SSA ones. This is not a surprising result given that the former group is economically developed and when imports become expensive then its economies can easily substitute imports with cheaper local products. Own income (lagged 1 year) and government expenditure are found to be positive and significant in determining imports in both the SSA and OECD countries.[11] Thus, higher government spending will lead to higher spending on foreign goods and hence it deteriorates trade balances. This result is consistent with empirical evidence by Kim S. (2015). In addition only for the SSA group, FDI (lagged 1 year) generates more imports (this lag is reasonable as it takes time for developing countries to import high technology products following some FDI which establish new factories, *etc.*).

When comparing the regressions for exports with imports we can notice that the relative coefficients indicate that the balance of trade improves with devaluations. This can be verified by noticing that the coefficient for own income is much larger for exports than for imports for both groups. Also, the elasticity of exchange rates in relation to exports is marginally lower (based on the GMM) than that for imports although in opposite signs (as expected) for the SSA countries; however, if we consider the other three models (FE, RE, and SUR) this elasticity is larger for imports than for exports thus, devaluations have a positive effect on trade balances. This conclusion is much clearer and more definite for the non-Euro OECD countries, most probably because the latter nations have a more solid production basis. In addition, foreign income is not significant in the case of imports but large and significant in the case of exports for the SSA group; this also makes sense since the OECD developed nations are more self-sufficient and have more intra-industry trade amongst themselves.

Another important point regarding the comparison between exports and imports and for the two groups is the Marshall-Lerner condition for trade balances improvements. Thus the addition of the exchange rates elasticities for exports and imports in the GMM model (which uses lags

[11] Following the Keynesian line of argument, it is expected that an increase in domestic income will stimulate imports yielding a positive income elasticity. However, there are indications in the literature that if increases in domestic income are due to an increase in the production of import substitute goods, imports may actually fall, resulting in negative income elasticity.

Table 4
Trade Balance Response

Var.	SSA countries				Non-Euro OECD Countries			
	RE	FE	SUR	GMM	RE	FE	SUR	GMM
	Coef.	Coef	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
E	-0.33***	-0.42***	-0.33***	-0.43***	-0.12***	-0.17***	-0.12***	-0.20***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)
Yd	-0.31***	(-0.37)	-0.31***	-0.46***	0.12**	0.09	0.12**	0.13*
	(0.00)	0.00***	(0.00)	(0.00)	(0.02)	(0.15)	(0.02)	(0.08)
Yf	-0.42	-0.44	-0.42	-0.24***	-0.10	-0.12	-0.09	-0.19***
	(0.17)	(0.15)	(0.17)	(0.04)	(0.23)	(0.15)	(0.22)	(0.00)
Const.	0.07***	0.08***	0.07***	0.07***	0.00	0.00	0.02***	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.95)	(0.55)	(0.00)	(0.37)
R2-with	0.08	0.08			0.11	0.11		
R2-b/n	0.01	0.01			0.02	0.01		
R2-O.rall	0.07	0.07			0.10	0.10		
Pr > chi2	0.00	0.00		0.00	0.00	0.00		0.00
No. Obs.	305	305	305	288	306	306	306	279
No. of countries	17	17	17	17	17	17	17	17
No. instru				24				24
Arellano-Bond t. for AR(2) in first diff:				0.29				0.05
Hansen test of overid. restrictions:				0.77				0.86

Notes: (i) RE, FE SUR, GMM stand for random effect, fixed effect, seemingly unrelated regression and general method of moment.
(ii) P-values in parentheses; ***, **, * denote 1 percent, 5 percent and 10 percent level of significance respectively
(iii) For definitions of variables see notes of Table 2.

and hence we can assume some long term impacts) is 1.17 (0.57 + 0.60) for the SSA group overall and 1.67 (0.47 + 1.20) for the OECD group. These figures indicate that in the long term devaluations improve trade balances, especially in the OECD group according to the Marshall-Lerner condition as applied to our empirical results.

Let us now directly discuss the effect of exchange rates and other

variables on trade balances. The estimated coefficients in Table 4 indicate that trade balances improve with respect to devaluations of the exchange rate in SSA countries; this improvement being stronger in the case of SSA countries than in the other group. Also, an increase in domestic output (Yd) improves trade balances in the case of SSA countries. The negative coefficient suggests that as own income increases the rate of the ratio of imports to exports values declines which indicate improvements in trade balances. However, in the case of OECD countries, domestic income worsens trade balances. This means that these nations are more integrated globally and the role of intra-trade versus inter-trade is more important in this case (outsourcing in foreign countries counterbalances the effect of exchange rates on imports and exports). An increase in trade partners' income shows a positive impact for both groups of economies which implies that an increase in the top trade partners' income improves trade balances in both regions.[12]

Regarding the output model, when a country devalues or revalues its currency, it may also engage in applying fiscal and monetary policies to manage the economy overall and production in particular. Thus, a common practice in the literature is to relate total output not only to (real or nominal) exchange rate but also to measures of monetary and fiscal policies. Table 5 shows the results according to 4 different methods for panel data (FE, RE, SUR, and GMM). Also, the same models are used for data in nominal terms; the results are shown in Table 6.

As we can see in Table 5, the real exchange rate has a significant effect on real GDP in both groups of countries, non-Euro OECD and SSA ones; although the coefficient for SSA nations is much smaller than the one for the other group. This is not surprising given the small role foreign trade still plays in SSA countries. However, the sign of the independent variable *E* (exchange rate growth) is negative. Although this sign is theoretically also plausible, this negative or inverse relationship might be due to the expression of the data of GDP *etc.* in US$ (as can be easily seen through a simple example). Hence we also tried the same regressions with the same variables expressed in local currency (results

[12] Both government spending and broad money supply may play their positive role in this case also but the relevant regressions are not shown here for space reasons (however, see Appendix where we show some extra results and M2 is significant).

Table 5
Response of Real GDP (Dependent Variable)

Variables	SSA countries				Non-Euro OECD Countries			
	RE	FE	SUR	GMM	RE	FE	SUR	GMM
	Coef.	Coef	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
Re	-0.002	-0.002	-0.02	-0.004***	-0.08***	-0.08***	-0.08***	-0.12***
	(0.25)	(0.58)	(0.27)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
RGE	0.05***	0.05***	0.03***	0.089***	0.04**	0.05***	0.03*	0.07***
	(0.00)	(0.00)	(0.01)	(0.00)	(0.04)	(0.01)	(0.09)	(0.00)
RM2	0.04**	0.03*	0.05***	0.05**	0.05***	0.04**	0.06***	0.07***
	(0.03)	(0.07)	(0.01)	(0.04)	(0.00)	(0.02)	(0.00)	(0.00)
Const.	0.04***	0.04***	0.04***	0.05***	0.02***	0.03***	0.02***	0.02***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
R2-within	0.08	0.08			0.15	0.16		
R2-b/n	0.27	0.23			0.07	0.02		
R2-Overall	0.11	0.11			0.14	0.13		
Prob > chi2	0.00	0.00		0.00	0.00	0.00		0.00
No. Obs.	299	299	299	288	288	278	278	249
No. of countries	17	17	17	17	17	17	17	17
No. instrum				23				26
Arellano-Bond t. for AR(2) in the first diff:				0.76				0.05
Hansen test of overid. restrictions:				0.78				0.86

Notes: (i) RE, FE SUR, GMM stand for random effect, fixed effect, seemingly unrelated regression and general t method of moment
(ii) P-values in parentheses; ***, **, * denote 1 percent, 5 percent, and 10 percent level of significance respectively
(iii) The number of observations in the case of OECD countries is 278 because of unavailability of broad money supply (M2) and government expenditure data for some countries in some years.
(iv) For definitions of variables see notes of Table 2.

not shown here, except one regression for the SSA nations and the RE case as shown below at the end of this paragraph, regression (6)). The sign of the *E* (exchange rate) becomes positive which overall agrees with the remaining of the analysis. Thus, as expected when the currency is devalued, exports growth is positively affected (see also above, the

TABLE 6
RESPONSE OF NOMINAL GDP (DEPENDENT VARIABLE)

Variables	SSA countries				NonEuro OECD Countries			
	RE	FE	SUR	GMM	RE	FE	SUR	GMM
	Coef.	Coef	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
E	-0.37***	-0.40***	-0.37***	-0.74***	-1.00***	-1.00***	-1.00***	-1.06***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
GE	0.24***	0.23***	0.24***	0.21	0.38***	0.24***	0.38***	0.14***
	(0.00)	(0.00)	(0.00)	(0.11)	(0.00)	(0.00)	(0.00)	(0.01)
M2	0.12**	0.03*	0.12**	0.29***	0.20***	0.15***	0.20***	0.22***
	(0.05)	(0.06)	(0.04)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Const.	0.06***	0.07***	0.06***	0.05	0.02***	0.03***	0.021***	0.03***
	(0.00)	(0.00)	(0.00)	0.01	(0.00)	(0.00)	(0.00)	(0.00)
R2-within	0.35	0.35			0.85	0.86		
R2-b/n	0.08	0.01			0.81	0.47		
R2-Overall	0.33	0.33			0.85	0.84		
Prob > chi2	0.00	0.00		0.00	0.00	0.00		0.00
No. Obs.	299	299	299	277	283	283	283	253
No. of countries	17	17	17	17	17	17	17	17
No. instrum				25				25
Arellano-Bond t. for AR(2) in first diff:				0.11				0.91
Hansen test of overid. restrictions:				0.81				0.71

Notes: (i) RE, FE SUR, GMM stand for random effect, fixed effect, seemingly unrelated regression and general moment method.
(ii) P-values in parentheses; ***, **, * denote 1 percent, 5 percent, and 10 percent level of significance respectively
(iii) The number of observations in the case of OECD countries is 278 because of unavailability of broad money supply (M2) and government expenditure data for some countries in some years.
(iv) For definitions of variables see notes of Table 2.

results for exports) which in turn boosts the demand for local goods and hence GDP grows.

$$GDP\ nominal = 0.21\ E + 0.20\ GE + 0.20\ M2 + 0.06 \qquad (6)$$

All variables are significant at the 1% level and the R^2 "between" is 0.86.

From these empirical results, we can understand that all types of fiscal and monetary policies, thus including exchange rate fluctuations, are important policy instruments. In addition, the FE and RE models have a higher R^2 for OECD countries than the SSA countries. From this, we can conclude that OECD countries' real output is better explained by fiscal, monetary and exchange rate policies together in OECD countries than in SSA. It also shows that developed nations such as the ones considered here have reached a sustainable growth which automatically adjusts to monetary, fiscal and exchange rate changes as predicted by theory.

From Table 6 we can see that the results for nominal output growth rates are similar to those for the model using real values for the variables concerned (as in Table 5). This confirms the validity of our results and also shows that any difference in inflation between nations for both groups do not play an important role in this regard.

V. Conclusion

The objective of this study is to investigate the effects of exchange rates on output, imports, exports and trade balances in Sub-Saharan countries and to compare these effects with those of non-Euro OECD economies. The study used panel data from 1995-2013 for 17 SSA countries in one group and 17 OECD economies in the other.

Detailed conclusions can be found in the previous section, but here we can summarize our empirical evidence by confirming our two hypotheses in section I. First exchange rates play a significant positive role in increasing exports, reducing imports and improving trade balances; they generate output growth (nominal and real). In addition, there is some evidence (but not clear) that government expenditure and generally monetary policy based on the money supply are complementary to the effects of exchange rates fluctuations. As a corollary, we also confirmed the Marshall-Lerner condition for trade balances improvements.

Second, the same conclusions are true for the SSA and the non-Euro OECD countries; overall the results are often more robust for the non-SSA nations (not surprisingly); however, the results for the SSA nations seem to be sometimes more "important" than for the other group. Thus, our hypothesis number 2 is not always confirmed in our empirical results; consequently we can re-inforce our conclusions regarding

hypothesis 1 because the policy measures of devaluations etc. can have a stronger effect on SSA group than on the other group.

A side effect of these conclusions is that despite the large difference between the development stage of the SSA countries and the non-Euro OECD nations, exchange rates are effective as a policy tool for both groups of countries. They are also similar in the direction of effectiveness (*e.g.* same sign of relevant coefficients) with only some minor differences. Consequently, the results of our paper have some policy implications: governments in SSA nations are encouraged to further pursue their exchange rates policy with devaluations or depreciations (and accompanied with monetary or fiscal policies); and as they develop their industries, they may rely more and more on unmanaged floating exchange rates.

Finally, the likely drawback of this work is the inability to analyze the detailed effects of exchange on output and trade balances for each individual country. In addition, this study is based on aggregate trade balances but the empirical effects on disaggregate output and trade balances could also be relevant; thus, further studies are required to address these two drawbacks of this paper. Nonetheless, it remains that our research has provided some clear empirical results which can assist governments in SSA nations to continue applying sound foreign economic policies. We thus hope to have contributed to the existing gap in the existing literature in this regard.

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Appendix

Appendix Table 1

Extra Results: The Effect of Exchange Rate on Exports, Imports, Trade Balance and Output

	SSA Countries					Non- Euro OECD Countries				
	FE	FE	FE	FE	FE	FE	FE	FE	FE	FE
Dep.										
Var.	X	M	(M/X)	RGDP	NGDP	X	M	(M/X)	RGDP	NGDP
E	0.176*	-0.29***	-0.2**		-0.356***	0.594***	0.43***	-0.126**		-0.932***
	(0.054)	(0.001)	(0.039)		(0.000)	(0.000)	(0.000)	(0.014)		(0.000)
Yd	0.5***	0.247***	-0.7**			0.974***	1.12***	1.2***		
	(0.000)	(0.010)	(0.03)			(0.000)	(0.000)	(0.000)		
Yf	0.58		-0.27			0.290***		-0.63		
	(0.210)		(0.83)			(0.000)		(0.11)		
M2	0.05	0.055	-0.038		-0.0129	0.0118	-0.077	-0.085*		0.036
	(0.6)	(0.595)	(0.72)		(0.843)	(0.805)	(0.134)	(0.064)		(0.174)
GE	0.14**	-0.00507	0.028		0.214***	-0.144*	-0.0170	0.0565		0.330***
	(0.049)	(0.945)	(0.67)		(0.000)	(0.066)	(0.842)	(0.337)		(0.000)
COPI	0.20**	0.200***	-0.125	0.0165	0.167***	0.27***	0.31***	0.0250	0.0530***	0.101***
	(0.03)	(0.001)	(0.14)	(0.154)	(0.000)	(0.000)	(0.000)	(0.445)	(0.000)	(0.000)
D	-0.009	-0.0056	-0.03	0.0026	0.0187	0.00051	-0.0138	-0.0075	-0.0184***	-0.0207***
	(0.73)	(0.804)	(0.27)	(0.572)	(0.193)	(0.948)	(0.101)	(0.491)	(0.000)	(0.000)
RE				-0.0091					-0.049***	
				(0.596)					(0.002)	
RM2				0.0070					0.031**	
				(0.710)					(0.029)	
RGE				0.032***					0.052***	
				(0.007)					(0.004)	
Cons.	-0.036	0.07***	0.063	0.05***	0.065***	-0.0086	-0.0008	-0.0154	0.026***	0.037***
	(0.235)	(0.001)	(0.22)	(0.000)	(0.000)	(0.219)	(0.914)	(0.103)	(0.000)	(0.000)
N	299	299	305	305	299	283	283	278	278	284
No. C	17	17	17	17	17	17	17	17	17	17

Notes: P-values in parentheses; ***, **, * denote 1 percent, 5 percent, and 10 percent level of significance respectively.

E, Yd, Yf, M2, GE, COPI, RE, RM2, RGE, X, M, (X/M), RGDP, NGDP, Cons., N and No. C. represent growth rates for nominal exchange rate, nominal domestic GDP, nominal foreign GDP, nominal Money supply, nominal government expenditure, nominal commodity price index, real exchange rate, real money supply, real government expenditure, nominal exports, nominal imports, nominal imports to exports ratio, real GDP, nominal GDP, constant, number of observations and number of countries, respectively.

D represents a dummy variable taking the value 1 for global shocks from 2007 to 2010.

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