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DEVELOPING AND TESTING NEW MEASURES OF EXCHANGE MARKET PRESSURE IN SUB-SAHARAN AFRICA

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1 Introduction

Traditionally, a common source of instability in both the exchange rate and the price level is the high creation of money. It does follow that price inflation and exchange rate depreciation should be closely linked in the presence of large monetary shocks. This relationship is very important in an unstable monetary environment (López-Villavicencio and Mignon, 2017).

In fact, most of the major monetary shocks have in some way involved a fixed or pegged exchange rate regime. Thus countries that did not have pegged rates – as observed also by Obstfeld and Rogoff (1995) – have avoided this type of crises that affected mostly emerging market countries (Fischer, 2001).

Despite this, monetary authorities involved in dealing with these crises have warned strongly against the use of adjustable pegs and other soft pegged exchange rate regimes for countries open to international capital flows. Fischer (2001) proposes that a wide variety of flexible rate arrangements remain available considering the fact that

policy conditions in most countries will not be indifferent to exchange rate movements.

The breakdown of the Bretton Woods System, and the brief experiment with floating exchange rates that followed it, led to most countries adopting some form of intermediate exchange rate system. By this, policy authorities seek to neutralise the impact of its foreign exchange market transactions on the domestic market through the purchase or sale of foreign exchange to prevent a collapse of the domestic currency.

1.1 Motivation and importance of the study

Monetary policy in Sub-Saharan Africa (SSA) went through significant transformation over the same period. Literature points to the fact that SSA countries that were presumed to have been freed from fiscal dominance, became capable of pursuing inflation and stabilization objectives through market-based policies (Berg et al. 2015).

For instance in emerging economies certain structural characteristics make them more vulnerable to external shocks. These have made emerging economies

more concerned about the level of appreciation or depreciation of their exchange rate. As a result, these countries will use both monetary policy and possibly foreign exchange intervention policy to respond to exchange market pressures (Fischer, 2001).

Though most countries in SSA operate managed floats and are committed to transparency (except for political interference) in the conduct of monetary policy, the economies within which they operate differ sharply from those in developed economies (Kiss and Pontet, 2015). Shocks play an important role in SSA countries due to the fact that they are mainly commodity exporters (oil) and rely heavily on remittances and foreign aid or borrowings (Berg et al, 2015). These volatilities can among others lead to instability in commodity prices, the banking system and the debt sustainability of these countries – as was the case in Ghana and Kenya.

Due to these characteristics, SSA countries like other developing countries mainly keep a parallel foreign exchange system – Ghana, Tanzania and Zambia have been noted to have high parallel premiums – in other to

prevent volatilities in their exchange rates or exchange rate crisis (Kiguel and O'Connell, 1995). This observation may be driven by the rule of thumb of keeping reserves of up to three months of import cover. This leads to an implicit limit on how far countries can afford to rely on their reserves to defend their currencies. Under such a situation a full-blown exchange rate crisis can occur. Also, with a lot of foreign denominated debt, SSA countries may not be able to afford large depreciations of their currencies as it will mean more foreign exchange to service those debts. This as history has shown can trigger an exchange rate crisis (Jonas and Mishkin, 2004). This is the motivation of the study as SSA countries (Nigeria, Botswana, Ghana, Cameroon, South Africa and Kenya) lose a lot of reserves whenever there are sharp depreciations (increase) in their domestic currencies.

Studies – Nakatani (2018) – have found that the effects of these shocks on the probability of a crisis are larger for floating exchange rate regimes and that capital controls mitigate the effects of some of the shocks in pegged regimes. Soe and Kakinaka (2018), also found that

an IT regime helps stabilize pressure on a currency. Goldfajn and Gupta (2003) also found that a tight monetary policy facilitates the reversal of currency depreciation through nominal appreciation. These normally occur through foreign exchange interventions of the central bank. It usually require a high level of foreign exchange reserves which in turn introduces a limit to the level of intervention (Krušković, 2017). This was what influenced Girton and Ropper (1977) to develop an exchange market pressure (EMP) index to identify periods were there were excess pressure on the exchange rate. This idea had been modified by subsequent authors to capture the reaction function of monetary authorities by adding the interest rate variable to the original index developed by Girton and Ropper (1977). The EMP index has thus become the most common index in measuring pressure on a currency.

1.2   Objectives of the study

In identifying exchange rate crisis using the EMP index, most of these authors used extreme values of the EMP index to identify exchange rate crisis. The index is a

simple average of exchange rate changes and a foreign reserve depletion indicator, and more recently an interest rate indicator – to capture policy reactions of monetary authorities. For most studies, a crisis is detected when the index exceeds 1.5 of the standard deviation and the sample mean of the EMP index. Others used various conventional methods based on a certain arbitrary number of standard deviations (usually ranging from 1.5 to 3 standard deviations) above the mean of the EMP index (Pontines and Siregar, 2008) – this I term the 'threshold problem'. This was also discovered by Pontines and Siregar (2008) and Bertoli et al. (2010). They cautioned against the use of the index as it is highly sensitive to the choice of the weighting scheme for each component of the EMP index and the statistical parametric assumption used in the constructions of crisis thresholds. Also the modification of the index to include the interest rate variable makes the index more suitable for countries implementing an IT framework as observed by Soe and Kakinaka (2018). However, with about eighteen (18) SSA countries using money targets and three (3) adopting the IT framework, it is obvious that the recent changes to the EMP index – to

include the interest rate variable – will have to be adjusted to capture the type of monetary policy frame work that exist in SSA in other for it to effectively identify exchange rate crisis. The aim of this study will be to develop an EMP index that will effectively capture EMP in SSA – bearing in mind the different monetary and exchange rate regimes in SSA.

The research objectives and questions to be explored by this study will be the following:

- Is the EMP index in its current form effective in identifying exchange rate crisis in SSA?

- Is the new EMP index identified by this study effective in identifying exchange rate crisis in SSA?

- Is there a relationship between the EMP index and other macroeconomic variables in SSA?

  - What is the effect of the EMP index on bank specific factors in Ghana?
  - What is the effect of the EMP index on retail fuel prices in SSA?
  - What is the effect of the EMP index on the debt levels of countries in SSA?

Answers to these questions is going to help determine exchange market crisis in SSA and also explore policies to prevent their reoccurrence. In addressing the study gaps and the research questions illustrated above, this study is suggesting and testing different estimates of the EMP index with emphasis on the different monetary policy frameworks in SSA.

The structure of the thesis is broken down into the empirical and theoretical review chapter which compares and contrast the various ideas underlying exchange rate theory, the methodological chapter which discusses the data, variables and methods used for the analysis, the empirical result chapter which the discusses the outcomes of the various methods used in this study and the conclusion chapter which summarises the entire study and make some policy recommendations.

2 Methodology

This study combines economic theory with actual measurements using the theory and technique of statistical inference, making it unavoidable for econometric research method to be employed (Haavelmo, 1944).

Data for this study was mainly sourced from the IMF's International Financial Statistics (IFS), the World Bank's international debt statistics, the IMF's Financial Soundness Indicators (FSI), Kenya National Bureau of Statistics and the globalpetrolprices.com.

The EMP index introduced by Girton and Roper (1977) is a simple average of exchange rate changes and a foreign reserve depletion indicator. When the index passes over a threshold, excess pressure is flagged and a binary variable representing a crisis takes on a value of one for that period. The index captures both depreciation and the type of pressure on a currency – as would happen in the presence of depreciation expectation – which is often softened or diverted through monetary authority interventions and does not normally show in the nominal

exchange rate dynamics.

The index has evolved over the years and this study considers all these variations in other to capture the different monetary policy frameworks in SSA. First, I estimate a measure that only deals with changes in the exchange rate and the reserve losses. Secondly, I estimated the EMP index to include the money variable to capture the policy reaction of the eighteen (18) SSA countries that use money targets as their policy framework. Finally, I estimated another measure that includes the interest rate differential to capture the three (3) SSA countries that have adopted the IT frame work. In addition, the study considered other variations of the index as estimated by Hossfeld and Pramor (2018). In all six (6) different definitions – based on the literature – of the EMP was considered.

These different variations of the EMP index were tested against changes in the exchange rate to identify which one of them is good at explaining it. Since the indexes where derived using the exchange rate variable, multicollinearity among the various indexes could not

easily be assumed away – in fact multicollinearity were identified and were dealt with by the use of a Dynamic Ordinary Least Square (DOLS) model, A Generalized Method of Moments (GMM) and a ridge regression model. It is worth noting that the multicollinearity were not identified in all cases.

After dealing with multicollinearity and selecting the appropriate EMP index to use for the rest of the analysis, I employed the use of a discrete threshold regression model to help identify crisis episodes in both South Africa and Ghana. This is to help deal with the threshold problem pointed out by Pontines and Siregar (2008) in the reviewed literature. The main goal is to find a value of values of the data series that triggered the regime change – exchange rate crisis. The assumptions underlining this model is similar to Hansen (2000) and Bai and Perron (2003).

Using the original form of the EMP index, this study developed two new variations of the index with the foreign exchange reserves scaled by the one-period-lagged value of imports of goods and services and short-

term external debt. This was based on the assumption that a country will be able to wade of speculative attack on the currency if it has reserves that can cater for previous year's imports or short-term external debt. The focus of this study on variations of the reserve variable is born from the fact that an earlier study conducted, which considered previous variations of the index, favoured the index with just the reserve variable and the reserve variable adjusted for by the money variable. This led to the conclusion that the reserve variable still plays a very important role in SSA even though SSA is characterised by countries with different monetary policy frameworks.

In testing the impact of the EMP index on other macroeconomic variables (banking sector, retail gasoline sector and debt sustainability) the study employed different regression models. Thus a GMM model was used to test for the impact of the EMP index on the banking crisis in Ghana. A Non-linear Auto-Regressive Distributed Lag (NARDL) was used test the impact of the EMP index on the retail price of gasoline in Ghana and Kenya. I also relied on the framework for fiscal policy and

public debt sustainability analysis (DSA) in market-access countries (MACs), to estimate the impact of the exchange rate variable on the debt sustainability of Ghana and Kenya.

3 Results

The choice of the best EMP index for SSA is guided by first the Variance Inflation Factor (VIF) and then the sign and size of the coefficients. The relationship between the EMP index and the changes in the log exchange rate (dependent variable) is expected to be positive. Thus, a positive raw ridge coefficient which indicates how much change in the dependent variable (changes in the log of the exchange rate) occurs for a one-unit change in an EMP index when the remaining indexes are held constant. This is also a way of dealing with the weighting problems associated with the EMP index.

3.1 First objective

The results show that among the six variations of the EMP index considered, equation two (2) and five (5) could explain changes in the log of the exchange rate better than the other estimates because their VIF did not shrink the fastest as the lambda/ bias approached 0.04 in all five situations considered and their coefficients were positively related to changes in the exchange rate variable. The difference between equation two (2) and five (5) is

that in equation (2) the reserve variable is adjusted for by the broad money whereas that is not the case in equation (5). Also, in equation (5) the components are normalised by their own standard deviation. Since all the respective VIFs are lower than five (5), equation 5 appears to have the largest, positive explanatory power in three out of the five possible cases. This is true if: all 31 countries in SSA are considered as a whole based on just the exchange rate variable and their reserves; out of the 31 countries we consider the 14 countries that use reserve money as their operational target based on also just the exchange rate variable and the reserve indicator; three (3) of the countries that use the reserve money as an operational target based on the changes in the exchange rate, the reserve indicator and the reserve money variable. These results mimic the initial DOLS model estimated. If primacy is given to variables that have significant positive relationship with the change in the log of the exchange rate variable.

By this result one could say that the current definition of the index as defined in equation (1), does not do a good job of explaining and predicting changes in

exchange rate in SSA if countries that have adopted the IT framework are involved. For those countries' equation (2) which considers the degree to which alterations in the domestic source of broad money lead to changes in the demand for domestic base and thereby the total quantity of reserves outstanding. This raises issues about the autonomous of monetary authorities in these countries and also if they are implementing the IT framework effectively.

In other to clear all doubts, I dwell on the IT countries in SSA (Ghana and South Africa). Here we use the same criteria as stated above, by testing the different estimates of the EMP index to the log changes of the exchange rate variable to identify which of the index will be good at explaining it. This confirmed that the EMP index with the reserve variable adjusted for by the broad money could explain changes in the log of the exchange rate variable better than the other estimates. Ghana and South Africa announce that they use Inflation Targeting (IT) – De jure – and is assumed to have a freely floating exchange rate regime but De facto, it heavily manages or targets the exchange rate (Knedlik, 2006: Mminele, 2013).

These two targets two instruments situation could be complicating the identification of the policy framework and analysis of monetary policies of these countries.

In dealing with the threshold problem associated with the EMP index, a discrete threshold regression was estimated for Ghana and South Africa individually. In all twenty eight (28) crisis episodes were identified for Ghana irrespective of whether EMP_1 or EMP_2 is used as the dependent variable. This will suggest that the use of the interest rate as a reaction function by the Central Bank was not effective in reducing exchange rate pressure. The crisis periods were more pronounced in 2008 to mid-2009, first half of 2012 and late 2013 to 2015. The maximum threshold variable for the two indexes used were significantly different confirming the diversity of the two indexes. For South Africa there were thirty-one (31) and twenty-seven (27) crisis episodes when the EMP_1 and the EMP_2 are respectively used as dependent variables. The crisis periods were more pronounced in 2008, late 2011 to the first half of 2012 and from 2013 to 2015. This confirms the use of the interest rate to dampen pressure on the exchange rate in South Africa since more crisis were

discovered if the index adjusted for the interest rate is used. This observation is not as pronounced as one will expect under an IT regime.

3.2 Second objective

Based on the findings that reserve adequacy could be expected to vary amongst developing countries depending on their economic circumstances. For the second objective, the results from other regression however present some new perspectives on the subject matter. Since the reserve adequacy measure was used in this case to help access the ability of countries in SSA to use their reserves to wade off currency pressure, after they have catered for previous period's imports, short-term external debt and the broad money. This differs significantly from most of the studies conducted in the subject area.

The results for the second objective showed that all the explanatory variables, including the new EMP index proposed, were significant. All had the expected positive signs with the exception of the EMP 19 (the index with the reserve variable adjusted for by broad money) which

had a negative sign on the log changes of the exchange rate variable. Broad money is regarded by many as the measure of money. It is defined as the sum of currency, checking deposits, savings deposits, retail money market mutual funds, and small-time deposits. The negative relationship between the EMP 19 and the log changes of the exchange rate variable could mean that most of the measure of broad money in SSA are not reservable or are not effectively captured as checking deposits and so are not liabilities of depository institutions (Carpenter and Demiralp, 2012). The frequency of the data set can also be a contributory factor – yearly rather than monthly data.

3.3   Third objective

In investigating the impact of the EMP index on some macroeconomic indicators in SSA, this study looks at the 2017-18 banking crisis in Ghana, asymmetry in the retail gasoline sector in Ghana and Kenya and the debt sustainability in Ghana and Kenya. Before establishing the causes of the crisis in Ghana, I determine the best EMP index for Ghana to be used for the analysis. The

conclusion was not different from that reached under the first objective.

Two equations were estimated with one having the NPL as the dependent variable and vice versa. In both equations, there was a negative relationship between the EMP index and bank profitability indicators in Ghana. The negative sign meant that depreciation of the domestic currency also affects bank profit which is consistent with literature.

On the impact of the EMP index on retail prices of gasoline in SSA, the NARDL model used showed that both positive and negative lag movements of the EMP index were mostly significant with fluctuations in the ex-pump price of premium gasoline for Ghana, Kenya, and Colombia. Highlighting the importance of the exchange rate and the policy response in terms of retail gasoline prices in these three countries in the short-run.

The long-run results revealed that the exchange rate was very significant in determining the ex-pump price of gasoline in the study countries except for Kenya. The situation in Kenya could be due to the country moving back and forth in the regulation of the retail fuel sub-

sector; price regulation prior to 1994, price deregulation from 1994 to 2005, and then back to price regulation from 2006 onwards. A Wald test conducted on the positive and negative changes of the EMP index did not suggest that these effects were significantly different from each other for all countries. The study period corresponds mostly with the period of price deregulation in Ghana, that is, since 2015. This may have accounted for the significance of the EMP index and the acceptance of the null hypothesis of the Wald test on the equal effects of the positive and negative movements of the EMP index on the changes in the ex-pump premium gasoline prices.

4   Conclusion

This study has highlighted the importance of the exchange rate variable. The literature reviewed discussed the historical antecedents that led to emerging economies moving towards the adoption of a flexible exchange rate system. This policy prescription as discussed is quite challenging for developing economies. Countries in SSA like other developing countries insure themselves against current account shocks (volatilities in the exchange rate) using international reserves. Even though in some instances current account imbalances have increasingly been financed through portfolio investment (Eurobonds) inflows, helping to ease pressure on reserves (IMF, 2018), the results from this study shows that most countries in SSA still rely heavily on their reserves to wade off pressure on their currency. This will mean that developing countries that even adopt the IT framework will not be in the position to allow their domestic currencies to freely float.

Models that have been used to measure exchange market pressure – specifically variations of the EMP index

– have indirectly assumed that most countries adopt the IT framework by including the interest rate in the reaction function of countries who experience exchange market pressure. Other authors also warned of the use of the index in SSA. Citing specifically the method of selecting the appropriate threshold for identifying crisis episodes.

In other to deal with the sensitivity issues raised by Pontines and Siregar (2008) and Bertoli et al. (2010), different variations of the EMP index were thus estimated and tested against changes in the exchange rate variable to identify which one of them is good at explaining the log changes in the exchange rate variable.

In dealing with the threshold problem pointed out by Pontines and Siregar (2008), the threshold regression model, a non-linear time series model with the local regimes switching, was used to identify crisis episodes in South Africa and Ghana. The study finds that the EMP index with the reserve variable adjusted for by broad money was more appropriate in determining exchange market pressure in SSA.

In an attempt to develop a new EMP index for SSA, the paper showed that the EMP index with the

reserve variable adjusted for by imports of goods and services is more responsive to the changes in the log of the exchange rate variable. This conclusion confirms the observations by Nowak, Hviding and Ricci (2004) that the exchange rate crisis in the sampled countries (emerging economies) emanates mostly from the current account of the balance of payments. Significant relationships were discovered between the exchange rate and other macroeconomic variables in SSA.

4.1   Recommendations

This will imply that the reserve adequacy of these SSA countries can be judged by the size of trade flows as proxied by the value of imports. This conclusion notwithstanding, the significance and the explanatory power of the other two indexes including the HIPC dummy will mean that these other versions of the EMP index used in this study cannot be overlooked. As economies in SSA become sophisticated the causes of exchange rate crisis may shift from the current account to the capital accounts. Also, as these countries deepen their domestic capital markets, the effect of capital flights

cannot be assumed away. Therefore, depending on how sophisticated a country's economy is, any of the indexes proposed may be important as they were all significant in determining changes in the exchange rate variable in SSA.

Accumulating reserves could be at the expense of stimulating the economy through the issuance of domestic bonds and investments in much needed infrastructure. This is because foreign exchange reserves in most SSA countries are managed and held by the central bank for the government. Since foreign reserve levels are already low in SSA countries, in my view, the benefits of accumulating reserves outweigh the cost of holding same due to the fact that SSA countries are still mainly commodity exporters and do not control the prices of these commodities. All measures of reserve adequacy come with the provision that other economic fundamentals remain sound. This is rooted in the fact that reserve accumulation may create a false sense of security if, for instance, fiscal deficits remain high crowding out private sector investments or create debt overhang problems. This may overwhelm the insulating effect of reserves and surprise a country previously considered

secure (Green and Torgeson, 2007). Therefore, an avenue for further studies will be to explore the effect of fiscal policy measures on the proposed EMP indexes in this study.

The study suggests that the exchange rate is likely to be an important variable in determining the ex-pump price of petrol or gasoline once the petroleum sub-sector moves towards deregulation, as is evident in the case of Ghana and Colombia.

The policy recommendation in this case would have been to allow the ex-change rate to freely float but, considering its effects, if there is excessive depreciation and appreciation pressure, the accumulation of reserves is recommended as an immediate solution to prevent exchange rate shocks. However, this solution also comes with the opportunity cost of using these reserves for much-needed investments in these countries. The effect of taxes cannot also be ignored once deregulation takes place – this is the case in Ghana.

Also despite the different exchange rate regimes in SSA, the exchange rate depreciations contribute to increasing pressures on the gross debts of countries in

SSA (Ghana and Kenya). There is no doubt that the COVID-19 pandemic had worsened the debt sustainability of developing economies – Ghana and Kenya. The path to recovery is going to be very complex and challenging, especially when these countries do not have the fiscal space to naturally bring down the debt levels. There have been significant calls for debt forgiveness for developing countries facing debt sustainability problems. This solution is however difficult to implement now mainly because of the significant private participation in the liabilities of these countries.

The impact of fiscal consolidation for SSA countries would need to be softened by more efficient spending – ensuring that government spending is channelled to areas where it is most needed. This should be guided by the need to create fiscal buffers domestically to ensure the fulfilment of futures debt service obligations. The mistakes of the past should not be repeated, where developing countries are assured debt forgiveness and also assured access to external funds unabated. To build long-lasting economic recoveries in these countries, the focus should be on the creation of domestic fiscal buffers

and fiscal space towards the attainment of a long-term debt sustainability.

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6 Publication list

6.1 Peer reviewed journal

Klutse, S. K. (2020): Competitiveness in the European Consolidated Banking Sector After the 2008 Financial Crisis. *Review of Economic Perspectives*, *20*(4), 431-444.

Klutse, S. K., and Kiss, G. D. (2021): Test for asymmetry on the ex-pump price of premium gasoline in Ghana, Kenya, and Colombia. *HUNGARIAN STATISTICAL REVIEW: JOURNAL OF THE HUNGARIAN CENTRAL STATISTICAL OFFICE*, *4*(1), 73-89.

Klutse, S. K., Kiss, G. D. and Sagi, J. (2022): Exchange market pressure in SSA countries – the role of imports and short-term external debt. *Regional Statistics*, **Accepted for publication**.

6.2 Conference proceedings

Klutse S.K. (2021): Testing New Measures of Exchange Market Pressure in Sub-Saharan Africa. In: Procházka D. (eds) Digitalization in Finance and Accounting. ACFA 2019. Springer Proceedings in Business and Economics. Springer, Cham. https://doi.org/10.1007/978-3-030-55277-0_12

Klutse, S. K. (2020): The problem of economic growth in Sub-Saharan Africa – The case of Ghana, Republic of Congo, Kenya and Lesotho. In: Andreász Kosztopulosz – Éva Kuruczleki (eds.) (2020): The Challenges of Analyzing Social and Economic Processes in the 21st Century. University of Szeged Faculty of Economics and Business Administration, Szeged, https://doi.org/10.14232/casep21c.9

Klutse, S. K. (2020): Inflation forecasting in developing economies using SARMA models: the case of Ghana. In: Proceedings of the 4th Central European PhD Workshop on Technological Change and Development. University of Szeged, Doctoral School in Economics, Szeged, 286–302. doi:10.14232/eucrge.2020.proc

Klutse, S. K., and Kiss, G. D. (2022): A Re-Examination of the Remedial Action Adopted by the Central Bank during Banking Crisis–The Case of Ghana. *STRATEGICA, 385*.

6.3   Papers under review

Klutse, S. K., Kiss, G. D. and Sagi, J. (2022): Exchange Rate Crisis among Inflation Targeting Countries in Sub-Saharan Africa. *Risks*.