A Greek wedding in SADC? - Testing for structural symmetry towards SADC monetary integration

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A Greek wedding in SADC? - Testing for structural symmetry towards SADC monetary integration

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Abstract

This paper investigates structural symmetry among SADC countries in order to establish, judged by modern OCA theory, which of these countries may possibly make for a good monetary matrimony and which countries may be left out in the cold. SADC remains adamant that it would conclude monetary union by 2018. It can ill afford a repeat of the type of financial and fiscal instability brought about by ex ante structural economic differences and asynchronous business cycles in the EU. This study contributes to the literature on macro-economic convergence in the SADC region. We make use of the Triples test to analyse each country's business cycles for symmetry and then evaluate SADC countries' ratio of relative intensity of co-movements in business cycles with co-SADC country and versus that of major trade partners. We find that not all countries in SADC conform to OCA criteria judged by both asymmetrical business cycles and weak co-movements in business cycles.

JEL Classification: E32, F15, F33

Keywords: Triples test, optimal currency area, SADC, structural symmetry

1 INTRODUCTION

African Union (AU) member states want to establish regional monetary integration with the belief that it would further overall integration and bring about

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a large number of economic benefits to the continent. In spite of many attempts to integrate African economies on a regional basis, overlapping membership of various Regional Economic Communities (RECs) and a lack of investment in the institutions and systems required for integration, are seen as the main reasons why the economies of most African countries remain detached from each other (ECA, 2010; Jovanovich, 2006). Even though the East African Community (EAC) has lost some momentum with integration, it is now targeting monetary union and ultimately a Federation (Buigut and Valev, 2006). The pace of integration among the Central African Economic and Monetary Community (CEMAC), the Economic Community of West African States (ECOWAS), and the Common Market for Eastern and Southern Africa (COMESA) has been very slow and complicated (World Bank, 2000; ECA, 2004). In the southern part of the continent, the Southern African Development Community (SADC[1]) is moving towards the creation of a monetary union by 2018 (Belle, 2010). The economic integration in southern African countries is one of the oldest economic integration initiatives in the world and could be traced back to the Southern African Customs Union (SACU) which was created in 1910 between South Africa and its neighbours.

The launch of the European Monetary Union (EMU) in the early 2000s has sparked renewed interest in the creation and expansion of monetary unions across the world (Alesina et al., 2002; Masson and Pattillo, 2005, and Jefferis, 2007). Nevertheless, to pursue meaningful and effective monetary union in different parts of Africa, it is important to learn from already established monetary unions in the world. The United States enjoys a much higher degree of economic integration when compared to Europe. However, it took the United States at least one hundred and fifty years and several financial crises to become a monetary union (Rockoff, 2000). Currently the viability of the European monetary system is questioned as a result of the crisis that started in Greece and culminated into a crisis of the whole Euro zone. Portugal, Italy, Ireland, Greece and Spain (together known as the PIIGS) are now depending on their rescue from the strong EU economies. As we show in our literature review, the PIIGS, and particularly Greece, did not comply with OCA theory prior to accession when measured against the criteria of business cycle synchronisation. Could the crisis have been avoided had the PIIGS complied with proper Optimal Currency Area (OCA) criteria prior to accession to the EMU?

The focus in this paper is on investigating the similarity of business cycles of SADC countries. This is firstly done by evaluating each country's real GDP (measure of business cycle) for symmetry. Secondly, SADC countries are then paired with each other, with non-SADC African countries and with major external trade partners and the co-movement in business cycles as a result of real shocks evaluated. For this very reason, this study is undertaken – to ascertain which countries in SADC could join in monetary matrimony without running the risk of destabilising the union, as was the case with the PIIGS.

[1] The fifteen countries forming SADC are Angola, Botswana, Democratic Republic of Congo, Lesotho, Malawi, Madagascar, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe.

The rest of this paper is organised as follows. Section 2 is the literature review. Section 3 reviews the theoretical models and data that guide us in our empirical investigation. Section 4 presents the results followed by conclusions in the last section.

2 LITERATURE REVIEW

2.1 Co-movement and Optimum Currency Area (OCA) theory

The theory of optimal currency areas, from the classic contributions by Mundell, 1961; McKinnon, 1963; Kenen, 1969; and Ingram, 1973 to its modern applications and revisions stresses that asymmetric, country specific shocks represent a key element in the choice of an exchange rate regime or of adopting a common currency. There are two broad approaches to modern OCA theory: the *traditional* and *endogenous approaches* (Tavlas, 2009). The traditional approach assumes that a country's characteristics are invariant to the adoption of a common currency while the endogenous approach assumes that a monetary union alters the economic structure of members. It is postulated that business cycle movements would become more similar over time for countries that join a monetary union. The argument for an endogenous optimal currency area emphasises that the monetary union itself could act as a catalyst for business cycle synchronisation, essentially by reducing foreign exchange transaction costs and therefore by promoting trade integration across countries (Corsetti and Pesenti, 2002).

However, there are counter arguments to the above. Eichengreen (1992) and Krugman (1993) stress that monetary integration could lead to greater specialisation in production, thus lowering output correlation and making regions more vulnerable to local shocks. Evidence presented by Frankel and Rose (1998) however, supports the view that trade links raise income correlations. The conclusion is that the OCA criterion may be satisfied ex-post even if it fails ex-ante (Corsetti and Pesenti, 2002).

Traditional OCA theory however, states that the requirements for suitable monetary unions are the symmetry of shocks, the mobility of factors, the diversification of factors of production, the similarity of inflation rates, the flexibility of wages and prices and the capacity of risk sharing (Tapsoba, 2009). As clearly stated by De Haan (2008), if business cycles in countries forming a monetary union diverge considerably the common monetary policy will not be optimal for all countries concerned. This is because countries in the downward phase of the cycle might prefer a more expansionary monetary policy while countries in the upward phase of the cycle might prefer a more restrictive policy stance. This study attempts to evaluate the feasibility of SADC monetary integration in line with modern OCA theory focusing on business cycle symmetry and comovement *ex ante*.

2.2 Structural Symmetry and SADC Monetary Integration

Economic heterogeneity across regions and countries is, in many ways, a vital sign of growing and healthy economies. However, OCA literature has for long emphasised that some elements of economic heterogeneity increase the likelihood of a-synchronous business cycle fluctuations at a regional level. Such fluctuations, according to Corssetti (2008), work against achieving the common goals of a currency area. This is evident from the experience of the EMU. Using an HP filter Boone and Maurel (1998) calculate correlation coefficients between the cyclical components of industrial production and unemployment rates for selected Central and Eastern European Countries (CEECs) against Germany and the EU. These authors find a relatively high degree of business cycle correlation for the CEECs with Germany, indeed higher than for Portugal or Greece. Because of technologically inferior production systems and a lower competitive position in the region, EMU countries such as Greece, have shown lack of cyclical convergence with the Euro area (Gouveia and Correia, 2008) and little sign of convergence (Crowley and Lee, 2005) (all discussed in Tsiapa and Panteladis, 2011). Using a Bayesian dynamic factor model, Lehwald (2012) examines the co-movements of output, investment and consumption among Euro area countries before (1991-1998) and after (2000-2010) monetary union and finds that the co-movements of the main macroeconomic variables increase for core European countries from the first to the second period, while it decreases for most PIIGS economies. Böwer and Guillemineau (2006) also found that the correlation of Greece's main macroeconomic variables with the rest of the Euro members reduced after accession to the EMU. Within the SADC context, integrated development of the region as a whole is a priority. Despite large differences in the levels of economic activity and the peculiar structural features of the fifteen member countries, there is hope that all could potentially benefit significantly from regional monetary integration and economic co-operation (Khamfula and Mengsteab, 2004). However, Khamfula and Huizinga (2004) posit that the very diverse economic structures among these countries pose a very serious obstacle to regional monetary integration in SADC.

There are many questions that require answers before adopting monetary union in SADC (Jovanovic, 2006). Modern OCA theory emphasises, among other things, the importance of having symmetrical business cycles. This is certainly helpful if there is one common currency, hence one common exchange rate and one common monetary policy with which to stabilise the economies of the union in the face of external shocks. Specifically, asymmetric real shocks weaken the case for a common currency, as member states of a monetary union lose their ability to use domestic exchange- and interest rate policies for stabilisation purposes. General inferences of studies undertaken so far explicitly state that a common currency and single monetary policy may not be appropriate to all SADC countries. Some authors, however, obtained results supportive of a monetary union comprising a relatively small group of countries, usually including South Africa, sometimes with other Common Monetary Area (CMA) countries.[2] Such findings should not be surprising for the same reason that similar results had been obtained for Euro-area countries prior to the formation of European monetary union. Tavlas (2009, p.24), in his summary of many studies carried out from late 1990s to 2007 concluded that the results are mixed and countries in the region with a higher share of trade with South Africa exhibit relatively higher co-movements in output growth.

In their review of the costs and benefits for South Africa of joining a SADC monetary union, Khamfula and Mengsteab (2004) state that it is unlikely that economic integration can flourish in the southern African region. They also caution that integration among countries with divergent levels of economic growth might run into serious problems. Instead they recommend adopting a common monetary area (CMA) such as that exists among South Africa, Namibia, Swaziland and Lesotho as a pace setter to the formation of a fully-fledged monetary union in the SADC region.

Bayoumi and Ostry (1997) in their study of 11 SADC countries found that bilateral correlations among SADC countries tend to be positive but small and insignificant, while the few positive and significant shocks do not involve continuous states. In contrast, Karras (2007) calculated correlations for 9 SADC countries against the SADC as a whole, and suggest monetary union of Malawi, Mozambique, South Africa, Zambia, and Zimbabwe. Similarly, Buigut and Valev (2006), using the Blanchard-Quah[3] decomposition technique suggest a monetary union of the CMA countries including Mozambique and Zambia. Using the same technique aided by cluster analysis to group several variables, Buigut (2006) also obtained support for a monetary union, under the assumption that the rand was the anchor currency, for a small group of countries. His optimum cluster analysis supported monetary union comprising Botswana, Namibia, Seychelles, South Africa, and Swaziland. Grandes (2003), Khanfula and Huizinga (2004) provide support for monetary union among the same five countries. Results obtained by Masson and Pattillo (2005) and Wang et al. (2006) are less supportive of monetary union among SADC countries.

Following the *endogenous* approach to OCA theory, Frankel and Rose (1998) state that an economy that fails to satisfy OCA criteria prior to entry into a monetary union can satisfy the criteria after joining the union. Studies following the endogenous OCA approach were conducted in relation to SADC by Guillaume and Stasavage (2000), Carrere (2004), Masson and Pattillo (2005), and Masson (2006). Guillaume and Stasavage in their study covering the period 1968-93 for 5 core SADC countries analyse the credibility of a regional central bank by comparing measures of checks and balances in political systems including the degree of party fractionalisation and levels of constraints at the executive branch. They found mixed results. Low-party fractionalisation and low levels of constraint on executive branches indicated a low cost of breaking rules, which is unfavourable

[2] CMA were South Africa, Lesotho, Swaziland, and Namibia (Grandes, 2003; Masson and Patillo, 2005; and Wang et al., 2006).

[3] The application of the Blanchard-Quah methodology to assess the suitability of countries for monetary union was first made by Bayoumi and Eichengreen (1993). For the limitations of this technique see Tavlas (2009, p.18)

for monetary union. Ease of exit and non-compliance from regional agreements has rarely been favourable for monetary union. Carrere (2004) in his analysis of trade creation uses a sample covering the period 1995-98 for 14 SADC countries using a gravity model. He uses bilateral nominal exchange-rate volatility as a proxy for the common-currency effect and obtained inconclusive results. Masson and Pattillo (2005) used a gravity model to assess trade-creation effects for 13 SADC countries and recommend a gradual and selective path to monetary union in the region. Later, Masson (2006) in his independent study for 15 SADC countries for the sample period covering 1995-2000 extended Masson and Pattillo's[4] calibration model to include endogenous trade-creation effects. His study shows that under symmetric monetary union conditions, the costs of union exceeded the benefits for four CMA countries. Most other countries were net gainers.

Nowhere in the literature could evidence be found that member countries' business cycles consistently move closer together over time after having become part of a monetary union. Empirical evidence in support of endogenous OCA theory is thus weak. In fact, empirical evidence suggests that the business cycles of Greece, for example, tended to diverge more from other EMU members after accession. For this reason, a sober policy option in the presence of asymmetric business cycles and weak co-movement of business cycles would be not to accede to membership of a monetary union. For this reason we support a policy of compliance to these OCA criteria prior to accession.

The literature surveyed in the preceding paragraphs contains mixed evidence insofar as the symmetry and co-movement of various macro variables of SADC member countries are concerned. In the sections that follow, we introduce and apply methodologies that were found to provide robust results in the study of time-series cycles. These methodologies are however novice to the study of business cycles in SADC, hence two new contributions are made to the study of monetary integration and specifically the analysis of business cycle symmetry and co-movement in SADC: updated data and new techniques.

3 METHODOLOGY

3.1 Data

In this paper we use annual real GDP data measured in 2005 constant US dollar prices for all fifteen SADC countries as well as of Africa's fifteen major trade partners for the years 1970 – 2010. Real GDP is preferred in this study because it is the most comprehensive measure of economic activity and it is generally available for African countries on annual basis (Tapsoba, 2009; Mendonça, et al, 2011). Data were obtained from the World Bank's *World Development Indicators,* UN *statistics,* and the IMF's *International Financial Statistics.*

[4] It is simulation based analysis of costs and benefits of a monetary union among SADC countries.

Table 1 presents descriptive statistics of SADC countries. Considering average GDP over 40 years, South Africa is, by far, the country with highest real GDP in the region. However, South Africa has the largest fluctuations in real GDP measured by highest standard deviation over the sample period. The rest of the member states have a comparable size of real GDP while Lesotho, Madagascar, and Swaziland have the lowest real GDP.

3.2 Methodology for Evaluating Business Cycle Asymmetry and Synchronisation

3.2.1 The Triples Test

In this study we use a nonparametric method called the Triples test - first developed by Randles et al. (1980)[5] and later introduced to the economics literature by Verbugge (1997) and Razzak (2001), respectively. The reason to adopt the Triples test is its accessibility and superior results[6]. The Triples test method is more efficient than many other methods used in the literature to detect symmetry. The other good reason is that it is asymptotically distribution free, which means that the outliers and changes in the variance of the distribution of the time series cannot affect the test.

To perform the Triples test, we face the immediate problem of decomposing the series into trend and cyclical components. To carry out the Triples test, the series needs to be decomposed and de-trended to leave only the cyclical component of the series. We use the Baxter and King (1999) filter (B-K filter) to do this. The B-K filter was developed as a method to isolate business cycle components by applying moving averages to the macroeconomic data. The band pass filter designed by Baxter and King (1999) passes through the components of the time series with fluctuations between 6 (18 month) and 32 (96 month) quarters, removing higher and lower frequencies.

We then apply the Triples test to evaluate the symmetry of the classical cycles. Intuitively, the Triples test counts all possible triples from a sample of size N(i.e., $\begin{matrix} N \\ 3 \end{matrix}$) combinations) of a univariate time series. When most of the triples are right-skewed, the time series said to be asymmetric. If $i, j,$ *and* k aree three distinct integers such that $1 \leq i, j, k, \leq N$, the triple of observations x_i, x_j, x_k forms a right triple or skewed to the right if the middle observation is closer to the smallest observation than it is to the largest observation. This is illustrated by:

Right triple	x x x
Left triple	x x x

[5] Randles et al. (1980) noted that an article by Davis and Quade (1978) appeared after their article was submitted and contains the essential ideas of the triple test.

[6] Randles et al. (1980), shows Monte Carlo results for power comparisons. Eubank et al. (1992) suggests that the test is the test of choice against unimodel alternatives to symmetry found in Granger and Anderson (1978).

Formally, let $x_i, ..., x_N$ denote a random sample drawn from $F(x-\theta)$ where $F(.)$ is a cumulative distribution function for a continuous population with $F(0) = \frac{1}{2}$ and θ is the median of the χ population.

Let

$$f^*(x_i, x_j, x_k) = [(sign\,(x_i + x_j - 2x_k) + sign\,(x_i + x_k - 2x_j) + sign(x_j + x_k - 2x_i)]^3, \quad (1)$$

where $sign(u) = -1, 0$,or 1 as u $<, =,$ or > 0. Then we say x_i, x_j, x_k forms a right triple if $f^*(x_i, x_j, x_k) = \frac{1}{3}$. Note that $f^*(x_i, x_j, x_k)$ can only assume the values $-\frac{1}{3}, 0, \frac{1}{3}$.

We define *a left triple* (looks skewed to the left) as any (x_i, x_j, x_k) for which $f^*(x_i, x_j, x_k) = -\frac{1}{3}$ (again see the figure above). Finally, when $f^*(x_i, x_j, x_k) = 0$, the triple is neither right nor left skewed. This last event, however, has probability zero when sampling from a continuous population. The proposed test statistics is then the *U statistics* given by:

$$\eta^\wedge = \binom{N}{3}^{-1} \sum_{i<j<k} f^*(x_i, x_j, x_k) \quad (2)$$

So that...

$$\hat{\eta} = \frac{[(number \text{ of right triples}) - (number \text{ of left triples}]}{\left[3\binom{N}{3}\right]} \quad (3)$$

It follows from Hoeffding (1948) that this is a U statistics estimate

$$E(\hat{\eta}) = \eta = \Pr\{X_1 + X_2 - 2X_3 > 0\} - \Pr\{X_1 + X_2 - 2X_3 < 0\}, \quad (4)$$

with

$$var(\hat{\eta}) = \left(\begin{array}{c} N \\ 3 \end{array}\right)^{-1} \sum_{c=1}^{3} \left(\begin{array}{c} 3 \\ c \end{array}\right) \left(\begin{array}{cc} N & -3 \\ 3 & -c \end{array}\right) \zeta_c \quad (5)$$

where

$$\zeta_c = var\lfloor f_c^*(x_1, ..., x_c) \rfloor \quad (6)$$

and

$$f_c^*(x_1, ..., x_c) = E[f^*(x_1, ..., x_c, X_{c+1}, ...X_3) \quad (7)$$

Letting $\sigma A^2 = 9\zeta_1$ and since $0^2 A + 0(1)$, Randles et al.(1980) use the Slutsky Theorem to show that $N^{1/2} = (\eta - \eta)/\sigma_A$ also has a standard normal limiting distribution.

We now discuss the appropriate hypotheses to be tested. First note that if the underlying distribution is symmetric, $X_1 + X_2 - 2X_3$ has the same distribution as $-X_1 - X_2 + 2X_3$ and therefore, $\eta = 0$. Hence we can use $\hat{\eta}$ as a statistic for testing

$$H_0 : \hat{\eta} = 0 \text{ versus } H_1 : \hat{\eta} \neq 0 \quad (8)$$

This is a two-sided test, but could possibly be a one-sided test. This test is used to test the hypothesis that the distribution is symmetric around the unknown median θ against a broad class of asymmetric alternatives. The Triples test interpretation goes with hypothesis testing in equation (8). If we have significant evidence to reject the null hypothesis it means asymmetry. If we fail to reject the null hypothesis the opposite holds true.

The simple nature of $f^*(.)$ makes $\zeta_1\zeta_2, and\ \zeta_3$ expressible in terms of probabilities, and thus it is possible to use U statistics to estimate these quantities consistently as follows:

$$\zeta_1 = var[f_1^*(x_1)\}, with\ f_1^*(x_1) = E[f_1^*(.)] \tag{9}$$

$$\zeta_1 = N^{-1}\sum_{i=1}^{N}(f_1^*(x_i) - \eta)^2 \tag{10}$$

where

$$f_c^*(x_1) = \begin{pmatrix} N-1 \\ 2 \end{pmatrix} \sum_{\substack{j<k \\ j\neq i\neq k}} \sum f_1^*(x_i, x_j, x_k) \tag{11}$$

Similarly,

$$\zeta_2 = \frac{1}{N_2}\sum_{j<k}\sum f_2^*(x_i, x_k) - \hat{\eta})^2 \tag{12}$$

Where

$$f_2^*(x_i, x_k) = \frac{1}{N-2}\sum_{\substack{j<k \\ j\neq i\neq k \\ i\neq k}} f^*(x_i, x_j, x_k), \tag{13}$$

And,

$$\zeta_3 = \frac{1}{9} - \hat{\eta}^2 \tag{14}$$

Replacing each with ζ_i and $\hat{\zeta_i}$ in the expressions σ_N and σ_A gives the estimators $\hat{\sigma_N}$ and $\hat{\sigma_A}$. Both estimators are consistent because each $\hat{\zeta_i}$ is written as a linear combination of U statistics. To test the hypothesis in (8), the Triples test is defined based on $T_1 = n^{1/2}\hat{\eta}/\hat{\sigma_N}$ and an associated test based on $T_2 = n^{1/2}\hat{\eta}/\hat{\sigma_A}$ so that they *reject* H_0 as $|T| > Z_{(\alpha/2)}$ as the upper percentile of the standard normal distribution. Note that these tests are asymptotically distribution free provided only that the underlying distribution is not degenerate. Although we have illustrated how to construct an asymptotically distribution-free test of (8), we should keep in mind that the parameter η is defined in terms of the distribution of the triple X_1, X_2 and X_3 rather than the original F distribution. Results from Triple test are reported in Tables 1and 2, and in the other tables reported in the annexure.

3.2.2 Correlation of cyclical and structural components – bilateral co-movement

The next step in our analysis is to evaluate the bilateral co-movement of cycles by first considering pairs of SADC countries and pairs of SADC versus main trading partner countries. Following Croux et al. (2001) on the definitions of dynamic and static correlations in the particular case of a bivariate analysis and the notion of cohesion introduced by Tripier (2002), we can have the following notation specifying the coherency of the real GDPs of every pair of countries in our data sample.

Let's denote $r_{xy}(w)$, as the first co-movement index. It is defined by

$$r_{xy}(\omega) = \frac{S_{xy}(\omega)}{\sqrt{S_x(\omega)S_y(\omega)}} \tag{15}$$

where $S_{xy}(\omega)$ is the cross spectrum between real GDPs of pair of countries, $S_{xy}(\omega)$ and $S_y(\omega)$ are spectrum of every pair of countries in our analysis. This index in equation (1) measures the correlation between the complex representations of X_t at Y_t frequency ω. Unfortunately, since the cross spectrum has an imaginary part this index is not real (Tripier, 2002). To obtain a more convenient measure of co-movement, the squared coherency $r^2_{XY}(\omega)$ is then generally preferred in the literature. It is defined by:

$$r^2_{XY}(\omega) = \frac{|S_{xy}(\omega)|^2}{S_x(\omega)S_y(\omega)} \tag{16}$$

To obtain results from equation (15) we apply a simple regression to each pair of countries and extract the R^2 of the regression as a measure of the strength of the connection between the cyclical components of real GDP between the pair of countries in the region and among major trade partners. As rule of thumb, R^2 values higher than 0.5 exhibit moderate to strong co-movements while values below 0.5 shows a weak connection among the country pair. The results from this process are reported in Table 4.

Lastly, using the coefficient of determination computed in equation (16), we compute SADC countries' ratio of relative intensity of co-movements (RICM) versus each other and that of major trade partners as follows:

$$RICM = \frac{\sum SADC\ R^2}{\sum nonSADC\ R^2} = \frac{\sum\limits_{y=SADC} r^2_{XY}}{\sum\limits_{y=nonSADC} r^2_{XY}} \tag{17}$$

The results from the above computation are reported in Table 5.

4 RESULTS

In the first part of this section results from the Triples test and graphical illustration of the co-movements in log real GDP are presented. The second part presents evidence from bilateral co-movements using the coefficient of determination as a measure of cyclical co-movements and we discuss the index of relative intensity of co-movement as a measure of relative strength of co-movement between pairs of member states and pairs of member states and their trade partners.

4.1 Triples Test Results

The Triples test statistics for symmetry for SADC countries are shown in Tables 2 and 3. As shown in both Tables symmetry in the first-difference dominates in SADC region. Figure 1 also supports the same line of argument showing that the real GDP of many of the SADC countries exhibits symmetry and possible co-movement. The null hypothesis is rejected only in the case of Malawi, Mozambique, South Africa, Swaziland and the Democratic Republic of Congo (DRC). The resulting tests are consistent because in the majority of the cases 'h' is statistically different from zero (Randles et al., 1980). This implies that the null hypothesis stated in equation (9) is not rejected in the majority of the cases and the test asserts that the log of the first difference of real GDP data in this analysis is symmetrical. As shown in Table 2 below, when the p-value is greater than 0.05, we fail to reach significance; therefore the null hypothesis is not rejected in the majority of cases.

Madagascar, Malawi, Mozambique, South Africa, Tanzania, Zambia and DRC show negative coefficients of symmetry (η) as shown in table below. In other words, half of SADC member states including five of the most important economies in the region have negative symmetrical business cycles. Negative symmetry implies that the time series falls rapidly, but rises very slowly. This indicates that for the most important SADC members, economic recovery happens far slower than the preceding downswing. It also indicates that expansionary policy measures may be inadequate or that policy harmonisation and bilateral/multilateral co-operation among the member states are weak. However, the rest of the SADC countries exhibit positive symmetry. The majority of the industrialised trade partners to the region also exhibit negative symmetry (the results are not reported here). Positive symmetry implies that GDP undergoes rapid increases over a short period of time and slow, gradual decreases over long periods of time.

The finding in this section of this study asserts that ten out of fifteen SADC countries exhibit symmetry in the distribution of real log GDP data (business cycles) for the full period (1970-2010). As reported in Table 3, when dividing the time series into subsequent window periods of decades, the symmetry further strengthens and the number of countries with symmetrical business cycles increases.

Results in column 2 of Table 3 above are taken from Table 2, while the results in column 3, 4, and 5 are taken from Tables 10, 11 and 12 respectively as reported in the annexure. This result suggests that the majority of SADC countries are good candidates to form the envisaged monetary union in the region, had symmetrical business cycles been the only OCA criteria to be fulfilled. However, having symmetrical business cycles does not necessarily mean that the cycles move together. Having a single currency and monetary policy require that business cycles move closely together. In the next section we explore this issue.

4.2 Results From Bilateral Co-Movements Tests

The intensity of co-movements in real GDP across SADC countries is measured by the coefficient of determination. The value of the coefficient of determination lies between zero and one; when its value is higher than the average value of 0.5 it implies that there is a higher degree of co-movement between countries under study. In other words, a value higher than 0.5 indicate that member countries' business cycle exhibit synchronisation. The coefficients of determination reported in Table 4 are obtained by using equation (16) in the methodology section. Unlike the correlation coefficients, coefficients of determination are additive. The regional mean of the determination coefficients is 0.04 with a standard deviation of 0.06. There seems to be a general lack of co-movement in log real GDP for SADC countries. Seychelles, Namibia, Madagascar, Mauritius, Malawi, and Botswana have average coefficients of determination below the regional mean; the rest of the SADC countries have average coefficients of determination above the regional mean. However, this value does not confirm that those countries can form any sensible monetary union in near future. This result is in line with the findings by Carmignani (2010) for CEMAC countries. In his study of CEMAC countries the corrected concordance index is barely above zero, which shows a lack of concordance of the cyclical phases across CEMAC countries (Carmignani, 2010).

The results reported in Table 5 are computed by using equation (17) in the methodology section by taking the R^2 values from Table 4. Results in the column 2 of Table 5 are computed by the summation of the R^2 of SADC country 'i' with the rest of the countries included in the sample minus one (i.e. equals to one when country 'i' regressed with its own real GDP), after regressing the log GDP of country 'i' with each with that of the other countries in the sample individually. The values in column three are computed in the same way as those in column two, except that values in column three are computed using the summation of the R^2 of SADC country 'i' with the rest of non-SADC countries minus one.

Column 4 reports the relative intensity of SADC country 'i' with the rest of SADC member countries by dividing entries in column three by respective entries in column two (see equation 17). By dividing the sum of R^2 the of all SADC-to-SADC country regressions by the sum of all SADC-to-nonSADC countries, gives the relative intensity of co-movement. A value of one means that the strength of the co-movement of a SADC country relative to the rest of SADC countries is just as strong as the strength of the co-movement of a SADC country relative to all non-SADC countries. If the value in column 4 is > 1, it means that the SADC country's business cycles co-move more closely with other SADC countries. Conversely, if the value in column 4 < 1, the SADC country's business cycles co-moves more closely with non-SADC countries (Non-SADC trade partners) compared to SADC countries.

As suggested by Carmignani (2010), countries must strengthen policy harmonisation and political connectivity in order to activate the channels through which business cycles can become more synchronised and hence maximize the benefits from the envisaged monetary integration in the region. This fact is evident from the result shown in Table 5 below that compare the relative intensity indexes of co-movement in the business cycles of pairs of *SADC-SADC* versus *SADC-Trade Partner* countries. Among SADC countries; Mozambique, Zimbabwe, Zambia, Seychelles, Swaziland, Tanzania, Mauritius, and DRC show a relatively strong intensity in the co-movement of real GDP compared to the rest of SADC members (see the last column of Table 5). Note that the values in bold in Table 5 show countries with strong relative intensity of co-movement with SADC members. However, nearly half of the member states have more significant co-movement with their major trade partner countries than with member states.

5 CONCLUSIONS AND POLICY IMPLICATIONS

The overall results confirm that some SADC member countries are potentially capable of forming a monetary union in the region based on OCA theory. Ten out of fifteen SADC countries exhibit symmetry in the distribution of their business cycles (real log GDP data) for the period (1970-2010). When dividing the time-series into decades, it is shown that symmetry strengthens among member countries. When we consider evidence from bilateral co-movements using the coefficients of determination; the result shows a general lack of co-movements in the business cycles of SADC countries. Mozambique, Zimbabwe, Zambia, Seychelles, Tanzania, Mauritius, and DRC, however, have relatively strong intensities in the co-movement of their business cycles when compared with the rest of SADC members. These findings confirm that there is not sufficient macroeconomic convergence among all member states for the entry into the monetary union.

This implies that a common monetary policy will not be optimal for all countries in the region, especially in the short run. These findings are in line with that of Carmignani (2009, P.39) in his study for CEMAC countries and other studies reviewed in this paper.

Many studies explicitly show that among the EMU countries, Greece and the rest of the PIIGS displayed patterns in the level of economic activity that are considerably different to developments in the other economies in the region. We argue that the crisis in the Euro zone could have been avoided if the PIIGS had complied with the traditional OCA criteria prior to accession to the EMU.

Lessons that SADC could learn from experiences elsewhere is to strengthen policy harmonisation and coordination for business cycles to become more synchronised as a precondition to monetary union. Without doing so, SADC countries face the same risk as the PIGGS, having to contend with a fixed exchange rate and monetary policy with which to defend their own economies against adverse external shocks.

Recommended future research in the SADC region that would supplement the findings of this study includes testing the Generalised Purchasing Power Parity (G-PPP) hypothesis. It is also important to investigate the economic, political, and institutional prerequisites for SADC countries to gain an understanding of the factors that would determine the speed of integration in the region.

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Table 1:Descriptive Statistics of Real GDP of SADC (1970-2010)

Country	Country Code	N	Minimum	Maximum	Mean	Std. Deviation
Angola	AGO	40	1.1928E9	5.3656E9	1.971519E9	1.1347071E9
Lesotho	LSO	40	2.5756E8	1.6380E9	8.596244E8	3.9748264E8
Botswana	BWA	40	1.1928E10	5.3656E10	1.971519E10	1.1347071E10
Madagascar	MDG	40	2.5756E8	1.6380E9	8.596244E8	3.9748264E8
Malawi	MWI	40	3.7876E8	1.1845E10	4.878896E9	3.7484315E9
Mauritius	MUS	40	3.1931E9	6.0226E9	3.937153E9	8.2769429E8
Mozambique	MOZ	40	8.3329E8	3.9799E9	1.996265E9	7.3295242E8
Namibia	NAM	40	1.0561E9	8.1212E9	3.762245E9	2.1153807E9
Seychelles	SYC	40	1.6794E9	9.3240E9	3.574007E9	2.1467677E9
South Africa	ZAF	40	1.0562E11	2.8844E11	1.786916E11	5.0376219E10
Swaziland	SWZ	40	2.0511E8	1.2124E9	6.443806E8	2.8978468E8
Tanzania	TZA	40	3.6645E9	1.9682E10	8.278777E9	4.3294791E9
Zambia	ZMB	40	4.2368E9	9.8903E9	5.705324E9	1.3328577E9
Zimbabwe	ZWE	40	3.6482E9	8.7530E9	6.168796E9	1.4522248E9
Demo. Rep. of Congo	DRC	40	5.6939E9	1.1564E10	8.739692E9	1.7228744E9

Table 2: SADC Countries log difference Triples Test Statistics for Symmetry (1970-2010)

Country code	η	*Ksi1*(ζ_1)	*Ksi2*(ζ_2)	*Ksi3*(ζ_3)	*U-stat*	*P-value (α=0.05)*
Angola	0.0285	0.0045	0.0230	0.1103	0.8328	0.1977
Lesotho	0.0209	0.0070	0.0266	0.1107	0.5013	0.2912
Botswana	0.0330	0.0054	0.0200	0.1100	0.9087	0.1711
Madagascar	-0.0473	0.0045	0.0188	0.1089	-1.406	0.0749
Malawi	**-0.0405**	0.0047	0.0199	0.1095	-1.175	**0.0401**
Mauritius	0.0146	0.0077	0.0238	0.1109	0.3407	0.3632
Mozambique	**-0.0595**	0.0045	0.0187	0.1076	-1.772	**0.0314**
Namibia	0.0344	0.0037	0.0158	0.1099	1.1213	0.1251
Seychelles	0.0025	0.0040	0.0131	0.1111	0.0800	0.4801
South Africa	**-0.0518**	0.0017	0.0129	0.1084	-2.334	**0.0094**
Swaziland	**0.0972**	0.0061	0.0228	0.1017	2.5073	**0.0054**
Tanzania	-0.0389	0.0037	0.0163	0.1096	-1.271	0.0885
Zambia	-0.0422	0.0060	0.0158	0.1093	-1.131	0.1251
Zimbabwe	0.0055	0.0028	0.0127	0.1111	-0.203	0.4013
Demo.Rep.of Congo	**-0.0556**	0.0026	0.0132	0.1080	-2.129	**0.0154**

Source: computed from sample data

Note: The trend is estimated using the B-K filter. Number of observation is 40.[1] *The figures in bold show significant p-values at 5 percent level of significance and hence the null hypotheses in equation 9 in methodology section is rejected which implies asymmetry in the series***.**

[1] A GAUSS code to compute the statistic is available from the authors.

Table: 3 Summary results of Triples test for SADC countries for the full period (1970-2010) and subsequent window periods

SADC country	**Full Period**	**'70s-'80**	**'80s-'90**	**'90s-2000s**
Angola	Symmetric	Symmetric	Symmetric	Symmetric
Lesotho	Symmetric	Symmetric	Symmetric	Symmetric
Botswana	Symmetric	**Asymmetric**	Symmetric	Symmetric
Madagascar	Symmetric	Symmetric	Symmetric	Symmetric
Malawi	**Asymmetric**	Symmetric	Symmetric	Symmetric
Mauritius	Symmetric	Symmetric	Symmetric	Symmetric
Mozambique	Symmetric	**Asymmetric**	Symmetric	Symmetric
Namibia	Symmetric	Symmetric	Symmetric	Symmetric
Seychelles	Symmetric	Symmetric	Symmetric	Symmetric
South Africa	**Asymmetric**	Symmetric	Symmetric	Symmetric
Swaziland	**Asymmetric**	Symmetric	Symmetric	Symmetric
Tanzania	Symmetric	Symmetric	**Asymmetric**	Symmetric
Zambia	Symmetric	Symmetric	Symmetric	**Asymmetric**
Zimbabwe	Symmetric	Symmetric	Symmetric	Symmetric
Demo.Rep.of Congo	**Asymmetric**	Symmetric	Symmetric	Symmetric

Source: computed from sample data

Table 4: Coefficients of determination as a measure of cyclical co-movements

Row name	AGO	LSO	BWA	MDG	MWI	MRT	SYC	MOZ	NAM	ZAF	SWZ	TZA	ZMB	ZWE	DRC
Angola	1														
Lesotho	0.002	1													
Botswana	0.048	0.001	1												
Madagascar	0.000	0.000	0.001	1											
Malawi	0.058	0.002	0.005	0.040	1										
Mauritius	0.010	0.082	0.001	0.046	0.007	1									
Seychelles	0.005	0.214	0.002	0.028	0.001	0.028	1								
Mozambique	0.038	0.024	0.019	0.005	0.008	0.059	0.031	1							
Namibia	0.044	0.059	0.034	0.000	0.004	0.045	0.004	0.003	1						
South Africa	0.228	0.019	0.030	0.024	0.001	0.111	0.055	0.218	0.037	1					
Swaziland	0.021	0.101	0.036	0.039	0.005	0.119	0.016	0.049	0.104	0.135	1				
Tanzania	0.029	0.052	0.023	0.000	0.110	0.021	0.000	0.117	0.078	0.028	0.025	1			
Zambia	0.001	0.003	0.012	0.002	0.064	0.032	0.023	0.146	0.000	0.122	0.047	0.116	1		
Zimbabwe	0.073	0.049	0.007	0.008	0.033	0.008	0.063	0.261	0.008	0.110	0.024	0.011	0.063	1	
DRC	0.266	0.001	0.037	0.000	0.001	0.002	0.020	0.058	0.046	0.189	0.009	0.002	0.004	0.071	1

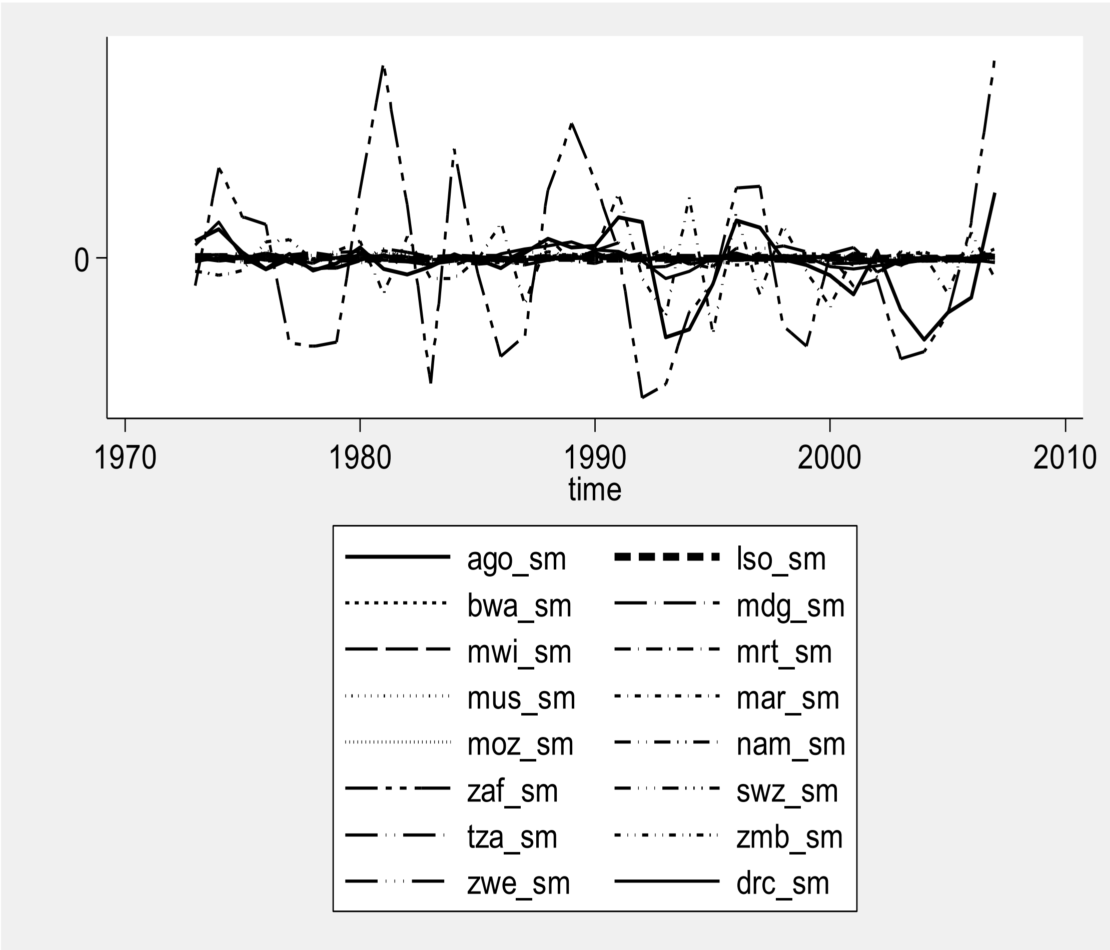
Source: computed from sample data

Table 5: Comparison of SADC countries' ratio of relative intensity of co-movements (RICM) and that of major trade partners

Row name	Total all	SADC all	SADC relative intensity
Angola	2.922757	0.820042	0.389992
Lesotho	1.326669	0.534191	0.674077
Botswana	1.881879	0.254965	0.156717
Madagascar	1.498395	0.148454	0.109971
Malawi	0.712644	0.332029	0.872347
Mauritius	0.58334	0.381326	**1.887621**
Mozambique	1.33429	1.101481	**4.731282**
Namibia	1.194135	0.433222	0.569344
Seychelles	0.857648	0.466165	**1.190766**
South Africa	3.50578	1.197229	0.518606
Swaziland	0.978067	0.611418	**1.667587**
Tanzania	1.068255	0.630444	**1.43999**
Zambia	0.901105	0.608246	**2.076927**
Zimbabwe	1.319048	0.965	**2.725618**
Demo. Rep. of Congo	1.410106	0.706682	**1.00463**

Source: computed from sample data

Figure 1: Cyclical movements of SADC countries' real GDP



Source: plotted from sample data

ANNEXURE

Table 6:Triples Test Statistics for trend level difference Symmetry (1970-2010) for SADC Countries

SADC Country	η	ζ_1	ζ_2	ζ_3	Variance	U-stat
Angola	0.0285	0.0045	0.0230	0.1103	0.0012	0.8328
Lesotho	0.0209	0.0070	0.0266	0.1107	0.0017	0.5013
Botswana	0.0330	0.0054	0.0200	0.1100	0.0013	0.9087
Madagascar	-0.0473	0.0045	0.0188	0.1089	0.0011	-1.4068
Malawi	-0.0405	0.0047	0.0199	0.1095	0.0012	-1.1745
Mauritius	0.0146	0.0077	0.0238	0.1109	0.0018	0.3407
Mozambique	-0.0595	0.0045	0.0187	0.1076	0.0011	-1.7719
Namibia	0.0344	0.0037	0.0158	0.1099	0.0009	1.1213
Seychelles	0.0025	0.0040	0.0131	0.1111	0.0010	0.0800
South Africa	-0.0518	0.0017	0.0129	0.1084	0.0005	-2.3343
Swaziland	0.0972	0.0061	0.0228	0.1017	0.0015	2.5073
Tanzania	-0.0389	0.0037	0.0163	0.1096	0.0009	-1.2712
Zambia	-0.0422	0.0060	0.0158	0.1093	0.0014	-1.1312
Zimbabwe	0.0055	0.0028	0.0127	0.1111	0.0007	-0.2034
DRC	-0.0556	0.0026	0.0132	0.1080	0.0007	-2.1293

Source: computed from sample data

Triple Test Results by window periods

a) Result from Level difference

Table 7: SADC Countries Triple Test Statistics for level difference Symmetry (1970-1980)

SADC Country	η	ζ_1	ζ_2	ζ_3	Variance	U-stat
Angola	-0.0444	0.0022	0.0163	0.1091	0.0016	-1.1007
Lesotho	0.1064	0.0017	0.0158	0.0998	0.0014	2.8433
Botswana	-0.0509	0.0053	0.0229	0.1085	0.0030	-0.9278
Madagascar	-0.0386	0.0077	0.0263	0.1096	0.0040	-0.6079
Malawi	0.0006	0.0049	0.0213	0.1111	0.0028	-0.0110
Mauritius	-0.0187	0.0028	0.0210	0.1108	0.0021	-0.4133
Mozambique	-0.1175	0.0038	0.0170	0.0973	0.0022	-2.5104
Namibia	0.0035	0.0036	0.0143	0.1111	0.0020	0.0780
Seychelles	0.0041	0.0016	0.0179	0.1111	0.0015	0.1065
South Africa	0.0006	0.0037	0.0193	0.1111	0.0023	0.0122
Swaziland	0.0094	0.0030	0.0141	0.1110	0.0018	0.2209
Tanzania	0.0713	0.0049	0.0169	0.1060	0.0026	1.3962
Zambia	-0.0544	0.0021	0.0146	0.1082	0.0015	-1.4128
Zimbabwe	0.0649	0.0015	0.0124	0.1069	0.0012	1.8747
DRC	0.0058	0.0056	0.0196	0.1111	0.0030	0.1068

Source: computed from sample data

Table 8: SADC Countries Triple Test Statistics for level difference Symmetry (1980-1990)

SADC Country	η	ζ_1	ζ_2	ζ_3	Variance	U-stat
Angola	-0.0152	0.0110	0.0321	0.1109	0.0055	-0.2055
Lesotho	0.0094	0.0038	0.0183	0.1110	0.0023	0.1955
Botswana	-0.0942	0.0051	0.0200	0.1022	0.0028	-1.7706
Madagascar	-0.0637	0.0038	0.0242	0.1070	0.0025	-1.2645
Malawi	0.0228	0.0068	0.0234	0.1106	0.0036	0.3813
Mauritius	-0.0480	0.0033	0.0193	0.1088	0.0022	-1.0323
Mozambique	0.0673	0.0032	0.0161	0.1066	0.0019	1.5235
Namibia	0.0140	0.0047	0.0147	0.1109	0.0024	0.2836
Seychelles	0.0216	0.0038	0.0143	0.1106	0.0021	0.4708
South Africa	-0.0199	0.0037	0.0131	0.1107	0.0020	-0.4445
Swaziland	0.0585	0.0026	0.0142	0.1077	0.0016	1.4406
Tanzania	-0.1082	0.0034	0.0185	0.0994	0.0021	-2.3386
Zambia	0.0146	0.0065	0.0208	0.1109	0.0034	0.2518
Zimbabwe	-0.0333	0.0035	0.0166	0.1100	0.0021	-0.7305
DRC	-0.0585	0.0025	0.0133	0.1077	0.0016	-1.4750

Source: computed from sample data

Table 9: SADC Countries Triple Test Statistics for level difference Symmetry (1990-00s)

SADC Country	η	ζ_1	ζ_2	ζ_3	Variance	U-stat
Angola	-0.0246	0.0072	0.0218	0.1105	0.0036	-0.4070
Lesotho	-0.0287	0.0065	0.0202	0.1103	0.0033	-0.4972
Botswana	-0.1000	0.0045	0.0187	0.1011	0.0025	-1.9854
Madagascar	-0.0789	0.0037	0.0173	0.1049	0.0022	-1.6872
Malawi	-0.0263	0.0053	0.0201	0.1104	0.0029	-0.4908
Mauritius	-0.0392	0.0067	0.0247	0.1096	0.0036	-0.6546
Mozambique	0.0257	0.0052	0.0207	0.1104	0.0029	0.4784
Namibia	0.0409	0.0048	0.0156	0.1094	0.0025	0.8157
Seychelles	0.0292	0.0061	0.0170	0.1103	0.0031	0.5293
South Africa	-0.0713	0.0012	0.0175	0.1060	0.0013	-1.9609
Swaziland	-0.0789	0.0025	0.0137	0.1049	0.0016	-1.9742
Tanzania	-0.0298	0.0081	0.0205	0.1102	0.0039	-0.4778
Zambia	-0.1556	0.0014	0.0124	0.0869	0.0011	-4.6068
Zimbabwe	0.0556	0.0025	0.0137	0.1080	0.0016	1.3864
DRC	-0.0585	0.0053	0.0160	0.1077	0.0027	-1.1270

Source: computed from sample data

b) Results from log difference

Table 10: SADC Countries Triple Test Statistics for log difference Symmetry (1970-1980)

SADC Country	η	ζ_1	ζ_2	ζ_3	Variance	U-stat
Angola	-0.0444	0.0022	0.0163	0.1091	0.0016	-1.1007
Lesotho	0.1064	0.0017	0.0158	0.0998	0.0014	2.8433
Botswana	**-0.0509**	0.0053	0.0229	0.1085	0.0030	-0.9278
Madagascar	-0.0386	0.0077	0.0263	0.1096	0.0040	-0.6079
Malawi	0.0006	0.0049	0.0213	0.1111	0.0028	-0.0110
Mauritius	-0.0187	0.0028	0.0210	0.1108	0.0021	-0.4133
Mozambique	**-0.1175**	0.0038	0.0170	0.0973	0.0022	-2.5104
Namibia	0.0035	0.0036	0.0143	0.1111	0.0020	0.0780
Seychelles	0.0041	0.0016	0.0179	0.1111	0.0015	0.1065
South Africa	0.0006	0.0037	0.0193	0.1111	0.0023	0.0122
Swaziland	0.0094	0.0030	0.0141	0.1110	0.0018	0.2209
Tanzania	0.0713	0.0049	0.0169	0.1060	0.0026	1.3962
Zambia	-0.0544	0.0021	0.0146	0.1082	0.0015	-1.4128
Zimbabwe	0.0649	0.0015	0.0124	0.1069	0.0012	1.8747
DRC	0.0058	0.0056	0.0196	0.1111	0.0030	0.1068

Source: computed from sample data

Note: The trend is estimated using the B-K filter. Number of observation is 40. The figures in bold show significant p-values at 5 percent level of significance and hence the null hypotheses in equation 9 in methodology section is rejected which implies asymmetry in the series

Table 11: SADC Countries Triple Test Statistics for log difference symmetry (1980-1990)

SADC Country	η	ζ_1	ζ_2	ζ_3	Variance	U-stat
Angola	-0.0152	0.0110	0.0321	0.1109	0.0055	-0.2055
Lesotho	0.0094	0.0038	0.0183	0.1110	0.0023	0.1955
Botswana	-0.0942	0.0051	0.0200	0.1022	0.0028	-1.7706
Madagascar	-0.0637	0.0038	0.0242	0.1070	0.0025	-1.2645
Malawi	0.0228	0.0068	0.0234	0.1106	0.0036	0.3813
Mauritius	-0.0480	0.0033	0.0193	0.1088	0.0022	-1.0323
Mozambique	0.0673	0.0032	0.0161	0.1066	0.0019	1.5235
Namibia	0.0140	0.0047	0.0147	0.1109	0.0024	0.2836
Seychelles	0.0216	0.0038	0.0143	0.1106	0.0021	0.4708
South Africa	-0.0199	0.0037	0.0131	0.1107	0.0020	-0.4445
Swaziland	0.0585	0.0026	0.0142	0.1077	0.0016	1.4406
Tanzania	**-0.1082**	0.0034	0.0185	0.0994	0.0021	-2.3386
Zambia	0.0146	0.0065	0.0208	0.1109	0.0034	0.2518
Zimbabwe	-0.0333	0.0035	0.0166	0.1100	0.0021	-0.7305
DRC	-0.0585	0.0025	0.0133	0.1077	0.0016	-1.4750

Source: computed from sample data

Note: The trend is estimated using the B-K filter. Number of observation is 40. The figures in bold show significant p-values at 5 percent level of significance and hence the null hypotheses in equation 9 in methodology section is rejected which implies asymmetry in the series

Table 12: SADC Countries Triple Test Statistics for log difference symmetry (1990-00s)

SADC Country	η	ζ_1	ζ_2	ζ_3	Variance	U-stat
Angola	-0.0246	0.0072	0.0218	0.1105	0.0036	-0.4070
Lesotho	-0.0287	0.0065	0.0202	0.1103	0.0033	-0.4972
Botswana	-0.1000	0.0045	0.0187	0.1011	0.0025	-1.9854
Madagascar	-0.0789	0.0037	0.0173	0.1049	0.0022	-1.6872
Malawi	-0.0263	0.0053	0.0201	0.1104	0.0029	-0.4908
Mauritius	-0.0392	0.0067	0.0247	0.1096	0.0036	-0.6546
Mozambique	0.0257	0.0052	0.0207	0.1104	0.0029	0.4784
Namibia	0.0409	0.0048	0.0156	0.1094	0.0025	0.8157
Congo	0.0292	0.0061	0.0170	0.1103	0.0031	0.5293
South Africa	-0.0713	0.0012	0.0175	0.1060	0.0013	-1.9609
Swaziland	-0.0789	0.0025	0.0137	0.1049	0.0016	-1.9742
Tanzania	-0.0298	0.0081	0.0205	0.1102	0.0039	-0.4778
Zambia	**-0.1556**	0.0014	0.0124	0.0869	0.0011	-4.6068
Zimbabwe	0.0556	0.0025	0.0137	0.1080	0.0016	1.3864
DRC	-0.0585	0.0053	0.0160	0.1077	0.0027	-1.1270

Source: computed from sample data

Note: The trend is estimated using the B-K filter. Number of observation is 40. The figures in bold show significant p-values at 5 percent level of significance and hence the null hypotheses in equation 9 in methodology section is rejected which implies asymmetry in the series

Table 13: List of Africa's major trade partners in the sample

OECD-Europe	OECD-other	Non-OECD
Belgium France Germany Italy Netherlands Portugal United Kingdom	Canada Japan Korea Turkey United States	Brazil China and Hong-Kong India Russian Federation

Source: OECD Fact book 2011: Economic, Environmental and Social Statistics - ISBN 978-92-64-11150-9 - © OECD 2011