The Impact of Financial Inclusion on the Interest Rate Channel of the Monetary Policy Transmission Mechanism

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ABSTRACT  Many African countries are characterized by a high level of financial exclusion. Insights from theoretical models indicate that the presence of a substantial share of financially excluded consumers within the population might impede the transmission mechanism of an inflation targeting policy. This paper uses a panel vector error correction (PVEC) methodology for the period 2001Q1 to 2016Q4 to test the hypothesis that economies with lower levels of financial inclusion have weaker monetary policy transmission mechanisms than economies with higher levels of financial inclusion. This hypothesis is tested using four African countries (Ghana, Mauritius, South Africa and Uganda) which have adopted inflation targeting monetary policy frameworks. These are divided into two groups differentiated by their level of financial inclusion, with panel vector auto-regressions (PVARs) on each group estimated to assess the strength of the impulse response of inflation to the monetary policy variable. The results suggest that economies with higher levels of financial inclusion exhibit stronger impulse responses, although this does not necessarily imply that higher levels of financial inclusion are the cause of stronger monetary transmission mechanisms as the degree of financial inclusion may be correlated with other aspects of development which also affect the monetary transmission mechanism.

Keywords: Financial Inclusion, Monetary Policy, Monetary Policy Transmission Mechanism

JEL classification: C23, C33, C15

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The authors are grateful to anonymous referees for constructive comments. The usual disclaimer applies. The data used in the analysis are available on request.
I. Introduction

Financial inclusion, generally defined in the literature to mean access of the working age population to financial services provided by formal financial institutions; credit, savings, payments, and insurance (Demirguc-Kunt et al., 2014; Global Partnership for Financial Inclusion, 2016), has gained prominence in the policy agenda in developing countries. The World Bank Global Findex database provides indicators of financial inclusion across the world. The latest Global Findex (2014) shows that although Sub-Saharan Africa (SSA) is still significantly below the world averages, improvements have been made. Between 2011 and 2014 the percentage of the population aged 15 and above that held accounts in financial institutions in SSA grew from 23.9 percent to 28.9 percent compared to 50.6 percent and 60.7 percent for the world in 2011 and 2014, respectively (Table 1). SSA, however, dominates the world in mobile accounts with 11.5 percent of the population aged 15 and above holding mobile accounts in 2014 compared to the world average of 2.0 percent.

Table 1: Indicators of Financial Inclusion for selected African countries and major country groups

<table>
<thead>
<tr>
<th>Country/Region</th>
<th>Account at a financial institution (% age 15+)</th>
<th>Borrowed from a financial institution (% age 15+)</th>
<th>Saved at a financial institution (% age 15+)</th>
<th>Mobile account (% age 15+)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ghana</td>
<td>29.4</td>
<td>5.8</td>
<td>16.1</td>
<td>13.0</td>
</tr>
<tr>
<td>Mauritius</td>
<td>80.1</td>
<td>14.3</td>
<td>30.8</td>
<td>0.9</td>
</tr>
<tr>
<td>South Africa</td>
<td>53.6</td>
<td>8.9</td>
<td>22.1</td>
<td>14.4</td>
</tr>
<tr>
<td>Uganda</td>
<td>20.5</td>
<td>8.9</td>
<td>16.3</td>
<td>35.1</td>
</tr>
<tr>
<td>Sub-Saharan Africa (developing only)</td>
<td>23.9</td>
<td>4.8</td>
<td>14.3</td>
<td>11.5</td>
</tr>
<tr>
<td>World</td>
<td>50.6</td>
<td>9.1</td>
<td>22.6</td>
<td>2.0</td>
</tr>
<tr>
<td>Low- Middle Income Countries</td>
<td>28.7</td>
<td>7.3</td>
<td>11.1</td>
<td>2.5</td>
</tr>
<tr>
<td>Low Income Countries</td>
<td>21.1</td>
<td>11.7</td>
<td>11.5</td>
<td>10.0</td>
</tr>
<tr>
<td>Upper-Middle Income Countries</td>
<td>57.4</td>
<td>7.9</td>
<td>25.1</td>
<td>0.7</td>
</tr>
</tbody>
</table>


Most of the research on financial inclusion has focused on issues of distribution, inclusive growth and poverty reduction. However, the degree to which private sector agents have access to financial services, especially services which allow for saving and borrowing at a market interest rate, is potentially relevant for monetary policy and in particular the strength of the monetary transmission mechanism. Inflation targeting monetary policy frameworks utilize a policy interest rate as the main policy instrument. The rationale for the use of this instrument is that aggregate demand is inversely related in the short term to the real interest rate. However, theoretical considerations, discussed in section 2, suggest that the magnitude of the relationship between the real interest rate and aggregate demand might be affected by the extent of financial inclusion among consumers, among other factors. In SSA, four countries South Africa, Mauritius, Ghana and Uganda currently operate an inflation targeting (IT) monetary policy regime. As shown above in Table 1, among the four SSA countries with an IT regime, South Africa and Mauritius generally have higher financial inclusion indicators than Ghana and Uganda; however, the latter two have registered higher usage of the mobile money service. This difference is consistent with the trend for the World Bank’s low income
and upper middle income country groupings in which South Africa and Mauritius are classified as upper middle income and Ghana and Uganda are classified as low-middle income and low-income respectively.

In standard neo-Keynesian macroeconomic models (which are used by central banks for policy analysis and forecasting) the transmission of monetary policy depends on private expenditures being interest elastic, so that a rise (fall) in the policy interest rate induces (with a lag) a fall (rise) in private expenditures, which in turn affects real output and inflation. Implicitly, consumers have a permanent income consumption function, in which consumers can optimally allocate their consumption inter-temporally. The market interest rate in any period, which reflects the price of saving in that period relative to other periods, influences the intertemporal allocation of consumption and savings. The intertemporal allocation of private investment is also influenced by the market interest rate in each period, as this affects the user cost of capital. Most standard neo-Keynesian macroeconomic models contain no explicit modeling of the financial system. Implicitly, it is assumed that private agents (e.g. consumers) have access to financial services at the going market interest rate for these services: i.e. they can borrow and save at market interest rates (Berg et al, 2006; Clarida et al, 1999; Svensson, 1998).

The assumption that all consumers can borrow and save at market interest rates is hardly tenable in many developing economies, where there are large sections of the population who are excluded from access to financial services and especially from access to credit. Consumers who cannot borrow to smooth their consumption in the face of income shocks are sometimes referred to as “non-Ricardian” or “rule of thumb” consumers. In principle, a large share of financially excluded private agents in the population would reduce the interest elasticity of private spending and thereby weaken the interest rate transmission of monetary policy, although other channels of monetary policy transmission, such as the exchange rate and expectations of future inflation, might not be affected.

An important premise of practical monetary policy is the “Taylor principle” which states that monetary policy will stabilize inflation provided that, when inflation rises, the central bank raises the nominal interest rate by more than the rise in inflation so that real interest rates rise, and vice versa when inflation falls (e.g. Woodford, 2001). The Taylor principle underlies the interest rate rules used by many central banks as a guide to the setting of policy interest rates. However, the validity of the Taylor principle is undermined if private sector spending and hence aggregate demand is not interest elastic. Even if the Taylor principal still holds, a low interest elasticity of aggregate demand implies that a central bank would have to implement more aggressive changes in the policy interest rate to achieve a desired change in the target variables. Hence the issue of whether the degree of financial inclusion affects the monetary policy transmission mechanism has important consequences for the conduct of monetary policy in SSA and elsewhere. This study combines insights from the theoretical
literature on the implications of financial excluded consumers for the monetary policy transmission mechanism with empirical research utilizing a panel vector error correction model (PVECM) econometric methodology. PVECM is increasing becoming a popular time series methodology where a cross section of countries is involved. We deploy the technique to investigate the monetary policy transmission mechanism empirically.

A critical issue however is how to introduce financial inclusion in the estimation framework given that it is a structural factor, changing only very slowly over time and cannot as such explain the variation in short term innovations in variables such as inflation and output. This paper takes exception and assumes that the degree of financial inclusion influences the way in which the endogenous variables e.g. inflation and output respond to innovations in other variables such that one then expects variations across countries depending on the degree of financial inclusion. We test this by dividing the countries into two sub-samples, one with a high level of financial inclusion (South Africa and Mauritius) and the other, (Ghana and Uganda) with low financial inclusion. The hypothesis is then that countries with a high level of financial inclusion exhibit stronger responses of target variables e.g. inflation and output to innovations in monetary policy variables. We then estimate PVARs for both groups and compare the impulse response functions of inflation to a change in the policy interest rate.

The remainder of the paper is structured as follows: Relevant literature is reviewed in Section 2 while Section 3 discusses the econometric methods and the data used in the paper. Empirical results are given in section 4 while conclusions are drawn in Section 5.

II Review of the Literature

2.1 Theoretical literature

Most of the theoretical literature examining the implications of financial exclusion for the monetary policy transmission mechanism has involved the construction and calibration of dynamic stochastic general equilibrium models which explicitly model the behavior of optimizing economic agents. These models are then calibrated and used to explore the consequences of monetary policy changes on macroeconomic variables. Instead of a single representative consumer who has access to financial assets and liabilities at market interest rates, researchers have constructed models for different types of consumers; Ricardian and non-Ricardian, and explored the consequences of changing the relative shares of these two types of consumers in the total population of consumers.

A seminal paper by Gali, Lopez-Salido and Valles (2004) explored the implications of non-Ricardian consumers for the properties of interest rate monetary policy rules at a theoretical level. The authors model monetary policy using a conventional neo-Keynesian model with sticky prices, but incorporate non Ricardian consumers alongside their conventional Ricardian counterparts. They
found that the stabilizing properties of interest rate rules based on the Taylor principle do not necessarily apply when there is a significant presence of non-Ricardian consumers. In particular, they found that, when the share of non-Ricardian consumers exceeds a certain threshold, the implementation of an interest rate rule satisfying the Taylor principle may not guarantee a unique equilibrium of outcomes and that, as a result, the central bank may have to pursue a more aggressive anti-inflationary policy than would be the case in the absence of non-Ricardian consumers (i.e. larger changes in the interest rate are required to stabilize inflation).

Several researchers have built on the work of Gali et al. (2004) to analyze further, using theoretical models, the implications for monetary policy of the presence of non-Ricardian consumers. Bartolomeo and Rossi (2007) use a new Keynesian Dynamic Stochastic General Equilibrium (DSGE) model with both Ricardian and non-Ricardian consumers. They find that a larger share of the non-Ricardian consumers actually makes monetary policy more effective. Although an interest rate change does not directly affect the consumption of the non-Ricardian consumers, it does affect their real wages (through its impact on the consumption of the Ricardian consumers and thereby on output). The standard Keynesian effects of changes in income on the consumption of the non-Ricardian consumers outweigh the lack of interest rate induced changes in the inter-temporal allocation of their consumption, hence strengthening the interest rate channel of monetary policy.

Colgiago (2011) constructs a New Keynesian model and finds that, despite the presence of non-Ricardian consumers, the impact of the Taylor principle is restored if nominal wages are sticky (which dampens the consumer spending of non-Ricardian consumers in response to an output shock). Bilbie (2008) introduces into a standard dynamic general equilibrium model two classes of consumers; one which participates in asset markets and one which does not; the latter consumes current income. If the share of non-asset market participants is small enough, the model has standard new Keynesian properties with respect to the impact of the real interest rate on aggregate consumption. But as the share of non-asset market participant consumers rises, the interest elasticity of consumption demand rises but once it passes a certain threshold, higher real interest rates have a positive effect on consumption (reversing the slope of the IS curve).

2.2 Empirical Literature

The empirical literature on financial inclusion and monetary policy transmission in developing countries is rather limited, but growing. A review of the literature on financial inclusion and monetary policy over the period 2007 to 2015 by Agoba, Sare & Bugiri-Anarfo (2017) revealed that most studies on monetary policy had focused on the determinants and that there was still a “wide research gap” on the relationship it has with financial inclusion, innovation and financial development. Agoba et al. found that only a few studies such as Mehrotra and Yetman (2014) and Mehrotra & Yetman (2015) had attempted to investigate the effect of financial inclusion on monetary policy. Mehrotra and Yetman (2014) using a PVAR found that the ratio of output
Mehrotra & Yetman (2015) highlighted the potential effects of financial inclusion on monetary policy. The authors arrived at two key conclusions, first, that increased financial inclusion facilitates consumption smoothing, as households have easier access to instruments for saving and borrowing, which makes output volatility less costly and thus may support the central banks’ monetary policy. Secondly, they conclude that growing financial inclusion is likely to increase the importance of the interest rate channel of monetary policy transmission as a greater share of economic activity is brought under the influence of interest rates.

Mbutor and Uba (2013) developed a simple model of the relationship between financial inclusion and monetary policy for Nigeria using data for the period 1980 and 2012, which they estimated using the VAR approach. Their model linked the inflation rate to a vector of financial inclusion indicators covering the number of bank branches, total number of loans and advances of commercial banks as a percentage of GDP and aggregate share of rural bank branches of deposits and loans. The model included commercial banks’ average lending rate and the foreign exchange rate of the naira as control variables. Their key result was that a 1 percent increase in the ratio of total loans and advances by the commercial banks reduced inflation by 0.01 percent, suggesting that financial inclusion supports the attainment of monetary policy objective of low inflation. However, the coefficient of the number of bank branches was positive, indicating that this particular financial inclusion indicator did not support monetary policy effectiveness but largely because bank’s main objective for opening branches is to make profits and not necessarily financial inclusion. However, the model used by the authors lacks theoretical backing and therefore does not provide conclusive estimates of the relationship between financial inclusion and monetary policy.

Evans (2016) adopted the Vector Error Correction Model (VECM) to analyse financial inclusion and monetary policy effectiveness using panel data for 15 African countries: Algeria, Angola, Botswana, Cameroon, Ghana, Kenya, Libya, Malawi, Mali, Morocco, Namibia, Niger, Nigeria, Senegal and South Africa. The study used inflation as the proxy for monetary policy effectiveness and included money supply and interest rate as control variables alongside their measure of financial inclusion, the number of depositors with commercial banks (per 1,000 adults). Evans found evidence of a long run relationship between inflation and financial inclusion, however, the policy reaction to the positive financial inclusion shock was not significant and in the long-run, more than 45 percent of variations in policy effectiveness were explained by interest rate shocks. In addition, the Granger causality analysis revealed that there was a one-way causality from monetary policy effectiveness to financial inclusion. Based on these findings, the study concluded that financial inclusion is not a significant driver of monetary policy effectiveness in Africa, but rather that monetary policy effectiveness is the driver of financial inclusion. This study also lacks theoretical
backing from which conclusive estimates of the relationship between financial inclusion and monetary policy can be drawn.

Lenka and Bairwa (2016) developed a structural model to estimate the effect of financial inclusion on inflation in 8 countries in the South Asian Association for Regional Cooperation (SAARC) (Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka) using annual data for the period 2004 to 2013. The model was estimated using generalized least squares (GLS) estimation for Fixed Effects (FE), Random Effects (RE) and Panel-Corrected Standard Errors (PCSEs) models including a financial inclusion index constructed by the authors as one of the explanatory variables; the other control variables were the interest rate and exchange rate. The authors constructed their Financial Inclusion Index using financial access variables; geographic penetration (commercial bank branches per 1,000 km2, number of ATMs per 1,000 km2), demographic penetration (commercial bank branches per 100,000 adults, number of ATMs per 100,000 adults), and banking penetration ( Outstanding loans from commercial banks (% of GDP) and outstanding deposits with commercial banks (% of GDP)). Their FE model estimated that a 1 percent increase in financial inclusion and the interest rate reduced inflation by 0.284 percent and 0.743 percent, respectively. Their results for the PCSEs model revealed that financial inclusion index and the interest and exchange rates were statistically significant and negatively associated with inflation with estimated coefficients of 0.015, 0.042 and 0.114 percent respectively.

In terms of monetary policy transmission mechanism, empirical estimates for South Africa suggest weak transmission of monetary policy impulses to the real economy. Using a structural VAR, De Waal and Van Eyden (2012) estimated the effect of a shock to the monetary policy interest rate (repo rate) on the inflation rate to have a monetary policy lag of about 24 months (8 quarters). Gumata, Kabundi and Ndou (2013) used a Bayesian Vector Autoregressive model to investigate the channels of transmission of monetary policy shock in South Africa using data for the period 1990Q1 to 2012Q2. They found that the interest rate channel was the most important channel compared to the credit, interest rate, asset prices, exchange rate, and expectations channels. The prime overdraft and the three-month Treasury bill (TB) rates reacted contemporaneously by 0.43 percent and 0.38 percent, respectively to a one per cent rise in the repo rate. The effect on both rates was found to dissipate after only two quarters after the initial shock. In addition, the results revealed that the long-term interest rates were less responsive relative to the short-term rates.

The monetary policy transmission has also been found to be weak in the case of Mauritius. Tsangarides (2010) used a recursive VAR and a structural VAR to investigate the transmission mechanism of monetary policy on output and prices for Mauritius, using data for 1999–2009 and found evidence that a shock to the policy rate (repo rate) had a statistically significant effect on the headline CPI, but not on core CPI. The monetary policy shock had a small but statistically significant effect of 0.2 percent on inflation 4 quarters after the shock. Based on the difference in
results depending on the measure of inflation, Tsangarides posited that different monetary policy rules should be considered depending on whether headline or core CPI is targeted; the Taylor-type rules would be more applicable for headline CPI, where the interest rate channel was found to be effective while the McCallum-type rules that target money supply could be more appropriate for core CPI.

Monetary policy transmission has also been estimated to be weak in Ghana. Kovanen (2011) and Akosah (2015) found evidence of pass-through of changes in the policy interest rate to the market interest rates (interbank and Treasury bill) in Ghana, and more so for the Treasury bill rates. Kovanen (2011) developed a structural model for the determinants of market and bank level interest rates to analyze the interest rate pass-through in Ghana for the period 2005 to 2010 and found that about one-half of the change in the policy interest rate (the prime rate) was reflected in the market interest rates with a month lag, while the long-term responses were more prolonged. The estimation results for the bank-level interest rates revealed that interest rates adjusted to changes in the market interest rates, but the speed was rather slow and the adjustment was incomplete in the long run. Akosah (2015) employed the VECM to estimate the effect of changes in the policy interest rate on market and bank level interest rates for the period 2002M1 to 2014M12 and found evidence of incomplete monetary policy transmission in both the short and long run. In the short run, the exchange rate shock had a larger influence on inflation than the policy interest rate which explained only 2.2 percent of the variation in CPI by the 12th month, and the commercial banks’ lending rate provided relatively higher explanation to Variation in CPI than that emanating from the policy interest rate.

Mugume (2011) and Montiel (2013) found evidence of weak monetary policy transmission in the case of Uganda, which they attributed to a shallow and underdeveloped financial sector. Mugume (2011) used a SVAR with quarterly data for the period 1999Q1 to 2009Q1 and found that monetary policy had an effect on inflation and output, but with weak transmission channels. The results indicated that the credit and exchange rate channels of monetary transmission were not effective and that the interest rate channel was weak. The impulse responses indicated that a monetary contraction caused a decline in both inflation and output but that there was no effect from, and on, the exchange rate. Shocks to M2 had no significant effect on output growth and inflation and monetary policy had no significant effect on private sector credit, although private sector credit innovations significantly raised inflation. Montiel (2013) employed a VAR to examine the strength of the monetary policy transmission mechanism for Uganda using monthly data for the period December 2001 to June 2011 and found no evidence of strong impacts of the bank lending transmission channel of monetary policy on aggregate demand in Uganda. Specifically, positive shocks to the monetary base resulted in statistically significant effects on the exchange rate and bank lending rate but not on the price level and real GDP.
However, Davoodi, Dixit and Pinter (2013) estimated a SVAR model to investigate whether changes in monetary policy affect inflation and output in the EAC and found that interest rate increases in Uganda reduced inflation under a Factor-augmented VAR (FAVAR) more than in the simple Structural VAR or Bayesian VAR (BVAR). One of their key findings was that monetary transmission mechanism tended to be generally weak when using standard statistical inferences, but somewhat stronger when using non-standard inference methods. They observed that while recursive SVARs are the most widely used models for monetary policy transmission analysis, they potentially suffer from the problems of over-parameterization and misspecification, which may undermine the robustness of the empirical results. The Bayesian estimation techniques provide an effective treatment for problems of over-parameterization by the use of prior information and the FAVARs allow for the use of information contained in other variables while simultaneously reducing the number of parameters in the VAR. The BVAR and FAVAR assume a larger information set is being used by central bankers, which assumption Davoodi et al. considered to hold in the case of Uganda, which explained the difference in their findings from those of Mugume (2011).

Although a search in the literature returned only a handful of studies (Mehrotra and Yetman, 2014; Mbutor and Uba, 2013; and Evans, 2016) on financial inclusion and monetary policy transmission in developing countries, none of these has investigated whether the degree of financial inclusion affects the strength of monetary policy transmission. We therefore aim to address this gap in the literature. Moreover, studies on monetary policy transmission mechanism have largely utilised VAR models, possibly because of their obvious advantages in modelling time series data, but then the choice and ordering of variables in the VARS ought to be guided by economic theory. Li et al. (2016) adds nuance, casting doubt on the effectiveness of VARs to uncover even a strong monetary policy transmission mechanism where data problems, such as short time series, measurement errors in variables and the need to estimate output gaps, are prominent, as is often the case in developing countries. The fact that this paper considers two heterogeneous IT groups, the PVARs are particularly suited to analyzing the transmission of idiosyncratic shocks across units and time and do not necessitate specification of the entire structure of the economy (Canova & Ciccarelli, 2013).

III: Theoretical framework, Methodology and Data

3.1 Theoretical Framework
The underlying theory for our study is the New Keynesian model consisting of three equations: the aggregate demand (IS) curve, aggregate supply (Philips) curve and the Uncovered Interest Rate Parity (UIP) equation.

The aggregate demand curve for an open economy can be represented as:

$$ y_t = \alpha_1 y_{t-1} + \alpha_2 r_t + \alpha_3 rer + \varepsilon_t $$  

$$ \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cdots \cd - 8
Where $y_t$ is output, $r_t$ is the real interest rate, $rer$ is the real exchange rate, $\varepsilon_t^\gamma$ is an aggregate demand shock and coefficients $\alpha_1, \alpha_2$ and $\alpha_3$ are the persistence of output, impact of the interest rate on output and the impact of the exchange rate on output respectively.

The aggregate supply curve can be defined as:

$$\pi_t = \beta_1 \pi_{t-1} + \beta_2 y_t + \beta_3 rer + \varepsilon_t^\gamma$$

(2)

Where $\pi_t$ is inflation, $\varepsilon_t^\gamma$ is an aggregate supply shock and coefficients $\beta_1, \beta_2$ and $\beta_3$ are the persistence of inflation, impact of output on inflation and the impact of exchange rate on inflation respectively.

The uncovered interest rate parity equation that captures the relationship of the domestic economy with the rest of the world can be represented as:

$$S_t = \gamma_1 S_{t-1} + (i_t^* - i_t) + prem + \varepsilon_t^\gamma$$

(3)

Where $S_t$ is the nominal exchange rate, $i_t$ is the domestic nominal interest rate, $i_t^*$ is the foreign nominal interest rate, $prem$ is the risk premium, $\varepsilon_t^\gamma$ is the exchange rate shock and coefficient $\gamma_1$ is the persistence of exchange rate movement.

The real exchange rate can be derived as $rer_t = S_t \star \frac{1}{p} \left[ \prod_{i=1}^{n} p_i^w \right]$ where $p$ is the domestic consumer price index, $p_i$ is the consumer price index of country $i$, $w_i$ is the weight attached to country $i$ in the basket of countries that trade most with the domestic economy and $n$ is the number of trading partners. The interaction of equations 1, 2 and 3 in the model is the basis upon which we select our variables namely, consumer price index (CPI), nominal exchange rate, nominal gross domestic product (GDP) and the policy interest rate. Consistent with the New Keynesian theory, a methodology that allows for interdependence between variables is appropriate, and the PVARs, which allows for heterogeneous groups, is preferred.

3.2 Panel Vector Error Correction Framework
Following from Mehrotra and Yetman (2014), we employ a maximum-likelihood-based panel test for the cointegrating rank (Larsson et al., 2001), in line with the standard rank trace statistic of Johansen (1995) – to test the hypothesis that financial inclusion enhances the effectiveness of the interest rate monetary policy channel. We consider a panel data set of $N$ fixed cross-sections, each observed over a relatively long $T$ time periods. In the notations (hereafter), $i$ is the index for the cross-section while $t$ is the index for time dimension and $p$ is the number of variables in each cross-section. Following Anderson et al. (2006), the Panel VAR, in general, takes the form:

$$y_{it} = \left( y_{i1t}, y_{i2t}, ..., y_{ipt} \right)$$

(4)
Where \( \mathbf{y} \) is a \( p \times 1 \) vector of cross section \( i \), in period \( t \). If we suppose \( \mathbf{y}_i \) follows non-stationary process, a heterogeneous panel VAR (\( k_i \)) model would be:

\[
\mathbf{y}_i = \delta d_t + \sum_{i=1}^{k_i} \Phi_{ik} \mathbf{y}_{i, t-k} + \mathbf{e}_i \quad ; \quad i = 1, 2, ..., N \tag{5}
\]

Where \( \Phi_{ij} \) is a \( p \times p \) coefficient matrix, \( \mathbf{e}_i \) is Gaussian white noise with a non-singular covariance matrix \( \mathbf{e}_i \sim N_p(0, \Omega_i) \), and \( d_t \) is a vector of deterministic components; that is \( d_t = 1 \) or \( (1, t)' \), and \( \delta_i \) is a \( p \times 1 \) or \( p \times 2 \) matrix of parameters. Thus \( \delta_i d_t \) is a \( p \times 1 \) vector with the \( j \)-th element equal to \( \delta_{ij} \) or \( \delta_{1ij} + \delta_{2ij} t \) representing the deterministic component of the model. The panel vector error correction (PVEC) representation for eqn. 5 then becomes

\[
\Delta \mathbf{y}_i = \delta d_t + \Pi_i \mathbf{y}_{i, t-1} + \sum_{j=1}^{k_i-1} \Gamma_{ij} \Delta \mathbf{y}_{i, t-j} + \mathbf{e}_i \quad ; \quad i = 1, 2, ..., N \tag{6}
\]

Where each of the \((n \times n)\) matrices \( \Gamma_{ij} = -\sum_{s=j+1}^{k_i} \phi_{is} \) for \( j = 1, 2, ..., (k_i-1) \) and \( \Pi_i = -\left( I_m - \sum_{j=1}^{k_i} \phi_{ij} \right) \) comprise coefficients to be estimated by Johansen Fisher panel cointegration test, following the Johansens (1988) sequential procedure for a \((t = 1, ..., T)\) sample of data, \( j = 1, ..., k_i - 1 \) is the number of lags included in the system.

In the reduced rank form, it is possible to write the \( \Pi_i \) matrix in the form \( \Pi_i = \mathbf{a}_i \beta_i' \) where \( \mathbf{a}_i \) and \( \beta_i \) are both \((n \times r)\) and \( r \) is the rank of \( \Pi_i \) corresponding to the number of linearly independent relationships among the variables in \( \mathbf{y}_i \), which neatly facilitates economic interpretation to the PVECM in eqn. 3. The \( r \) columns of \( \beta_i \) represents the co-integrating vectors that quantify the ‘long-run’ (or equilibrium) relationships between the \( p \) variables in the \( N \) cross-section and the \( r \) columns of error correction coefficients of \( \mathbf{a}_i \) load deviations from equilibrium (i.e. \( \beta_i' \mathbf{y}_{i, t-k} \)) into \( \Delta \mathbf{y}_i \) for correction, thereby ensuring that the equilibrium is maintained. The \( \Gamma_{ik} \) matrices in eqn. 6 estimate the short-run or transient effect of shocks on \( \Delta \mathbf{y}_i \) and thereby allow the short and long-run responses to differ.

In this panel cointegration test, our assumption is that all of the \( N \) cross-sections have at most \( r \) cointegrating relationships, defined by the standard Log likelihood ratio (LR) - bar statistic for panel
cointegration rank test among the $p$ variables. Where $r > 1$, and is not a result of some stationary $p$ (Harris and Sollis, 2003) in the panel, issues of identification arise, but these are sufficiently addressed by means of imposing over identifying restrictions (Pesaran and Shin, 1995b).

In this study, the panel data set consists of four (4) cross-sections observed over 2000Q1 to 2016Q4 time periods for South Africa, Mauritius, Ghana and Uganda and considers four variables across each of these countries, namely consumer price index (CPI), nominal exchange rate, nominal gross domestic product (GDP) and the policy interest rate.

3.3 The Data

The study uses quarterly unbalanced panel data for the period: 2000Q1 to 2016Q4 of four African countries that have adopted an interest rate based monetary policy framework. These four countries are split into two sub-panels on the basis of their levels of financial inclusion, as either high or low. The distinction is based on the number of deposit accounts in commercial banks per 1,000 adults of age 15 and older. Various measures of financial inclusion have been used in the literature, but for reasons related to data availability for all the four countries in our sample, we use the number of deposit accounts in commercial banks. Over the period 2004 to 2015, the average deposit accounts in commercial banks per 1,000 adults in South Africa and Mauritius were 1,007 and 2,166, respectively and they were 381 and 161 in Ghana and Uganda, respectively. This informs our categorization of the two sub-panels, with South Africa and Mauritius constituting high financial inclusion sub-sample, while Ghana and Uganda constitute the low financial inclusion sub-sample.

For each of these countries, we utilise quarterly country level time series data on nominal GDP, CPI, nominal exchange rate and the policy interest rate. The data on GDP, CPI, exchange rate and policy rate are obtained from the World Bank Development Indicators Database, while the data on the number of deposit accounts is from the IMF Financial Access Survey database. All the variables except the monetary policy rates were transformed into natural logarithms. The idea is that financial inclusion has a key influence on monetary policy effectiveness so that one can expect a higher impact of monetary policy in countries with a higher level of financial inclusion.

There are key issues to note regarding the data used in this study. Firstly, the varying time of adopting an interest rate based monetary policy framework. To reflect this, we include dummies for

\[
\omega_{tR} \left[ H(r)/H(p) \right] = \frac{\sqrt{N} \left( \sum_{i=1}^{N} \sum_{j=r+1}^{p} \ln \left( 1 - \hat{\lambda}_{i,j} \right) \right) - E(Z_k)}{\sqrt{Var(Z_k)}}
\]

where $\hat{\lambda}_{i,j}$ is the $j^{th}$ eigenvalue of the $i^{th}$ cross-section, in a fashion as to the eigenvalue problem in Johansen (1995): $E(Z_k)$ and $Var(Z_k)$ are the mean and variance of the asymptotic trace statistic $Z_k$. 

1
Uganda and Ghana for the period 2011Q2 to 2016Q4 and 2007Q1 to 2016Q4 respectively, i.e. 
\[ d_{it} = \begin{cases} 1 & \text{if the time corresponds to the period when the framework was in place, zero otherwise.} \\ 0 & \end{cases} \]

Secondly, there were significant structural changes including the change of the policy rate from a bank rate to a repo rate in Mauritius, for which we include a dummy that takes the value 1 from 2007Q1 to 2016Q4, and zero otherwise.

IV: Econometric Results

4.1 Panel unit root tests
As a precursor to panel cointegration analysis, the four data series are formally tested for the order of integration or non-stationarity of panel units using panel unit root tests proposed by Levin, Lin, and Chu (2002). As shown in Annex Table 1, the panel unit root tests indicate that all variables are nonstationary in levels, but are stationary in first difference at the conventional 1 percent level of significance. This inference is held even when the panel is subdivided into high and low financial inclusion sub-panels.

4.2 Panel cointegration
On the basis of unit root test results in Annex Table 1, where all the 4-series are order one unit root non-stationary, they could, in principal, be cointegrated. The unrestricted 4-dimensional panel vector autoregressive (PVAR) model is estimated with a restricted constant. The choice of the lag-length was determined as the minimum number of lags that merits the crucial assumption of time independence of the residuals, based on a Lagrange Multiplier (LM) test. We began with k=5 lags. Although Akaike information criterion (AIC) and Hannan-Quinn criterion (H-Q) chose 4 lags, Schwarz information criterion (SC) favored 3 lags, and with k=3, the LM test could not reject the null hypothesis of no serial correlation in the residuals. Thus, the underlying PVAR model is estimated using 3 lags.

Having determined the appropriate specification of the data generating process, existence of long-run equilibrium relation (s) was determined using the Johansen Fisher panel trace cointegration test; following the Johansens (1988) sequential procedure. The resulting test results are reported in Annex Table 2. Consistent with Evans (2016), collectively, the presence of one long-run equilibrium (stationary) relation among the variables at the conventional 5 percent level of significance cannot be rejected. However, at country level, there are varying inferences. While for Ghana and Uganda, there is one stationary long-run relationship, there are two for South Africa and none for Mauritius. Nonetheless, country level trace test inconsistencies are inconsequential to the analysis herein as the focus is not country specific relationships, but rather relationships in a panel framework.
As our objective in assessing whether the degree of responsiveness of prices to monetary policy differs with the extent of financial penetration, unless otherwise noted, the only existing cointegrating relation is normalized for the quarterly change of CPI in order to interpret the estimated coefficients. The normalized results are reported in Table 2.

### Table 2: Panel Vector Error Correction Model Estimates

<table>
<thead>
<tr>
<th></th>
<th>LCPI</th>
<th>LEXR</th>
<th>LGDP</th>
<th>P_rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(\beta')</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All countries</td>
<td>-1.00</td>
<td>0.202</td>
<td>0.161</td>
<td>-0.025</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(7.463)</td>
<td>(5.776)</td>
<td>(-2.007)</td>
</tr>
<tr>
<td></td>
<td>(\alpha)</td>
<td>-0.005</td>
<td>-0.005</td>
<td>-0.073</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-0.801)</td>
<td>(-0.508)</td>
<td>(-8.265)</td>
</tr>
<tr>
<td></td>
<td>Dum_UG</td>
<td>0.009</td>
<td>0.008</td>
<td>0.063</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.001)</td>
<td>(0.578)</td>
<td>(4.762)</td>
</tr>
<tr>
<td></td>
<td>Adj. (R^2)</td>
<td>0.06</td>
<td>0.08</td>
<td>0.61</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.07</td>
</tr>
<tr>
<td>High financial inclusion countries</td>
<td>(\beta')</td>
<td>-1.000</td>
<td>2.495</td>
<td>0.733</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3.101)</td>
<td>(2.791)</td>
<td>(-4.544)</td>
</tr>
<tr>
<td></td>
<td>(\alpha)</td>
<td>0.000</td>
<td>0.004</td>
<td>-0.010</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.062)</td>
<td>(0.913)</td>
<td>(-6.166)</td>
</tr>
<tr>
<td></td>
<td>Dum_MAU</td>
<td>-0.007</td>
<td>-0.013</td>
<td>-0.032</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-0.741)</td>
<td>(-1.017)</td>
<td>(-5.885)</td>
</tr>
<tr>
<td></td>
<td>Adj. (R^2)</td>
<td>0.01</td>
<td>0.06</td>
<td>0.90</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.06</td>
</tr>
<tr>
<td>Low financial inclusion countries</td>
<td>(\beta')</td>
<td>-1.000</td>
<td>0.554</td>
<td>0.333</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(4.198)</td>
<td>(4.808)</td>
<td>(-7.914)</td>
</tr>
<tr>
<td></td>
<td>(\alpha)</td>
<td>0.015</td>
<td>0.041</td>
<td>-0.157</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.933)</td>
<td>(0.987)</td>
<td>(-3.261)</td>
</tr>
<tr>
<td></td>
<td>Dum_UG</td>
<td>0.005</td>
<td>0.019</td>
<td>0.038</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.792)</td>
<td>(1.086)</td>
<td>(1.864)</td>
</tr>
<tr>
<td></td>
<td>Dum_GHA</td>
<td>0.070</td>
<td>0.213</td>
<td>0.725</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.036)</td>
<td>(1.191)</td>
<td>(3.498)</td>
</tr>
<tr>
<td></td>
<td>Adj. (R^2)</td>
<td>0.13</td>
<td>0.08</td>
<td>0.48</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.50</td>
</tr>
</tbody>
</table>

Note: In parentheses are t-statistic values; and where dummies are not significant, results are not reported.

_Ceteris paribus_, estimates in Table 4 show a positive long run correlation of nominal exchange rate and GDP with CPI and a negative association with the policy rate. In the long-run, estimates, for all the four countries, show that a percentage point q-o-q depreciation in the nominal exchange rate and increase in GDP lead to about 0.20 and 0.16 percentage point change in CPI, respectively. A percentage point increase in the policy rate reduces CPI, on average by about 0.03 percentage points, suggesting in general fairly strong interest rate transmission channel of monetary policy.

The high financial inclusion countries post a higher long run impact of exchange rate depreciation, GDP and policy rate on CPI of 2.50, 0.73 and -0.36 percentage points, respectively. The impact in the low financial inclusion countries is slightly lower than that of the high financial inclusion countries though higher than for all the four countries in the panel - with depreciation, GDP and policy rate impacts of 0.55, 0.33 and -0.05 percentage points, respectively on CPI. Overall, the policy
rate has a higher impact on inflation (-0.36) in the high financial inclusion countries than in the low financial inclusion countries (-0.05). These results are largely consistent with the findings in Mehrotra and Yetman (2014), where the ratio of output volatility to inflation volatility was found to increase with the share of financially included consumers in the economy.

The dummies for Uganda (DUM_UGA) and Ghana (DUM_GHA), which capture the change in the monetary policy framework to Inflation Targeting in 2011Q2 and 2007Q1, respectively, are positive and significant. This suggests this has had a positive impact on monetary policy in the two countries over the sample period considered here. The change in policy rate from a bank rate to a repo rate in Mauritius, captured by DUM_MAU dummy has had a negative and significant impact on the country’s GDP over the sample period considered here. Across all country groups, equilibrium in the event of disequilibrium is re-instated within the GDP equation, with an adjustment speed of 7.3, 1.0 and 15.7 percent, respectively.

Note however that these are partial derivatives (by construction) predicated on the *ceteris paribus* clause (Lütkepohl and Reimers 1992), and have been interpreted in this light. Where variables in an economic system are characterized by potentially rich dynamic interaction (as is the case here), inference based on 'everything else held constant' is both of limited value and may give a misleading impression of the short- and long-run estimates. Therefore, since what we want is to actually estimate what might happen to all variables in the system following a perturbation of known size in the policy rate equation, impulse response analysis, which describes the resulting chain reaction of knock-on and feedback effects as it permeates through the system, provides a tractable and potentially attractive value of the policy rate pass-through providing no other shocks hit the system thereafter (see Johnston and DiNardo, 1997). This is discussed in the next section.

### 4.3 Impulse Responses

The results of the policy rate shock are shown in **Figure 1**. Specifically, the figure shows the impact of a one standard deviation shock, defined as an exogenous, unexpected, temporary increase in the policy rate with a 95 percent confidence level on domestic price inflation in period one for all, high and low financial inclusion countries. The solid line in each graph is the estimated response while the dashed lines denote a two standard error confidence band around the estimate. Since the data are in first differences of logarithms, the impulse response functions need to be regarded as measuring a proportional change in the rest of the macro variables due to one standard innovation (at the initial period) in the policy rate.

**Figure 1**: Response to Cholesky One S.D. Innovations ± 2 S.E.
It is clear from the figure that the effect of a policy rate shock on CPI is gradual achieving stable inflation in about 4 to 8 quarters, depending on the level of financial inclusion. The initial effect of a structural one standard deviation shock to the policy rate on CPI, in the case of all countries is zero, but rises to 0.0019 (0.19 percent) in period 2. The impact of the shock dissipates after the 8th quarter. For high financial inclusion countries, the initial impact of a structural one standard deviation shock to the policy rate on CPI is 0.001 (0.12 percent) and rises to a maximum of 0.005 (0.47 percent) in the 2nd quarter, thereafter it begins to dissipate. And it is -0.0003 (-0.03 percent) for low financial inclusion countries category, rising to 0.001 (0.1 percent) in the second quarter, before dissipating thereafter.

Consistent with the PVECM results, the impact of policy shock is more pronounced for high financial inclusion countries, which suggests that economies with higher levels of financial inclusion
have stronger monetary policy transmission mechanisms than economies with lower levels of financial inclusion. However, although the low financial inclusion economies display a weaker transmission mechanism, the speed of that mechanism is faster than in the high financial inclusion countries: a larger proportion of the overall impact of a monetary shock is felt in the first quarter after the shock in the low financial inclusion economies than in the high financial inclusion economies. This might reflect differences in the institutional structure of the two groups of countries which affect the pace at which prices change, for example, many prices (e.g. wages) in the more developed economies, which also have higher rates of financial inclusion, are determined through contractual arrangement, which makes them sticky in the short run.

V. Conclusion and Policy Implications

This study uses a Panel Vector Error Correction Model (PVECM) to examine the relationship between inflation, economic growth, exchange rate and the monetary policy rate for four African countries, from 2000 to 2016. The results broadly imply that the effect of tighter monetary policy, through higher interest rates, on inflation is negative and significant, in line with economic theory. Using the number of deposit accounts to distinguish between high and low levels of financial inclusion, we establish that the effect of monetary policy on inflation is greater for countries with a high level of financial inclusion. However, it is possible that financial inclusion is correlated with other aspects of financial development which also affect the monetary policy transmission mechanism, such as the level of financial depth and intermediation in the economy. As such, the stronger monetary policy transmission mechanism estimated in the high financial inclusion country sample might be the result of these other aspects of financial development, rather than financial inclusion per se. Future research that includes other aspects of financial development would provide more understanding on the effect of financial inclusion on monetary policy transmission.

References


Sharma, S., & Chutoo, S. Assessment of the Effectiveness of Monetary Policy in Mauritius. cmi.comesa.int/wp-content/uploads/2016/03/Mauritius.docx


Annex Tables

Table 1: *Panel unit root test results*

<table>
<thead>
<tr>
<th>Variables</th>
<th>Level</th>
<th>First difference</th>
<th>Inference</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP(_{it})</td>
<td>0.945 (0.828)</td>
<td>-2.452(0.007)</td>
<td>I(1)</td>
</tr>
<tr>
<td>CPI(_{it})</td>
<td>-1.123 (0.131)</td>
<td>-4.773 (0.000)</td>
<td>I(1)</td>
</tr>
<tr>
<td>EXR(_{it})</td>
<td>1.043 (0.852)</td>
<td>-11.534 (0.000)</td>
<td>I(1)</td>
</tr>
<tr>
<td>P(_{rateit})</td>
<td>-0.089 (0.464)</td>
<td>-11.579 (0.000)</td>
<td>I(1)</td>
</tr>
</tbody>
</table>

Notes: In parenthesis are p-values; T=264 for test in levels and N=4.

Table 2: *Panel cointegration rank Trace test*

<table>
<thead>
<tr>
<th>Hypothesized No. of CEs</th>
<th>All countries Fisher Trace Stat.*</th>
<th>High financial Inclusion countries Fisher Trace Stat.*</th>
<th>Low financial Inclusion Countries Fisher Trace Stat.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>40.96 (0.000)</td>
<td>26.32 (0.000)</td>
<td>14.64 (0.006)</td>
</tr>
<tr>
<td>At most 1</td>
<td>22.24 (0.060)</td>
<td>14.03 (0.074)</td>
<td>8.205 (0.170)</td>
</tr>
<tr>
<td>At most 2</td>
<td>13.22 (0.105)</td>
<td>8.632 (0.104)</td>
<td>4.586 (0.333)</td>
</tr>
<tr>
<td>At most 3</td>
<td>9.692 (0.287)</td>
<td>7.380 (0.117)</td>
<td>2.312 (0.679)</td>
</tr>
</tbody>
</table>

Country by country Trace test Statistics

<table>
<thead>
<tr>
<th>Country</th>
<th>r = 0</th>
<th>r = 1</th>
<th>rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ghana</td>
<td>53.392 (0.014)</td>
<td>29.112 (0.060)</td>
<td>1</td>
</tr>
<tr>
<td>Mauritius</td>
<td>39.649</td>
<td>18.3773</td>
<td>0</td>
</tr>
<tr>
<td>Uganda</td>
<td>48.041 (0.048)</td>
<td>22.4095</td>
<td>1</td>
</tr>
<tr>
<td>South Africa</td>
<td>78.780 (0.000)</td>
<td>23.685 (0.002)</td>
<td>2</td>
</tr>
</tbody>
</table>

In parentheses, in lower panel are probability values.