The pattern of exchange rate co-movement in selected African countries

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Abstract

Purpose – The concept of co-movement has witnessed a resurgence in the international finance literature in recent years after the black swan events. This might be due to a renewed focus on globalization and financial market integration in the world over. The purpose of this paper is to examine the dynamic linkages in the foreign exchange market resulting from recent globalization and financial market integration in Africa.

Design/methodology/approach – A conceptual framework was adapted from the extant literature and was used as the basis of modeling foreign exchange market in Africa. This paper adopts a quantitative research approach and opted for dynamic panel data analysis to empirically unearth the determinants of foreign exchange market co-movement.

Findings – It is interesting to note that exchange rate co-movements were externally determined. Robust support was found for trade intensity, competition and world interest rate on foreign exchange rates co-movement, but regional interest rate differential decreased it. These findings clearly demonstrate the level of financial development and challenges that sometimes exist in exchange rate policy implementation by policy makers in Africa.

Research limitations/implications – Future research might incorporate bilateral investment into the model of exchange rate correlation.

Originality/value – Studies focussing on simultaneous consideration of intensity, trade competition and capital account openness to exchange rate correlations in the contexts of Africa are almost non-existent, and this study makes an important contribution in not only addressing this imbalance but also more importantly improving the relatively parsimonious literature on foreign exchange co-movement.

Keywords Dynamic panel, Africa bilateral trade, Co-movement, Financial integration

Paper type Research paper

1. Introduction

Changes in a country's exchange rate have significant impact on its financial market operation and development as well as other financial markets. Exchange rates changes affect international competitiveness and thus influence real income and output. Efforts aimed at assessing the co-movement patterns of currencies are imperative, because a strong co-movement between currencies has important implications for economic policies and international capital budgeting decisions since negative shocks affecting one market may be transmitted quickly to another through contagious effects. This issue has become more serious with the occurrence of recent black swan events that engulfed the US economy with a series of negative shocks consisting of disappointing economic growth, financial scandals, uncertainty about a potential war with Iraq and terrorist threats. Financial markets, in particular, the stock market, fell by almost 17 per cent; other important markets around the world experienced similar downturns, and some examples are the markets of Ireland (14 per cent), Mexico (11 per cent) and Hong Kong (6 per cent) (Lin, 2012). Over the same period, Iceland's stock market

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experienced positive returns of 26 per cent, South Africa 21 per cent, Ghana 32 per cent, South Korea 12 per cent and Colombia 11 per cent (Joyce and Nabar, 2009; Allen and Wood, 2006; Bawumia, 2014).

Foreign exchange markets in Africa were no exceptions. For example, on average, African currencies depreciated by almost 42 per cent, specifically, the Ghana cedi depreciated by 56 per cent, South Africa rand by 45 per cent, Nigeria naira by 62 per cent and Kenyan shilling by 63 per cent (Bawumia, 2014). This demonstrates that shocks to the developed economies' financial markets often spread to emerging markets which destabilize negatively exchange rate policy. The critical issue is that such interdependence has potential to affect imports competitiveness as well as increasing risk exposure to traders and investors. It would be interesting to verify whether co-movement in the foreign exchange market behaves differently in this era of globalization and financial market integration. When asset markets are under integration, returns will be lower and volatility greater as well as the correlation between asset markets tending to be higher (Coudert *et al.*, 2011; Lin, 2012; Sanjay and Wasim, 2015). The necessity of currency co-movement is essential for understanding different insights on risks as well as its management.

This paper examines dynamic linkages in the foreign exchange market resulting from recent globalization and financial market integration in Africa. The focus on Africa stems from her relatively recent integration with mature markets in Europe and North America. Africa is interesting to analyse since the market is fragile as well as growing in terms of market capitalization. The study tries to analyse why foreign exchange markets often appear to have such large depreciation or appreciation together, yet receive diverse effects from other financial markets. More specifically, the paper attempts to answer two questions. First, how important are bilateral trade flows and trade competition in third markets? Second, can capital account liberalization produce exchange rate dependence?

The paper differs from existing research in the following ways. First, in simultaneously considering bilateral trade, trade competition and capital account openness, this study makes a modest contribution to the examination of exchange rate correlations in Africa. Second, unilaterally considering foreign exchange market alone makes this paper unique since studies usually look at stock market and exchange rate co-movement. The paper further contributes to the literature in deviating from the previous studies by using the Chinn-Ito capital account openness index to capture financial liberalization instead of the usual dummy variable approach.

Third, all previous studies were done only on the mature and emerging markets especially Asia. The present research is extended to five countries in Africa including South Africa which became part of Brazil, Russia, India, China and South Africa (BRICS) in 2010. Fourth, the current paper attempts to add to the limited volume of literature on the usefulness of panel data models in understanding the dynamic relationship. The paper is structured as follows: Section 2 reviews previous literature on co-movement, Section 3 presents a framework of analysis which is followed by a discussion of results in Section 4, Section 5 provides sensitivity tests and conclusions to the study are presented in Section 6.

2. Literature

The review is done under two perspectives: studies related to channels of contagion and research on foreign exchange markets were analysed.

Generalised Purchasing Power Parity (G-PPP) remains a benchmark against which the misalignment of a currency can be measured. The G-PPP is appropriate for countries

having a high degree of economic interdependence. When economic interdependence is high, it makes sense intuitively that a country's bilateral exchange rate may be explained by the exchange rates of other countries and probably the economic fundamentals of other countries. The G-PPP allows a test that goes beyond the traditional two-country test. The original test of G-PPP theory could not find cointegration among the real exchange rates of the industrialized countries (Enders and Hurn, 1994). However, when the system was augmented to include both industrialized countries and some emerging economies in the Pacific Rim, G-PPP was found to hold importance. The interpretation of the result is that this group considered as a whole may be suitable for monetary integration. Empirical tests of G-PPP conclude on cointegration of the real exchange rates (Aggarwal and Mougoue, 1993; Tse and Ng, 1997; Liang, 1999; Ogawa and Kawasaki, 2003).

Traditional trade theory posits that trade openness leads to a greater specialization across board such that business cycles are dominated by industry-specific supply shocks to reduce business cycle synchronization (BCS). On the other hand, if the patterns of trade specialization are dominated by intra-industry trade, greater trade integration should be associated with a higher degree of co-movement. Greater trade integration driven by demand factors increased business cycle synchronization independent of inter- or intra-industry trade specialization. Frankel and Rose (1998) provided empirical findings that trade linkages increased BCS. Further studies (Siedschlag and Tondl, 2011; Rana *et al.*, 2012) confirmed the positive effect of BSC for the EU15, Crespo-Cuaresma *et al.* (2011) for the EU25 and Gouveia and Correia (2013) for the Euro Area 12 countries. Demand shocks are transmitted through trade relations so countries with similar economic structures are more likely to be affected by similar demand shocks (Enders and Hurn, 1994). Johnson and Soenen (2009) suggest that a higher share of imports by Germany from other EU countries increased volatility in the exchange rate co-movement. Abeysinghe and Forbes (2005) focussed on contagion through trade and found significant impact of trade on foreign exchange co-movement.

In spite of financial liberalization having several positive effects on the operation of the financial sector, and promoting investment and economic growth, there are also sentiments about complete financial liberalization since the severity of the black swan, and the Asian flu, has questioned the ability of financial market liberalization to promote investment and economic growth (Kaminsky and Schmukler, 2008) find that the empirical evidence on the effects of financial liberalization is rather mixed. Imbs (2004) finds a positive effect. More recent studies such as Kalemli-Ozcan *et al.* (2013) find a strong negative effect of banking integration on output co-movement, conditioned on global shocks and country-pair heterogeneity. The interaction between the global financial crisis and banking integration suggests that the negative association between forms of financial integration and output co-movement is attenuated during crisis period (Abiad *et al.*, 2013; Kalemli-Ozcan *et al.*, 2013). Kaminsky and Schmukler (2008) also argue that removal of capital controls may trigger, in the short run, financial booms and busts and subsequent output collapses in economies with substantial financial markets distortions. Yet, in the long run, financial liberalization may lead to improvements in institutions and accountability of investors. The time-varying financial liberalization explains the capital flow reversals which were observed during the Asian flu and financial crisis of 2009. Kaminsky and Schmukler (2008) demonstrated that sudden stops were an important source of financial crises and contagion among the international financial markets. Thus, foreign investors liquidated their portfolio investments in order to invest in the mature markets in a typical "flight to quality" movement.

Reviewing the literature, it was observed that co-movement changes over time due to globalization (Longin and Slonik, 2001; Caporale *et al.*, 2005; Bekaert *et al.*, 2009). According to Hochstotter and Weskamp (2012) and Brockman *et al.* (2010), commonality and degree of commonality in firm specific news drive co-movement. Using regression analysis, Ammer *et al.* (2011), while studying co-movement between emerging and non-emerging stock and bond markets in the period 1992-2009, observed that the responsiveness of emerging market's asset prices to movements in US high-yield corporate bond spreads has declined over the past decade. Co-movement between stocks in high-tech industries is stronger than in traditional industries and stronger in bull than in bear markets (Guo and Shih, 2008). Christoffersen *et al.* (2012) provided evidence that on average, dependence among developed markets is higher than in emerging markets. Connolly *et al.* (2007) found that co-movement is stronger in uncertain time periods. Walti (2011) examined stock market co-movements with macroeconomic variables to determine financial integration and found these variables to have an effect on financial integration. The conclusions motivate investigation of contagion in changing economic regimes and unanticipated shocks among African economies.

On institutional aspects of currency synchronization, some studies (Fukuda and Ohno, 2008; Ogawa and Kawasaki, 2008; Chinn and Ito, 2007) showed that after the Asian crisis, when most countries adopted managed floats, their currencies' correlation with other currencies particularly in Asia increased. For instance, a policy change in Malaysia increased the correlation of not only the Malaysian ringgit with the USD but also of the Singapore dollar and Thai baht with the USD. On the other hand, McKinnon and Schnabl (2003) reported that while there is evidence of increased co-movement between yen/USD, and German mark/USD bilateral rates, the USD was still the dominant currency in determining exchange rates in this area. Also, fragility of a country's financial system can attract capital flows into the country.

Contagion literature has identified a variety of reasons for the spreading of contagion from one country to the other (Enders and Hurn, 1994; Claessens *et al.*, 2001; Chan-Lau, 2007; Blanchard *et al.*, 2010; Kalemli-Ozcan *et al.*, 2010; Dungey *et al.*, 2011; Moore and Wang, 2014). Mechanisms for contagion transmission have been broadly grouped into trade channels, financial channels and similar economic characteristics. Empirical examinations of the channels in explaining co-movement have found significant impact for the channels with global market factors exhibiting dominating effects (Blanchard *et al.*, 2010; Kalemli-Ozcan *et al.*, 2010; Dungey *et al.*, 2011). Other studies (Caballero *et al.*, 2008; Mendoza and Terrones, 2008; Forbes, 2010; Ju and Wei, 2011; Bacchetta *et al.*, 2013) confirm the significance of pull factors in explaining contagion. Changes in domestic growth rates are often caused by global productivity shocks, which generate lending booms and busts, and associated with shifts in capital flows (Aguiar and Gopinath, 2007; Broner *et al.*, 2010). Volatility spillover results indicate that the movement of volatility spillover takes place from futures to spot in the short run while that from spot to futures is found in the long run (Sanjay and Wasim, 2015).

The main focus of the present study is to examine the source of exchange rate co-movement and transmission of shocks from the global world to African countries and swiftness of globalization and integration in Africa. This analysis would enable us to understand whether African economies actually remain insulated and could still be considered for portfolio diversification.

3. Model and estimation framework

3.1 Correlations

This section describes the modeling framework used to estimate the importance of different cross-country linkages over long periods, as well as how their importance has changed over time. In the first place, a fixed-effect model of bilateral correlations, controlling for trade, global and regional factors, is estimated. In the second stage, a dynamic panel analysis is used to estimate bilateral correlations for factors leading to four types of bilateral linkages: bilateral trade intensity, trade competition, world interest rate and capital account openness.

Exchange rate correlations in two countries could co-move due to a number of factors. First, shocks to one country are transmitted to other countries through cross-country linkages, such as bilateral trade, export competition in third markets and capital account openness or bilateral investment flows. Second, exchange rate correlations in both countries could be affected by global shocks, such as changes in the world interest rate, oil prices and other commodity prices. Third, exchange rate correlations in both countries could be affected by regional shocks that simultaneously affect all countries that have exposure to the given sector. One typical example is the expansion of banking sector activities in Africa that has recently received substantial attention in the late 2000s. Apart from cross-country linkages as the focus of the paper, it is important to ensure control for regional macroeconomic shocks in order to accurately estimate the magnitude of these linkages and to avoid the tendency of spurious regression results for co-movement.

The Dynamic Conditional Correlation (DCC) model is chosen in order to overcome constant conditional correlation problems. Engle (2002) and Tse and Tsui (2002) developed models for estimating time-varying correlations, but this study focusses on the Dynamic Conditional Correlation Generalised Autoregressive Conditional Heteroscedasticity (DCC-GARCH) model of Engle (2002), which is a two-step estimation procedure. In the first step, the individual conditional variances are specified as univariate GARCH processes, and in the second step, the standardized residuals from the first step are used to construct the conditional correlation matrix. This method guarantees positive definiteness of the covariance matrix, and it also enables the estimation of time-varying volatilities, covariances and correlations. The DCC model defines the time-varying conditional correlation as follows:

$$\rho_{ij,t} = \rho_{ji,t} = \frac{q_{ij,t}}{\sqrt{q_{ii,t}q_{jj,t}}} \tag{1}$$

where $\rho_{ij,t}$ is the bilateral exchange rate correlation between country i and j, $q_{ij,t}$ is the covariance and q_{ii} is the variance of country i. The time-varying correlations do not only cover contemporaneous co-movement, but also possible shifts in business cycles are determined by the dynamic nature of the model. The estimation method of DCC model is Quasi-Maximum Likelihood (QML) under a multivariate student distribution (Fiorentini *et al.*, 2003). The multivariate student distribution is applied. The GARCH results used to generate the ρ are presented below.

Conditional return correlations on a constant and a time trend in order to examine whether the conditional correlations changed over time are estimated and shown in Table AI. Table AI reports the regression results which show that the average conditional correlations between the exchange rate returns of South Africa, Egypt, Nigeria, Ghana, and Kenya were almost of the same magnitude. The fitness of the conditional correlations

is given by R^2 squared and the F-statistic, which measures overall performance of the regression. These findings showed that a statistically significant rise over time in conditional correlations was detected for all the pairs examined (except for the pairs Egypt-Ghana and Egypt-Kenya) at the 5 per cent level of significance. This rise in correlations was measured by the term $\Delta\rho$ which is equal to the difference between the last and first fitted values. The increase in correlation was particularly high for South Africa and Nigeria suggesting that these markets have become more interrelated over the period analysed. However, these markets together with the Egyptian market were still the least correlated since the correlation coefficients are very small.

Figure A1 presents the evolution of the estimated conditional correlation coefficients based on the time series of the five African markets during the period 1990-2013. A common characteristic of the depicted pair-wise correlations is that they move steadily during the second half of 2008, which coincided with the stock market crash of 2008 in the USA with the collapse of several key firms such as Lehman Brothers and Merrill Lynch. By the end of October 2008, a currency crisis had developed, with investors transferring vast capital resources into stronger currencies such as the US dollar and the Swiss franc, leading African economies to seek financial aid from the IMF. Actually, the spillover effect of such crises took time to reach African economies, which is why most of the pair-wise correlations dissipated in the early part of 2008. The high pair-wise correlations in the 1990s were the results of joint implementation of IMF stabilization programme in early 1980s which may simultaneously impact the expectations of various participants across markets. An additional characteristic of the conditional correlation coefficients behaviour was that the Egyptian pound was significantly poor (Figure A1 and Table AI).

3.2 Linear specification

In order to estimate the importance of these bilateral linkages in explaining foreign exchange rate co-movement, a model similar to those of Kodres and Pritsker (2002), Kose *et al.* (2003), and Walti (2011) is specified as follows:

$$\rho_{ij,t} = \beta_0 + \sum_{a=1}^{A} \beta_a Fin_{it} + \sum_{b=1}^{B} \lambda_b Global_{it} + \sum_{c=1}^{C} \gamma_c trade_{it} + \varepsilon_{ij,t} \quad (2)$$

The dependent variable is the bilateral exchange rates of time-varying conditional correlation series between countries i and j, estimated from Equation (1). The variables of interest are global economic shock represented by the short-term interest rates of the USA, UK and Japan. These countries are selected due to the size of their economies in their respective regions, oil prices, and gold prices. Financial integration is accounted for by capital account liberalization, and trade linkage is incorporated into the model by bilateral trade and trade competition (Frankel and Rose, 1998; Fidrmuc *et al.*, 2010; Siedschlag and Tondl, 2011; Glick and Rose, 1999).

However, there is the possibility of the explanatory variables being endogenous. Hence, Equation (3) based on the dynamic panel analysis is estimated using capital account openness, trade intensity and trade competition, regional macroeconomic variables and gold and oil prices. The dynamic model includes lags of the dependent variable as explanatory variable. The standard econometric techniques such as ordinary least square do not usually yield efficient estimates of the parameters (Sevestre, 2002), but the Generalised Method Moments (GMM) method provides a

solution to the problems of simultaneity bias, reverse causality and omitted variable bias (Kpodar, 2007). It also enables estimation of unobserved country-specific effect coefficients for which the usual methods ("within" or "difference") would be inappropriate given the dynamic nature of the regression (Calderon *et al.*, 2004). Therefore, the dynamic model is defined as follows:

$$\Delta\rho_{ij} = \beta_1\Delta\rho_{ij,t-1} + \beta_2\Delta Fin_{it} + \beta_3\Delta trade_{it} + \beta_4\Delta global_{it} + \Delta u_{it} \quad (3)$$

The first-difference type of GMM model was employed in this paper. In this case, all variables were first differenced to eliminate individual and time-specific effects. Variables in levels lagged twice or more were then used as instruments for the explanatory variables, assuming that the errors of the equation in levels are not autocorrelated. However, at times, those lagged variables are weak instruments. But, Arellano and Bond (1995) and Blundell and Bond (1998) have proposed a system GMM estimator, which is based on assumptions about the initial conditions such that the moment conditions remain valid even for persistent series. This estimator combines the equations in first differences with equations in which the level variables are instrumented by their first differences. Two types of tests are usually carried out in this context: the Sargan-Hansen test for overidentifying restrictions to test the validity of the lagged variables as instruments (i.e., whether or not the instruments are exogenous) and the autocorrelation test of Arellano and Bond (1995) where the null hypothesis of no autocorrelation of second order of the equation in first difference is performed.

3.3 Measurement of variables

The factors influencing exchange rate co-movement are described in the paragraph below.

Trade. Trade is computed in two ways. The first indicator of trade integration relates to Frankel and Rose's (1998) and Siedschlag's and Tondl's (2011) index of bilateral trade intensity which is more convincing than other measures relating bilateral trade to total worldwide trade of both partners as suggested in Imbs (2004) and Fidrmuc *et al.* (2010). Since intense bilateral trade is characterized by highly correlated business cycles in a wide range of theoretical models, ranging from multi-sector international models with intermediate goods trade to one-sector versions with either technology or monetary shocks, bilateral trade is expressed as follows:

$$bilatrade = \frac{X_{ij} + M_{ji}}{GDP_{i,t} + GDP_{j,t}}$$

where $X_{i,j,t}$ denotes total merchandise exports from country i to j in quarter t, $M_{i,j,t}$ denotes imports from j to i and $GDP_{i,t}$ denotes nominal GDP in country i. This is the standard benchmark for bilateral trade. The second indicator of trade integration is by Glick and Rose's (1999) index of export competition in third market. It measures the importance to country i export competition in third markets between country i and country j. Their method of trade integration assesses the extent to which two countries compete in the same export markets. It is possible that these countries competing in the same export markets have exchange rates that react similarly to shocks originating in these export markets. The trade indicator of Glick and Rose (1999) is given by the following:

$$\text{Trade competition} = \frac{\sum_1^k x_{ik,t} + x_{jk,t}}{X_{i,t} + X_{j,t}}\left(1 - \frac{x_{ik,t}/X_{i,t} - x_{jk,t}/X_{j,t}}{x_{ik,t}/X_{i,t} + x_{jk,t}/X_{j,t}}\right)$$

where $x_{ik,t}$ *and* $x_{jk,t}$ represent exports from country i and j to country k (k is the group of countries i and j sell their exports to), respectively. Also $X_{i,t}$ *and* $X_{j,t}$ are total exports of country i and j, respectively. The trade variable determines and captures the extent of the openness of these economies in terms of exports and imports with the world particularly North America and Europe. Strong and significant positive impact of trade variable on the correlation implies economic integration may matter for the linkage.

Financial liberalization. The Chinn and Ito (2002) Compiled Index (KAOPEN), which has a wide coverage (more than 100 countries) for a long time period and also measures the intensity of capital controls, is used to measure financial liberalization in recent times. The Chinn-Ito Index (2002) is a *de jure* measure of financial openness because it measures regulatory restrictions on capital account transactions (Cheung *et al.*, 2006; Edison *et al.*, 2002). The KAOPEN consists of standardized principal component of SHAREk3, K_1, K_2, and K_4. K_1 indicates the presence of multiple exchange rates, K_2 indicates restrictions on current account transactions, $SHAREK_3$ indicates restrictions on capital account transactions, and K_4 indicates the requirements to surrender export proceeds. In this paper, KAOPEN is used to measure financial liberalization due to its wide coverage, public availability of index data and its extensity. It is highly correlated with the other existing methods of capital account openness.

Global shock. Following previous studies (Chinn and Forbes, 2004; Kose *et al.*, 2003; Hamilton, 2003), global variables of interest rates, oil prices and gold prices are controlled for. Significant financial integration plays a major role in the foreign exchange market co-movement which is derived from the traditional macroeconomic view. The world is represented by the USA, the UK and Japan due to the size and the effect of their economies on others. In addition, a regional specific control variable of financial development, which has potential impact on the conditional correlation, independently from those major sources, is introduced. Included are inflation, interest rate and financial development differentials as measures of the extent of financial development. Also, dummy for exchange rate regime and an interactive term for trade and exchange rate regime are introduced to examine further the size of trade effect on foreign exchange co-movement.

3.4 Data sources

The data frequency is quarterly. The nominal exchange rates in local currency per unit of US dollar are used due to data availability and to avoid in most general case restrictions imposed for proportionality and symmetry. The sample period runs from first quarter of 1990 to 2013 final quarter. For the countries, the study includes the three largest countries in the African continent as ranked by GDP at the end of the sample period (2013). These three large countries are: South Africa, Egypt and Nigeria. The two extra countries included are Ghana and Kenya, which have high trade partnership with large countries. All data were taken from International Monetary Fund (IMF)'s Direction of Trade Statistics, International Financial Statistics of IMF, IMF balance of payment and central banks of each country. Over this period, the global economy experienced unprecedented economic crises of various types consisting typically of Asian flu, America's financial crunch, terrorism and European sovereign debt crisis, which might have fuelled BCS with possibility of spillover to African markets. Based on exchange rates (s), the return of exchange rate changes ($r_{s,t}$) at time t is calculated as $r_{s,t} = 100x \log(s_t/s_{t-1})$.

4. Empirical results

4.1 Descriptive statistics

The average regional bilateral trade in Africa is relatively low at about 10 per cent (0.099). The mean regional bilateral trade is high between Ghana and South Africa followed by trade between Nigeria and South Africa but that of Egypt, Kenya, and Ghana is relatively small. The small bilateral trade between Egypt and the other countries may be attributed to her trading more with Arab countries than Sub-Sahara African neighbours. Trade competition in the new emerging economies BRICS and in the traditional export markets stands at 0.97 and 1.624, respectively, indicating that competition is higher in the traditional market than in the BRICS. The high trade competition in traditional exports market attests to the fact that Africa is glued to their old market probably for securities and maintenance of long-term developed relationships and partnership. Capital Account Openness (KAOPEN) data showed that the regional average is −0.6, with Kenya and Nigeria having the highest capital account openness and the rest having least openness. Economies usually change the restrictions frequently to suit changing domestic economic fundamental stress (Chinn and Ito, 2002). Comparatively, South Africa ranks high in financial development with 63 per cent, followed by Nigeria with 45 per cent, Egypt with 57 per cent, Kenya with 46 per cent and the last is Ghana with 25 per cent. The top three economies stand better in terms of performance relating to capital account openness, interest and inflation rates than Ghana and Kenya. The mean average global interest rate stands at 3 per cent which is even far less than the 11 per cent minimum average in Africa. None of the skewness of these indices is equal to zero, and none of the kurtosis follows normal distribution. The negative skewness and excess kurtosis illustrate that the negative large shocks are more frequent than the expected shocks. The non-normal distribution of the data sets is further confirmed by the Jarque-Bera test as the null hypothesis of normal distribution was rejected.

4.2 Panel regression results

Tables I and II present the estimated results of the panel data models. In contrast to the estimated models of Table I, the specifications of Table II allow for dynamics in the co-movement through the addition of an autoregressive term of order one (R(1)). The dynamic specification is supported by the significant AR(1) component and the presence of an autocorrelation indicated by the Wooldridge test in Table I. However, the main results relating to the impact of trade, world interest rates and financial liberalization are qualitatively the same. The specification tests are reported at the bottom of the tables to indicate the adequacy of the estimation process and the choice of particular techniques. First, the Hausman test, which is used to make a decision on fixed effect or random effect, was not performed in this study because the number of cross-sections is less than the number of time-series period. Following Gujarati, (chapter 16, pp. 650-651) the fixed effect is preferred to random effect in such circumstances. From Table II, dynamic panel results, the estimated AR(1) coefficient is of the order 0.635 and highly significant. It shows that dynamics might be elusive when one fails to account for unobserved heterogeneity. The fixed-effect panel may underestimate adjustment time to long-run equilibrium. Moreover, the Arellano-Bond test for autoregressive of order two (AR(2)) in first difference accepts the null of no second-order serial correlation which is consistent with the literature (Holmlund and Söderström, 2007). Finally, *J*-statistic tests accept the validity of the instruments.

Table I.
Fixed-effect panel results

Depend variables: bilateral correlation	(1)	(2)	(3)	(4)	(5)	(6)
Constant	0.144 (0.076)*	0.1410 (0.076)*	0.1976 (0.072)***	0.138 (0.076)*	0.129 (0.073)*	0.179 (0.057)***
Bilateral trade intensity	0.156 (0.068)**	0.172 (0.068)***	0.168 (0.068)***	0.167 (0.068)***	0.171 (0.068)***	0.172 (0.068)***
Trade competition in BRICS	0.0860 (0.047)*	0.026 (0.0367)		0.0316 (0.036)	0.029 (0.036)	
Trade competition in trad. markets	−0.0512 (0.025)*		−0.022 (0.019)			
Inflation differential	0.127 (0.418)	−0.023 (0.417)	−0.0452 (0.417)	−0.073 (0.412)	−0.037 (0.416)	
Interest rate differential	−0.004 (0.002)**	−0.005 (0.002)***	−0.005 (0.002)***	−0.005 (0.002)***	−0.005 (0.002)***	−0.006 (0.002)***
Financial development differential	−0.953 (0.294)**	−1.037 (0.293)***	−0.858 (0.290)***	−0.979 (0.283)***	−1.027 (0.292)***	−0.857 (0.242)***
World interest rate	0.032 (0.012)***	0.031 (0.012)***	0.023 (0.011)***	0.032 (0.012)***	0.034 (0.011)***	0.025 (0.008)***
Oil price	0.001 (0.0012)	0.001 (−0.001)	0.0013 (0.001)		0.0004 (0.0007)	
Gold price	−5.82E (8.69E)	−4.71E (8.73E)	−7.69E (8.73E)	8.40E (4.79E)		
Exchange rate regime(dummy)	−0.6785 (0.2342)	−0.456 (0.764)	−0.038 (0.017)**	−0.586 (0.943)	0.087 (0.035)**	
Regime × trade intensity	0.4658 (0.675)	0.6572 (0.843)	0.195 (0.082)**	0.033 (0.074)	−1.306 (0.196)	0.156 (0.943)
Financial liberalization	0.047 (0.017)***	0.049 (0.017)***	0.051 (0.017)***	0.052 (0.017)***	0.052 (0.016)***	0.056 (0.016)***
Obs	460	460	460	460	460	460
LM BP test	0.08***	0.594***	0.385***	0.46**	0.096**	0.367***
F test	4.219**	4.16**	4.255*	4.526**	4.559**	6.526***
R^2	0.34	0.35	0.33	0.35	0.32	0.35

Notes: In parenthesis are the standard errors of coefficients. This is a fixed-effect panel data. LM B-P (Breusch-Pagan) test of no first-order serial correlation. *,**,***Significant at 10, 5 and 1 per cent levels, respectively

Table II.
Dynamic
panel results

Depend variables: bilateral correlation						
Correlation (−1)	0.625 (0.008)***	0.634 (0.029)***	0.633 (0.013)***	0.629 (0.009)***	0.627 (0.012)***	0.629 (0.009)***
Bilateral trade intensity	0.058 (0.012)***	0.138 (0.019)***	0.062 (0.017)***	0.0609 (0.012)***	0.057 (0.016)***	0.059 (0.009)***
Trade competition in BRICS	0.068 (0.022)***	0.030 (0.013)***		0.043 (0.013)***	0.046 (0.009)***	0.041 (0.006)***
Trade competition in trad. markets	0.0293 (0.019)		0.014 (0.011)		0.0092 (0.011)	
Inflation differential	0.062 (0.422)	0.092 (0.381)	0.065 (0.454)	0.102 (0.406)	0.0733 (0.423)	
Interest rate differential	8.19E (0.001)	−0.001 (0.0001)***	−0.001 (0.0003)***	7.40E (0.0008)	0.0002 (0.0007)	0.0002 (0.0011)
Financial development differential	−0.006 (0.008)	−0.004 (0.005)	0.0019 (0.008)	−0.003 (0.008)	−0.004 (0.008)	−0.857 (0.242)***
World interest rate	0.019 (0.005)***	0.022 (0.002)***	0.017 (0.004)***	0.020 (0.0072)***	0.018 (0.006)***	0.019 (0.0052)***
Oil price	−0.001 (0.001)	−0.001 (0.001)	−0.001 (0.007)		−0.0002 (0.006)	2.32E (3.64E)
Gold price	3.62E (2.15E)	4.72E (2.48E)*	4.21E (1.99E)**	3.23E (4.20E)		
Exchange rate regime (dummy)	−0.001 (0.962)	−0.243 (0.335)	−0.071 (0.782)	−0.053 (0.837)	0.193 (0.159)	
Regime × trade	−0.36 (0.154)	0.097 (0.713)	0.095 (0.267)	−0.271 (0.246)	0.364 (0.322)	0.503 (0.163)
Financial liberalization	0.027 (0.011)***	0.0251 (0.014)*	0.025 (0.017)	0.022 (0.012)*	0.021 (0.013)	0.021 (0.011)*
Obs.	460	460	460	460	460	460
Q(2)	0.963 (0.336)	0.834 (0.404)	0.959 (0.338)	0.987 (0.324)	0.971 (0.332)	0.949 (0.343)
J-statistics (Hansen test)	282.45 (0.185)	283.28 (0.186)	283.89 (0.178)	284.75 (0.182)	285.99 (0.168)	287.93 (0.159)

Notes: In parenthesis are the standard errors of coefficients. This is a dynamic panel data. The Q(2) statistic represents the test for second-order serial correlation. The values are the statistics, and in parenthesis are the *p*-values of the test. The *J* test specification tests for the validity of the instruments. *,**,***Significant at 10, 5 and 1 per cent levels, respectively

Estimation results revealed that in general, world interest rate, trade and capital account openness and interest rates differentials were robustly related to foreign exchange co-movement. These results are in line with the findings of Edison and Warnock (2008) and Fidrmuc *et al.* (2010) that trade and financial linkages explain co-movement. All of them find real variables to explain co-movement in European stock market returns instead of domestic variables. However, a dummy for fixed exchange rate regime, an interactive term for trade intensity and exchange rate regime, appeared to be statistically insignificant but was rightly signed. Fixed exchange rate actually reduces co-movement. The interactive term for trade intensity and exchange rate regime was positive which shows how essential trade is to co-movement, but currency crisis dummy was not significant.

Surprisingly, oil price and gold price alternated signs in the models with very small coefficients which may suggest that they may not be all that important in explaining currency co-movement in Africa. In the dynamic panel data, gold price was positively related to foreign exchange co-movement and statistically significant, but it became insignificant and negatively correlated to foreign exchange co-movement. For the oil price, it tended to be negative and insignificant. Global risk aversion increment tended to lead to greater synchronization as reflected by the positive sign of oil and gold prices. The changing signs of gold and oil prices were surprising, because it meant that periods of higher oil and gold prices are usually associated with recessions, and it is a known fact that business cycles are more synchronized during such periods. Changes in oil prices are a common shock to oil importing countries which makes business cycles more synchronized during economic downturns.

Specification in the dynamic panel data indicates that oil price exhibits insignificant coefficient. It remains that it caused less correlated exchange rates co-movement, but oil price decreases raise co-movement which contradicts our hypothesis.

The expectation was to observe stronger foreign exchange market co-movement when oil prices increase and little effect when such prices decrease. The results here contrast that of Dungey *et al.* (2011) and Kalemli-Ozcan *et al.* (2010) who observe that cross-country linkages explain positively BCS globally. The relatively small estimated coefficients of oil and gold prices are in order since African economies have little control of commodity prices internationally. Therefore, it is prudent to conjecture that dynamics of oil and gold prices may not matter for exchange rate co-movement in Africa.

Although the effect of trade, either intensity or competition, on co-movement remains ambiguous in most empirical studies (Kose *et al.*, 2003; Glick and Rose, 1999; Chinn and Forbes, 2004), this study reveals positive effect of trade intensity and competition on exchange rates co-movement. Trade intensity is positively and highly significant in all the models, suggesting how important trade channel is in explaining the foreign exchange rates co-movement. Analytically, while trade competitions in both the BRICS and traditional markets appeared positive, competition in BRICS was significant. The works of Joyce and Nabar (2009) and Allen and Wood (2006) had similar positive results of trade intensity and competition. Trade intensity ultimately leads to an increase in the correlations which means that asymmetric information is important for home country biasness. The significant effect of trade linkages might hint that trade liberalization reforms take a longer time to exert significant effects than financial market liberalization. The evidence on trade role suggests signaling effects for international investors' decision.

Another important revelation is that financial openness has a positive and highly significant impact on foreign exchange co-movement. The impact might have been

because almost all African countries borrow funds from institutions such as the IMF, World Bank and bond markets in Europe and America and selling exports. Milesi-Ferretti and Tille (2011) see the growing financial market liberalization and integration to have resulted from increased transactions of economies and these institutions, but the side effect has been significant increase in foreign exchange supply. It is worth mentioning that, average world interest rate consistently related positively and significantly to exchange rates co-movement. The intuition comes from the financial assistance and budgetary support from the global financial institutions to African countries, whose success depends on the interest rate. The result is in line with Calvo and Mendoza (2008) and Kaminsky and Schmukler (2008) report on financial liberalization.

Regional macroeconomic variables like interest rate differential, inflation differential, and financial development differential were also found to relate to foreign exchange co-movement. While interest rate differential and financial development were negatively and highly significant, inflation differential was insignificant in the dynamic model. Thus, high interest rate and financial development differentials decrease foreign exchange co-movement. The general reduction of co-movement by macroeconomic variables signals low degree of financial market development and competition in the region which is likely to reduce correlation in specified markets.

In spite of empirical evidence supporting theoretical underpinnings of co-movement, African economies are not likely to enjoy the growth-promoting benefit of financial integration because of sluggish macroeconomic management policy, political risk and poor conflict resolutions in the region. High interest and inflation rates are typical macroeconomic problems facing the region. The benefit of financial globalization in Africa can be fruitful if authorities in Africa can rigorously ensure a sound and resilient macroeconomic environment. The crucial thing to be done is to move towards full capital account openness and practice proper economic governance in order to enjoy growth-promoting benefits of financial liberalization. A holistic risk management approach is important because financial integration has the potential to alter the nature and frequency of risks faced by the economic system. African leaders should try to work perfectly on having democratic and independent institutions to speed up trade integration regionally.

5. Sensitivity analysis

This section provides sensitivity tests of the results by examining whether the key conclusions are robust to changes in model specification, sample selection and control variables. It focusses on Equation (3), and only the top three economies are considered.

Sensitivity tests start with examination of the effect of modifying variable definitions. First, levels of variables of financial development, short-term interest rate, inflation were used for the estimation. Capital controls statistic developed by Edison and Warnock (2008), which is based on restrictions on the foreign ownership of equities, was also introduced. Results are reported in columns 1 and 2 in Table III (see Appendix). Second, exchange rate regime dummy and interactive term for bilateral trade, and trade competition, were included in columns 3 and 4 in Table III. The relative size of coefficients and significant levels is now less, but the key results were unchanged relatively.

The signs and significance of coefficient estimates fluctuate across specifications. However, the coefficients on capital account openness and trade intensity were consistently positive and highly significant. The coefficient on world interest rate was positive and significant in approximately all of the specifications. The regional short-term interest rate was negative and significant in some of the estimations.

Table III. OLS results

Depend variables: bilateral correlation	(1)	(2)	(3)	(4)	(5)
Constant	0.017 (0.103)	0.150 (0.029)	0.153 (0.087)	0.1504 (0.0864)	0.086 (0.376)
Bilateral trade intensity	0.161 (0.037)	0.0007 (0.0015)**	0.019 (0.411)***	0.069 (0.411)**	0.164 (0.053)***
Trade competition in BRICS	0.419 (0.432)***	0.067 (0.420)		0.089 (0.028)***	0.074 (0.027)**
Trade competition in trad. markets	−0.123 (0.042)***		−0.082 (0.027)		
Inflation	−0.313 (0.268)	−0.328 (0.272)	0.00031 (0.0015)	−0.328 (0.271)	
Interest rate	−0.00099 (0.0016)	−0.0012 (0.0012)	0.319 (0.272)*	−0.001 (0.0006)	−0.258 (0.265)**
Financial development	0.0023 (0.0014)	−0.0036 (0.001)*	0.061 (0.0014)	0.001 (0.0013)	0.0653 (0.036)
World interest rate	0.0199 (0.0115)***	0.028 (0.011)*	0.026 (0.011)**	0.0283 (0.0102)**	0.0371 (0.009)***
Oil price	−0.00032 (0.0012)	0.0007 (0.002)		0.0007 (0.0015)	
Gold price	−5.21E05 (9.03E−05)	−2.40E06 (8.99E−05)	−7.80E05 (4.81E−05)		
Exchange rate regime (dummy)			−0.012 (0.039)	−0.006 (0.0389)	
Regime × trade			0.167 (0.399)	0.243 (0.398)	
Financial liberalization	0.066 (0.018)***	0.039 (0.016)*	0.036 (0.016)**	0.0402 (0.0149)***	0.048 (0.012)***
Obs.	275	275	275	275	275
R^2	0.145	0.118	0.114	0.117	0.1296
F	3.773 (0.0000)	3.257 (0.0003)	3.483 (0.000)	3.596 (0.0002)	4.021 (4E−05)

Notes: In parenthesis are the standard errors of coefficients. This is ordinary least square regression. The R^2 determines the amount of variation in the dependent variable. The F statistics tests for joint significant of all the variables and in parenthesis are the p-values of the test. *,**,***Significant at 10, 5 and 1 per cent levels, respectively

While the coefficient on trade competition is negative and significant in approximately two-thirds of the specifications, regional financial development and inflation rates were rarely significant. The coefficients on regime dummy and interactive term had the expected signs but were never significant. These results confirmed trade intensity, capital account openness and world interest rate as the most important determinants of co-movement in the African foreign exchange markets.

6. Conclusions and policy implication

This paper focusses on the potential variables underlying foreign exchange co-movements in Africa over the period 1990 to 2013 using dynamic panel data analysis. Synchronization was measured by a correlation coefficient, in particular, using quarterly dynamic panel data sets from 1990 to 2013. This paper provides the following key results: first, the results demonstrate that, on the average, exchange rates co-movements were externally determined through trade. Second, capital account openness has positive effect on co-movement. Third, the result also shows that the low level of financial development and other regional macroeconomic variables negatively affect exchange rate co-movement. The results thus provide support to the existing findings that exchange rate co-movement for economies that depend predominantly on trade is high, and such economies are more risky and less resilient to crisis (Guo and Shih, 2008; Walti, 2011).

On the policy implication, the fact that the level of economic integration affects foreign exchange co-movement, currency stability, to some extent, should be of high relevance to policy makers, traders, investors and regulatory authorities. For policy makers and regulatory authorities, the paper has the following policy recommendations: first, that high degree of trade openness does not only increase the foreign exchange co-movement but also increases currency risk exposure; the regulatory authority should introduce guidelines that enable investors to have a considerable level of currency stability. Considerable trade openness is needed, because too much or too little trade openness will negatively affect investors' and traders' behaviour and stability (Milesi-Ferretti and Tille, 2011).

Second, global shocks, such as changes in world interest rate, have been found to play a significant role in enhancing exchange rate co-movement and accelerating currency risk, so does capital account openness. Thus, regulatory initiative that allows investors to withhold a significant portion of their capital in foreign currency for risk management purposes must be pursued. For investors, mechanisms should be put in place to attract investors as well as adoption strategies that will reduce risk exposure of investors. With regard to market participants, if traders are aware that capital account openness and average world interest rate produces currency co-movement, the sizeable amount of their investment should be directed towards forward contract or options with considerable stability.

Finally, the findings of this paper show that trade openness in itself is not detrimental to co-movement, but the level and the application of it could affect exchange rate risk exposure. Therefore, regulatory, supervisory and monetary authorities should co-ordinate to put in place a comprehensive regulatory framework that would allow investors and traders to have a substantial amount of currency stability that is robust and consistent with any coordination policy. A single regulatory authority like currency union would be a prudent decision in the region. Future research could include bilateral cross-border investment especially in the emerging markets since liberalization leads to an increase in these bilateral investment flows.

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(The Appendix follows overleaf.)

Appendix

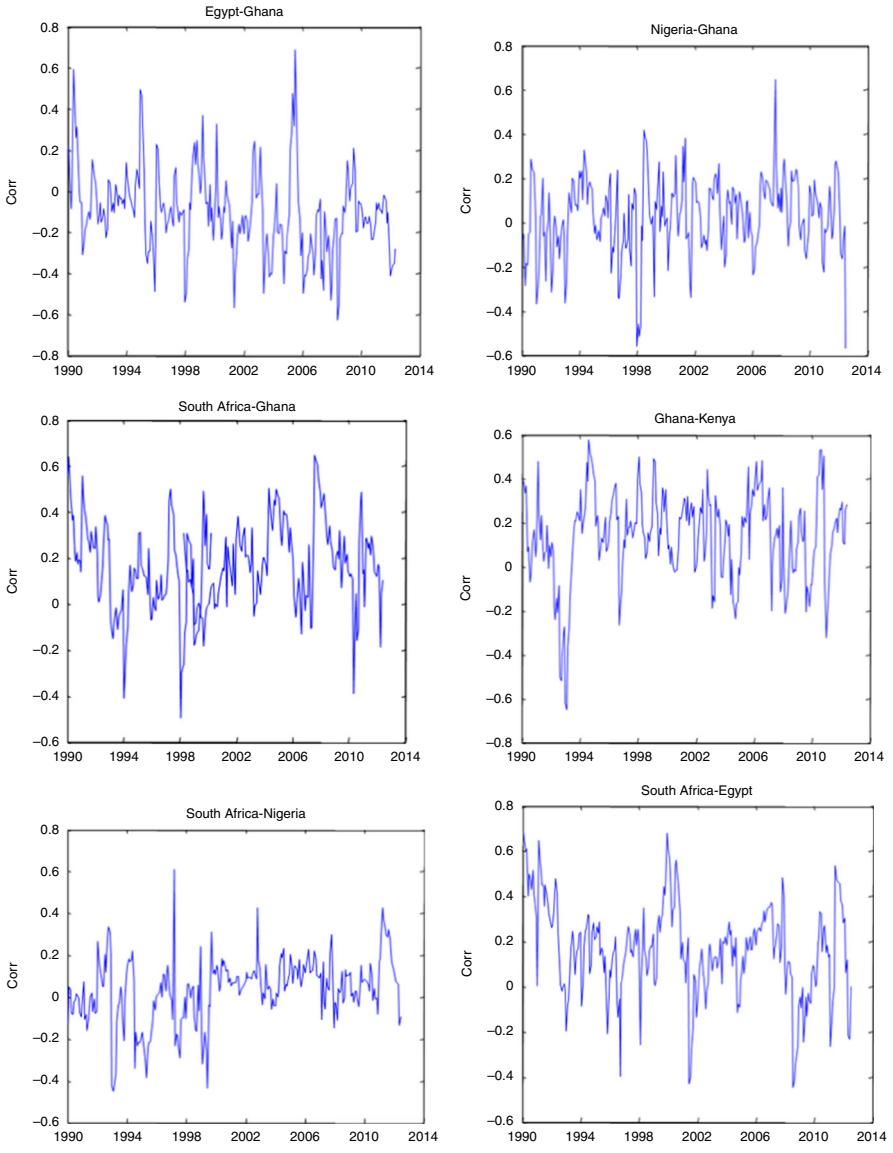

Figure A1. Estimated conditional correlation coefficients between exchange rate returns in each of the African country

(*continued*)

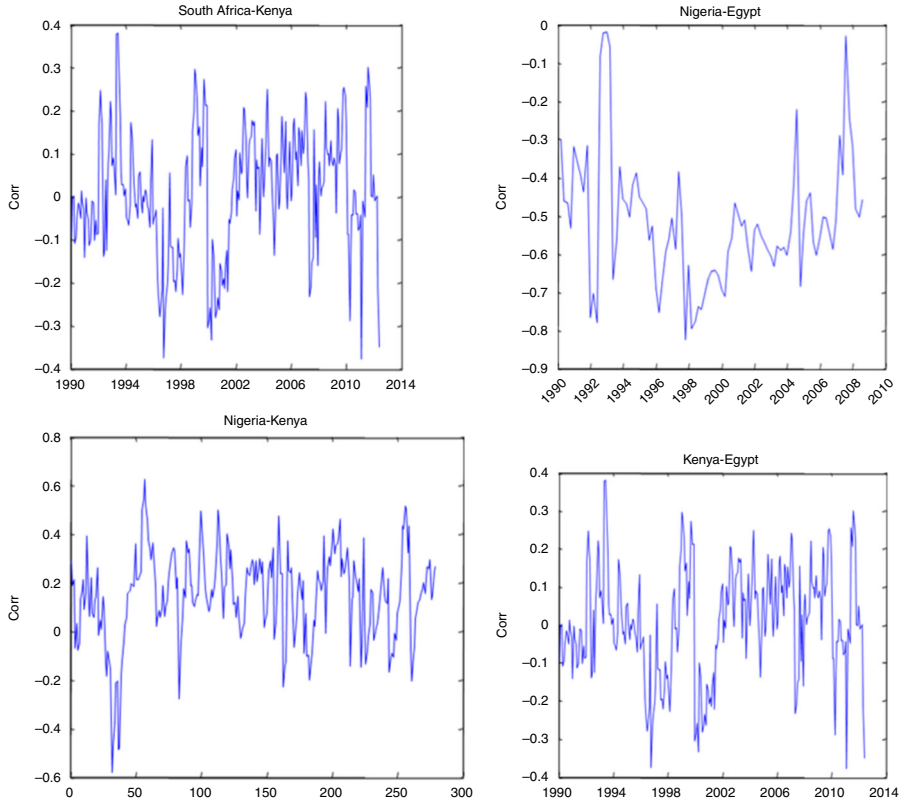

Figure A1.

	Average	SD	*t*-statistic	$\Delta\rho$ (%)
South Africa-Egypt	0.4605	0.0606	7.5942	1.23
South Africa-Nigeria	0.2053	0.0541	3.798	38.97
South Africa-Ghana	0.4687	0.0352	13.3295	32.77
South Africa-Kenya	0.476	0.0352	13.5291	20.99
Ghana-Nigeria	0.5167	0.0487	10.6111	10.59
Ghana-Egypt	0.0124	0.0297	0.41478	4.43
Ghana-Kenya	0.2252	0.0332	6.7816	11.62
Nigeria-Egypt	0.1219	0.0582	2.0945	8.91
Nigeria-Kenya	0.28802	0.0536	5.3737	20.99
Kenya -Egypt	0.29859	0.3951	0.7557	3.99
Average R^2	0.53			
F-statistic	6.6795 (0.000)***			

Notes: $\Delta\rho$ is the difference between the last and the first fitted values of a regression of conditional; correlations on a constant and zero mean time trend. ***Significant at 1 per cent level

Table AI.
Dynamic conditional correlation from DCC estimation

Table AII.
Descriptive statistics of regional bilateral trade

Variable	Trade_ghsa	Trade_kesa	Trade_sanig	Trade_saeg	Trade_egnig	Trade_egke	Trade_eggh	Trade_kenig	Trade_kegh	Trade_niggh
Mean	0.00083	0.00148	0.00065	8.21E−06	9.03E−05	9.65E−05	9.63E−05	0.000387	8.20E−05	0.00062
Max	0.00339	0.003444	0.000301	0.00021	0.00087	0.00032	0.00042	0.00081	0.000246	0.00043
Min	0	0	0	0.000000	0	0.00000	0.0000	0	0	0
SD	0.000607	0.000829	0.000765	5.75E−05	6.32E−06	6.54E−06	6.25E−06	0.00006	5.84E−05	0.00072
Skewness	1.250107	−0.384751	−0.5432	0.4356	−0.7685	−0.73245	0.34901	−0.7659	0.440617	0.08432
Kurtosis	6.610394	2.491534	4.8907	2.09879	2.7683	3.8943	3.0781	2.8548	2.385794	2.5009
Jarque-Bera	77.14***	3.4027	12.0091***	4.8635***	3.987***	82.16***	37.9624***	3.9006***	4.6153*	4.762***
	(0.0000)	(0.1824)	(0.00087)	(0.0060943)	(0.000000)	(0.00001)	(0.000000)	(0.000)	(−0.0995)	(0.0054)
Observations	94	94	94	94	94	94	94	94	94	94

Notes: In parenthesis is the probability of accepting the null hypothesis. *,**,***Significant at 10, 5 and 1 per cent levels, respectively
Sources: Data from IFS, IMF

Table AIII. Descriptive statistics of trade competition

Variable	Com_ghsa	Com_kesa	Com_sanig	Com_saeg	Com_egnig	Com_egke	Com_eggh	Com_kenig	Com_kegh	Com_niggh
Mean	0.070899	0.101083	0.064687	0.007654	0.03233	0.02110	0.03876	0.05098	0.046430	0.0797
Max	0.480811	0.706257	0.18799	0.29768	0.100512	0.06592	0.12134	0.365879	0.165119	0.18592
Min	0.000000	0.000000	0.00041	0.000000	0.000112	0.00015	0.00013	0.00028	0.000335	0.000432
SD	0.091775	0.140771	0.04876	0.061743	0.040127	0.01019	0.04000	0.05467	0.040127	0.0577
Skewness	2.026370	2.123325	1.05498	2.92145	1.54321	1.98791	1.9768	2.67658	1.066028	3.87945
Kurtosis	8.044894	7.965127	5.87650	7.98894	4.76548	4.803428	2.9788	5.8785	3.700488	4.9834
Jarque-Bera	165.7578**	168.9675***	73.76854***	134.8576**	18.8769**	21.94553***	20.0987***	19.0987***	19.93553***	76.3873
	(0.000)	(0.000)	(0.0012)	(0.000)	(0.047)	(0.002)	(0.000)	(0.0021)	(0.0047)	(0.071)
Observations	95	95	95	95	95	95	95	95	95	95

Notes: Com is the trade competition in the emerging economies (BRICS – Brazil, India, Russia, China, South Africa). **,***Significant at 5 and 1 per cent levels, respectively

Source: Data stream

Table AIV.
Descriptive statistics of trade competition

Variable	Comp_ghsa	Comp_kesa	Comp_sanig	Comp_saeg	Comp_egnig	Comp_egke	Comp_eggh	Comp_kenig	Comp_kegh	
Mean	0.255894	0.273975	0.3687	0.16687	0.1933	0.18110	0.2076	0.2308	0.212658	1,097
Max	0.569916	0.588532	0.28789	0.12681	0.38512	0.4092	0.2934	0.365879	0.317920	0.1897
Min	0.000000	0.000000	0.00053	0.000000	0.000121	0.00000	0.0000	0.04322	0.119850	0.19870
SD	0.207157	0.213479	0.05768	0.031787	0.03247	0.018769	0.06540	0.06464	0.047412	0.05872
Skewness	−0.145963	−0.257598	1.5897	−2.08765	−1.09871	1.00910	3.97368	0.78649	0.272974	80,985
Kurtosis	1.453184	1.456351	1.5850	1.89540	4.00648	4.503448	3.0780	2.00089	2.296420	3.90984
Jarque-Bera	9.808200***	10.48277**	13.76854***	14.05467**	16.8069***	19.5430***	17.9654***	18.9801***	3.139287	16.3873
	(0.0074)	(0.0053)	(0.0013)	(0.0099)	(0.000)	(0.0001)	(0.000)	(0.0021)	(0.2081)	(0.00481)
Observations	95	95	95	95	95	95	95	95	95	95

Notes: Comp is the trade competition in the big economies (USA, UK, Germany, Japan and Australia. **,***Significant at 5 and 1 per cent levels, respectively
Source: Data stream

Variable	Mean	Max	Min	SD	Skewness	Kurtosis	Jacque-Bera obs.	
Interest Rate_Ghana	25.481	35.0	12.5	10.892	0.5854	2.0803	8.4045***	95
Interest Rate_Kenya	23.226	33.2	16.5	4.924	0.6179	2.1269	8.6815***	95
Interest Rate_Nigeria	22.354	34.0	13.5	10.0765	0.7654	2.3203	8.7695***	95
Interest Rate_S.Africa	11.697	21.9	5.0	4.155	0.1248	2.0942	3.3468***	95
Interest Rate_Egypt	21.332	32.6	9.5	5.0432	0.5987	2.0839	8.6543***	95
Inflation_Ghana	0.0474	0.1927	−0.036	0.0415	0.7088	3.7546	9.7773***	95
Inflation_Kenya	0.0313	0.1741	−0.033	0.0379	1.3711	5.6572	55.283***	95
Inflation_Nigeria	0.0569	0.1876	−0.045	0.0585	0.9788	4.8752	13.459***	95
Inflation_S. Africa	0.0179	0.0443	−0.012	0.0112	0.2815	2.7123	1.5153***	95
Inflation_Egypt	0.0186	0.0483	−0.022	0.0134	0.6843	3.0865	2.9860***	95
M2_gdp Ghana	0.258	0.3411	0.1414	0.0532	−0.3411	2.2369	3.9726***	95
M2_gdp Kenya	0.4038	0.5116	0.3098	0.0539	0.7929	2.657	9.9826***	95
M2_gdp Nigeria	0.448	0.4411	0.0967	0.0843	−0.4529	2.7659	5.8726***	95
M2_gdp S.Africa	0.525	0.6707	0.3946	0.0783	0.1769	1.9091	(4.987)***	95
M2_gdp Egypt	0.6031	0.7647	0.4189	0.0865	0.2009	2.0876	6.0675***	95
Kaopen_Ghana	−1.259	−0.117	−1.875	0.3895	0.3577	4.7274	13.254***	90
Kaopen_Kenya	0.410	1.111	−1.875	1.2226	−1.1944	2.498	22.593***	90
Kaopen_Nigeria	−1.059	−0.197	−1.875	0.5876	0.4897	7.0983	14.875***	90
Kaopen_S. Africa	−1.151	−0.117	−1.875	0.4055	0.8053	5.0711	26.099***	90
Kaopen_Egypt	−1.358	−0.219	−1.875	0.5076	0.9345	8.717	24.876***	90
Oil Price	43.779	121.11	11.643	32.424	0.9569	2.4881	15.536***	95
Gold Price	601.67	1717.7	259.3	430.12	1.4679	3.7993	36.646***	95
World interest Rate	3.0233	9.267	0.1253	2.1436	0.8333	4.0124	15.051***	95

Notes: Jacque-Bera test the null hypothesis of that the variables are normally distributed. ***Significance at 1 per cent level
Source: Data stream

Table AV.
Descriptive statistics of the variables

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