

Exchange Rate Regime Choice and Economic Growth: An Empirical Analysis on African Panel Data

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Abstract

The purpose of this paper is twofold. First, it tests a panel data concerning 30 African countries based on the thesis of currency neutrality, and it attempts to rank, in case of rejection of this thesis, exchange rate regimes according to their economic performances by referring to economic growth rate. Second, it aims to list the internal structural characteristics of the panel countries by crosschecking them with exchange rate regimes to find out which are most favorable to economic growth.

The paper concludes the absence of currency neutrality in case of African countries and an outperformance of intermediate regimes. On the one hand, the latter are more conducive to economic growth in the case of countries experiencing positive terms of trade shocks and benefiting from FDI inflows. On the other hand, the opening of capital account is incompatible with intermediate regimes, and external indebtedness does not favor economic growth regardless of the exchange rate regime adopted. These results remain robust by testing several alternative econometric specifications (long-term estimate on five years' window data, estimates by controlling regional effects and by adopting finer aggregations of exchange rate regimes).

keywords: Exchange Rate Regime, Economic Growth, FDI, External Debt, Opening of Capital Account, Terms of Trade, Panel Data, Africa.

1. Introduction: the terms of the debate on exchange rate regime choice

The debate over the choice of the optimal exchange rate regime is ancient, but not yet worn out. Overall, it appears that the question of the superiority of one regime over the others doesn't result in any lasting consensus that can be generalized to all countries. Since the beginning, this question has been addressed in such a way that the optimal choice is at times conditioned by the country's internal structural characteristics and other times by the major changes affecting the international economy.

By imagining a global system governing the modalities of determining the external value of currencies, Mundell (1961) argued in favor of a flexible global market where currencies are freely exchanged, with the caveat that each of these currencies be backed by an "optimal currency zone" where the parities of the

said currencies within the zone are fixed. Thus, Mundell's system foresees a nesting of different regimes whose contours of the monetary zones are conditioned by a convergence of the internal characteristics of the economies. In fact, a monetary zone is only optimal if the factors of production are perfectly mobile between the zone's member countries, which experience similar external shocks.

At the same time, the choice of the optimal exchange rate regime was also related to the degree of economies' openness (McKinnon, 1963) and to the diversification of their productive apparatus (Kenen, 1969). By adopting a fixed exchange rate, a small but increasingly open economy would gain in terms of its internal price system stability. However, a flexible regime is more appropriate through smoothing the impact of real external shocks in case of a less diversified productive structure.

More recent works continue on the same positive approach by considering the economies' internal specificities in the choice of an exchange rate regime. Eichengreen and Hausmann (1999), for example, consider that countries with heavy external debts should opt for a fixed exchange rate regime in order to control their fiscal sustainability. Other authors, taking note of 1990s crises and financial integration acceleration, particularly in emerging and developing countries, conclude the instability of intermediate regimes in the medium and long terms and the irreversibility, as a corollary, of the bipolar choice (Obstfeld and Rogoff, 1995; Fisher, 2001; Eichengreen, 1998). As for Levy-Yeyati and Sturzenegger (2001), they argue for a flexible exchange rate regime in countries experiencing terms-of-trade shocks and characterized by nominal rigidities. In line with the level of economic development, Ferrari-Filho and De Paula (2008) and Guzman et al. (2017) argue that a managed exchange could be used as an additional lever of economic policy in developing countries. According to these authors, the possibility of currency manipulation should ensure both a stability favorable to investment and gains in competitiveness accelerating the industrialization dynamic in these countries.

Moreover, the consensus that emerges from time to time around a particular exchange rate regime is also a direct result of major changes in the international environment (Frenkel, 2017). Indeed, the recent history of exchange rate regimes choice dates back to the early 1970s with the end of the Bretton Woods fixed exchange rate system, which paved the way for multiple choices towards more or less flexible exchange rate regimes. Since then, and following the trend, more and more countries opted for an intermediate regime that lasted until the end of the 1990s, when this consensus subsided following a succession of currency crises in Europe (1991), Brazil (1998), Mexico (1994) and Southeast Asia (1997). This episode in history has resulted in countries migrating towards extreme regimes.

Then, the 2002 Argentinean exchange rate (currency board) regime crisis

marked a halt to the bipolar choice and left the scene for a new global consensus around the superiority of flexible regimes only, supported in this by international institutions (Ghosh et al., 2003).

Thus, it goes without saying that both the academic works and countries' practical history are conclusive with regard to the absolute superiority of a particular exchange rate regime. The choice of the optimal regime is then subject to a trade-off between the stability provided by fixing the exchange rate and the expected competitiveness from a flexible exchange rate (Bénassy-Quéré and Coeuré, 2002), governed by the internal conditions of countries interacting with new trends in the international economy. It is then a case-by-case choice (Frankel, 1999).

In this sense, the practical answer to the question of the exchange rate choice necessarily involves a positive empirical approach. Therefore, this article looks at the African case and aims to assess which of the exchange rate regimes is the most suitable. Instead of a direct approach that consists of identifying the determinants of the probability of choosing a particular exchange rate regime and then deducing from it the most appropriate regime for a given context¹, we opt for an alternative approach that allows to judge the opportunity of choosing a foreign exchange regime via these real economic performances. Beside the possibility to capture the final effect of a particular foreign exchange regime on economic growth, this approach also highlights the interactions that the latter may have with macroeconomic behaviors and which may affect the magnitude of this effect.

The purpose of this article is not to reach a conclusion on the intrinsic superiority of an exchange rate regime, but rather to help guide the choice of the regime towards the one that best meets the (internal and external) structural characteristics of our panel countries. More explicitly, the article seeks to provide some answers to the following questions:

i/ Is exchange rate regime nature neutral in terms of the effect on economic growth? In other words, does the classic postulate of the dichotomy between the real and monetary spheres prove true on exchange rate policy in Africa?

ii/ What makes countries with a particular exchange rate regime record higher or lower rates of economic growth? And under which internal and external conditions, the intensity of the impact of a particular regime would have been more or less important?

¹ Russel (2012) presents a critical review of the work on the determinants of the choice of exchange rate regime and highlights their difficulty in predicting the most appropriate regime because of their intrinsic instability over time.

2. Exchange rate regime and economic growth: literature reviews

i. The postulate of the dichotomy of real and monetary spheres: the case of exchange rate

On the theoretical level, the origin of the divergence between economic thought currents on the equation of exchange rate choice is the dichotomous nature of monetary and real spheres' thesis. On the one hand, the neokeynesians, like the neoclassics before them, exclude any incident of exchange rate evolution and a fortiori of the modalities of determination of its value on the long-term equilibrium. The latter is stable, and the shocks eventually end up being absorbed as adjustment delays are reduced and the rigidities trail off. Thus, both spheres are dichotomous in the long run, and exchange rate policy, as monetary policy, is neutral. In this context, the only viable economic policy is one that removes the obstacles hindering the convergence dynamics of the economy towards its long-run equilibrium and the only exchange rate regime compatible with such a vision of the economy can only be the flexible regime.

In short run, these two schools diverge. Based on a particular set of assumptions (rational expectations, markets structure in pure and perfect competition, absence of rigidities and adjustment delays), the neoclassics go so far as to assume that not only exchange manipulation (supposing that the regime in place allows it) is still ineffective, but it is also counterproductive².

Furthermore, by refuting the result of the neutrality of monetary policy either in the short or in the long term, the heterodox current (post-keynesians, new structuralists) believes that exchange rate policy has a primordial role in macroeconomic management. This role is more important in the case of developing countries (DCs) to constitute one of their industrial policy levers (Guzman et al., 2017), essential to get out of the trap of sub-development (Szirmai, 2009).

As a result, the theory is unable to settle the debate on the real effects of exchange rate evolutions and, as a corollary, on the superiority of one or another exchange rate regime. The approach to be adopted in this debate is necessarily empirical.

The first empirical works on exchange rate neutrality go back to Baxter and

² A monetary injection, for example, on the foreign exchange market in order to create a competitive depreciation of the value of the domestic currency should result, according to a pre-established normative scheme, in an increase in inflation (in the absence of any monetary illusion) which drives down consumption and increases savings (to keep real cash balances constant) and a rise in investment. In the end, the effect on real output is zero, but with a higher level of inflation.

Stockman (1989) and Baxter (1991). Comparing the real performances of a group of 42 countries before and after the collapse of the Bretton Woods system. In their works, they reject any causal link between the nature of the exchange rate regime and macroeconomic aggregates dynamic. For that, they resorted to Real Business Cycle model (RBC), whose constructive assumptions fall under the neoclassics' standards that eliminate any real lasting impact of any macroeconomic policy. Apart from exogenous shocks to productivity, the economy is forced to return to its initial steady state.

By abandoning the normative approach based on canonical models for a positive approach, Ghosh et al. (1997) reach the same conclusion of real exchange rate neutrality for a large panel of 136 countries. On a larger panel, the same authors (Ghosh et al., 2003) confirm the absence of any real impact of the nature of the exchange rate regime on macroeconomic performances. Similarly, on time series data treating the countries separately, Mills and Wood (1993) and Rose (1994) find no causal link between the change of exchange rate regime and growth, during the collapse of the Bretton Woods system, respectively in the United Kingdom and Germany.

The conclusions of these works, which can be described as first generation, are limited in scope and have several limitations. In the Ghosh et al. (1997) study, for example, growth regressions on the exchange rate regime do not eliminate the effect of other traditional determinants of growth, and the estimators used may be biased. Also, it adopts a de jure classification of exchange rate regime relating to official statements of countries that do not necessarily converge with their actual policies. This explains the fact that empirical works that followed the first generation have systematically used a de facto classification of exchange rate regimes (Calvo and Reinhart, 2002) (Rogoff et al., 2003) (Levy-Yeyati and Sturzenegger, 2003) (Husain, Mody and Rogoff, 2005) (Miles, 2006) (Aghion et al., 2009) (Petreski, 2009; De Vita, and Kyaw, 2011) and some authors went so far as to develop their own classifications (Reinhart and Rogoff, 2004) (Dubas et al., 2005) (Levy-Yeyati and Sturzenegger, 2005, 2016).

This new empirical literature verifying the theory of neutrality of the choice of the exchange rate regime also remains inconclusive. Some authors (Petreski, 2009; De Vita and Kyaw, 2011), for example, approve the neutrality thesis using panel data. Whereas for Husain et al. (2005), the choice of exchange rate regime is not neutral and economic growth is positively sensitive to flexible regimes.

Other authors find more nuanced results and make them depend on the level of development of the countries: Levy-Yeyati and Sturzenegger (2003, 2001) and Dubas (2005) only take up this thesis of neutrality in the case of industrialized countries and reject it for the DCs. According to them, a fixed exchange rate regime is associated in DCs with a low rate of growth and contained inflation. Rogoff et al. (2003), for their part, show that fixed regimes in DCs do not present any obstacle to growth but, on the contrary, they provide a certain credibility of

institutions propitious to investment and growth. Similar results were obtained in the case of South-East and Central European countries by De Grauwe and Schnabl (2005). That said, one of the major limitations of these empirical works that we found in literature, which reduces the scope of their results, is that they only conceive a causal relationship between the choice of the exchange rate regime and economic growth in a unidirectional frame. However, this causal link can be very well bidirectional and the non-treatment, if any, of this effect of return of the exchange rate regime leads to biased regressions. After correcting this endogeneity bias in their regressions using adapted econometric techniques, Levy-Yeyati and Sturzenegger (2003), Miles (2006) and Aghion et al. (2009) refute the neutrality thesis and demonstrate that the link between the economic growth rate and the exchange rate regime is statistically significant.

ii. Exchange rate regime, economic structure and development

Although the exchange rate neutrality thesis remains a subject of theoretical and empirical debate that is not ruled out for advanced countries that are close to full employment, its rebuttal should, in principle, be more implicit in the case of developing countries where full employment, if it exists, is suboptimal. The actual effect of the choice of the exchange rate regime is well established in developing countries (Guzman et al., 2017) and is conditioned by economic, financial and institutional context in these countries.

Indeed, exchange rate regime choice impact on economic growth in developing countries depends on the combined effect of this regime with the frequency and the nature of external shocks (positive versus negative) and the presence of internal nominal rigidities, financial development (Aghion et al., 2009), external debts and Foreign Direct Investment (FDI) weight, capital account openness (Bailliu et al., 2003) and the existence or not of a parallel market (Miles, 2006).

In absolute terms, flexible exchange rate regime is renowned for its ability to absorb external shocks, but at the risk of financial instability and inflationary pressures negatively affecting growth. In the event of a real negative shock, adjusting the parity of the currency avoids the economy the cost of distortions in resources allocation that can be undergone in the short term in a context of domestic price rigidity (Freidman, 1953) (Bailliu et al., 2003). On the other hand, the scope of a positive shock is reduced in a flexible regime. In the event of the same shock, a flexible regime also saves the economy the cost of a rise in the interest rate that would have occurred in case of a fixed exchange rate. That said, the interest rate response depends on how Central Banks use the size of their balance sheet. For an unchanged balance sheet size, Central Banks would opt for

a sterilization operation of the withdrawal of liquidity in order to maintain a fixed exchange rate by supplying the monetary market and maintaining as a result the interest rate to its pre-shock level.

In an extensive empirical work, covering 183 countries, Edwards and Levy-Yeyati (2003) and Levy-Yeyati and Sturzenegger (2003) demonstrate that exchange rate flexibility is conducive to economic growth in the case of developing countries and reduces half of the negative impact of a deterioration of the terms of trade. In advanced countries, the nature of exchange rate regime has no real effect. Miles (2006) takes on his behalf the results of the latter works for developing countries and nuances them, considering that these countries suffer already from internal distortions negatively impacting growth regardless of the nature of the chosen exchange rate regime. By crossing fixed regime with an approximate variable of the internal distortions (Black Market Premium) in a regression of economic growth, it shows that the negative effect of the fixed regime goes through these distortions that characterize at least a part of the DCs. These distortions take the form of rampant inflation, unsustainable macroeconomic imbalances, poor quality of institutions (Calvo and Mishkin, 2003) or all of this together.

As for the risk of financial instability inherent to the exchange rate volatility in a flexible regime and its negative impact on the real economy, Aghion et al. (2009) make it depend on the ability of companies to be able to finance themselves and invest in order to improve their productivity. The authors clearly differentiate the case of developing countries with a shallow financial market and financing institutions that are relatively shy in the event of risks from advanced countries. For the first category of countries, they show that productivity is negatively related to the degree of flexibility of the exchange and consider preferable the adoption of a fixed regime.

The inflation risk is not to be discarded in case of flexible exchange. If an inflationary spiral would be unlikely to settle, following a negative external shock, via a salary indexing mechanism since the latter is often failing in DCs, it can still be triggered by imported inflation where the extent depends only on penetration rate and price elasticity of imports and/or of a low productivity which characterizes the developing countries far from the technological frontier.

In addition, the choice of the exchange rate regime also affects economic growth according to the debt structure of the economy (Eichengreen and Hausmann, 1999). The higher the private and public external debt, the more exchange rate flexibility may hinder growth in the event of a negative external shock. The latter is emphasized in the presence of a flexible exchange rate by a depreciation of external value of currency immediately increasing the internal cost of debt tightening the vice of the sustainability constraint (Calvo, 2000). Eventually, the risk premium increases for the next round of foreign currency fundraising jeopardizing further the programming of investment projects and, as a result,

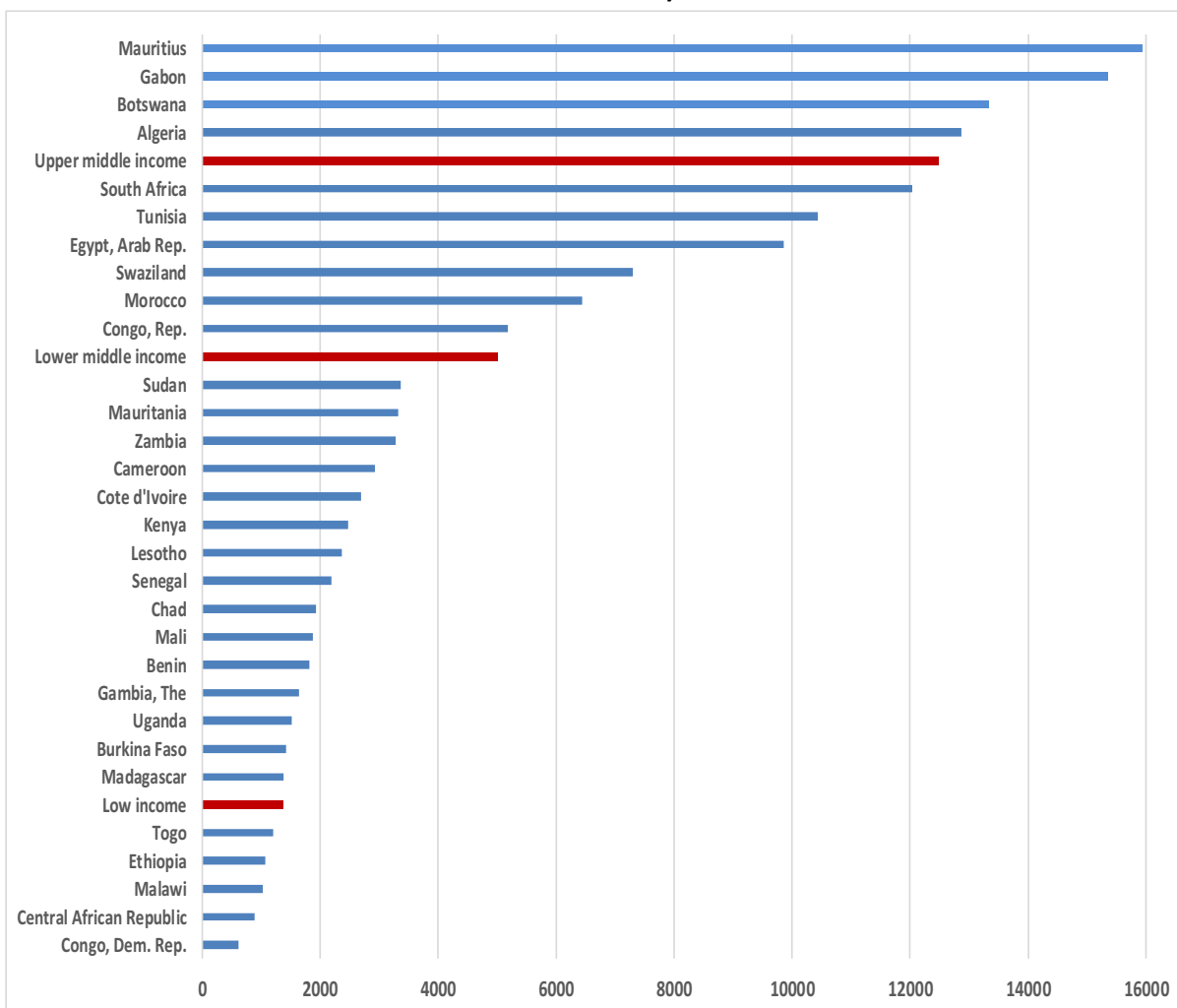
potential growth.

Another internal characteristic to be considered in assessing the ability of a particular exchange rate regime to generate growth, but which has received very little attention in the economic literature dealing with this issue, is FDI behavior. The variation in FDI would theoretically have two opposite effects on real output, depending on the degree of flexibility of the exchange rate regime: on the one hand, a net inflow of FDI in a flexible regime leads, *ceteris paribus*, to an appreciation of the exchange rate and a degree of control of imported inflation favorable to consumption and therefore to growth; on the other hand, if the Marshall-Lerner condition is verified, this exchange rate appreciation ends up reducing production by undermining cost competitiveness. In the presence of a fixed exchange rate, the adjustment goes through interest rate, which reacts to the decline and consequently favors the investment. Also, capital account openness is another aspect to detain in the choice of exchange rate regime. In the aftermath of the 1990s crises, the first factor to blame was capital account openness and its incompatibility with the intermediate regimes prevailing in the countries that were at the heart of these crises. For some authors (Obstfeld and Rogoff, 1995; Fisher, 2001; Eichengreen, 1998), corner regimes are the only solutions able to avoid currency crises in a context of financial integration at an international level. For others (Bénassy-Quéré and Coeuré, 2002; Williamson, 1999, 2000), none of the exchange rate regimes is immune to speculative attacks.

3. Exchange rate regimes in Africa: a descriptive analysis

The article studies the behavior of the choice of exchange rate regime for a panel composed of 30 African countries. With exception of a few countries with a very rich basement (Algeria, Gabon and Botswana) or managed both effectively and equitably (Mauritius), the rest of the panel countries have a relatively comparable level of development and are broadly in terms of per capita GDP between the average of the lower middle-income countries and that of the low-income countries (Figure 1). In fact, any economic policy, including the one relating to the choice of the exchange rate regime, should be designed in a logic of economic catch-up and judged in the light of its ability to put these countries on a higher growth trajectory.

Figure 1 - Ranking of our panel's African countries by GDP per capita in 2010 (in dollars and PPP)



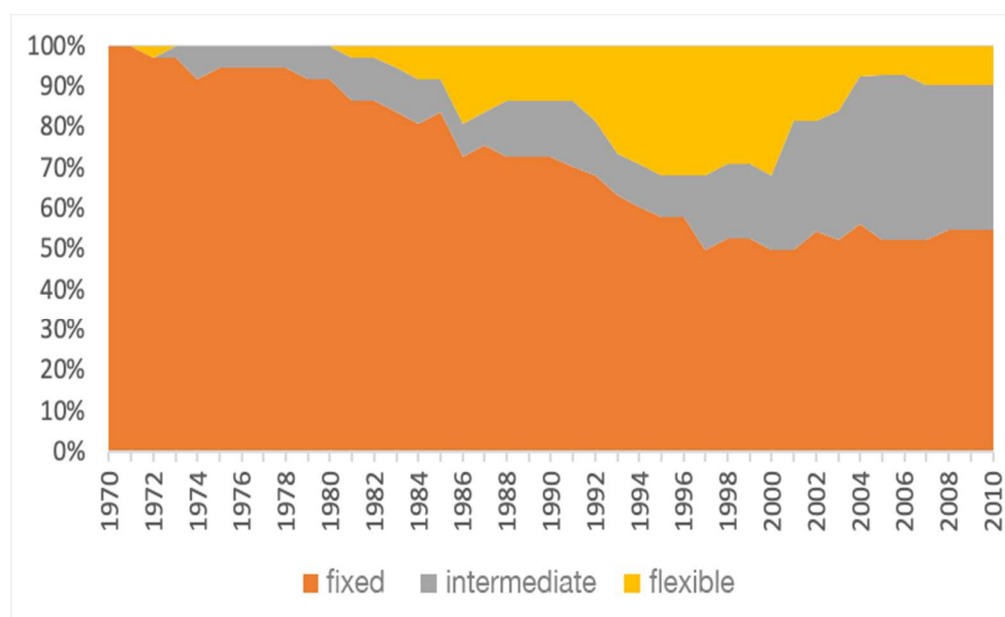
Source: World Development Indicators

Exchange rate regimes distribution in Africa remains dominated in 2010 by fixed regimes, but its share has been declining since the abandonment of the Bretton Woods system in the early 1970s (Figure 2). Migration to the flexible regime only began in the 1980s under the auspices of international institutions under the structural adjustment programs and stopped abruptly in the aftermath of the currency crises of the 1990s. Since then, the actual choice has shifted more and more to the intermediate regime, although some of these countries have continued to declare a float (Calvo and Reinhart, 2002).

The gradual abandonment of fixity in the 1970s was marked by a particular

international situation, characterized by a drop in the demand for raw materials and energy due to the rise in their price and the economic slowdown of the formerly industrialized countries. This reversal of the international situation has reduced foreign exchange inflows in African countries and made it difficult to maintain fixed exchange rates.

Figure 1 - De facto exchange rate regimes evolution in Africa between 1970 and 2010



Source: Reinhart and Rogoff (2004)

The observation of descriptive statistics comparing economic performances of African countries through exchange rate regimes put in place allows us already to have a first insight about the ranking of exchange rate regimes. They show that the middle regime outperforms the corner regimes in terms of economic growth, regardless of the country's level of development and its degree of trade openness (Table 1). On the other hand, the choice between a fixed and a flexible regime seems to depend on the level of development: if these two regimes are valid for the countries situated on the upper bracket of median income, fixed exchange rates generate better economic performances in the low-income countries. By referring to the degree of trade openness, between the two corner regimes the fixity is compatible with higher economic growth.

By widening the observation of statistical data to other macroeconomic aggregates, the latter finding of the superiority of the intermediate regimes

seems to be confirmed, without however concluding, at this stage, the existence of a causal link between the intermediate regime and economic performance (this link will be further econometrically tested). Thus, the highest investment rate is associated with the panel countries having opted for an intermediate exchange rate regime. Inflation, for its part, is between a floor level that prevailed in the fixed-rate countries and a high level characterizing countries whose value of money is determined by the market.

Table 1 - Median growth rates under exchange rate regimes in Africa and by the level of development and trade openness degree over the period 1980 – 2010

		Exchange rate regimes		
		Fixe	Intermediate	Flexible
Economic growth rate		1.1	2.9	0
Relatively Income panel countries	Low	1.2	2.8	-0.4
	High	0.9	2.9	0.9
.... Degree of trade openness	Low	1.1	2.8	-1
	intermediate	0.9	2.3	1
	High	1.2	3.4	-0.7

Source: Africa Development Indicators

Table 1 - Median investment share of GDP and inflation rate by exchange rate regime in Africa over the period 1980 – 2010

	Exchange rate regimes		
	Fixe	Intermediate	Flexible
Investment ratio	19	23.5	16
Inflation rate	4.1	7.4	17.9

Source : Africa Development Indicators

4. Exchange rate regimes and economic growth in Africa: Methodology and estimations

i. Data and models

The data is macroeconomic in nature, mainly from the World Bank's (Africa Development Indicators) database and covers the period from 1980 to 2010. The following table regroupes the variables of interest and control introduced in the different regressions, their description, as well as the sources of information. The variables of interest represent the different exchange rate regimes and the control variables were chosen from among the standard recurrent determinants found in growth theory (Barro and Sala-i-Martin, 2004).

Table 2 - variables, descriptions and sources³

	Variables	Variables description	Sources
Interest variables	Fixe	1 if ERR is fixed ; 0 if not	Reinhart et Rogoff (2010)
	Intermediate	1 if ERR is intermediate ; 0 if not	
	Flexible	1 if ERR is flexible ; 0 if not	
	Free Falling	1 if the country in an hyperinflation situation ; 0 if not	
	Monetary Union	If the country is a member of CFA zone ; 0 if not	
Control variables	Real GDP per capita growth	Real GDP per capita growth rate	World Bank (Africa Development Indicators)
	Initial GDP	Real GDP per capita level in 1980	
	Investment	Investment ratio to GDP	
	Trade openness	Trade ratio to two times GDP	
	Public expenditures	Public expenditure in final consumption ratio to GDP	
	Inflation	Inflation	
	Δ terms of trade	Change in terms of trade	
	Reserves/ broad money	Reserves ratio to broad money	
	External debts	Stock of external debts to GNI	
	Domestic credit	Domestic credit	
	FDI	Foreign direct investment ratio to GDP	
	Natural ressources	Rent derived from natural resources ratio to GDP	
	Size of the economy	Country's GDP ratio to the sum of all panel countries GDP	
	Schooling	Average number of years of schooling	Barro et Lee (2013)
	Capital account	Capital account openness index of Chinn-ito	Chinn et ito (2008)
Institutional quality	Institutional quality index of Kuncic, A.	Kuncic, A. 2012	
Terms of trade volatility	Average of the absolute values of deviations from the trend	Authors	
GDP volatility	Average of the absolute values of deviations from the trend	Authors	

Two types of models are estimated in this article. The first is linear and aims to evaluate the reaction of growth to different exchange rate regimes.

³ Schooling variable is only available in 5 years periods. We had to make it annual on the assumption that the growth rate remains constant within each 5-year interval.

$$y_{i,t} = c + \sum_{l=1}^L \beta_l X_{l,i,t} + \sum_{m=1}^M \gamma_m Z_{m,i,t} + \alpha_i + \varepsilon_{i,t}$$

The second is non-linear and introduces cross-variables with exchange rate regimes in order to identify which of the internal features of the economies are compatible with a particular exchange rate regime. It is written in the following canonical form:

$$y_{i,t} = c + \sum_{l=1}^L \beta_l X_{l,i,t} + \sum_{m=1}^M \gamma_m Z_{m,i,t} + \sum_{n=1}^N \varphi_n (X_{n,i,t} * Z'_{n,i,t}) + \alpha_i + \varepsilon_{i,t}$$

Where $y_{i,t}$ designates GDP per capita growth rate in country i at date t , $X_{l,i,t}$ is a line vector of variables of interest with L terms representing the nature of the exchange rate, the intermediate regime being the omitted modality. The control variable line vector Z is of dimension M and includes all the classical determinants of economic growth. β, γ et φ are column vectors of sensitivity coefficients to estimate. α_i is a random component representing the individual effect specific to each country, $\varepsilon_{i,t}$ the term of the error and c a common constant to all the individuals in the sample.

The estimation method is that of a panel data random-effect model, as applied by Dubas et al. (2005) to address the same kind of questions. But first, special treatment has been reserved for endogeneity. In contrast to the Ordinary Least Squares (OLS) model used by Levy-Yeyati and Sturzenegger (2003), which assumes a perfect homogeneity of the individuals in the panel, even at the level of the variables of interest, the random effect model, considering a specific individual effect for each individual in the panel, is most appropriate for the heterogeneous nature of the choice of exchange rate regime between countries.

In addition, the fixed-effect model as used by De Vita and Kyaw (2011) to assess exchange rate performance in a panel of countries is not the most appropriate, because variables transformation (in deviation from the individual mean) required to validate the hypothesis of no correlation between the individual effects and the explanatory variables ($cov(\alpha_i, Z_{i,t}) = 0$) can not be applied to structural qualitative variables, in this case, exchange rate regimes.

Thus, the random effect model is the most appropriate for data that show variability among panel members, but some inertia over time. Which is the case for our variables of interest. That said, the composite structure of the error term with a time-invariant term is a source of autocorrelation whose processing involves the use of the Generalized Least Squares estimator (GLS), which consists in applying the method of OLS to a well-transformed model captures the inter-individual variability.

As for the risk of the endogeneity of the variables of the exchange rate regime, we

tested it by adopting a two-step approach, inspired by the work of Yougbaré (2009)⁴. First, we estimated a Logit model of the determinants of exchange rate choice in order to identify the relevant variables to retain as instruments in a linear instrumental variable regression model (Table 6). Subsequently, to test the endogeneity of the variables of interest, we used the two-step instrumental variable method (IV-GMM) applied to pooled data. Angrist and Krueger (2001) argue that the consistency of the instrumental variable estimator in the second stage is persistent regardless of the specification of the model in the first stage. The convergence of the estimated coefficients in the second step is ensured, disregarding the functional form of the "true" model of the first stage whether linear or not (Angrist, 2001).

Finally, the estimation of the determinants of economic growth by the instrumental variables method (Table 7) shows that the instruments used are valid (in terms of Hansen's orthogonality conditions) and the endogeneity assumption is rejected (according to the Durbin-Wu-Hausman test). Several model variants have been tested and conclude that there is no endogeneity bias in our application case.

ii. Estimations 1: exchange rate regimes and economic growth

In this section, it is a question of estimating the explanatory models of economic growth in Africa by explaining the effect of the exchange rate regime. Table 4 summarizes the results of the retained estimates (M1 to M5) which, after eliminating the role of traditional determinants of growth, test the hypothesis of exchange rate neutrality and rank them according to their economic performance. Models from M1 to M4 are estimated on annual data. The M5 model, on the other hand, tests the stability of the results of the first regressions over the long term and introduces the variables as means over 5 years.

⁴ to deal with this endogeneity bias, other authors (Petreski, 2009; De Vita and Kyaw, 2011) have opted for an alternative method, that of the GMM system estimator applied to panel data. However, this approach poses a problem in the case of structural dummy variables because the transformation into a first difference of these variables does not make it possible to distinguish between the countries having respectively opted for different exchange rate regimes for two consecutive periods.

Table 3 - Modeling the determinants of economic growth in Africa and the role of exchange rate regimes⁵

	M1	M2	M3	M4	M5
Fixe	-0.0147*** (-3.51)	-0.0183*** (-4.19)	-0.0145*** (-3.23)	-0.0201** (-2.26)	-0.0123** (-2.44)
Flexible	-0.0202*** (-5.15)	-0.0176*** (-4.29)	-0.0145*** (-3.70)	-0.0131*** (-3.60)	-0.0240*** (-4.23)
Free Falling			-0.0337*** (-6.64)	-0.0338*** (-5.67)	
Monetary Union				-0.00694* (-1.77)	
Initial GDP	-0.00647*** (-2.77)	-0.00639** (-2.18)	-0.00731*** (-3.13)	-0.00841*** (-3.67)	-0.00471* (-1.94)
Investment	0.0126** (2.41)	0.0166*** (3.35)	0.0114* (1.92)	0.00981 (1.56)	0.0112* (1.95)
Trade openness	0.00919** (2.44)	0.0149** (2.11)	0.0111*** (2.99)	0.0128** (2.26)	0.00733* (1.82)
Public expenditures	-0.0221*** (-3.88)	-0.0159*** (-2.79)	-0.0220*** (-3.74)	-0.0217*** (-3.53)	-0.00218*** (-4.05)
Δ terms of trade	0.0165* (1.73)	0.0216** (2.26)	0.0165* (1.74)	0.0188** (2.16)	
Inflation	-0.0240*** (-11.54)	-0.0151*** (-4.82)	-0.0206*** (-7.62)	-0.0195*** (-5.89)	-0.00280*** (-12.19)
Schooling	0.00111 (0.73)	0.00277** (2.07)	0.000801 (0.54)	0.000261 (0.15)	0.000512 (1.37)
FDI	0.0975*** (2.77)	0.0782** (2.15)	0.0914*** (2.66)	0.0900** (2.53)	
Natural ressources		-0.0255* (-1.84)			
GDP volatility					-0.00218*** (-4.05)
Terms of trade volatility					-0.0300* (-1.71)
c	0.0399** (2.02)	-0.00376 (-0.11)	0.0417** (2.13)	0.0416* (1.91)	0.0393* (1.94)
N	625	593	625	624	141
Overall	0.2930	0.2877	0.1964	0.2952	0.5583
Between	0.8379	0.8485	0.5956	0.8318	0.8786
Within	0.1506	0.2877	0.1084	0.1485	0.2640
Autocorrelation p value	0.5397	0.6567	0.5449	0.5545	0.1591

*,**,*** significant at a 10%,5% and 1% level. i) *t*-students between brackets; ii) M1, M3, M4 and M5 include dummy variables to control for regional concentration effects

⁵ The statistical properties of the models are satisfactory: the heteroscedasticity is corrected upstream on STATA and the autocorrelation hypothesis is rejected. The Durbin Whu Hausman test associated with the IV-GMM method does not reject the null hypothesis of exogeneity of the explanatory variables, including those relating to exchange rate regimes (Table 7).

Overall, control variables are statistically significant in all models and come out with the expected sign: the coefficient related to the initial GDP variable takes a negative value, in line with the economic catch-up dynamics à la Solow; investment, trade openness, changes in terms of trade and FDI flows have a positive impact on economic growth in Africa; public expenditures, inflation and the abundance of natural resources have a recessive effect; The positive impact of the schooling only appears when the potential effect of the curse of natural resources is captured (M2), otherwise the two effects compensate for the non-significance of the schooling variable in the rest of the models.

Interest variables relating to the exchange rate regimes are of a qualitative nature, interpreted in relation to the omitted variable, which is, in this case, the intermediate regime. The M1 and M2 estimates conclude that intermediate regime is superior in terms of its ability to generate economic growth compared to corner regimes. This result reinforces the conclusions of some of the work on the question pleading for an intermediate regime in the particular case of developing countries (Williamson, 1999, 2000; Ferrari-Filho and De Paula, 2008; Guzman et al., 2017). The recurring argument in favor of this choice of regime is that it brings together the advantages of the corner regimes, while reducing the scope of their respective negative effects. Indeed, between a fixed exchange rate ensuring macroeconomic stability through the control of inflation and a floating exchange isolating the economy from negative external shocks and improving cost competitiveness, the intermediate regime gives the faculty to dose the intensity of fixity / flexibility to be introduced in the system by adapting to the specificities of each country and to the reversals of the situation of the international economy⁶.

The M3 model re-evaluates the previous result of the underperformance of the flexible regime compared to the intermediate regime by separating from the group of countries opting for flexibility those characterized by galloping inflation (grouped under the Free Falling regime). This result remains unchanged and the superiority of the intermediate regime is confirmed. The M4 model goes into more detail by separating the CFA franc zone from the fixed regime assuming, a priori, that the adoption of a single currency encourages trade and growth. The estimation of this model hardly alters the first result of relative superiority of the middle regime. However, the negative impact on the growth of the monetary union is less than that of the fixed regime outside the monetary union.

⁶ Another argument found in the literature used to guide the choice of the exchange rate regime is the independence of monetary policy and its ability to smooth the economic cycle that the flexibility supposed to ensure. It is increasingly challenged, and Mundell's trilemma tends to be reduced to a dilemma because of increased financial integration and trade openness (Rey, 2015; Han and Wei, 2016). Edwards (2015), for example, highlights the presence of a contagion effect of US monetary policy on that of South American countries having recently chosen the flexible exchange rate regime.

The M5 model tests the robustness of the results over the long term, neutralizing the effect of changes in economic conditions on the behavior of variables. As the regression is enriched by volatility variables in terms of GDP and terms of trade, the short-term result remains robust and the intermediate regime dominates the corner regimes in the case of African countries.

iii. Estimations 2: exchange rate regimes, internal characteristics and economic performances

As the effect of the choice of the exchange rate regime on growth is empirically established, it is now necessary to specify the explanatory models of growth that make it possible to identify the economic characteristics that are compatible with one or another exchange rate regime. In order to do this, cross-variables were introduced in the growth rate regressions (Table 5), testing the combined effect of the exchange rate regime with the variations of terms of trade (M6), FDI weight (M7), the degree of openness of the capital account (M8) and external debt weight (M9).

Table 5 - Panel Data Modeling of Transmission Channels of Exchange Rate Effect on Economic Growth in Africa⁷

	M6	M7	M8	M9
Fixe	-0.0183*** (-4.11)	-0.0158*** (-3.56)	-0.0156*** (-2.88)	-0.0218*** (-2.97)
Flexible	-0.0163*** (-3.97)	-0.0204*** (-3.53)	-0.0148*** (-3.09)	-0.0148* (-1.69)
Fixe* Δ terms of trade	0.0354** (2.28)			
Intermediate* Δ terms of trade	0.0344* (1.96)			
Flexible* Δ terms of trade	-0.0129 (-1.60)			
Fixe* FDI		0.0410 (1.04)		
Intermediate* FDI		0.122*** (3.84)		
Flexible* FDI		0.228*** (2.97)		
Fixe* Capital account			0.00263 (0.63)	
Intermediate* Capital account			-0.00267** (-2.12)	
Flexible* Capital account			0.00436*** (2.84)	
Fixe* external debts				-0.0106*** (-3.36)
Intermediate* external debts				-0.0145** (-2.10)
Flexible* external debts				-0.0142*** (-4.05)
Initial GDP	-0.00654** (-2.31)	-0.00566* (-1.80)	-0.00723** (-2.07)	-0.00706** (-2.41)
Investment	0.0164*** (3.44)	0.0158*** (3.13)	0.0138*** (2.64)	0.0134*** (2.85)
Trade openness	0.0152** (2.15)	0.0149** (2.02)	0.0169** (2.17)	0.0155** (2.29)
Public expenditures	-0.0154*** (-2.69)	-0.0151** (-2.54)	-0.0156** (-2.48)	-0.0115* (-1.91)
Inflation	-0.0173*** (-5.77)	-0.0136*** (-4.32)	-0.0151*** (-4.70)	-0.0109*** (-2.91)
Schooling	0.00270** (1.99)	0.00261* (1.89)	0.00320** (2.24)	0.00121 (0.80)
Δ terms of trade		0.0213** (2.21)	0.0197** (2.05)	0.0221** (2.36)
FDI	0.0774** (2.11)		0.0760** (2.20)	0.0504 (1.56)
Natural resources	-0.0259* (-1.84)	-0.0256* (-1.90)	-0.0170 (-1.07)	0.00104 (0.07)
c	-0.00390 (-0.12)	-0.00935 (-0.27)	-0.000565 (-0.01)	0.0111 (0.40)
N	593	593	593	579
Overall	0.2018	0.1991	0.1961	0.2228
between	0.6737	0.6572	0.5887	0.7994
within	0.1008	0.1012	0.1091	0.1019
Autocorrélation p value	0.6591	0.5617	0.6728	0.6050

⁷ The statistical properties of the models are satisfactory: the heteroscedasticity is corrected upstream on STATA and the autocorrelation hypothesis is rejected.

As for the first group of models (M1 to M5), the classic determinants of growth are, for the most part, statistically significant in this second group of regressions (M6 to M9) and stand out with the expected signs.

In these regressions (Table 5), the intermediate exchange rate regime outperforms, in absolute, the regimes of the corners (first two rows of the table), but its positive effect on growth is more pronounced in the case of positive shocks of the terms. Trade (M6), FDI inflows (M7) and a controlled opening of the capital account (M8). External indebtedness negatively affects African economic growth regardless of the nature of the chosen exchange rate regime. Nevertheless, its impact in fixed regime is slightly less important in absolute value than in flexible regime.

The model results (Table 5) also argue that between the two end regimes, the preference for flexibility (versus fixity) in African countries would be dictated by the occurrence of positive (versus negative) external shocks, positive FDI flows (versus negative), and an open capital account (versus closed).

5. Conclusion

The story of exchange rate regime choice has not yet reached a consensus. Between early works on the subject (Mundell, 1961; McKinnon, 1963) and the most recent (Frenkel, 2017; Guzman et al., 2017), no superiority of one specific foreign exchange regime over the others has been established *ad vitam aeternam*. It is all in a case by case basis.

This paper tested the thesis of currency neutrality through a panel data concerning 30 African countries and the results confirmed the absence of currency neutrality in case of African countries and an outperformance of intermediate regimes.

Secondly, having rejected the thesis of currency neutrality, the paper attempted to rank exchange rate regimes according to their economic performances by referring to economic growth rate and listed the internal structural characteristics of the panel countries by crosschecking them with exchange rate regimes to find out which are most favorable to economic growth.

On the one hand, intermediate regimes resulted more conducive to economic growth in the case of countries experiencing positive terms of trade shocks and benefiting from FDI inflows. On the other hand, the opening of capital account is incompatible with intermediate regimes, and external indebtedness does not

favor economic growth regardless of the exchange rate regime adopted.

These results remain robust by testing several alternative econometric specifications (long-term estimate on five years' window data, estimates by controlling regional effects and by adopting finer aggregations of exchange rate regimes).

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