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Abstract

The financial sector of an economy is now widely agreed to constitute a potential important channel for growth. Many regions such as Sub-Saharan Africa, however, have relatively underdeveloped financial sector. Although several policy designs have been used to induce growth in the sector, there has been little or no success in the majority of the countries in the region. Existing theories suggest that inflation has negative effects on financial development. Other theories argue that inflation has a threshold effects on financial development. In this study, we provide a comparative study on the threshold effects of inflation on financial development between the Economic Community of West African States (ECOWAS) and the Southern Africa Development Community (SADC) for the period 1980-2011 using a novel Panel Smooth Transition Regression. Our results suggest evidence of the existence of a robust single threshold of inflation in both regions. Particularly, it indicates 17.9% and 14.5% of inflation for ECOWAS and SADC respectively, suggesting that inflation above these thresholds presents statistically significant detrimental effects for financial development in both regions. The study therefore argues that price stability policies with inflation targeting framework should be the primary objective in monetary policy, since high inflation is economically costly to financial development of the two regions.

JEL Classification Numbers: G21, O16, O43 O55

Keywords: ECOWAS, SADC, financial development, inflation, Panel Smooth Transition regression, threshold effects.

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1 Introduction

The basic aim of financial sector policies is to induce growth and stability in the sector as finance is an important potential channel in determining economic growth. This is a grave concern in Sub-saharan Africa (SSA). Following the economic and financial sector reforms of the 1980s, in order to promote financial sector development (FSD), most of the countries in SSA demolished their post-independent repressive economic and financial sector regimes leading to the sector opening up. These reforms resulted in the dismantling of credit controls, privatization of state-owned banks and liberalization of interest rate which were among some of the measures taken in the 1980s. To spur growth in the financial sector, financial sector policies mostly aim at inducing competition that will promote efficiency and subsequent expansion of the sector. However, despite measures being taken both in the past and present, the financial sector of SSA is still relatively thin and under developed revealing FSD deficit¹. From this perspective, we argue that these policies are essential but need the support of other enabling macroeconomic conditions to induce commendable growth in the sector. Further investigations are thus required, particularly on the optimal level of macroeconomic policy variable of inflation which is essential for promoting financial development.

Existing studies, such as Huybens and Smith (1998) and Huybens and Smith (1999), indicate that macroeconomic policy variable of inflation has a detrimental effect on the financial sector's ability to operate efficiently since it interferes with the development process of the sector. The studies posit that, increases in the rate of inflation erode returns on investment, which adversely affect credit market friction. This, in turn, impacts on FSD negatively and hence, long-run real activity. Studies such as those conducted by Boyd, Levine and Smith (2001), BenNaceur and Ghazouani (2005), Detragiache, Gupta and Tressel (2006), Kablan (2010), and many others provide empirical evidence in supported of this theory.

However, other theories argue that there is existence of threshold effects of inflation on FSD, as in Azariadis and Smith (1996) and Choi, Smith and Boyd (1996). These theories propose that some amount of inflation is desirable for FSD up to certain threshold level. Beyond this threshold level will witness the detrimental effects of inflation on the sector's development. Hence, it is important, especially for policy makers to understand the dynamic relationship between inflation and FSD in order to make sound and achievable policies that will increase development in the sector. Consequently, exploring further the link between inflation and financial development in terms of threshold effects is vital. As a precondition, policy makers should aim at low rates of inflation so as to avoid the detrimental effect of this variable in the process of financial development. The question to ask then is 'What is the optimal level of inflation that is required and suitable for FSD?'

The main objective of this study is to determine the optimal level (threshold

¹Except South Africa

level) of inflation suitable for FSD. This is done by considering a comparative study between Economic Community of West African States (ECOWAS) and Southern Africa Development Community (SADC). Comparative study is important because firstly, regional blocs are considered as the pillars of Africa Economic Community and are an increasingly dominant feature today². For this reason, the study does not only reveal the peculiarities in each bloc but also the extent by which this macroeconomic policy variable is beneficial for FSD in each bloc and why if there are any differences between the two regions. This provides guidelines for policy recommendations. Secondly, it is particularly insightful to separate and compare regional groups in SSA, since member states in each bloc pursue almost the same policies in attempt to achieve similar goals that will lead to meeting the convergence criteria³ set by the bloc. These blocs were chosen because (i) they seem to be one of the oldest and make up almost two thirds of SSA; (ii) consistent data exist for most of the countries.

Existing empirical studies on threshold effects of inflation on FSD is relatively limited and few if not nothing exists, especially on SSA. However, some progress is being made. Some of the few studies include .Boyd, Levine and Smith (2001). This study determined the optimal level of inflation suitable for financial development for combination of developed and developing countries. Even though the study deepens our understanding on the behavior of inflation on finance, it had the following weaknesses. The study imposed an *a priori* threshold of inflation instead of endogenously estimating it. In addition, no formal test is done to establish whether there exists a non-linear relationship in the data between inflation and finance. Other studies, such as those conducted by Rousseau and Watchtel (2002), Rousseau and Yilmazkuday (2009) and Jude (2010), did not examine the threshold of inflation directly on FSD but merely suggested an indirect effect of inflation on finance-economic growth relationship. Furthermore, these studies only used single measures of financial development instead of composite measure that captures broadly the basic functional forms of the financial sector. Finally, the data used in these studies are usually made up of developed and developing economies. For instance, Boyd, Levine and Smith (2001) used 97 countries of both developed and developing economies whereas Rousseau and Watchtel (2002) as well as Jude (2010) used 84 and 71 respectively. The findings are generalised and may be deceptive.

Based on the above gap in the literature, this study makes three main contributions. Firstly, the study used a composite measure of FSD that is constructed using three measures of financial development indicators. Secondly, although the previous studies provide some evidence that inflation has some threshold effects on FSD, they are based on non-linear models that are not adequate to model non-linearities properly as in some cases the threshold value is imposed such as in Boyd et al. (2001) and no formal test to establish the existence of such non-linearity is conducted as in Boyd et al. (2001) and Abbey (2013). Hence, in

²As evidenced by the recent ideas and call for the formation of Tripartite Cooperation in Trade in SSA

³Some of which includes achieving a low inflation rate as well stable exchange rate and stable economic growth rate

this study, we contribute to the inflation-finance literature by not only testing for the existence of thresholds effects between finance and inflation but use a more robust and novel Panel Smooth Transition Regression (PSTR) approach recently developed by González, Teräsvirta and Dijk (2005) that endogenously estimates the threshold value of inflation. Even though PSTR has been used in some studies such as inflation-growth nexus (for example Bessec and Fouquau 2008; Omay and Ozgur 2010; Ibarra and Trupkin 2011; Seleteng et al. 2012), its application in inflation-finance relationship has yet to be examined. Lastly, the study is conducted on the direct effects of inflation threshold on financial development in the context of comparing regional blocs in SSA.

To our knowledge this is the first study conducted that: (i) provides an exclusive comparison of regional groupings in SSA to determine the thresholds effects of inflation on finance that is appropriate to induce FSD; (ii) apply the novel technique of PSTR to panel data that endogenously determines the threshold level of inflation on FSD in the two regions. Hence this study is dissimilar to earlier studies like Boyd, Levine and Smith (2001), Khan, Senhadji and Smith (2001), Aziakpono (2004) and Rousseau and Yilmazkuday (2009). The PSTR approach has an advantage of estimating the threshold value rather than imposing it by *a priori*. In addition, it allows for speed of transition from one regime to another depending on the threshold variable.

As a preview to our results, the PSTR approach does not only confirm a single threshold of 17.9% and 14.5% of inflation for ECOWAS and SADC respectively, but also reveals statistically significant negative effects of inflation on finance for inflation rates above the thresholds. These results suggest that countries in ECOWAS and SADC can prevent inflation from interfering with the efficient operation of the financial system in the two regions if only they can obtain and maintain inflation rates below their respective inflation thresholds.

The rest of the paper is organized as follows: Section 2 discusses the literature review. Section 3 contains the methods and model specification which gives description of PSTR. The data used is described in Section 4. The analysis and discussion of results are done in Section 5. Section 6 gives summary and conclusion of the paper.

2 Literature Review

Existing theories on the threshold effect of inflation on financial development propose that a negative relationship between financial development and inflation is only noticed when inflation rate exceeds certain threshold, thereby suggesting a nonlinearity between finance and inflation (Azariadis and Smith, 1996). The models developed by Azariadis and Smith (1996) and Choi, Smith and Boyd (1996) argue that when inflation is suitably low credit market frictions may be “nonbinding” which renders inflation incapable of distorting the flow of information in the financial market. With this, the effects of increases in inflation is powerless in impeding financial sector’s ability to allocate resources efficiently. The models explain that under this low inflation condition, coupled with suf-

ficiently high real rates of returns on savings, adverse selection in the credit markets is not binding. This implies that credit rationing is not required to induce lenders to lend rather than borrow. This thus suggests that increases in inflation induces agents to substitute cash for investment in physical or human capital or both which will stimulate long run growth.

Moreover, the theories posit that when inflation increases excessively real rates of returns on assets will be pushed down resulting in credit market frictions becoming binding. If increases in inflation exceed this threshold level or critical value, subsequent increases in inflation will cause credit rationing to intensify. This is capable of distorting information flows and, as a consequence, harm the efficient workings of the financial system. The transmission mechanism implies that lower rates of returns caused by increases in inflation will induce severity of adverse selection which will necessitate widespread credit rationing in the economy. Hence, these effects result in reduction in financial system expansion. Thus, an important conclusion of these models is that threshold effects exist between inflation and financial development.

The theories further predict a second threshold effects of inflation on finance. They also contend that if inflation exceeds this critical value perfect foresight dynamics are related with endogenous oscillations in all variables causing inflation to be highly correlated with inflation variability and assets return volatility⁴. In addition, a third threshold effect is confirmed by other models⁵. When inflation reaches this critical value all the harm to financial system development has already been done and further increases in inflation have no extra impact for financial development or growth.

On a broader empirical literature relating inflation to financial development, contemporary empirical literature has mostly recorded a significant negative relationship. These studies include Haslag and Koo (1999), BenNaceur and Ghazouani (2005), Detragiache, Gupta and Tressel (2006), Zoli (2007) and Kablan (2010). Studies on SSA include Aziakpono (2004) on Southern Africa Custom Union (SACU), McDonald and Schumacher (2007) and Andrianaivo and Yartey (2009). All these studies documented evidence that increases in inflation reverse FSD.

Empirical literature on threshold effects of inflation has largely been devoted to explaining inflation-growth nexus and finance-growth nexus. Relatively few studies are directed to the determination of the direct effect on inflation-finance relationship. Studies that attempted to find the threshold effects of inflation on growth include Schiavo and Vaona (2007), Omay and Kan (2010), Mignon and Villavicencio (2011), Ibarra and Trupkin (2011) and Seleteng, Bittencourt and van Eyden (2012). These studies argue that the debilitating effects of inflation on economic growth is only observed after certain threshold level.

On the nascent empirical literature directed at finding the threshold effects of inflation on finance-growth nexus, studies are usually a broad mixture of both developing and developed economies. These studies attempt to estimate the

⁴See Boyd et al. (2001) for more details.

⁵See Boyd and Smith (1998) Huybens and Smith (1998, 1999) for more details

threshold value of inflation suitable for the financial sector to induce economic growth. Among such studies include the study of Rousseau and Watchtel (2002) Rousseau and Watchtel (2002) used five-year averages of measures of financial development (M3 and M3 less M1 and total credit to GDP), inflation, and economic growth rates of 84 countries for the period 1960 to 1995. The study concluded that there is an inflation threshold for the finance-growth relationship that lies between 13% and 25%. This implies that, above these thresholds, the financial sector is powerless in inducing economic growth in these countries. In a similar way to Rousseau and Watchtel (2002), Lee and Wong (2005) obtained single threshold value of 7.25% in Taiwan and double thresholds of 2.5% and 9.66% in Japan. The study employed a threshold autoregression (TAR) model.

Further studies in this area include Rousseau and Yilmazkuday (2009) and Jude (2010) Rousseau and Yilmazkuday (2009) posit that higher levels of financial development, combined with low-inflation, are related to higher rates of economic growth, especially in lower income countries. However, financial development loses much of its explanatory power in the presence of high-inflation. The study found double threshold of inflation between 4% and 19%. Jude (2010) used PSTR on data of 71 panel of countries that include both developed and developing countries for the period 1960 - 2004. The conclusion of the study is that there is a double threshold of inflation of 9.5 % and 24 % for finance-growth relationship beyond which the finance-growth coefficients are negatives. These findings are in line with the existing theory. The implication is that when inflation rates are high, financial intermediation becomes more difficult, since this high inflation exacerbates information asymmetry and, consequently, render the FSD powerless to induce economic growth, if not retard it. Also in line with the studies of Rousseau and Yilmazkuday (2009) and Jude (2010), Huang et al. (2010) applied Caner and Hansen's (2004) instrumental-variable threshold regression approach⁶ and found 7.3% and 7.7% respectively for policy variables alone and for full sample. The study used private credit as a measure of FSD and followed Rousseau and Wachtel (2002) in using the period-averaged inflation as a candidate threshold variable.

Even though the above empirical studies broaden our understanding on the threshold effects of inflation on financial development, these studies focused mainly on specific threshold value beyond which financial sector loses its growth inducing power on economic growth. Thus, these group of studies failed to inform us about the asymmetric effects of inflation directly on FSD.

Studies that directly estimated the threshold effects of inflation on financial development as mentioned earlier are relatively few. No study is specifically done on SSA in this area. The available studies attempted to determine at what threshold level does increase in inflation reverse FSD. Among the few known studies is the work of Boyd et al. (2001). This study obtained a double digit inflation threshold of 15% for FSD for a number of developing and developed countries. The study indicates that the relationship between finance and

⁶The study used the dataset of Levine et al. (2000) to determine whether there are any inflationary thresholds in the finance-growth linkage.

inflation is nonlinear for the 97 countries in their sample for the period 1960–1995. However, as indicated, the main weakness of the study is the imposition of threshold by *a priori* and also lack of test of existence of nonlinearity. This study presented results on three different measures of FSD which include liquid liabilities, bank assets and private credit. Also in the same year, Khan, Senhadji and Smith (2001) used a sample of large cross-country and found evidence of the existence of threshold of inflation between 3% and 6% a year. These findings depend on the specific measure of financial depth used. The measures are domestic credit to the private sector, summation of domestic credit and stock market capitalization and summation of the second indicator with private and public sector bonds market capitalization⁷. However, this study is made up of 168 countries that included both developed and developing economies. Hence, generalization of the threshold value for both developed and developing economies may be misleading since there are significant differences between these groups of countries.

Finally, on a single country analysis, Abbey (2013) argues that inflation threshold rates between 11-16% per annum is observed in the inflation-finance relationship in Ghana. The study used the cointegration approach and the Granger causality testing procedure coupled with Conditional Least Squares technique to address the relationship between inflation and FSD. The study thus recommended price stability for inflation rates between 11-16% in support of financial development in Ghana. The study relied on ratio of private sector credit to GDP and the market capitalization ratio separately as measures of FSD.

From the ongoing discussion on the empirical literature, we can thus highlight the following observations or gaps from the above literature: (i) that no study has been conducted on the direct effects of inflation threshold on financial development in the context of comparing regional blocs in SSA; (ii) some studies that attempted to examine the threshold effect directly on financial development imposed the threshold value by an *a priori* which can either be too low or too high. (iv) all the studies discussed used a single measure of financial development which are unlikely to capture broadly the financial sector. Therefore, the main contributions of this paper is not only to examine the direct effects of inflation threshold on financial development in the context of regional comparison of ECOWAS and SADC in SSA, but also to create a composite measure of FSD and apply a novel PSTR that has the advantage of endogenously determining the threshold value.

3 Method and Model specification

To capture the threshold effect of inflation on financial development, we follow the approach of González et al. (2005) by specifying the PSTR model. The advantage of this model is that it can estimate the threshold parameter endogenously. This approach allows the relationship between finance and inflation to

⁷The authors acknowledged that this last variable was only available for advanced countries.

depend on the level of the threshold variable. The PSTR is a fixed effect model with exogenous regressors and caters for heterogeneity problem in the model. According to González et al. (2005), the model permits parameter heterogeneity by assuming that the regression coefficients are continuous function of an observable variable through a bounded function of this variable, called transition function, and fluctuates between regimes.

The PSTR has some advantages over other earlier approaches such as the Panel Threshold Regression (PTR) of Hansen (1999) that also estimates the threshold effect. According to Hansen (1996, 1999), the PTR model divides the observations into two or more regimes and these regimes are separated by different regression slopes. PTR approach requires that different groups of observations can clearly be distinguished from each other based on the value of the threshold variable with sharp or discontinuous ‘borders’ or thresholds separating each group. In practice, this is more restrictive and may not always be feasible. Hence, an advantage of PSTR is the generalization of the PTR model that relaxes this restriction of the approach. In particular, PSTR allows the regression coefficients to change gradually when moving from one group to another. This permits smooth transition from one regime to another which is not possible in the Hansen (1999) approach.

A simple two-regime PSTR model with a single transition function is specified in equation 1 but can be generalized to allow for more than two different transition functions as in equation 2:

$$y_{it} = \alpha_i + \beta_0 x_{it} + \beta_1 x_{it} \varphi(q_{it}; \gamma, \delta) + \varepsilon_{it} \quad (1)$$

$$y_{it} = \alpha_i + \beta_0 x_{it} + \sum_{j=1}^r \beta_j x_{it} \varphi_j(q_{it}^j; \gamma, \delta) + \varepsilon_{it} \quad (2)$$

Where i is individual country at time t and $i = 1 \dots N$; $t = 1 \dots T$. $\varepsilon_{i,t}$ is the error term. The variable x_{it} is a k -dimensional vector of regressors. We modeled finance-inflation relationship using inflation rate (*inflation*), ratio of government expenditure to GDP (*gov*), financial openness (*finop*), trade openness (*traop*) and real GDP per capita (*rgdppc*) defined by x_{it} following studies by Boyd et al. (2001) and Baltagi et al. (2009). We extend this model to include communication infrastructure, which is the number of mobile and telephones lines per thousand people. This variable is expected to affect financial development positively as more access to communication infrastructure may lead to more access to information about the services and products of the financial system and, hence, lead to demand of such services and products. An important issue namely endogeneity problem that may lead to biased coefficients is addressed considering lags of the variables as in Baltagi et al. (2009) and Jude (2010). Also, the time series properties of the variables used were considered since in PSTR model the variables should be stationary⁸.

⁸This is not reported but will be provided upon requested. This was done using Im et al. (2003) and Levin et al. (2002) approaches.

The α_i is fixed country effects and q_{it} is the threshold variable which is the rate of inflation. The threshold parameter is δ and $j = 1 \dots r$. γ is slope parameter and denotes the smoothness of the transition from one regime to the other. The transition function is $\varphi(q_{it}; \gamma, \delta)$, which is a continuous function of the observable variable q_{it} . It is a normalized to be bounded between 0 and 1, and these extreme values are associated with β_0 and $\beta_0 + \beta_1$. In general, the value of q_{it} determines the value of $\varphi(q_{it}; \gamma, \delta)$. More precisely, the coefficient of inflation is equal to β_0 if it is smaller than δ and $\beta_0 + \beta_1$ if it is larger than δ . In this study, the coefficient β_0 can be positive or negative. If it is positive, it can be statistically significant or may be insignificant. If $\beta_0 < 0$, we expect it to be statistically insignificant. $\beta_0 + \beta_1$ is expected to be negative and statistically significant.

The dependant variable y_{it} is a scalar and represents indicator of financial development (*findex*), which is a composite measure constructed using equation 3.

$$\frac{1}{n} \sum_{j=1}^n \left[100 * \left(\frac{F_{j,it}}{F} \right) \right] \quad (3)$$

For F_j and F are FSD indicator and sample mean of F_j respectively, n is the number of FSD indicators. Equation 3 is instrumental because the measures of FSD face definitional problems. As one of the contribution of this study, this composite financial development index is constructed to measure broadly financial development. According to Levine (1997), FSD is improvement in the quality of five key financial functions⁹. Therefore, a measure of FSD should reflect at least the different functions of the financial system¹⁰.

With this assessment, equation 3 is estimated following the approach taken by Demirgüç-Kunt and Levine (1996) and Allen and Ndikumana (2000). We include three indicators commonly used in the literature (see for example Levine, 1997; Levine and Zervos, 1998; Levine, Loayza and Beck, 2000; Allen and Ndikumana, 2000; Aziakpono, 2004). These measures are bank private credit to GDP, liquid liabilities (M3 to GDP) and the ratio of domestic bank assets to the sum of domestic bank assets and central bank assets.

The transition function $\varphi(q_{it}; \gamma, \delta)$, follows a logistic function or exponential function. Thus, following the work of Granger and Terasvirta (1993) for time series Smooth Transition Autoregressive (STAR) models, González et al. (2005) consider the following logistic specification function:

$$\varphi(q_{it}; \gamma, \delta) = [1 + \exp(-\gamma \Pi_j^m (q_{it} - \delta_j))]^{-1}, \gamma > 0, \delta_1 \leq \delta_2 \leq \dots \delta_m \quad (4)$$

⁹ These functions are (i) Producing information on investment and allocating capital (ii) Monitoring and exerting corporate governance (iii) Facilitating trading and management of risk (iv) Mobilizing and pooling of risk and (v) Easing exchange of goods and services.

¹⁰ Accordingly, Aziakpono (2004) suggests that if the functional definition is accepted, then a single indicator cannot adequately measure FSD.

Where $\delta = (\delta_1 \dots \delta_m)'$ is a vector of m -dimensional location parameters and the restrictions $\gamma > 0$ and $\delta_1 \leq \delta_2 \leq \dots \delta_m$ are imposed for identification purposes. According to Gonzalez et al. (2005), it is usually sufficient in practice to consider $m = 1$ or $m = 2$ as these values allow for commonly encountered types of variation in the parameters. If, the model implies two regimes with low and high values of q_{it} .

In general, if the transition variable q_{it} is different from inflation, the sensitivity of finance to inflation for i th country at time t is defined as follows from equation 1:

$$e_{it} = \frac{\partial y_{it}}{\partial x_{it}} = \beta_0 + \beta_1 \varphi(q_{it}; \gamma, \delta) \forall i, \forall t \quad (5)$$

By definition of the transition function $\beta_0 \leq e_{it} \leq \beta_0 + \beta_1$, if $\beta_1 > 0$ or $\beta_0 + \beta_1 \leq e_{it} \leq \beta_0$, if $\beta_1 < 0$, since $0 \leq \varphi(q_{it}; \gamma, \delta) \leq 1, \forall q_{it}$.

Another advantage of the PSTR model is that the inflation-finance coefficient may be different from estimated parameters of the extreme regions i.e. β_0 , and β_1 . As demonstrated by equation 5, these parameters do not directly correspond to the direct impact of inflation on finance. Parameter β_0 , refers to the direct effects of inflation on finance if the transition function $\varphi(q_{it}; \gamma, \delta)$ tends towards 0. On the contrary, the sum of $\beta_0 + \beta_1$ equals' inflation-finance coefficient only if the transition function $\varphi(q_{it}; \gamma, \delta)$ tends to 1. In between these two extremes, there are infinite number of inflation-finance coefficients which are weighted average of the parameters β_0 , and β_1 . It is therefore important to observe that in the PSTR model, it is generally difficult to interpret directly the values of these parameters as in Logit and Probit models. It is generally preferable to interpret the signs of the coefficients as either an increase or decrease depending on the value of the transition variable. Therefore a negative/positive sign of the parameter β_j means that an increase in the transition variable involves a decrease/increase of the inflation-finance coefficient¹¹.

Following the procedure described by González et al (2005), we test linearity against the PSTR model and determine the number of r transition functions. This is important since PSTR is not identified if the data-generating process is linear. We follow Colletaz and Hurlin (2006) and used three tests¹². Once the PSTR model is established, the next stage is to identify the number of transition functions. A sequential methodological test is used. For linearity test, the null hypothesis is: $H_0 : \gamma = 0$ or $H_0 : \beta_1 = 0$. However, in these cases the test is non-standard since the PSTR contains unidentified nuisance parameters under the null hypothesis and a possible answer is to replace the transition function $\varphi(q_{it}; \gamma, \delta)$ by its first-order Taylor expansion around $\gamma = 0$ in equation 1 which leads to the following reparameterized auxiliary regression in equation 6:

$$y_{it} = \alpha_i + \beta'_0 x_{it} + \beta'_1 x_{it} q_{it} + \dots + \beta'_m x_{it} q_{it}^m + \varepsilon'_{it} \quad (6)$$

¹¹ See Gonzalez et al. (2005) for more details.

¹² Colletaz and Hurlin (2006) use three tests: Wald Test, Fischer Test and Likelihood Test.

$B'_1 \cdots B'_m$ are multiples of γ, ε_{it} is $\varepsilon_{it} + Z_m \beta'_1 x_{it}$ and Z_m is the remainder of the Taylor expansion. Hence, in this way testing the null hypothesis $H_0 : y = 0$ in equation 1 is equivalent to testing $H_0 : \beta'_1 = \dots = \beta'_m = 0$ in equation 6.

A similar approach is adopted to test the number of transition functions in the model if linearity test is rejected. Hence, we test the null of no remaining non-linearity in the transition function. Suppose we want to test whether there is one transition function ($H_0 : r = 1$) against at least two transition functions ($H_0 : r = 2$), thus we have:

$$y_{it} = \alpha_i + \beta_0 x_{it} + \beta_1 x_{it} \varphi_1(q_{it}^{(1)}; \gamma_1, \delta_1) + \beta_2 x_{it} \varphi_2(q_{it}^{(2)}; \gamma_2, \delta_2) + \varepsilon_{it} \quad (7)$$

The null hypothesis of no remaining heterogeneity can be formulated around $y_2 = 0$ in equation 7. Again this testing problem is complicated by the presence of nuisance parameter under the null hypothesis and this is avoided by replacing the transition function $\varphi(q_{it}^{(2)}; \gamma_2, \delta_2)$ by Taylor expansion around $y_2 = 0$ in equation 7 leading to the auxiliary regression below:

$$y_{it} = \alpha_i + \beta'_0 x_{it} + \beta'_1 x_{it} \varphi_1(q_{it}^1; \gamma_1, \delta_1) + \beta'_{21} x_{it} q_{it}^{(2)} + \dots + \beta'_{2m} x_{it} q_{it}^{(2)m} + \varepsilon'_{it} \quad (8)$$

Where γ_1 and δ_1 are estimates under the null hypothesis. The testing of null hypothesis of no remaining non-linearity is defined as $H_0 : \beta'_{21} = \dots = \beta'_{2m} = 0$ in equation 8. In summary, the testing procedure is as follows: Given PSTR model we test the null hypothesis that the model is linear. We proceed to two-regime PSTR if the null is rejected. With two-regime PSTR model, we test the null of no remaining non-linearity in the model and if it is rejected we move to test three-regime model. The testing continues until we cannot reject the null of no remaining non-linearity. To avoid excessive large models, at each step in the sequential procedure, the significance level must be reduced by a constant factor $0 < \tau < 1$ and we consider $\tau = 0.5$ following González et al (2005).

4 Data

We used annual data obtained from the World Bank's *Africa Development Indicators* (2013) and *Global Financial Development Database* (2013) and limited it to the periods 1980–2011. Financial variables are obtained from the latter and the rest of the data from the former. Financial variables are stock variables whereas GDP measures are flow. Most studies ignored this problem. *Global Financial Development Database* solves this flow-stock problem by deflating these variables with the relevant consumer price indices¹³. This gives rich and better

¹³This is done using this formula:

$$F_j = \frac{(0.5)[f_{it}/CPI(e)_{i,t-1} + f_{it-1}/CPI(e)_{i,t-1}]}{GDP_{it}/CPI(a)_{it}},$$

where F_j is the financial variable, $CPI(e)$ is the end of period consumer price index and $CPI(a)$ average annual CPI.

measures of these indicators. The study used the “de jure” financial liberalization index obtained from Chinn and Ito Index . This is an index of capital accounts openness (KAOPEN). It is constructed from four binary dummy variables that codify restrictions on cross-border financial flows. Even though this measure is accused of sometime overstating the measure of openness, it is broadly available for many countries in SSA for a long period of time. More so data on countries in SSA is not readily available from any alternative source for a long period (see Table 1C in the appendix for details of the data used).

As recommended by Hansen (1999), the study used balanced panel. Data is available for only twelve countries in each bloc¹⁴. However, PSTR is sensitive to extreme observations. As Zimbabwe, the Democratic Republic of Congo (DRC) and Ghana all experienced high inflationary periods, we excluded these countries from the calculation in order to avoid extreme observations which can potentially distort the regression results.

In addition, considering that the number of countries in each region is relatively few, inclusion of the outliers has leverage on the results significantly. Furthermore, the results will not be reflective of the sample.

The data indicates that Ghana has experienced high inflation rates, ranging from double to three digits, throughout the sample period 1980–2011. Year 2011 is the exception with mean of 30.1 and maximum of 122.9. These figures are conspicuously larger than the mean and maximum (8.9 and 80.8 respectively) for the eleven countries in ECOWAS as shown in Table 1. For the mean of DRC and Zimbabwe, the data indicates 1102.5 and 374.4 respectively. This greatly contrasts with the mean of the ten other countries (17.93) in SADC (see Table 1). The maximum is 183.3 (see Table 1) against the maximum of 23,773.1 for the twelve countries. These countries thus have significant influence, which is why they serve as outliers. As PSTR is sensitive to their inclusion, we report the results of the sample without these countries as our main results. However, Table 3A in Appendix A provides results that indicate the effects of the outliers on the threshold values in each region. The descriptive statistics of the data used for the 11 countries in ECOWAAS and the 10 countries in SADC is presented in Table 1.

4.1 *Descriptive statistics*

Table 1 provides summary statistics of the variables used in the study without Ghana, DRC and Zimbabwe. The mean inflation of ECOWAS is 8.9% and that of SADC is 17.9% for the period 1980–2011. The standard deviation suggests that the dispersion from the mean in ECOWAS is relatively smaller than that of SADC. The individual country averages are also shown below the Table indicating that on average DRC and Guinea Bissau has the highest inflation rate in SADC and ECOWAS respectively. Comparing Guinea Bissau to Ghana,

¹⁴**ECOWAS** includes: Benin, Burkina Faso, Cape Verde, Cote d’voire, Gambia, Ghana, Guinea Bissau, Mali, Niger, Nigeria, Senegal and Togo.

SADC: Botswana, Democratic Republic Congo (DRC), Lesotho, Malawi, Mauritius, Madagascar, Mozambique, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe.

the data indicates that the former only experienced few years of high inflation, whereas the latter country experienced high inflation almost throughout 1980–2011. Thus, making Ghana having influence on the threshold effects of inflation on financial development of ECOWAS. The other conditioning variables indicate that on average SADC performs relatively better than ECOWAS.

5 Analysis of Results

To determine whether there is non-linearity between financial development and inflation in the eleven and ten countries in ECOWAS and SADC respectively, Table 2 reports the linearity test. It supports the rejection of the null hypothesis that the model is linear for all the three tests at 1% significance level in both regions indicating that the relationship between finance and inflation is indeed nonlinear.

In line with the procedure outlined by Gonzalez et al. (2005), we proceeded to test whether there is existence of remaining non-linearity after assuming two regimes model and the test results are reported in Table 3. The null hypothesis which states that the PSTR is adequately modeled by only one threshold cannot be rejected in the two sub-regions, implying that we have one threshold or two regimes that separate low and high inflation regimes, as indicated by the probability values of the various tests.

We therefore report the estimated model parameters of our main estimates of PSTR in Table 4. The results suggest evidence of a single threshold of inflation in both regions. The endogenously estimated threshold values by PSTR reveals relatively lower figure for SADC. Particularly, the threshold level of inflation above which inflation significantly slows down development in the financial sector is estimated at 17.9% for ECOWAS and 14.4% for SADC. The implication of these threshold results is that it indicates inflationary rate at which the transition function reaches an inflexion point beyond which inflation will be detrimental to financial development. Hence, the significance of the results is that below 17.9% and 14.9% of inflationary rate, inflation may or may not influence the financial sector's ability to expand and also to allocate resources efficiently in ECOWAS and SADC.¹⁵ Therefore the results have considerable effects for the conduct of monetary policy.

Therefore as expected, the inflation-finance coefficient is not only negative in both regions beyond this threshold, but statistically significant at 1% level, which is in line with the existing theory as shown in Table 4. This suggests that increases in inflation above these thresholds present significant detrimental effects for financial development in both regions. As indicated, only the estimated signs of the coefficients can be interpreted given one transition function. What this implies is that beyond this threshold when inflation increases, the link between finance and inflation becomes more negative. This means that above

¹⁵For the sample of twelve countries in each region, the PSTR results indicate threshold of 23.6% and 21.3% for ECOWAS and SADC respectively in Table 3A in the Appendix A reflecting the impact of higher inflationary regimes in DRC and Zimbabwe and Ghana.

these thresholds, inflation may exacerbate informational friction in the financial system and erode returns on assets. This interferes with the expansion of the financial sectors of the two regions. The implication is that policies in the two regions should aim at rates below these thresholds since high inflation is economically costly for financial development.

Furthermore, the inflation-finance coefficient at the lower regime or below the threshold is positive but statistically insignificant in ECOWAS, as indicated by the standard errors. This means increases in inflation below the threshold does not interfere with financial sector activities in that region, which is also in line with theory. In contrast, the inflation-finance coefficient in SADC is not only positive, but also statistically significant at 1% level. The implication of this result is that increases in inflation below the threshold support financial development, meaning inflation-finance coefficient becomes more positive. This outcome may be in line with English's (1999) argument that increases in inflation rate encourages households to substitute purchased transaction services for money balances and thereby induce FSD.

The difference in the results between the two regions may be explained by the influence of South Africa in the SADC region. Monetary policy of this country, which includes inflation targeting framework, affects countries such as Lesotho, Swaziland, Namibia and Botswana. Moreover, the financial sector of South Africa, especially, the banking industry has footprints all over the region which may implement financial policies of South Africa in their destination.

The results have certainly considerable meaning for the conduct of monetary policy. The study therefore argues that price stability policies with inflation targeting framework should be the primary objective in monetary policy since high inflation is economically costly to financial development of the two regions.

As indicated earlier, literature in this area is limited. The results presented here is in line with earlier findings such as that of Rousseau and Watchtel (2002) who found the threshold to lie between 13 % and 25% (this indicates that the estimated thresholds of this study for both regions fall in this range); Boyd et al. (2001) who found threshold of 15% of inflation for FSD (which suggests that the threshold of SADC is slightly below it, while that of ECOWAS is above it); Rousseau and Yilmazkuday (2009) who found inflation between 4% and 19%; and Abbey (2013) who found a threshold ranging from 11% to 16 % on a single country study on Ghana. The thresholds of both regions fall in the threshold range of Rousseau and Yilmazkuday (2009). While SADC threshold falls at the range of Abbey (2013), the threshold of ECOWAS is slightly above it. Most of these studies, however, only estimated an indirect threshold effect of inflation on finance-growth relationship and not directly on finance. Given the existing relationship between financial development and growth and that financial development is a potential channel in inducing growth, our result is consistent since it falls within this range of results.

Furthermore, the findings of this study are in line with the broader existing studies on the effects of inflation on FSD. Some of these studies include Aziakpono (2004) on South Africa, Botswana, Namibia, Swaziland and Lesotho (SACU countries); McDonald and Schumacher (2007), Andrianaivo and Yartey

(2009) and Kablan (2010) on SSA. All these studies indicate that increases in inflation reverse FSD. More recent study of Mahawiya (2015) also indicates a negative effect of inflation on FSD of ECOWAS and SADC with the effects more in ECOWAS. Kim and Lin (2010) further argue that there is a negative long run relationship between inflation and FSD, but a positive relationship in the short run. Their study was made up of 16 countries from both ECOWAS and SADC¹⁶. Similarly, Odhiambo's (2005) study indicated a negative inflation effects on FSD in Tanzania and Kenya and an insignificant effects on the financial sector of South Africa. In another study in 2012, Odhaimbo found negative coefficient in Zambia.

The estimate of the slope y for ECOWAS is such that the transition from lower regime inflation to higher regime is very rapid, as demonstrated by Figure 1 which shows the plot of the estimated transition function against inflation. The estimated slope is 443.9 which is relatively large as shown on Table 4. In contrast, the transition from lower regime to higher regime inflation is relatively smooth in SADC. The slope parameter for SADC is low (2.28), revealing that the change in the effect of inflation on finance is relatively smooth from a low inflation regime to a high inflation regime than ECOWAS as shown in the Figure. This means that the regression coefficients change gradually when transitioning from low regime to high regime inflation. The Figure for ECOWAS indicates that the majority of the observations lie in either of the one of the extreme regimes. In contrast, even though the majority of the observations lie in both regimes in SADC, some lie in-between these two extreme regimes as shown by Figure 1.

Regarding the control variables, we observe that most of the results are consistent with the theory as shown in Table 4. At a low inflation regime, the coefficient associated with government expenditure (*gov*) is positive in both regions but only statistically significant in ECOWAS (that is, at 1% statistically significant level). This suggests that increases in inflation results in increases in finance-government expenditure coefficient. This is intuitive because at lower inflation rate increases in government consumption may serve as attractive avenue for the financial sector of the region to manage their liquidity. However, expectedly, beyond the threshold, increases in inflation in both regions will result in statistically significant negative coefficient of government expenditure. This implies that government expenditure affects financial development negatively at high inflation rate regime in both regions.

The implication of negative coefficient at high inflation regime in both regions is that it leads to reduction in financial development. This means that beyond the inflation threshold levels of these regions, there is a tendency that high level government expenditure may result in diversion of productive resources from the financial sector, hence impeding financial sector development. Moreover, this may also indicate that increases in government spending at high inflation regime further fuels the high inflation leading to erosion of real returns

¹⁶Ghana, Nigeria, Niger, Malawi, Sierra Leone, Cote D'voire, Gambia, Zambia, Madagascar, Mauritius Seychelles. The others are Swaziland, Togo, Burkina Faso, South Africa and Senegal.

on assets.

The coefficients of the level of economic development measured by real GDP per capita is positive at both low and high inflation regimes in the two regions at 1% significant level with the exception of ECOWAS where it is statistically significant at 10% level at high inflation regime. Intuitively, low inflation rate could be an incentive for the demand of financial products since returns on asset may be attractive. Therefore increases in the threshold variable in the low inflation regime may still cause increases in demand for financial services by the real sector thus leading to financial development. This is because the increases in inflation may not be enough to erode returns on assets completely. In the high inflation regime, the expectation is that, the coefficient should be negative to indicate that increases in inflation decreases real sector coefficient. However, the results indicate positive coefficient, thus revealing that increases in inflation results in increases in the coefficient of real GDP per capita. This means that, in both regions there is demand for financial services as inflation increases at the high regime. Intuitively, this may mean that agents do not care much about the effects of inflation on returns to assets in the two regions. Furthermore, most Central Banks and Monetary Policy Committee of member states usually adjust interest rates in response to increases in inflation in order to maintain returns on asset and this could be another possible reason. However, this is a costly approach since high interest rates may lead to reduction in borrowing by the private sector.

Furthermore, both coefficients of trade and financial openness is positive at 1% significance level at high inflation regime in SADC. However, only trade openness is statistically significant at 5% in low inflation in the same region. This implies that, in both low and high inflation regimes in SADC, more trade openness alone is related to FSD but this is only true at high inflation regime with more financial openness. Since these are structural policy variables, more trade and financial openness separately may lead to inflows of capital that will induce financial development. This may suggest that at high inflation rate above the threshold Rajan and Zingales's (2003) hypothesis that require simultaneous opening of both trade and financial sector may not be supported. Quite the contrary, this study shows that both trade and financial openness coefficient are statistically insignificant at low regime inflation and only the former is statistically significant at high inflation regime in ECOWAS at 1% statistically significant level.

Finally, access to communication infrastructure in both regions indicates statistically significant positive coefficient at low inflation regime at 1% and statistically significant negative coefficient at the high inflation regime at 1% significance level in SADC and 5% in ECOWAS. What this means is that low inflation regime is good for access to communication infrastructure to exert positive effect on financial development and the reverse is true at the high inflation regime. Intuitively, low inflation rate may make it less costly for access of information from the financial sector through communication infrastructure. However, at high inflation this may seem costly resulting in negative coefficient of access communication on financial development.

5.1 *Sensitivity analysis and robustness checks*

In addition to the base line regressors in equation 1, we added gross domestic saving (% of GDP) as a robustness checks and the results are reported in Table 3B in Appendix B. This variable is shown to cause financial development as in Odhiambo (2008). As indicated, our findings of nonlinearity are again supported by the linearity test which confirmed a single threshold in both regions as shown by Tables 1B and 2B. The threshold values are similar to those obtained in the base line equation indicating 17.87% and 14.4% for ECOWAS and SADC respectively. These findings are in contradiction to the argument of Omay and Ozgur (2010) who contend that the threshold value are decreasing significantly as new explanatory variables are added but in line with the study of Khan and Senhadji (2001). The results in both regions indicate that, statistically, there is significant negative coefficient of inflation above the threshold, revealing that high inflation is costly to financial development. The slope parameters again indicates relatively smooth transition from low regime to high regime for SADC ($y = 2.3$) but rapid transition in ECOWAS ($y = 429.9$) as indicated by the transition graphs of Figure 2B in the Appendix B. Furthermore, we replaced domestic saving with exchange rate which is another important conditioning variable. The results suggest no significant difference with the baseline equation.¹⁷

6 Summary and Conclusion

Financial sector development is an important potential channel for economic growth. Hence, several efforts are being made in Sub-Saharan Africa to raise growth in the sector with little or no success. One of the important policy variables that retard financial development is increases in inflation. Existing theories contend that the detrimental effect of inflation on finance is only observed after certain inflationary level and thus threshold effects exist between inflation and financial development. In this study we provided a comparative study between ECOWAS and SADC on the threshold effects of inflation on financial development for the period 1980–2011 using a novel Panel Smooth Transition Regression technique. In particular, the study examined the inflation level at which it is detrimental to financial development. Unlike previous studies that impose the threshold value exogenously, this approach has the advantage of endogenously determining the threshold value.

Our results suggest a robust single threshold of 17.9% and 14.5% of inflation for ECOWAS and SADC respectively. The significance of the results is that below 17.9% and 14.5% of inflationary rate, inflation may not interfere with the financial sector's ability to expand and also to allocate resources efficiently in ECOWAS and SADC respectively. However, above these thresholds, infla-

¹⁷The details of the results are not reported here and will be provided upon request. The threshold and slope for SADC are 14.9% and 1.89 respectively whereas it is 17.87% and 432.6 for ECOWAS.

tion may exacerbate informational friction in the financial system and hence interfere with its expansion. The PSTR results supported this argument with statistically significant negative inflation-finance coefficient above the threshold in both regions but with only statistically significant positive coefficient at the lower inflation regime in SADC. Therefore paying attention to these low and high inflation phenomena will result in significant gain to be achieved in the financial sector of both regions.

On the control variables, the estimated coefficients are largely consistent with existing theory. It reveals that government spending is positive at lower inflation regime in both regions but only statistically significant in ECOWAS indicating that increases in this policy variable raises FSD. However, it is significantly negative at higher inflation in both regions. This reveals its detrimental effect on finance at high inflation regime. The coefficient of the measure of economic development is both positive at low and high regimes inflation showing that demand for financial services increases in both regimes in the two regions.

Moreover, trade and financial openness are both positive at high regime in SADC with only the former indicating statistically significant positive coefficient in ECOWAS. Finally, access to communication infrastructure indicated statistically significant positive and negative coefficients in low and high regimes respectively for the two regions.

In terms of policy implications, the study argues that price stability policies with inflation targeting framework should be the primary objective for monetary policy since high inflation is economically costly to the FSD of the two regions. Countries such as Ghana and South Africa are already taking the lead by adopting this framework. The inflation targets of the two countries fall below the estimated low regime threshold of inflation in this study. South Africa has adopted a flexible inflation targeting regime where inflation band is set. Currently the band is 3%-6% which is in line with the lower inflation regime in this study. However, Ghana's current medium term target band is set at 8% plus or minus 2%. Hence inflation targeting monetary framework may be adopted by all member states in these two regions since they strive towards common macroeconomic goals in order to reach the convergence criteria. This can be replicated in other regional blocs of SSA. The adoption of this policy framework should be coupled with measures to achieve the targets.

Considering future research on threshold effects of inflation on financial development, we suggest focus can be on other smaller regional groupings such as West Africa Economic and Monetary Union (WAEMU) in ECOWAS. WAEMU includes Benin, Burkina Faso, Cote d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal, and Togo. The group has a common accounting system, periodic reviews of member countries' macroeconomic policies based on convergence criteria, a regional stock exchange, and legal and regulatory framework for a regional banking system. Other sub-groups include the Southern Africa Custom Union which is made up of Botswana, Lesotho, Namibia, South Africa and Swaziland. SACU arrangement requires free duties on goods locally produced within member states, but a common restriction to goods imported from the rest of the

world. Other smaller groups include Common Monetary Area (CMA)¹⁸. This is monetary and exchange rate arrangement between South Africa, Lesotho, Swaziland and Namibia. A comparative study can therefore be conducted between these subgroups to determine the inflation threshold requirements for financial development.

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¹⁸ Others are Central Africa Economic and Monetary Community (CEMAC) and East Africa Economic Community.

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Table 1: Showing descriptive statistics

ECOWAS						SADC				
Variable	Obs	Mean	Std.Dev	Min	Max	Obs	Mean	Std.Dev	Min	Max
findex	352	99.96	31.2	25.7	237.6	320	100.03	23.97	39.8	212.2
inflation	352	8.9	14.8	-14.9	80.8	320	17.93	20.9	-9.6	183.3
gov	352	14.4	5.9	4.8	54.5	320	18.3	7.8	6.3	42.2
rgdppc	352	618.7	409.5	230.09	2886.2	320	1710.5	1890.7	141.8	6592.7
traop	352	65.8	21.4	27.8	131.5	320	87.1	45.06	13.9	209.9
finop	352	-0.7	0.89	-1.9	2.4	320	-0.63	1.19	-1.9	2.43
com	352	101.3	200.7	0.68	940.8	320	151.2	277.04	2.11	1501.8

Note: Individual summary statistics of inflation;

ECOWAS: Benin = 4.3, Burkina Faso = 4.0, Cape Verdi = 5.2, Cote d'voire = 5.1, Gambia = 9.5, Ghana = 30.1(max=122.9), Guinea Bissau = 32.2 (max=80.8), Mali = 4.1, Niger = 3.4, Nigeria = 20.7, Senegal = 4.3, Togo = 4.9

SADC: Botswana = 10.0, DRC = 1102.5, Lesotho = 10.5, Madagascar = 15.1, Malawi = 19.6, Mauritius = 8.02, Mozambique = 28.7, South Africa = 9.7, Swaziland = 10.5, Tanzania = 19.0, Zambia = 48.1 and Zimbabwe = 374.4

Table 2: Test of linearity against non-linearity for ECOWAS and SADC

ECOWAS			SADC	
Test	Statistics	p-value	Statistics	p-value
Wald Test (LM)	19.529	(0.003)	30.445	(0.000)
Fisher Test (LMF)	3.280	(0.004)	5.336	(0.000)
Likelihood RT (LR)	20.110	(0.000)	32.046	(0.000)

H0: Linear Model, H1: PSTR model with at least one Threshold Variable (r=1)

Table 3: Testing the number of regimes: Tests of no remaining non-linearity

ECOWAS			SADC	
Test	Statistics	p-value	Statistics	p-value
Wald Test (LM)	10.791	(0.095)	7.635	(0.266)
Fisher Test (LMF)	1.699	(0.121)	1.187	(0.313)
Likelihood RT (LR)	10.966	(0.089)	7.731	(0.258)

H0: PSTR with r = 1 against H1: PSTR with at least r = 2

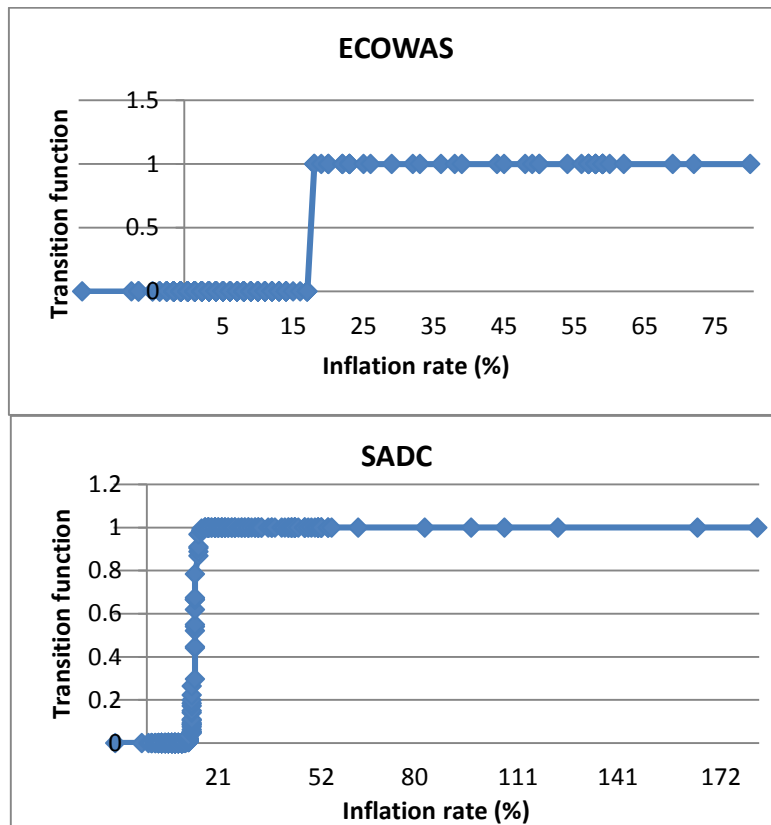
Table 4: PSTR Result of finance-inflation rate

Variables	ECOWAS		SADC	
	$\tilde{\beta}_0$	$\tilde{\beta}_1$	$\tilde{\beta}_0$	$\tilde{\beta}_1$
inflation	0.073 (0.2439)	-0.922*** (0.3018)	0.6709*** (0.3282)	-0.7229*** (0.3191)
gov	0.829*** (0.2478)	-1.371*** (0.3942)	0.1843 (0.3431)	-1.7006*** (0.3545)
rgdppc	0.083*** (0.0100)	0.042* (0.0215)	0.0086*** (0.0025)	0.0141*** (0.0022)
traop	-0.147 (0.0978)	0.492*** (0.1805)	0.1321** (0.0653)	0.3424*** (0.0609)
finop	1.633 (1.8618)	3.072 (5.8010)	-2.0536 (1.7221)	7.4981*** (2.5476)
com	0.050*** (0.0086)	-2.537** (1.2368)	0.0386*** (0.0069)	-0.4631*** (0.1010)
Threshold (δ)	17.9		14.5	
Slope (γ)	443.95		2.28	

*** /**/* show significant at 1%, 5% and 10% respectively and values in parentheses are standard errors corrected for heteroscedascity

Where *rgdppc* = real GDP per capita, *gov* = government expenditure (%GDP), *traop* = international trade openness, *finop* = capital flows or financial openness, *com* = access to mobile and telephones per 1000 people. Variables are not in logs

Figure 1: Estimated transition function of ECOWAS and SADC



Appendix A: Results that include DRC Ghana and Zimbabwe

Table 1A indicates that linearity is rejected at 1% significance levels both regions. However, Table 2A reveals the relationship is adequately modeled by a single threshold (two regime), hence, rejecting double threshold at 1% and 5% significance level.

Table 1A: Test of linearity against non-linearity

ECOWAS			SADC	
Test	Statistics	p-value	Statistics	p-value
Wald Test (LM)	23.621	(0.001)	41.450	(0.000)
Fisher Test (LMF)	4.000	(0.001)	7.398	(0.000)
Likelihood RT (LR)	24.404	(0.000)	43.946	(0.000)

H0: Linear model H1: PSTR with at least one threshold variable ($r=1$)

Table 2A: Testing the Number of Regimes: Tests of no Remaining Non-Linearity

ECOWAS			SADC	
Test	Statistics	p-value	Statistics	p-value
Wald Test (LM)	4.449	(0.616)	12.343	(0.055)
Fisher Test (LMF)	0.690	(0.658)	1.956	(0.071)
Likelihood RT (LR)	4.476	(0.613)	12.553	(0.051)

H0: PSTR with $r = 1$ against PSTR with at least $r = 2$

Table 3A: PSTR results with DRC Ghana and Zimbabwe

Variables	ECOWAS		SADC	
	$\tilde{\beta}_0$	$\tilde{\beta}_1$	$\tilde{\beta}_0$	$\tilde{\beta}_1$
inflation	-0.091 (0.2189)	-0.085*** (0.2355)	0.573** (0.2735)	-0.575** (0.2736)
gov	0.918*** (0.2393)	-2.572*** (0.4353)	-0.345 (0.3157)	-0.793* (0.4093)
rgdppc	0.078*** (0.0102)	0.014 (0.0204)	0.010*** (0.0024)	0.050** (0.0195)
traop	0.086 (0.1107)	0.332* (0.1843)	0.544*** (0.1023)	-0.144 (0.0993)
finop	4.200* (2.1517)	15.852*** (4.9133.)	-2.445 (1.5816)	11.200*** (2.316)
com	0.054*** (0.0082)	0.830*** (0.2230)	0.039*** (0.0071)	-0.072*** (0.0158)
Threshold (δ)	23.6		21.3	
Slope (γ)	74.8		1.25	

***/**/*show significant at 1%, 5% and 10% respectively and values in parentheses are standard errors corrected for heteroscedascity

Where *rgdppc* = real GDP per capita, *gov* = government expenditure (%GDP), *traop* = international trade openness, *finop* = capital flows or financial openness, *com* = access to mobile and telephones per 1000 people. Variables are not in logs

Appendix B: Sensitivity Analysis

The test of linearity suggests that the relationship is not linear from Table 4 and hence we tested for no remaining nonlinearity and results on Table 5 supports the existence of one threshold as indicated by the p-values

Table 1B: Test of linearity against non-linearity-savings

ECOWAS			SADC	
Test	Statistics	p-value	Statistics	p-value
Wald Test (LM)	20.026	(0.006)	31.739	(0.000)
Fisher Test (LMF)	2.879	(0.006)	4.774	(0.000)
Likelihood RT (LR)	20.638	(0.000)	33.484	(0.000)

H0: Linear model H1: PSTR with at least one threshold variable ($r=1$)

Table 2B: Testing the Number of Regimes: Tests of no Remaining Non-Linearity

ECOWAS			SADC	
Test	Statistics	p-value	Statistics	p-value
Wald Test (LM)	11.098	(0.134)	8.391	(0.299)
Fisher Test (LMF)	1.485	(0.172)	1.109	(0.358)
Likelihood RT (LR)	11.282	(0.127)	8.507	(0.290)

The PSTR results are reported on Table 3B which shows evidence of single threshold for the two regions similar to the baseline results.

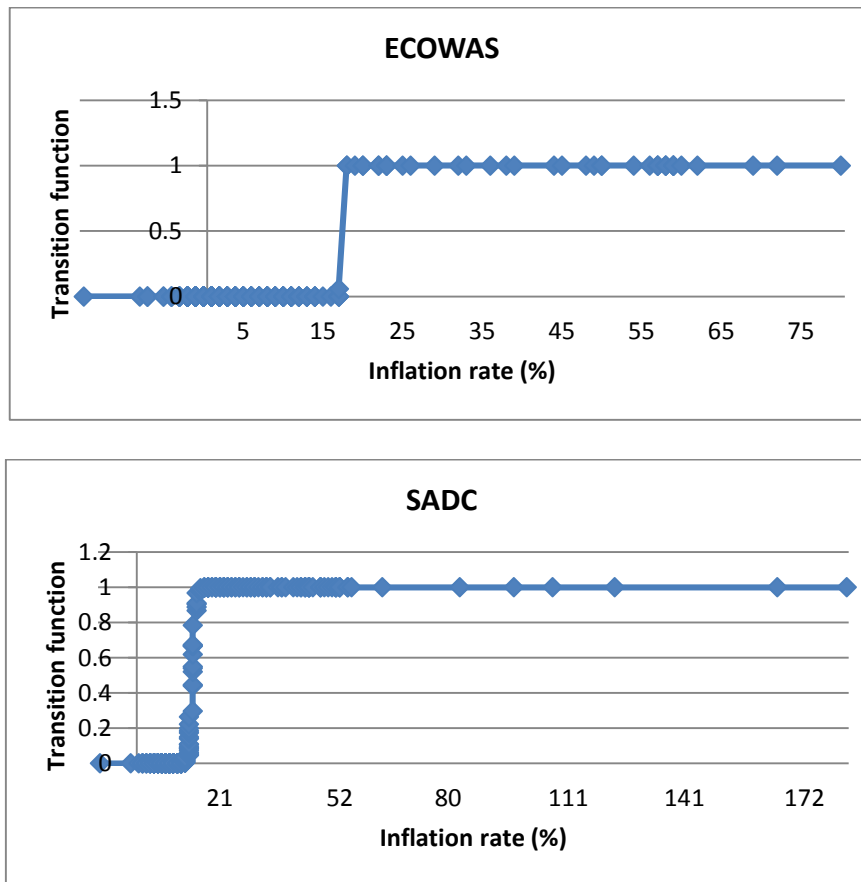
Table 3B: Sensitivity analysis of PSTR results with DRC Ghana and Zimbabwe

Variables	ECOWAS		SADC	
	$\tilde{\beta}_0$	$\tilde{\beta}_1$	$\tilde{\beta}_0$	$\tilde{\beta}_1$
inflation	-0.0508 (0.2463)	-0.9414*** (0.3054)	0.6891** (0.3336)	-0.7523** (0.3228)
Gov	1.226 *** (0.4272)	-1.2341 (1.3335)	-0.7523 (0.3429)	-1.7479*** (0.3435)
Rgdppc	0.0803*** (0.0100)	0.0433** (0.0214)	0.009*** (0.0026)	0.013*** (0.0026)
Traop	-0.1575 (0.0993)	0.4914*** (0.1800)	0.1310** (0.0652)	0.3585*** (0.0585)
Finop	1.1622 (1.9662)	3.5255 (6.0652.)	-2.1058 (1.6723)	7.3755*** (2.4884)
Com	0.0505*** (0.0088)	-2.5945*** (1.2538)	0.0377*** (0.0075)	-0.4555*** (0.1040)
gdsav	-0.4209 (0.3625)	-0.1256 (1.1874)	-0.0692 (0.1302)	0.0632 (0.1037)
Threshold (δ)	17.87		14.4	
Slope (γ)	429.9		2.3	

***/**/*show significant at 1%, 5% and 10% respectively and values in parentheses are standard errors corrected for heteroscedascity;

gdsav= gross domestic savings as percentage of GDP

Figure 2B: Transition function of the two regions



Appendix C

Table 1C: Showing description of data and source

Variable	Description	source
<i>bankprcr</i>	Ratio of bank private to GDP.	Global Financial Development Database, 2013
<i>dmba</i>	ratio of deposit money bank assets to the ratio of deposit money bank assets to the sum of deposit money bank assets and Central Bank assets	Global Financial Development Database, 2013
<i>m3</i>	ratio of liquid liabilities (M3) to GDP	Global Financial Development Database, 2013
<i>gov</i>	government expenditure as a percentage of GDP	World Bank's <i>Africa Development Indicators</i> , 2013,
<i>rgdppc</i>	real GDP per capita (at 2005 US \$)	World Bank's Africa Development Indicators, 2013,
<i>inflation</i>	annual percent change of the consumer price index	World Bank's Africa Development Indicators, 2013,
<i>traop</i>	Trade openness which is the sum of Exports and imports as a ratio of GDP	World Bank's Africa Development Indicators, 2013,
<i>com</i>	Telephone lines per 1000 people	World Bank's Africa Development Indicators, 2013,
<i>gdsav</i>	gross domestic savings as a percentage of GDP	World Bank's Africa Development Indicators, 2013,
<i>finop</i>	financial openness	Chinn and Ito Index (2011)