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Heterogeneous Effects of Exchange Rate Regimes on Misalignments in Africa

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Abstract:

The aim of our study is to analyse the heterogeneous effects of exchange rate regimes on real exchange rate misalignments in Africa. The BEER approach is employed to determine equilibrium exchange rates and the degree of misalignments. We use the Grouped Fixed Effect estimator. The study relies on annual data covering 37 African countries over the period 1996-2019. Considering Rodrik (2008) and the Balassa-Samuelson effect, two groups of countries have been identified endogenously. Furthermore, irrespective of the classification (country group or income level), fixed exchange rate regimes have a positive impact on misalignments, while intermediate and flexible exchange rate regimes have a negative effect. Additionally, the impact of flexible exchange rate regimes is greater than that of intermediate exchange rate regimes. Thus, African countries should prioritize floating regimes (intermediate and flexible) to contain the level of misalignment. The major innovation of this study lies in the use of the Grouped Fixed Effect estimator. This allowed for extending the study to cover the entire African continent, unlike previous studies.

Keywords: real exchange rate, misalignments, exchange rate regime, grouped fixed effects estimator, Africa.

JEL Classification: E42, O47, R1.

Introduction

The question of exchange rate alignment remains a major concern for researchers and policymakers. This article aims to analyse the heterogeneous effects of choice of exchange rate regimes on real exchange rate misalignments in Africa. According to Dubas (2009), the choice of exchange rate regime has been particularly crucial regarding the potential economic outcomes of developing economies.

The exchange rate regime can be defined as the set of rules determining the intervention of monetary authorities in the foreign exchange market and thus the behaviour of the exchange rate (Lahrèche-Révil, 1999). The choice of an optimal exchange rate regime pits two views against each other, namely proponents of flexible exchange rate regimes and those of fixed exchange rate regimes (Frankel, 1999). Some authors favour fixed exchange rate regimes over floating exchange rate regimes (Edwards, 1996), while others advocate for exchange rate flexibility (Eichengreen, 2011). Consequently, the recommendation of a currency system for all countries remains controversial to this day (Bénassy-Quéré & Coeuré, 2002; Dakoure et al., 2023).

Real exchange rate misalignment can hinder both short-term and long-term economic growth (Naja, 1998). Real exchange rate misalignment occurs when the real exchange rate deviates from its equilibrium level. The equilibrium exchange rate is defined as the exchange rate that ensures both internal and external balances, as well as the sustainability of external debt (Edwards, 1989a). Thus, misalignment is the result of inappropriate exchange rate policies adopted by some countries (Eichengreen, 2011).

Moreover, empirical studies yield divergent results. Some studies show that flexible exchange rate regimes limit the level of exchange rate misalignment (Mahraddika, 2020; Dakoure et al., 2023), while others conclude that the level of misalignment is low under fixed exchange rate regimes (Caputo, 2015; Fidora et al., 2021). Conversely, other authors find that intermediate exchange rate regimes are associated with higher degrees of misalignments (Nouira & Sekkat, 2015; Owoundi et al., 2021). Thus, there is a lack of consensus on the choice of an ideal exchange rate regime.

Furthermore, considering the methodologies employed in these works, especially in Africa (PMG, CS-ARDL, and GMM), we can identify limitations. For example, Chudik et al. (2016) highlight the potential limitations of the CS-ARDL approach in terms of model specification and its sensitivity to missing or aberrant data. Moreover, none of these studies include all regions of Africa in their analysis. To contribute to this debate, our article aims to analyse the heterogeneous effects of choice of exchange rate regimes on real exchange rate misalignments in Africa. For this purpose, our study employs recent developments in panel data econometrics, notably the Grouped Fixed Effects (GFE) estimator developed by Bonhomme & Manresa (2015) to determine the equilibrium exchange rate. Indeed, the GFE takes into account the unobserved time heterogeneity between groups of countries in panel data models. We consider this approach relevant because different types of countries may exhibit distinct dynamics and region-specific heterogeneity that macroeconomic factors struggle to adequately capture. Moreover, GFE models are less sensitive to the stationarity assumptions of the variables, making them more robust in the analysis of time series with different trends between groups. Additionally, the study covers 37 African countries analysed over the period 1996-2019.

1. Literature Review

The economic literature provides diverging perspectives on the relationship between the exchange rate regime and exchange rate misalignment. While Friedman (1953) and Mundell (1961) argue for a positive correlation between exchange rate misalignment and a fixed exchange rate regime, McKinnon (1963) and Dornbusch (1980) put forward an inverse relationship. As for the flexible exchange rate regime, Friedman (1953), Obstfeld (1982), and Eichengreen (1991) support the existence of a negative correlation with exchange rate misalignment, whereas McKinnon (1963) suggests that flexible exchange rate regimes may lead to prolonged misalignments.

Following these theoretical analyses, numerous authors have empirically studied the effect of the exchange rate regime on real exchange rate misalignment. Gao et al. (2022), Prabheesh et al. (2023) and Ugurlu & Razmi (2023) suggest that the choice of exchange rate regime influences misalignments. Dubas (2009) finds that the intermediate exchange rate regime helps to limit misalignment, but that the fixed exchange rate regime restricts misalignment more than intermediate and floating regimes in developed countries. However, Coudert & Couharde (2009) note that adjustments are faster in African countries with flexible exchange rate regimes over the period 1974-2004.

Additionally, Elbadawi et al. (2012) reach the same conclusion for sub-Saharan African countries during the period 1980-1996. Holtemöller & Mallick (2013) demonstrate that from 1970 to 2006, exchange rate flexibility reduces misalignment. This finding is corroborated by Jebeniani & Trabelsi (2022) for developing countries. Nouira & Sekkat (2015) observe that the intermediate exchange rate regime induces higher and more volatile misalignment than fixed and floating exchange rate regimes for developing countries over the period 1980-2010. However, Mahraddika (2020) finds that exchange rate flexibility and capital account policies negatively affect the persistence and magnitude of misalignment over the period 1980-2014.

Furthermore, Fidora et al. (2021) note that from 1999 to 2016, in the eurozone, misalignment is lower than in non-eurozone countries. Carrera et al. (2021) reach the same conclusion for Latin American countries over the period 1970-2016. Conversely, Owoundi et al. (2021) find that for sub-Saharan African countries over the period 1980-2016, the fixed exchange rate regime does not generate more misalignment compared to intermediate and floating regimes. Dakouré et al. (2023) demonstrate that real exchange rate misalignment is greater and more persistent in sub-Saharan countries with fixed exchange rate regimes than in those with floating exchange rate regimes over the period 1980-2019.

2. Research Methodology

Equilibrium Exchange Rate Model

There is no consensus on the best method for estimating exchange rate misalignments (Cheung et al., 2019). Several approaches to measure the equilibrium value of the real effective exchange rate are commonly used in the literature: 1) the macroeconomic balance approach or NATREX, 2) the external sustainability approach or FEER, and 3) the behavioural equilibrium exchange rate (BEER).

However, one of the main advantages of the BEER procedure is that it does not require formulating assumptions, as is the case with the macroeconomic balance approach (Ramos-Herrera & Sosvilla-Rivero, 2023). The BEER methodology is considered a direct and empirical estimation based solely on the empirical determination of equilibrium exchange rates. According to Thorstensen et al. (2014), this approach reduces subjectivity in estimating equilibrium exchange rates and consequently misalignments by allowing the use of a set of fundamentals to explain exchange rate behaviour.

Moreover, the nominal effective exchange rate of country i in period t ($NEER_{it}$) reflects the value of the currency of country i relative to a weighted average of foreign currencies:

$$NEER_{i,t} = \prod_{j=1}^{N} NER_{ij,t}^{w_{ij,t}} \quad (1)$$

where: N is the number of trading partners, $NER_{ij,t}$ is the nominal bilateral exchange rate between country i and its trading partner j during period t, and $w_{it,t}$ is the weight assigned based on trade with partner j.

The definition of the real effective exchange rate (REER) of country i during period t is very similar to $NEER_{i,t}$ but considers real bilateral exchange rates instead of nominal bilateral exchange rates, as shown in the following expression:

$$REER_{i,t} = \prod_{j=1}^{N} RER_{ij,t}^{w_{ij,t}} \quad (2)$$

where $RER_{i,t} = \frac{NER_{ij,t} * P_{i,t}}{P_{j,t}}$ is the real exchange rate of country i vis-à-vis the currency of its trading partner j in period t, N is the number of trading partners, $P_{i,t}$ is the price index for country i in period t, and $P_{j,t}$ is the price index for country j in period t.

It is important to mention that these authors consider both import and export weights because policymakers are more concerned with the international competitiveness of their countries. Therefore, the overall weight of each partner j in the trade of country i in period t $(w_{ij,t})$ is constructed as follows:

$$w_{ij,t} = \left(\frac{M_{i,t}}{M_{i,t}+X_{i,t}}\right) * w_{ij,t}^{imp} + \left(\frac{X_{i,t}}{M_{i,t}+X_{i,t}}\right) * w_{ij,t}^{exp} \quad (3)$$

where: $X_{i,t}$ and $M_{i,t}$ are the total exports and imports of country i, respectively, and $w_{ij,t}^{imp}$ and $w_{ij,t}^{exp}$ are the weights of imports and exports from country j, respectively.

According to the literature, the typical variables that are likely to affect the REER are: terms of trade, productivity, openness, capital flows, public consumption, and growth of the monetary surplus. Terms of trade (TOT), measured as the ratio of export prices to import prices, will have an ambiguous effect on the REER (Edwards, 1988). By definition, an improvement in terms of trade results in an increase in the price of tradable goods (real depreciation). The income effect associated with the increase in export prices will itself lead to an increase in the prices of non-tradable goods, causing appreciation. Relative productivity (PROD), measured as the ratio of GDP per capita of the home country to OECD per capita GDP, attempts to account for the Balassa-Samuelson hypothesis.

According to Balassa-Samuelson, productivity gains tend to concentrate more in the tradable sectors. Demand tends to increase for non-tradable goods, leading to appreciation of the REER. Openness (OPEN), measured as imports plus exports as a percentage of GDP, acts as an indicator of trade policy and will tend to decrease the price of tradable goods, resulting in a depreciation of the equilibrium exchange rate. Capital flows (KFLOW) are likely to exert pressure on the prices of non-tradable goods, resulting in currency appreciation. Public consumption (GOVCONS), measured as government spending as a percentage of GDP, is an imperfect measure of public consumption of non-tradable goods, so an increase in this variable tends to appreciate the REER. Excess credit (EXCR), measured as the ratio of money to GDP, is an indicator of monetary policy and again creates a demand effect on the price of non-tradable goods, resulting in appreciation (assuming non-neutrality in the short term at least). Once the equilibrium level is obtained, monetary misalignment can be calculated as the difference between the observed real effective exchange rate (REER) and the real equilibrium exchange rate (EREER). The significance of this misalignment refers to the magnitude necessary to restore long-term equilibrium. A positive sign indicates an overvaluation of the REER, implying that the real exchange rate must depreciate to regain its equilibrium value. Conversely, a negative sign suggests that the real exchange rate must appreciate to converge to equilibrium since it indicates undervaluation.

The model for determining the equilibrium exchange rate is as follows:

$$\ln (REER)_{it} = \beta_i + \beta_1 \ln (PROD)_{it} + \beta_2 \ln (TOT)_{it} + \beta_3 \ln(OPEN)_{it} + \beta_4 \ln (GOVT)_{it} + \beta_5 KFLOW_{it} + \beta_6 \ln (EXCR)_{it} + e_{it} \quad (4)$$

where: e_{it} representing the error term. The absolute value of the real exchange rate misalignment is then calculated as indicated in equation 5.

$$MIS_{it} = \left|\ln (REER)_{it} - \ln (\widehat{REER})_{it}\right| \quad (5)$$

With $\ln (\widehat{REER})_{it}$ representing the real effective equilibrium exchange rate (EREER) obtained by applying the Hodrick-Prescott filter to our fundamental variables.

The Model for Analysing the Relationship Between Misalignment and Exchange Rate Regime

Our model is inspired by the study of Dubas (2009). The empirical specification of the misalignment equation becomes:

$$MIS_{it} = \alpha_i + \varphi_1 FIXED_{it} + \varphi_2 INTERMEDIATE_{it} + \varphi_3 FLEXIBLE_{it} + \ +\varphi_4 CRISDEBT_{it} \ + \varphi_5 DEPTH_{it} + \mu_{it} \quad (6)$$

where: $FIXED_{it}$, $INTERMEDIATE_{it}$ and $FLEXIBLE_{it}$ are indicator variables capturing the adoption of a fixed exchange rate regime, an intermediate exchange rate regime, or a flexible exchange rate regime, respectively, and μ_{it} denotes the error term.

This document will follow the literature (Dubas, 2009) by including a dummy variable for debt crisis years ($CRISDEBT_{it}$). It is expected that crisis years will be marked by significant exchange rate misalignment, whether undervaluation or overvaluation, both before and after the crisis. Another important control variable, financial depth ($DEPTH_{it}$), measured by the M2 money supply as a percentage of GDP, tends to reduce misalignment. Countries with stronger financial institutions tend to have more stable exchange rates and perhaps fewer misalignments.

Estimation Method

We use the GFE estimator, which allows us to relax the strict assumption that all countries follow the same time trend. In this framework, our empirical models (equations 4 and 6) can take the following form:

$$g_{rj} = z'_{it}\theta + \alpha_{g_{rjt}} + \vartheta_{it}, \ i = 1, \dots, N, t = 1, \dots, T \quad (7)$$

where: $g_{rj} \epsilon [1, \dots, G]$ represents membership in a group, z_{it} are covariates assumed to be uncorrelated over time with the error term ϑ_{it} but may be arbitrarily correlated with the unobserved group-specific heterogeneity $\alpha_{g_{rjt}}$.

Countries within the same group share the same time profile, and the number of groups is decided or estimated by the researcher. The fundamental assumption is that the composition of the group does not change over time.

Our model is modified to allow for time-invariant additive fixed effects. Then, the "within" transformation to the dependent and independent variables is applied, and we estimate the model with variables in deviations from the "within" mean. The new transformed variables are denoted by $\ddot{g_{it}} = g_{it} - \overline{g_{it}}, \ddot{z_{it}} = z_{it} - \overline{z_{it}}$, etc. The GFE in the equations with the transformed variables assuming that θ is common across all groups is the result of minimizing the following expression:

$$(\hat{\theta}, \hat{\alpha}, \hat{\gamma}) = \underset{(\beta,\alpha,\gamma)\epsilon\Theta^G x A^{TG} x \Gamma G}{argmin} \sum_{i=1}^{T} \sum_{t=1}^{T} (\ddot{g}_{it} - \ddot{z}'_{it}\theta_{g_{ri}} - \ddot{\alpha}_{g_{rijt}})^2 \quad (8)$$

where: the minimum is taken over all possible groupings $\gamma = (g_{r1,\dots,g_{rN}})$ of the N units into G groups, common parameters θ, and group-specific time effects α. T is the number of periods. The parameter spaces θ and A are subsets of R^K and R, respectively. We denote by γ the set of all $\ddot{\alpha}_{g_{rij}} t's$, and by α the set of all ${g_{r_j}}'s$. Thus, $\alpha \epsilon \Gamma G$ denotes a particular grouping of the N units, where ΓG is the set of all groupings of $\{1, \dots, N\}$ into at most G groups.

For computational reasons, an alternative characterization is presented, based on concentrated group membership variables. The best group for each country is then determined by:

$$\hat{g}_{rj}(\hat{\theta}, \hat{\alpha}) = \underset{(\beta,\alpha)\epsilon\theta x A^{TG}}{\text{argmin}} \sum_{i=1}^{N} \sum_{t=1}^{T} (\ddot{g}_{it} - \ddot{z}'_{it}\theta - \ddot{\alpha}_{g_{rijt}})^2, \quad (9)$$

where: the minimum g_{rj} is chosen in case of non-unique solution.

The GFE estimator of $(\hat{\theta}, \hat{\alpha})$ could be expressed as follows:

$$(\hat{\theta}, \hat{\alpha}) = \underset{(\beta,\alpha)\epsilon\theta x A^{TG}}{\operatorname{argmin}} \sum_{i=1}^{N} \sum_{t=1}^{T} (\ddot{g}_{it} - \ddot{z}'_{it}\theta - \ddot{\alpha}_{\hat{g}_{rj}(\beta,\alpha)t})^2, \quad (10)$$

where: $\hat{g}_{ri}(\hat{\theta}, \hat{\alpha})$ is given by equation (9) and the group probabilities are unbounded and specific to the individual.

To minimize expression (10), two approaches are possible. The first utilizes a simple iterative approach and is suitable for small datasets, while the second, leveraging current developments in data clustering, is preferable for larger-scale problems. In this document, the first option is used in the empirical application.

We performed GFE calculations with the number of groups G varying between 1 and 8, and we calculated the Bayesian Information Criterion (BIC) to assess the statistical advantage of having more groups to determine the optimal number of groups (separately for each outcome variable).

The models for the equilibrium real exchange rate and misalignment take the following form:

$$\ln(REER) = \beta_i + \beta_1 \ln(PROD)_{it} + \beta_2 \ln(TOT)_{it} + \beta_3 \ln(OPEN)_{it} + \beta_4 \ln(GOVT)_{it} + \beta_5 KFLOW_{it} + \beta_6 \ln(EXCR)_{it} + \alpha_{ij} + e_{it} \quad (11)$$

$$MIS_{it} = \alpha_i + \varphi_1 FIXED_{it} + \varphi_2 INTERMEDIATE_{it} + \varphi_3 FLEXIBLE_{it} + \varphi_4 CRISDEBT_{it} + \varphi_5 DEPTH_{it} + \alpha_{ij} + \mu_{it} \quad (12)$$

where: α_{ij} denote the group-specific time fixed effect, which includes both group fixed effects as well as time fixed effects. Additionally, equations (11) and (12) are estimated using a two-stage least squares methodology, with standard errors clustered by country. This process will be referred to as the GFE-2SLS estimator.

Our study utilizes panel data from 37 African countries over the period 1985-2019. Most of the data were extracted from the World Bank database (World Development Indicators, 2023). Information on exchange rate regimes comes from the classification of exchange rate regimes proposed by Ilzetzki et al. (2019). Data on crises are sourced from the crisis classification by Laeven & Valencia (2020). The real effective exchange rate is collected from the CPEII database. Precise definitions of variables and data sources are presented in Table 1 and Table 2 summarizes the descriptive statistics of the data.

Table 1: Presentation of variables and data sources

Variable	Description	Source
The Real Effective Exchange Rate (REER)	It's a weighted average of real bilateral exchange rates.	CPEII
Relative Productivity (PROD)	The ratio of country i's real GDP per capita to the real GDP per capita of the OECD.	World Development Indicators (2023)
Degree of openness (OPEN)	Defined as the ratio of exports plus imports to GDP, trade openness affects the real exchange rate.	World Development Indicators (2023)
Terms of trade (TOT)	Terms of trade represent the ratio of a country's export prices to import prices, then multiplied by 100.	World Development Indicators (2023)
Government consumption (GOVT)	It represents the size of government consumption as a percentage of GDP.	World Development Indicators (2023)
Excess credit (EXCR)	Measured as Currency (current LCU) / GDP (current LCU).	IFS (FMI) (2021)
Capital flows (KFLOW)	Following Elbadawi (1994), capital flows for African countries are taken as equal to net inflows of foreign direct investment as a percentage of GDP.	World Development Indicators (2023)

Variable	Description	Source
Exchange rate regime	FIXED = 1 if the country is under a fixed exchange rate regime and 0 otherwise; FLEXIBLE = 1 if the country is under a flexible exchange rate regime and 0 otherwise; INTERMEDIATE = 1 if the country is under an intermediate exchange rate regime and 0 otherwise.	Ilzetzki et al. (2019)
Financial depth (DEPTH)	Measured as M2 as a percentage of GDP.	World Development Indicators (2023)
Debt crises (CRISDEBT)	It takes the value 0 before the onset of the crisis and 1 after	Laeven & Valencia (2020)

Table 2: Descriptive analysis of the data

Variable	Mean	SD	Minimum	Maximum	Observations
Real Effective Exchange Rate	0.7609298	0.1223785	0.4142168	1.894051	912
Relative Productivity	0.4855783	0.6213446	0.05411	3.418745	912
Degree of openness	0.3418071	0.1918878	0.0151541	1.41272	912
Terms of trade	0.9546216	0.2656834	0.1869824	2.231182	912
Government consumption	14.19305	6.464492	0.9112346	46.26219	912
Excess credit	31.93404	22.69213	2.857408	110.5403	912
Capital flows	3.689448	7.934398	-10.21474	161.8238	912

3. Results and Discussions

Equilibrium Real Effective Exchange Rate

Table 3 presents the estimation results for equation (11) using GFE and GFE-2SLS methods. To account for correlated unobserved heterogeneity, the GFE estimator is used. Lastly, the GFE-2SLS technique is applied to consider the possibility of endogeneity in relative productivity. Endogenous classification by country groups is detected based on the coefficient of relative productivity.

Table 3: Estimation results of equilibrium exchange rate

	GFE-2SLS (1)	GFE-2SLS (2)
Relative Productivity	0.12102*** (7.11)	0.12946*** (6.91)
Degree of openness	-0.10962*** (-6.91)	-0.07715*** (-6.43)
Capital flows	0.00629** (2.09)	0.00425** (2.16)
Excess credit	0.08868*** (3.05)	0.05459*** (3.75)
Terms of trade	0.08526*** (6.91)	0.00060*** (8.80)
Government consumption	-0.19775 ** (-2.44)	-0.09862** (-2.11)
Constant	0.19112* (1.73)	0.18433** (2.07)
Country FE	No	No
Group FE	Yes	Yes

	GFE-2SLS (1)	GFE-2SLS (2)
Year FE	Yes	Yes
Group-year FE	Yes	Yes
R2	0.5430	0.6217
BIC	-2,101.488	-2,176.038
RMSE	0.0993	0.0965

Notes: Fixed, Intermediate, and Flexible are dummy variables that take the value 1 if the country is classified, respectively, under a fixed, intermediate, or flexible exchange rate regime, or 0 otherwise (Ilzetzki et al., 2019) (see Appendix). The numbers within brackets represent the p-values. The numbers within parentheses are t-statistics. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Source: Author

It is noteworthy that the value of the Bayesian Information Criterion (BIC) for the GFE-2SLS estimation is lower than the value of the objective function for the GFE estimation.

Regarding the usual explanatory factors of the equilibrium real effective exchange rate, they exhibit signs consistent with the literature. As expected, productivity, capital flows, growth of the money supply, and terms of trade have a positive and significant effect on the real effective exchange rate. These results are consistent with those of Dubas (2009) and Dakoure et al. (2023). Conversely, public consumption and the degree of openness have a negative impact on the real effective exchange rate. These findings align with those of Elbadawi et al. (2011) and Owoundi & Bikai (2020).

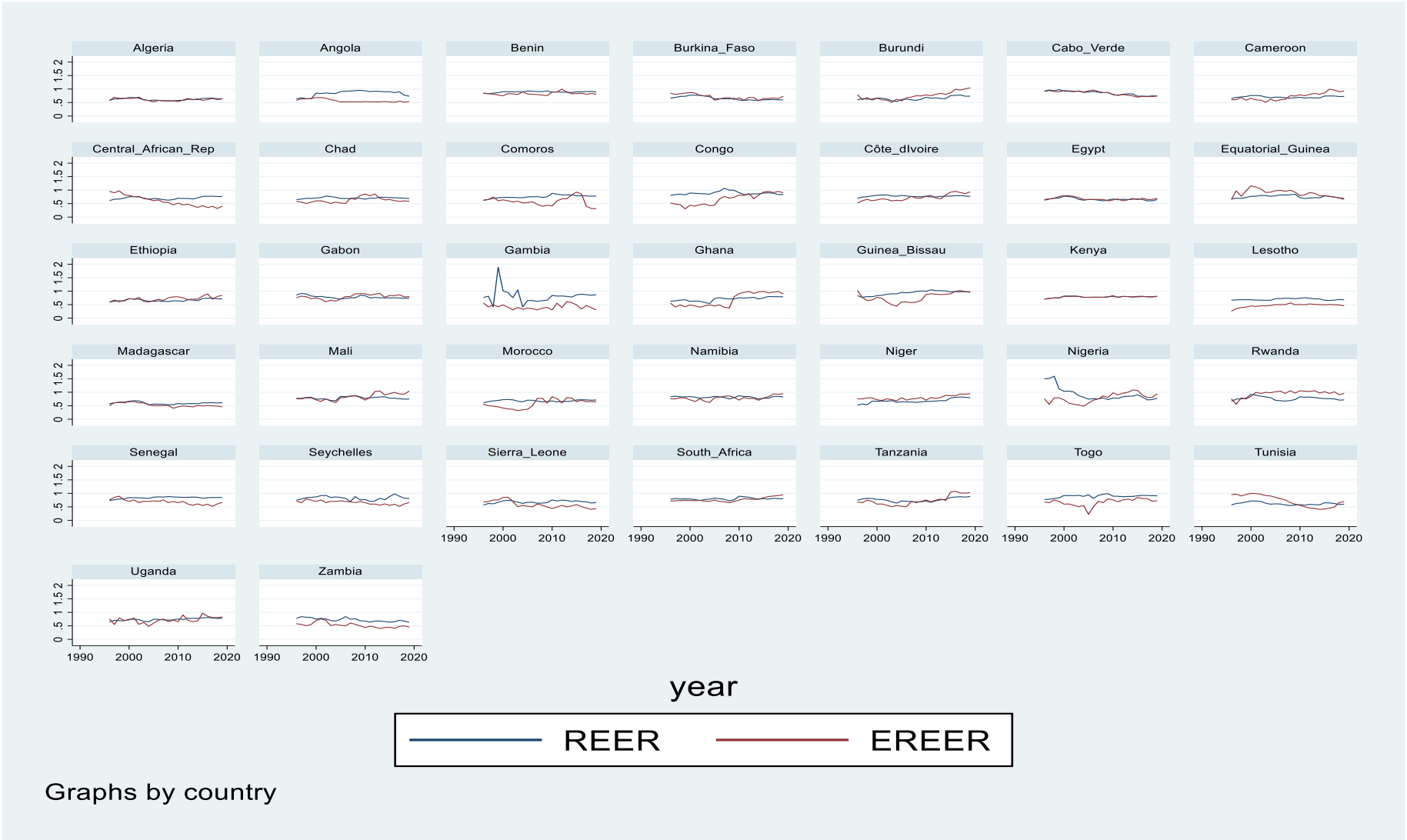
Using our GFE-2SLS results, we calculate the equilibrium real effective exchange rate. Following the literature, we use the Hodrick-Prescot filter to remove the cyclical part and retain only the 'permanent' components of our fundamental variables. We use this to calculate the equilibrium real effective exchange rate. Graph 1 depicts the simultaneous evolution of the real effective exchange rate and the equilibrium real exchange rate of African countries and Table 4 summarizes the descriptive statistics of the exchange rate misalignment.

Table 4: Summary table of real exchange rate misalignment in Africa countries

Variable	Mean	SD	Minimum	Maximum	Observations
Misalignment	0.1628685	0.1920487	0.0001013	1.471069	910

Source: Author

Figure 1. Simultaneous evolution of the real effective exchange rate and the equilibrium real exchange rate of African countries



Source: Author

The GFE-2SLS model endogenously identifies two groups (the number was chosen using information on BIC change). The estimated classification of countries belonging to each group is listed in Table 5, and the reader will find in Figure 2, a map of the countries belonging to each group.

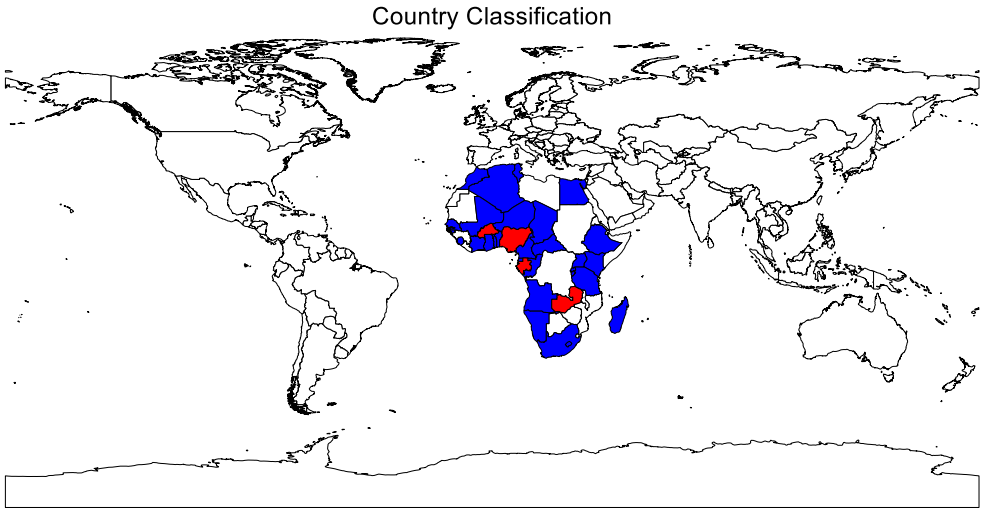
Table 5: Endogenous classification by groups of countries detected based on the productivity coefficient.

Group 1	Income class (FMI)	Region	RR aggregate	CRR
Algeria	EM	North Africa	INT	2
Angola	LIDC	Sub Saharan Africa	F	1
Burundi	LIDC	Sub Saharan Africa	F	1
Bénin	LIDC	Sub Saharan Africa	INT	2
Central African Republic	LIDC	Sub Saharan Africa	F	1
Ivory Coast	LIDC	Sub Saharan Africa	INT	2
Cameroon	LIDC	Sub Saharan Africa	FL	3
Congo	LIDC	Sub Saharan Africa	INT	2
Comoros	LIDC	Sub Saharan Africa	F	1
Egypt	EM	North Africa	INT	2
Ethiopia	LIDC	Sub Saharan Africa	INT	2
Gambia	LIDC	Sub Saharan Africa	INT	2
Ghana	LIDC	Sub Saharan Africa	INT	2
Guinea-Bissau	LIDC	Sub Saharan Africa	F	1
Equatorial Guinea	LIDC	Sub Saharan Africa	F	1
Kenya	LIDC	Sub Saharan Africa	INT	2
Lesotho	LIDC	Sub Saharan Africa	F	1
Morocco	EM	North Africa	INT	2
Madagascar	LIDC	Sub Saharan Africa	FL	3
Mali	LIDC	Sub Saharan Africa	F	1
Namibia	EM	Sub Saharan Africa	F	1
Niger	LIDC	Sub Saharan Africa	F	1
Rwanda	LIDC	Sub Saharan Africa	INT	2
Senegal	LIDC	Sub Saharan Africa	F	1
Sierra Leone	LIDC	Sub Saharan Africa	INT	2
Seychelles	EM	Sub Saharan Africa	INT	2
Chad	LIDC	Sub Saharan Africa	F	1
Togo	LIDC	Sub Saharan Africa	F	1
Tunisia	EM	Sub Saharan Africa	INT	2
Tanzania	LIDC	Sub Saharan Africa	INT	2
Uganda	LIDC	Sub Saharan Africa	FL	3
South Africa	EM	Sub Saharan Africa	FL	3
Group 2	**Income class (FMI)**	**Region**	**RR aggregate**	**CRR**
Burkina Faso	LIDC	Sub Saharan Africa	F	1
Cape Verde	LIDC	Sub Saharan Africa	F	1
Gabon	LIDC	Sub Saharan Africa	F	1
Nigeria	LIDC	Sub Saharan Africa	INT	2
Zambia	LIDC	Sub Saharan Africa	FL	3

Notes: The ranking of countries considers that of the International Monetary Fund. The classification of exchange rate regimes is based on the work proposed by Ilzetzki et al. (2019). For better interpretation, we aggregated this detailed classification into Aggregate ER where fixed corresponds to categories 1 to 4, intermediate to categories 5 to 11, and flexible to categories 12 to 15.

Source: Author

Figure 2. Endogenous classification by country groups



Source: Authors

Results of the Analysis of the Effect of Exchange Rate Regimes on Misalignments

We continue by estimating the reference model of misalignment (equation 12) using the GFE-2SLS method initially (Table 6). Secondly, we estimate this model taking into account specific slopes by introducing interactions between exchange rate regimes and group indicator variables, to examine if the choice of exchange rate regimes differently affects misalignments across groups (Table 7).

Table 6: Results of the effect of exchange rate regimes on misalignments

	GFE-2SLS (1)	GFE-2SLS (2)	GFE-2SLS (3)
Debt crises	0.00498*** (3.06)	0.00175** (2.05)	0.00250** (2.17)
Financial depth	-0.00014** (-2.09)	-0.00012*** (-3.65)	-0.00004** (-2.14)
Fixed	0.02437 * (1.76)		
Intermediate		-0.00366** (-2.31)	
Flexible			-0.01314** (-2.37)
Constant	-0.04522** (-2.14)	-0.02265** (-2.02)	-0.02264** (-2.10)
Country FE	No	No	No
Group FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Group-year FE	Yes	Yes	Yes
R2	0.8032	0.8011	0.7990
BIC	-2165.068	-2167.214	-2158.529
RMSE	0.09481	0.09367	0.09450

Notes: Fixed, Intermediate, and Flexible are dummy variables that take the value 1 if the country is classified, respectively, under a fixed, intermediate, or flexible exchange rate regime, or 0 otherwise (Ilzetzki et al., 2019) (see Appendix). The numbers within brackets represent the p-values. The numbers within parentheses are t-statistics. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Source: Authors

These results suggest that the choice of exchange rate regime affects the degree of misalignment, in line with the findings of Gao et al. (2022), Prabheesh et al. (2023) and Ugurlu & Razmi (2023). The results indicate that the fixed exchange rate regime increases the level of real exchange rate misalignment by 0.02437 percentage points. In contrast, intermediate and flexible exchange rate regimes (column 2 and column 3) exert a negative influence on misalignment. Moreover, the reduction effect attributable to the flexible exchange rate regime is greater than that of intermediate regimes (-0.01314 versus -0.00366). These findings demonstrate that higher exchange rate flexibility leads to lower levels of misalignment. This observation aligns with that of Dakoure et al. (2023) and Jebeniani & Trabelsi (2022). Regarding other control variables, they exhibit signs consistent with the literature. Financial depth and debt crises have positive and negative signs respectively. These results are in line with those of Dubas (2009).

Table 7: Heterogeneous effects of exchange rate regimes by country groups

	GFE-2SLS (1)	GFE-2SLS (2)	GFE-2SLS (3)
Debt crises	0.00479** (2.03)	0.00192** (2.32)	0.00301 ** (2.16)
Financial depth	-0.00013*** (-3.02)	-0.00010** (-2.38)	-0.00002** (-2.27)
Fixed*group1	0.02390 ** (2.07)		
Fixed*group2	0.02714** (2.33)		
Intermediate *group1		-0.01209** (- 2.11)	
Intermediate *group2		-0.00818** (-2.19)	
Flexible*group1			-0.02466*** (-3.14)
Flexible*group2			-0.03099*** (- 3.76)
Constant	-0.17137** (-2.16)	-0.17112** (-1.98)	-0.20142** (-2.06)
Country FE	Yes	No	No
Group FE	Yes	Yes	Yes
Year FE	No	Yes	Yes
Group-year FE	No	Yes	Yes
R2	0.8007	0.8016	0.7969
BIC	-2147.069	-2101.488	-2176.038
RMSE	0.09404	0.09326	0.09278

Notes: The numbers within brackets represent the p-values. The numbers within parentheses are t-statistics. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively

Source: Author

As illustrated in Table 7, the fixed exchange rate regime leads to an increase in the level of real exchange rate misalignment regardless of the country group. The coefficients of the interaction term between fixed exchange rate regimes and country groups (group 1 and group 2) are 0.02390 and 0.02714 respectively. However, the coefficients of the interaction term, respectively between flexible and intermediate exchange rate regimes and country groups, are negative and significant for all groups.

Moreover, regardless of the country group, the estimated impact of flexible exchange rate regimes is greater than that of intermediate exchange rate regimes. Indeed, the coefficient associated with the variable (Intermediate * group 1) is -0.01209 compared to -0.02466 for the variable (Flexible * group 1). The same pattern holds for the variable (Intermediate * group 2) with a coefficient of -0.00818 compared to -0.03099 for the variable (Flexible * group 2). It appears that allowing governments flexibility in exchange rates (and regimes) may offer the greatest scope to limit the negative impacts of exchange rate misalignments.

Furthermore, we proceeded with estimating the model using naive classifications of country groups based on income levels to confirm the validity of the empirical results. As shown in Table 8, regardless of the income group, fixed exchange rate regimes positively influence real exchange rate misalignments, while intermediate and flexible exchange rate regimes have a negative effect on these misalignments. Additionally, the impact of a fixed exchange rate regime in emerging African countries (0.13843) is less than in developing countries (0.21764). This can be explained by the fact that most of these economies exhibit higher governance quality indicators.

Table 8: Heterogeneous effects of exchange rate regimes by group using alternative classifications

	FE-2SLS (1)	FE-2SLS (2)	FE-2SLS (3)
Debt crises	0.00105 ** (2.11)	0.00066** (2.07)	0.00105** (1.99)
Financial depth	-0.00055** (-2.13)	-0.00031** (-2.56)	-0.00055 *** (-3.98)
Fixed*EME	0.13843*** (3.10)		
Fixed*LIDC	0.21764*** (5.904)		
Intermediate *EME		-0.01832** (-2.29)	
Intermediate *LIDC		-0.00124** (-2.25)	
Flexible*EME			-0.21764*** (-3.10)
Flexible*LIDC			-0.01091** (-2.01)
Constant	-0.08260** (-2.01)	-0.00374** (-2.15)	-0.01220 ** (-2.43)
Group FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Group-year FE	Yes	Yes	Yes
R2	0.8144	0.8098	0.8203
AIC	-2054.321	-2061.715	-2049.904
RMSE	0.1021	0.1019	0.1030

Notes: EME and LIDC are dummy variables that take the value of 1 if the country belongs, respectively, to Emerging Market Economies (EME) and Low-Income Developing Countries (LIDC), or 0 otherwise. The numbers within brackets represent the t-statistics. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Source: Authors

Our results align with those of Dakouré et al. (2023), who observed that a fixed exchange rate regime leads to higher misalignment compared to a flexible exchange rate regime. Similarly, Mahraddika (2020) noted that exchange rate flexibility facilitates a quicker adjustment of misalignment. These results are likely explained by domestic price rigidity, which constrains variations in the real exchange rate in a fixed exchange rate system. In the

event of an external shock, a floating exchange rate allows for necessary adjustments, unlike a fixed regime where price flexibility and factor mobility may absorb economic disturbances. Thus, it is likely that our results reflect the reality that African countries with fixed exchange rate regimes experience more significant shocks, and the policy response to these shocks is nonlinear, as suggested by Caputo (2015). However, our findings contradict those of Dubas (2009), who showed a more pronounced negative effect of fixed exchange rate regimes on misalignment compared to flexible exchange rate regimes. Similarly, the conclusions of Nouira & Sekkat (2015) and Owoundi et al. (2021) indicating that misalignment is more significant under an intermediate exchange rate regime are also called into question. This contradiction could be explained by differences in estimation methods and the temporal periods considered. Our results highlight that a flexible exchange rate regime is most suitable for reducing the level of real exchange rate misalignment.

Conclusion

The question of whether and how the choice of exchange rate regime influences misalignment has garnered attention from researchers. However, the answer from these studies is contentious. In this article, we contribute to the literature by applying the GFE method proposed by Bonhomme and Manresa (2015) rather than a standard fixed effects estimator to examine whether the relationship between exchange rate regimes and misalignments may differ substantially across different country groups. A sample consisting of 37 African economies, both emerging and developing, over the period 1996-2019 is used. The results indicate that a fixed exchange rate regime contributes to increasing the degree of real exchange rate misalignment, regardless of the classification used. Conversely, floating exchange rate regimes (intermediate and flexible) are associated with a faster adjustment speed of real exchange rate misalignment, regardless of the classification. Additionally, the reduction effects of flexible exchange rate regimes are greater than those of intermediate exchange rate regimes, regardless of the classification. Thus, allowing governments to design and have flexibility in exchange rates (and regimes) may offer the greatest latitude to limit the negative impacts of exchange rate misalignments.

Credit Authorship Contribution Statement

The authors contributed to all aspects of this research. Specifically, the conceptualization, study design, methodology selection, data collection, and formal analysis were carried out by the authors.

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Conflict of Interest Statement

The authors declare no conflicts of interest.

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