ASYMMETRY OF SHOCKS IN THE RAND MONETARY AREA.

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Abstract:

Recent developments in the EU, the formation of SADC and most recently the launch of NEPAD have important implications for the role and functions of the existing economic integration initiatives around the world. SADC has recently shifted its focus towards promoting stronger regional integration among its members. This development is likely to have implications for the future role and function of the CMA. The call for a SADC wide single currency may mean the end of the arrangement and the formation of a currency union. A currency union has the potential of making the shocks hitting economies to become more symmetric leading to improved policy co-ordination.

This paper examines this important macroeconomic dynamic for the CMA and as such provides lessons for SADC. The results suggest that the current arrangement has managed to reduce the impact of these shocks and at the same time foster economic stability for some member countries.

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1. INTRODUCTION.

Recent developments in the European Union (EU), the re-formulation of the Southern African Development Co-operation (SADC) and most recently, the launch of the New Partnership for Africa's Development (NEPAD) in 2001, have important implications for the future role and functions of the existing economic integration initiatives in different parts of the world. In the sub-Saharan, SADC was formed in 1980 to mainly promote co-operation among its members in a wide range of areas and to reduce dependence on South Africa. However, South Africa joined SADC in 1994 after the first democratic election. Since then the organisation has shifted its focus towards promoting stronger regional integration among its members.

One of the strong signs of commitment towards increased regional integration has been the call for a SADC-wide single currency by 2016, with South Africa and Botswana as the leading players. The process is expected to start with the establishment of a free trade-area in 2008, followed by a customs union in 2010 and a common market area by 2015. Furthermore, member countries are expected to maintain low inflation rates and budget deficits of 3 percent or less (Business report 13 July 2005).

In light of the above, the issue of increased regional integration has again turned attention towards the literature on Optimum Currency Areas (OCA). One of the tenets of a currency union is its ability make the shocks hitting these economies to be more symmetric and as such improve policy co-ordination (Tjirongo, M.T.: 1995:1). The study of the nature of shocks can be expected to shed light on the influence of a currency union on the performance and responses of economies to underlying disturbances.

This is an important area of concern for the conduct of monetary policy (inflation rate harmonisation) in the pursuit of an effective functioning of a currency union. However, this area of work has not received much attention in Africa and Sub-Saharan Africa because of shortage of data.[2] This paper explores this issue and attempts to overcome this problem by employing techniques that are suitable for

[2] See Bayoumi (1996), Holden (1994) and Stuart (1992).

situations where data is lacking. Furthermore, the time frame being considered offers enough data points to carry out proper research in this area. In addition is the almost exclusive focus of studies on industrialised economies and some-high income, semi-industrialised developing countries, to the virtual exclusion of low-income (particularly, African) countries. It is in such countries where various forms of cross-border arrangements exist and it would be interesting to find out if such conditions are conducive for a wider monetary integration.

Accordingly, this paper explores this topic from the perspective of an existing monetary arrangement – the Rand Monetary Agreement (RMA) formed in 1974.[3] This research work is expected to provide a better understanding of the nature of shocks within this common monetary area (CMA). Furthermore, this process will provide a benchmark about the likely nature of shocks within the SADC region following the introduction of a single currency.[4] Thus, the paper explores the characteristics and the type of responses to these shocks in the RMA. The results thereof are expected to test the validity of the RMA as currency union as well as provide lessons for SADC.

The remainder of the paper is divided into 4 sections: section 2 provides a brief overview of the literature on asymmetric shocks. Section 3 describes the methodology and the data sources utilised. Section 4 reports the empirical findings, and lastly section 5 presents the summary, conclusion and recommendations.

2. LITERATURE REVIEW

2.1 Theoretical Literature.

The scholarly attention on OCA has focused on two traditional approaches. The first approach tries to single out a crucial economic characteristic, which supposedly

[3] The RMA forms a pseudo currency union around the South African Rand. The three countries, which allow parallel circulation of the SA Rand (Lesotho, Swaziland and Namibia), have close connection with South Africa, both in terms of trade and in terms of macroeconomic interrelationships. See Collin, F.d'A et al (1978).

[4] Other important implications of a Monetary Union (MU) can be inferred from this analysis: price stability, convergence of inflation rate and monetary policy co-ordination.

indicates where the lines should be drawn. Early contributions to this approach can be attributed to Mundell (1961), McKinnon (1963) and Kenen (1969).
The second approach evaluates the costs and benefits of participating in a common currency from the point of view of the self-interest of a particular region or country. Recent advances in this area can be attributed to Bayoumi (1994) and Melitz (1995). Melitz (1995) offers a theory of OCA based on maximising the net benefits of a monetary union. Bayoumi (1994) has introduced a more comprehensive and complimentary approach, which incorporates the three criteria of Mundell, McKinnon and Kenen in a general equilibrium model of OCA. The objective of the model is to combine many of the insights from the earlier literature in a well-specified model with a stronger basis in microeconomic theory. Therefore, for the purposes of this study, the second approach will be briefly discussed below.[5] This will be followed by a review of the empirical work along the same lines.

The earlier approaches to the theory of OCA have been described as being overly restrictive **(Ishiyama: 1975:??).** This has led to the development of models that adopted a general equilibrium, benefit – cost approach (Bayoumi, 1994 and Melitz, 1995). The Bayoumi (1995) model shows that the costs of forming a currency union are also a function of the degree of asymmetry in the shocks, and the share of these goods in each country's domestic production. However, given the same structure of the underlying disturbances, a country will prefer to form a currency union with countries whose goods it uses in greater amounts rather than less (Bayoumi: 1995: 551). Therefore, what is critical is whether these countries are subject to different shocks.

Accordingly, the model employs the techniques of the general equilibrium approach where goods in each region are differentiated. The choice of a currency union depends on the size of the underlying disturbances, the correlation between these disturbances, the costs of transactions across countries, factor mobility and interrelationships between demand for different goods (Bayoumi: 1994: 537).

[5] See Ishiyama (1975) for a critical literature survey of the first approach.

Similarly, Melitz (1995) showed that the cost to a country of joining a monetary union and giving up the use of nominal exchange rate in the presence of sticky wages is dependent on the trade weighted covariance of equilibrium real exchange rate with its partners. If the covariance is high, then a change in the nominal exchange rate can be used to alter the real exchange rate and hence the cost of giving up the nominal exchange rate is accordingly high. The model shows that the more asymmetric the shocks experienced by a country wishing to join a currency union, the higher the covariance of that country's relative prices will be with the other countries (Melitz: 1995: 284). Accordingly, the costs and benefits of a monetary union for any country depend on the extent of the union and the degree of openness.

Given this brief theoretical background, the analysis in this paper focuses more on the work done by Bayoumi (1994). In the next section we look at the empirical evidence that followed this approach.

2.2 Empirical Evidence

The main objective of this paper as mentioned before is to investigate the feasibility of the SADC-wide monetary union. The criteria to be followed will be to examine whether CMA countries experience asymmetrical shocks and how they respond to such shcoks.

Investigative work on the theory of OCA can be divided into international and African studies. International studies cover Europe, North and South America and East Asia, while African studies are for research work in Sub-Saharan Africa, i.e., CFA and CMA.

Bayoumi (1992) investigated the effect of the European exchange rate mechanism (ERM) on the macroeconomic performance of its member countries. The procedure applied was to identify aggregate supply and demand shocks and analyse policy response to such disturbances. The aim here was to compare the behaviour of the ERM and non-ERM economies before (1971 to 1979) and after (1982 to 1990) its inception (Bayoumi: 1992:340). Vector auto regressions (VAR) of the change in the logarithm of real output and the GDP deflator, plus constant, were estimated for each country in both periods.

The results showed that ERM has had little effect on the nature of the shocks hitting the economies. However, the response of member countries to these shocks was found to be significant, while making them more elongated and more similar at the same time (Bayoumi: 1992:354).

Following a similar approach Bayoumi and Eichengreen (1994) considered the incidence of supply and demand shocks in Western Europe, East Asia and the Americas. The aim was to identify countries experiencing similar economic disturbances and hence satisfy one of the conditions for forming an OCA. Their findings suggested three regional groupings facing similar underlying disturbances: a Northern European bloc (Austria, Belgium, Denmark, France, Germany, the Netherlands, and possibly Switzerland): a Northeast Asian bloc (Japan, Korea, and Taiwan): and a Southeast Asian bloc (Hong Kong, Indonesia, Malaysia, Singapore, and possibly Thailand) (Bayuomi and Eichengreen: 1994:33).

Given this international body of evidence, we examine the empirical work done on African countries. Most of the research here concentrates on regional groupings like the Communauté financière de l'Afrique (CFA), the Common Monetary Area of Southern Africa (CMA) and Sub-Saharan Africa (SSA). The bulk of these studies examine the economic performance of member countries involved. [6] The findings here have suggested that a closer economic cooperation was feasible in East and West Africa. On the other hand, prospects for economic integration in countries of SSA were found to be minimal. The recent empirical work on the African continent explores the implications of macroeconomic shocks on union members.[7] This area of research is relevant for the work at hand. Accordingly, we review this line of empirical evidence in the next paragraphs.

Bayoumi and Ostri (1996) have examined macroeconomic shocks and trade-flows within SSA. The main objective of their paper was to study the possibilities for closer regional monetary arrangement in this region in the future. The approach followed was to examine the nature of the underlying real output disturbances. The approach followed involved both a preliminary statistical data analysis and a simplified time

[6] See Elbadawi (1996), Devarajan (1988) and Guillamont et al (1987).

series growth model. The data on growth and inflation collected for the study covered the period 1964 to 1993 (Bayoumi, T and Ostri, D: 1996: 418).
The authors have found no similarity of output shocks for both the CFA and SADC regions. These results have been attributed to poor quality of data and different political conditions across countries (Bayoumi, T and Ostri, D: 1996: 430).

In another study, Holden (2003) investigates how the trading relationships, synchronisation of business cycle and the existence of asymmetric shocks in the SADC region are related. The approach was based on the view that countries that trade together are likely to experience similar business cycle fluctuations (Baxter, M. and Kouparistsas, M: 2003:51**)**. A VAR model of output growths of two groups of SADC countries – South African Customs Union (SACU) and rest of SADC members excluding Tanzania and Angola – was estimated (Holden, M: 2003: 20).. The results have shown that SADC countries trade less between themselves some were however trading more with each other than with the rest of the world. However, the analyses of output shocks for SADC were found to be symmetrical (Holden, M: 2003: 25).

Buigut, S and Valev, N (2006) have applied a VAR model to investigate the possibility of forming currency unions in Eastern and Southern Africa. Both real GDP growth and implicit GDP deflator were used to measure changes in output and prices, respectively. The sample period covered was from 1971 to 2002 (Buigut, S and Valev, N: 2006: 8). The demand and supply shocks experienced by these economies have been examined in terms of their similarity and responses to such shocks. The authors found that for most countries the shocks were small and less correlated. However, their findings suggested possibility of expanding the CMA, East Africa Community and other island economies (Buigut, S and Valev, N: 2006: 13).

In general, the literature review has provided mixed results about the nature of shocks. Given the above literature review, the next section provides the methodological approach to be followed.

[7] See Buigut and Valev (2006), and Bayoumi and Ostri (1996)

3. RESEARCH METHODOLOGY

The purpose of this paper is to establish whether CMA can be used as a pure representation of OCA and as such provide a strong basis for future monetary integration within the region. The paper analyses the similarity of shocks within the CMA and responses to such disturbances. The analysis will employ vector auto regression (VAR) approach to determine the nature of shocks hitting CMA countries.[8]

The VAR method provides a new macroeconomic framework of systematically capturing the rich dynamics in multiple time series (Stock, J.H and Watson, M.W.: 101:2001). Much of the contribution in the development of VARs can be attributed to Sims (1980), who argued that the method provides a coherent and credible approach to data description, forecasting, structural inference and policy analysis. The idea is that in macroeconomic systems many variables are likely to be interdependent – rendering exogeneity of variables rare. In this instance, the use of standard ordinary least square estimation or large macroeconomic models may prove to be ineffective due to the difficulty of differentiating between correlation and causation (identification problem) in the system of equations to be estimated (Fedderke, J: 2000:212). However, there has been a lot of debate about the power of VAR in addressing these four macroeconomic tasks. Critics note that, a VAR model is a-theoretic (uses less prior information), may not be suitable for policy analysis because of the emphasis on forecasting and may be extremely challenged by choice of the appropriate lag length (Gujarati: 853:2003). However, such analysis falls outside the focus of this paper and as such would not be discussed. Accordingly, in the next paragraphs, the paper will describe the methodology of VAR as it is applied for the purposes of the present analysis.

A VAR is an *n*-equation, *n*-variable linear model in which each variable is in turn explained by its own lagged values, plus current and past values of the remaining *n*-1 variables (Stock, J.H and Watson, M.W.: 101:2001). All variables in the system are assumed to be endogenous and the number of lags is determined by applying either the Akaike (AIC) or Bayes information criterion (BIC). The model that provides the

[8] The approach is based on the work of Bayoumi (1992).

lowest value for each criterion is normally chosen for the analysis. These criteria are important in avoiding multicollinearity and specification of errors and thus render the error terms ~ *IN* (0, σ^2) (Gujarati, D: 849:2003). Therefore, a general form of a VAR system can be denoted as follows,

$$Z_t = A_1 Z_{t-1} + \ldots. + A_k Z_{t-k} + \mu_t$$

where;

Z_t is an $n \times 1$ vector of dependent variables – n number of equations,

A_k is an $n \times n$ matrix of coefficients for each lag *(k*),

μ_t is an $n \times 1$ vector of error terms in the system.

The system is effectively in reduced form and is usually interpreted using the moving average representation which allows application of shocks to the system and thus, be able to trace out the response of the system to these shocks (William, M: 73: 2000). An examination of impulse response functions usually indicates the impact of such shocks. The impulse response function traces out the reaction of current and future values of each of the variables to a one-unit increase in one of the disturbances. The assumption is that the disturbance would revert to its mean value in the next period(s) and that all other errors are held constant (Stock, J.H and Watson, M.W.: 106:2001).

The VAR approach is superior because other approaches conflate the effects of changes in the nature of shocks affecting an economy and changes in reaction to such shocks (Bayoumi, T: 331:1992).[9] Thus, an application of VAR aims to overcome this shortcoming by making a distinction between the underlying shocks and responses to these shocks. This characterisation allows for the analysis of the symmetry of shocks and policy coordination in response to such shocks (Bayoumi, T: 331:1992). Accordingly, the method of analysis to be followed seeks to identify the nature of shocks hitting these economies, the flexibility or ease of response to such shocks, their policy implications and interaction.

[9] Buigut, S and Valev, N (2006) also note that generalised purchasing power parity model fails to distinguish disturbances from responses.

Ideally, at this point it is important to provide a brief theoretical background on VAR. In the multivariate models the approach is to treat each variable symmetrically. Thus, in the case of a two variable system, the technique would be to let the time path of y_t be affected by the current and past realisations of z_t sequence and let the time path of z_t sequence be affected by current and past values of y_t sequence.[10] Thus, given the following system of equations;

$$y_t = b_{10} - b_{12}y_t + c_{11}y_{t-1} + c_{12}z_{t-1} + \in_{yt} \quad (1)$$

$$z_t = b_{20} - b_{21}y_t + c_{21}y_{t-1} + c_{22}z_{t-1} + \in_{zt} \quad (2)$$

where it is assumed that y_t and z_t are stationary, $\in_{yt}$ and $\in_{zt}$ are white noise residuals with standard deviations of σ_y and σ_z, respectively, and $\in_{yt}$ and $\in_{zt}$ are uncorrelated.

The two equations represent a first-order VAR with the longest lag being equal to unity. The structure of the system blends together a feedback effect because y_t and z_t are allowed to affect each other. Furthermore, the terms $\in_{yt}$ and $\in_{yt}$ are pure innovations (or shocks) in y_t and $z_{t,}$ respectively.

Equation (1) and (2) are not in reduced form because y_t has a simultaneous effect on z_t and z_t has a simultaneous effect on y_t. Transforming the system into a usable format requires employment of matrix algebra. Thus, in compact form the system becomes;

$$Bx_t = \Gamma_0 + \Gamma_1 x_{t-1} + \in_t \quad (3)$$

where;

$$B = \begin{bmatrix} 1 & -b_{12} \\ b_{21} & 1 \end{bmatrix}; \quad xt = \begin{bmatrix} y_t \\ z_t \end{bmatrix} \; ; \; \Gamma_0 = \begin{bmatrix} b_{10} \\ b_{20} \end{bmatrix}$$

$$\Gamma_1 = \begin{bmatrix} c_{11} & c_{12} \\ c_{21} & c_{22} \end{bmatrix}; \quad \text{and } \in t = \begin{bmatrix} \in_{yt} \\ \in_{zt} \end{bmatrix}$$

[10] For the purposes of our analysis, y_t will represents real GDP growth rate and z_t CPI inflation.

Equation (3) represents a VAR in primitive form. By multiplying by B^{1} gives the vector auto regressive (VAR) model in standard form (vector moving-average);

$$x_t = A_0 + A_1 x_{t-1} + \varepsilon_t$$

where;

$$A_0 = B^{1}\Gamma_0; \quad A_1 = B^{1}\Gamma_1; \text{ and } \quad \varepsilon_t = B^{1}\, \epsilon_t$$

For notational purposes, denoting a_{i0} as element i of vector A_0; a_{ij} as the element in row i and column $_j$ of the matrix A_1; and ε_{it} be element i of vector ε_t, (3) can be re-written in the following form;

$$y_t = a_{10} + a_{11} y_{t-1} + a_{12} z_{t-1} + e_{1t} \qquad (4a)$$

$$z_t = a_{20} + a_{21} y_{t-1} + a_{22} z_{t-1} + e_{2t} \qquad (4b)$$

Note that the error terms compose of two shocks, ϵ_{yt} and ϵ_{zt}. Given that $\varepsilon_t = B^{1}\, \epsilon_t$, the error terms are computed as follows;

$$e_{1t} = (\epsilon_{yt} - b_{12}\epsilon_{zt}) / (1 - b_{12}b_{21}) \qquad (5)$$

$$e_{2t} = (\epsilon_{zt} - b_{21}\epsilon_{yt}) / (1 - b_{12}b_{21}) \qquad (6)$$

Because ϵ_{yt} and ϵ_{zt} are white-noise processes, then both e_{1t} and e_{2t} have zero means, constant variances, and are individually serially uncorrelated. In addition, the covariance of the two terms is:

$$E\, e_{1t} e_{2t} = E[(\epsilon_{yt} - b_{12}\epsilon_{zt})(\epsilon_{zt} - b_{21}\epsilon_{yt})] / (1 - b_{12}b_{21})^2 \qquad (7)$$

$$= -(b_{21}\sigma^2_y + b_{12}\sigma^2_z) / (1 - b_{12}b_{21})^2$$

Generally, (7) will not be equal to zero so that the two shocks will be correlated. Given, that all variance and covariance are time-invariant, the variance-covariance matrix can be written as;

$$\Sigma = \begin{bmatrix} \sigma^2_1 & \sigma_{12} \\ \sigma_{21} & \sigma^2_2 \end{bmatrix} \qquad (8)$$

where;

$Var\ (e_{it}) = \sigma^2_i$ and $\sigma_{12} = \sigma_{21} = Cov(e_{1t}, e_{2t})$.

Accordingly, estimation would require applying the OLS procedure to equation (4a) and (4b), respectively with estimates being presumed consistent and asymptotically efficient. However, the results of the OLS estimation only provide estimates less than the number required by the primitive system – equation (1) and (2). This is a problem of identification. The primitive system contains ten parameters and VAR estimation yields only nine parameters. Therefore, it becomes necessary to impose certain restrictions on the primitive system for identification. The process is normally guided by economic theory and the choice of the type of decomposition that best suite the problem at hand.[11]

In the present case the appropriate approach would be the Blanchard and Quah decomposition. Blanchard and Quah (1989) have shown that the restrictions in the VAR can be implemented in the form of long-run restrictions on the effect of the variables, and this allows them to be derived from the long-run behaviour in a well-established theoretical framework. Bayoumi and Eichengreen (1993) have applied this technique to recover structural demand and supply shocks from a bivariate model output ad inflation. Accordingly, the present analysis follows this approach.

The familiar aggregate demand and supply model has been developed to conceptualise the effects of demand and supply shocks on the important macroeconomic variables.[12] Basically, the framework assumes that positive demand shocks will create a short-term rise in output, followed by a gradual return to the initial level, and a permanent rise in prices. On the other hand, supply shocks, would raise output permanently, with positive supply shocks lowering prices (the opposite of positive demand shocks). However, in terms of Southern African countries, some of these assumptions may not hold. For instance, supply shocks might be temporary and lower the level of output. These are basically driven by bad weather conditions –

[11] The most popular being the Choleski Decomposition and recently, the Blanchard and Quah has become the standard procedure in identifying different types of shocks in time series macroeconomic models.

[12] Textbook descriptions of this model include Dornbusch and Fisher (1986, chap.11), and Hall and Taylor (1988, chaps, 4 and 5).

droughts and floods – and external shocks to the terms of trade in the region. Thus, one could expect the negative supply shock to lower output and lead to a permanent rise in prices.[13] Accordingly, the analysis has been modified to explore these expectations.

Therefore, given the above bases of temporary supply shocks, the following restriction would be warranted on (3);

$$\sum b_{12i} = 0; \qquad i = 1,\ldots,\infty. \tag{9}$$

This is only one of the few restrictions required. As shown above estimating (4a) and (4b) yields nine parameters, the residuals from the VAR, e_{it}, can be transformed into demand and supply shocks. Given, that;

$$\varepsilon_t = B^1 \in_t$$

it becomes obvious that four restrictions are necessary in order to exactly define matrix B. Two of these restrictions would be simple normalisation – the variance of the shocks, $\in_{yt}$ and $\in_{zt}$ are set equal to unity. The third restriction comes from assuming that the demand and supply shocks are orthogonal (Bayoumi and Eichengreen, 1992). These three restrictions define matrix G such that;

$$GG' = \sum$$

where $\sum$ is defined as above.

The final restriction is presented by (9) above, which assumes that supply shocks have temporary effect on output. Accordingly, the matrix G will be uniquely defined and hence, the demand and supply shocks can be identified.

The above description leads us to the main discussion on how VAR analysis applies the vector moving-average (VMA) representation in examining the interrelationships

[13] Most of the studies fail to make this distinction and rely on positive supply shocks like technology that may be overshadowed by the conditions mentioned above.

among the variables. In this paper, this is shown by equation (3), where the variables y_t and z_t are expressed in terms of the current and past values of the two shocks $\in_{yt}$ and $\in_{zt}$. For instance, writing (4a) and (4b) in matrix form;

$$\begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} a_{10} \\ a_{20} \end{bmatrix} + \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \begin{bmatrix} y_{t-1} \\ z_{t-1} \end{bmatrix} + \begin{bmatrix} e_{1t} \\ e_{2t} \end{bmatrix}$$

Then, let μ_y and μ_z be the mean values of $\{y_t\}$ and $\{z_t\}$, respectively. Reiterating backwards, a following form is envisaged;

$$\begin{bmatrix} y_t \\ z_t \end{bmatrix} = \begin{bmatrix} u_y \\ u_z \end{bmatrix} + \frac{1}{1-b_{12}b_{21}} \sum_{i=0}^{\infty} \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}^i \begin{bmatrix} 1 & -b_{12} \\ -b_{12} & 1 \end{bmatrix} \begin{bmatrix} \in_{yt} \\ \in_{zt} \end{bmatrix} \qquad (10)$$

Next, the square matrix ϕ_i with elements ϕ_{ij} can be defined such that;

$$\phi_i = \frac{A_1^{\,i}}{1-b_{12}b_{21}} \begin{bmatrix} 1 & -b_{12} \\ -b_{12} & 1 \end{bmatrix}$$

By letting $\mu = [\mu y \; \mu z]'$ the moving-average representation of (10), becomes;

$$x_t = \mu + \sum_{i=0}^{\infty} \phi_i \in_{t-i}$$

This moving-average representation is the principal device important for examining the interaction between the series y_t and z_t. In generating the effects of $\in_{yt}$ and $\in_{zt}$ on the time path of the series y_t and z_t, the coefficients of ϕ_i are used. The four elements of $\phi_{ij}(0)$ are impact multipliers. For example, the coefficient $\phi_{12}(0)$ represents the instantaneous impact of a one-unit change in $\in_{zt}$ on y_t. Accordingly, the elements $\phi_{11}(1)$ and $\phi_{12}(1)$ indicate the one-period responses of unit changes in $\in_{yt-1}$ and $\in_{zt-1}$ on y_t, respectively. Taking one period ahead means that $\phi_{11}(1)$ and $\phi_{12}(1)$ will represent the effects of unit changes in $\in_{yt}$ and $\in_{zt}$ on $y_{t,+1}$.

The four sets of coefficients $\phi_{11}(i)$, $\phi_{12}(i)$, $\phi_{21}(i)$ and $\phi_{22}(i)$ are called the impulse response functions. A plot of the impulse response functions provides a visual representation of the behaviour of the y_t and z_t sequence in response to the various shocks. Furthermore, other different types of interrelationships across the series can be inferred from the values of the impulse response functions. As mentioned above this include, identifying the nature of shocks hitting countries under review, the flexibility or ease of response to such shocks within these countries, their policy implications and interaction. Thus, an examination of the impulse response functions will form an important contribution in the application of VAR analysis. Given, a brief review of VAR, the next paragraph provides a short version of the approach to be followed in this paper.

Given the above discussion, the VAR model used for the analysis is presented as follows,

$$y_t = y_{t-p} + z_{t-p} + \varepsilon_{t1}$$
$$z_t = y_{t-p} + z_{t-p} + \varepsilon_{t2}$$

where the choice of lags(p) will be determined using the AIC and BIC criterion as well as the likelihood ratio tests. The residuals are expected to represent the underlying real output and price disturbances. Thus, examining the correlation of residuals will indicate the nature of the underlying shocks while their standard deviations will determine the size. The correlation of impulse response functions on the other hand will provide the extent of policy co-ordination.

3.1 Data and Estimation issues.

The statistical software to be employed is Regression Analysis for Time Series (RATS), which allows for estimation of large time series models like VAR and generation of impulse response functions. The VAR approach has applied data on CPI inflation and real GDP growth for all countries under analysis. The data covers the period 1970 to 2000. The data sources include IMF's World Economic Outlook various issues, World Bank's World Development Indicators and African Development Bank's selected African countries' statistics.

Before presenting the results it is important to highlight a few measurement issues important for the analyses. The data on most of the variables used for estimation had pronounced structural breaks. In the present analysis the data on GDP growth and CPI has been transformed in other to render it stationary. In fact, this is one of the important requirements in the application of the Blanchard and Quah (1989) methodology in assessing demand and supply shocks. Accordingly, necessary steps have been taken to transform the data appropriately and test for the stationarity of the data series under examination. The data were transformed by taking the log of the first difference of both GDP growth and CPI inflation rate. The standard Dickey Fuller unit root tests were applied to test for stationarity of the data. The transformed series were found to be more significantly stationary. The lag length for each series has been determined by the use of the likelihood ratio (LR) test. The Akaike Information Criterion (AIC) and the Schwarz-Bayes Information Criterion (SBC) were applied to reinforce the LR test results. The majority of the results supported a one lag autoregressive model. Thus, given an outline of the methodological approach of assessing the nature of shocks in the CMA, the next section presents the results of our analysis.

4. EMPIRICAL RESULTS.

As mentioned above the procedure to be followed is based on the Blanchard and Quah decomposition, whereby the estimated vector autoregressive representation of the series is inverted and expressed as a moving average model. This allows for the analysis of the impact of current and past disturbances (demand and supply) on the underlying series. Accordingly, given that the transformed series is stationary, the following two variable VAR models have been estimated for each country for the specified sample period;

$$\Delta y_t = y_{t-p} + z_{t-p} + \varepsilon_{t1}$$

$$\Delta z_t = y_{t-p} + z_{t-p} + \varepsilon_{t2}$$

where, $p = 1$, ε_{t1} and ε_{t2}, are regression residuals representing demand and supply shocks, respectively.

Re-specifying the model as moving average gives the following;

$$\Delta y_t = \varepsilon_{1t-k} + \varepsilon_{2t-k}$$

$$\Delta z_t = \varepsilon_{1t-k} + \varepsilon_{2t-k}$$

where, the underlying restriction is that ε_{2t} is equal to zero.[14] This assumption implies that supply shocks do not have any long run effect on output. These restrictions are different from demand and supply restrictions under the neo-classical theory of equilibrium aggregate demand and aggregate supply. In that model demand shocks are expected to have a temporary effect on output and a permanent effect on prices. Supply shocks on the other hand are considered to have a permanent effect on output and lower prices temporarily (Dornbusch, R and Fisher, S: 1986:339). However, in Sub-Saharan Southern African countries, the types of shocks hitting these economies are quite different. For instance the typical supply shocks in the form of internal political instability, droughts and floods may have a temporary effect on output – a negative impact on production – and raise prices permanently. At the same time, demand shocks in the form of fiscal spending may have a minimal positive effect on output and raise prices at the same time. The subdued impact of demand shocks can be described by the fact that institutional economic structures (i.e., labour, money and goods markets) are not well developed to allow for the transmission mechanisms to function appropriately. We have incorporated these assumptions in the estimation procedure.[15] Accordingly, to identify the supply and demand shocks, the structural autoregressions of the form outlined above were estimated for each CMA country. We ran regression models of the logs of the first difference of GDP and inflation (CPI) on the first lag of both series. The results of the various analyses are presented below.

4.1 Asymmetry of Shocks

The discussion about the effectiveness of a fixed exchange rate regime centres on the symmetry and the increase in the contemporaneous correlation of shocks across countries. This implies that countries within a currency union will be subjected to symmetric shocks and at the same time, there should be an increased interrelationship

[14] Note that the variables Δy_t and Δz_t stands for the log of the first difference stationary series of output (GDP) and the log of the first difference-stationary series of inflation (CPI), respectively.

between members. To assess this behaviour, correlation matrices of demand and supply shocks from the estimated model were calculated and the results are presented in Tables 4.1a and 4.1b below.

Table 4.1a Correlations of contemporaneous Supply Shocks.

	Lesotho	Namibia	South-Africa	Swaziland
Lesotho	1.00			
Namibia	-0.02	1.00		
South Africa	0.38	0.16	1.00	
Swaziland	0.25	-0.54	0.07	1.00

Table 4.1a shows the correlation matrix of supply shocks. The majority of the correlations are positive even though they are very low. An analysis of the significance of the relationships showed the relationship between Lesotho and South Africa's supply shocks was positive and highly significant.[16] On the other hand, the relationship between Swaziland and Namibia was strongly negative, indicating non-similarities of supply shocks between the two countries. In general the relationship between South Africa and all members were positive, while that between the smaller members were negative. This indicates that the degree of similarities in the nature of supply shocks hitting these economies exists but is not very strong.

Table 4.1b Correlations of contemporaneous Demand Shocks.

	Lesotho	Namibia	South-Africa	Swaziland
Lesotho	1.00			
Namibia	0.31	1.00		
South-Africa	0.11	0.51	1.00	
Swaziland	0.07	0.09	-0.02	1.00

[15] See the methodology section above.
[16] STATA was used to calculate the various levels of significance were computed. These are based on the measure of association between two variables. In this case the significant level is 1 percent.

Table 4.1b presents the correlation matrix of demand shocks. The majority of demand shocks in the CMA are positive, with the exception of Swaziland-South Africa relationship, which is negative. Two-thirds of the correlations are significant at 10 percent and 1 percent, respectively. That is, the Lesotho-Namibia and South Africa-Namibia combinations were found to be strongly positive when compared to the group. These results indicate that there is similarity of demand shocks between the three members of CMA, namely, Lesotho, Namibia and South Africa. The relationship between Swaziland and the other smaller members is not strongly positive and less significant. The Swaziland-South Africa relationship was found to be less significant as well.

In general, the analyses suggest that the CMA has not let to the similarity in nature shocks for the entire group. In fact, the CMA has fostered similarity of shocks for three member countries, namely, South Africa, Lesotho and Namibia. Geographical proximity could be responsible for these results and political ties. However, the results put some doubt on the importance of CMA in making the shocks more similar.

4.2 The Size of the Shocks.

The size of the underlying shocks is important for proper functioning of monetary policy in any exchange rate regime. Larger disturbances may be disruptive and as such undermine the credibility of policy instruments being applied. On the other hand, the less disruptive disturbances lower the response of the economy, thus leading to the permanent fixation of the exchange rate and loss of monetary autonomy. The size of the disturbances has been calculated by using the standard deviation of the residuals from the estimated equations. These results are presented in table 4.2a below.

The table shows that the CMA countries have experienced smaller demand shocks. South Africa experienced the lowest demand shock in the entire group while Swaziland has the largest. This result implies these countries experience different sized demand shocks.

Table 4.2a. The Size of the Underlying Disturbances.

Country	Demand Shocks	Supply Shocks
Lesotho	0.30	10.4
Namibia	0.25	4.69
South Africa	0.17	2.81
Swaziland	0.59	5.66
Average	0.33	5.89
Difference CMA[1]	0.42	7.49

Notes 1. The difference is calculated by subtracting the highest from the lowest value in each group.

On the supply side, relatively a similar picture can be found. The size of supply shocks for South Africa is the lowest within the group. Lesotho showed the largest supply disturbances followed by Swaziland. Again, the results show that the sizes of supply shocks differ across member countries.

The overall results show that supply shocks are higher than demand shocks on average and in terms of the difference between the highest and lowest shocks. Furthermore, the South Africa experiences smaller shocks within the group followed by Namibia. Accordingly, the analysis reveals that the arrangement has not managed to reduce the size of the shocks hitting these economies.

4.3 The Analysis of Policy Co-ordination.

As mentioned above, a fixed exchange rate regime or a monetary union has the effect of making the responses to shocks for participating economies to become more similar. The impulse response functions are usually applied to assess the respond of output and inflation to supply and demand shocks.[17] To examine the coordination aspect of responses, we compute correlation matrices of impulse response functions of output and inflation with respect to the shocks. The tables below present the results of this analysis.

[17] For reasons of brevity we do not present the result of impulse functions analysis here.

Table 4.3a Impulse Response Functions of Output.

	Supply Shock Responses			
	Lesotho	Namibia	South-Africa	Swaziland
Lesotho	1.00			
Namibia	0.85	1.00		
South-Africa	0.69	0.93	1.00	
Swaziland	0.91	0.99	0.89	1.00

Table 4.3a shows the response of output to supply shocks. This shows high levels correlation, which imply policy co-ordination across the CMA countries.

Table 4.3b Impulse Response Functions of Output.

	Demand Shock Response			
	Lesotho	Namibia	South-Africa	Swaziland
Lesotho	1.00			
Namibia	-0.91	1.00		
South-Africa	-0.47	0.67	1.00	
Swaziland	0.90	-0.99	-0.72	1.00

Table 4.3b shows the response of output to demand shocks. The majority of correlation coefficients are negative. This finding is in contrast to expectations, given the manner in which monetary policy is contacted in this region. Furthermore, the smaller members, Lesotho and Namibia are negatively correlated with the anchor - South Africa. The overall picture is that policy responses to demand shocks on output in the CMA are not similar.

Table 4.3c Impulse Response Function for Inflation.

	Supply Shock Responses			
	Lesotho	Namibia	South-Africa	Swaziland
Lesotho	1.00			
Namibia	0.95	1.00		
South-Africa	0.47	0.53	1.00	
Swaziland	0.26	0.19	-0.71	1.00

Table 4.3c shows the response of inflation to supply shocks. The results show a positive relationship between South Africa and the rest of the group. The only difference is with Swaziland where the correlation coefficient is lower and negative. In general, the results suggest a lower level of policy co-ordination in response to supply shocks.

Table 4.3d Impulse Response Function for Inflation.

	Demand Shock Responses			
	Lesotho	Namibia	South-Africa	Swaziland
Lesotho	1.00			
Namibia	0.99	1.00		
South-Africa	0.99	0.99	1.00	
Swaziland	-0.89	-0.89	-0.92	1.00

The responses of inflation to demand shocks reported in table 4.3d are highly correlated. Given all the other impulse responses, this one provides good indications about the extent of policy co-ordination. The interrelationship between Lesotho, Namibia and South Africa are highly correlated. The difference is with Swaziland, which is negatively correlated with the rest of the group. Both these results are quite interesting. In the first instance high correlation between CMA members imply that there is strong case for policy co-ordination. Second the reversed relationship from Swaziland provides a strong evidence of monetary policy autonomy exercised by this country.[18]

5. SUMMARY AND CONCLUSIONS.

The main objectives of this study were to explore the ability of CMA to make the shocks hitting these economies to become more symmetric and at the same time bring about co-ordinated policy responses. Answers to these key areas of concern would provide an indication about the CMA's role as a monetary union, the possibility of its expansion and spur policy debates.

[18] The rand no longer circulates as currency in Swaziland.

Accordingly, the results on the asymmetry of shocks have shown similarity of shocks for Lesotho, Namibia and South Africa (LNS).[19] However, a further analysis has established that the size of shocks in the CMA differs. The smaller members of the group experience large shocks when compared to the anchor – South Africa. The findings also suggest that policy coordination only exists for LNS group.

The conclusion is that, the CMA does not operate as a full monetary union but arrangement has managed group together countries that experience similar shocks, of small size and hence make policy co-ordination possible. Hence, the effect of this was to reduce the impact of these shocks and foster stability for members.
For future research one should also focus on establishing the reasons for Swaziland's has fallen out from the analysis.

[19] One might want to name this group, the CMA trio!

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