# Optimal Currency Areas

## Theory and Evidence for an African Single Currency

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## ABSTRACT

Monetary integration, to varying degrees has become an increasingly important phenomenon within the modern global economic era. Africa has been planning economic, political and monetary union since 1963, partly as a means towards social integration. This study focuses on the economic elements of monetary union, placing it firmly within the context of the theory of optimal currency areas and with special reference to Africa. An assessment of theoretical and applied empirical literature is discussed. This encompasses a discussion of traditional optimal currency area theory as initiated by Mundell (1961) and McKinnon (1963) as well as further developments in the so called 'Modern' theory. It is found that there is a wide range of methodological tools with which to apply the theory though it was seen that most of these were understandably with regards to the European Union.

This literature review, along with data and time limitations informed the empirical methodology applied in this study. The empirical gaps, suggested by the literature were two fold: firstly the assignment of countries to a streamlined arrangement of regional economic communities and secondly an assessment of the possible trade benefits that a single currency can offer. These were addressed by an adaptation of Bayoumi and Eichengreen's (1997, 1997a) OCA index and followed by a Gravity model analysis of intra African trade. From this an assignment of regional economic communities was found based along predicted bilateral exchange rates and that those countries that had entered into regional currency unions within Africa had significantly higher bilateral trade. Two major points were concluded: that assignment of regional economic communities should occur sooner rather than later to prevent duplication of effort and contradictory policies; and that whilst complete monetary integration may not be feasible or beneficial, movement towards integration will certainly entail extra benefits.

## TABLES

# 1 Introduction

Interest in monetary integration, by academics and policy makers alike, has been increasing over recent years, fuelled by the European monetary integration and the subsequent acceptance of the importance of a strong global currency. To this end, several regions have been assessing the possibility of entering into a monetary union. Africa in fact has had monetary integration within its policy agenda for some time, far outdating the recent creation of the Euro. The Organisation of Africa Unity (the predecessor to the African Union) had monetary and economic integration as one of its objectives on its creation in 1963.

This paper seeks to assess this objective, with particular reference to the branch of economic theory that has become known as Optimal Currency Area (OCA). I proceed first with a brief historical background of monetary and economic arrangements in Africa in the post independence period. Section 2 is an extensive literature review separated between purely theoretical developments and empirical methodologies to operationalise OCA theory. This literature review has, along with data and time limitations, informed the empirical element of this paper seen in the 3rd section. The empirical investigation seeks to answers two policy questions of interest, namely: What is the ideal arrangement of regional currency blocs to form before reaching complete monetary integration? What is the trade effect of currency union membership on intra-African trade?

These questions are answered by using a perversion of Bayoumi and Eichengreen's (1997, 1997a) OCA Index methodology and a gravity model analysis of intra-African trade respectively. Using the OCA index I was able to arrange regional groupings based on convergence of prominent OCA criteria. The gravity model analysis, using a variety of panel data techniques found that membership in a currency union increases bilateral trade.

I shall conclude in Section 4 by highlighting the conclusions that have been made in my theoretical and empirical assessment, as well as outline any research gaps that have become evident and any policy advice that can be gained from this study.

### 1.1 Historical Background

Africa has a long colonial history, with almost all countries being a colony at some point in their past[1]. After the movement towards independence, generally taking place in the mid 20th century, the countries and their colonisers faced independence with mixed approaches and with mixed results. In particular Masson and Patillo (2005) indicate three generalised approaches that occurred in the post independence period: the experience of Francophone countries which generally remained linked to the French Franc, the experience of the colonies of other European countries and the experience of the Southern African economies which were generally drawn towards South Africa. These differing approaches remain evident today, with the CFA Franc Zone (now linked to the Euro) and the CMA Rand Area the only two single currency areas in Africa, with the other countries (generally colonies of Britain, Portugal, Spain and Belgium) using their own national currency. As well as these historical groupings, there has been renewed interest in regional co-operation, resulting in multiple regional economic communities (REC) that are generally based upon geographical as well as historical circumstance.

This interest in regional co-operation and integration has moved as far as continent wide commitment towards a single African currency. This is to be achieved through the progressive integration of countries within the RECs and then the integration of these RECs towards a unified economic and monetary system. The stages towards this integration were outlined in

[1] Ethiopia is the only country in Africa not to have been a colony, a fact that marks it out from most other developing nations.

the Abuja Treaty which was ratified in May 1994 when South Africa became the 53rd African state to sign the agreement.

BOX 1: STAGES TOWARDS AFRICAN ECONOMIC UNION

1. Strengthening of existing RECs and establishment of RECs where necessary (not to take more than five years).
2. Stabilisation of tariff and non-tariff barriers, customs duties and internal taxes within each REC and the strengthening of sectoral integration, particularly in the areas of trade, agriculture, finance, transport and communications, industry and energy. Harmonisation of the activities of the RECs (not to take more than eight years).
3. Establishment of free trade and customs union areas at the level of RECs with the associated harmonisation of tariff and non-tariff barriers (expected to take ten years).
4. Co-ordination and harmonisation of tariff and non-tariff systems among RECs with the movement towards a continental customs union (to take two years).
5. Establishment of an African common market and the adoption of common policies (to take four years) including the free movement of peoples.
6. Integration of economic, political, social and cultural sectors towards a single African market and a Pan-African economic and monetary union. The setting up of a single African Central Bank, single Pan-African Currency and the election of the Pan-African Parliament (to take no more than five years).

Source: South African Department of Foreign Affairs,
http://www.dfa.gov.za/foreign/Multilateral/africa/treaties/aec.htm

Originally intended to culminate by 2023 and 2028, the Sirte Declaration, as well as establishing the African Union (AU) as an amalgam of the African Economic Community (AEC) and the Organisation of African Unity (OAU), reduced the timescales associated with the convergence process. In particular the declaration was concerned with the rapid establishment of African financial institutions. Tito Mboweni, the South African Central Bank

Governor indicated in a series of lectures in 2004 that 2021 is the preferred target for complete African monetary integration.

BOX 2: REGIONAL ECONOMIC COMMUNITIES AND CURRENCY UNION MEMBERSHIP

| | |
|---|---|
| **AMU** | **COMESA** |
| Algeria, Libya, Mauritania, Morocco, Tunisia | Angola*, Burundi*, Comoros, Democratic Republic of Congo*, Djibouti, Egypt, Eritrea, |
| **SADC** | Ethiopia, Kenya, Madagascar, Malawi*, |
| Angola*, Botswana, Democratic Republic of Congo*, *Lesotho*, Malawi*, Mauritius*, Mozambique, *Namibia**, Seychelles*, *South Africa*, *Swaziland**, | Mauritius*, *Namibia**, Rwanda*, Seychelles*, Sudan, *Swaziland**, Uganda, Zambia*, Zimbabwe* |
| Tanzania, Zambia*, Zimbabwe* | **ECCAS** |
| | Burundi*, **Cameroon**, **Central African** |
| **ECOWAS** | **Republic**, **Chad**, Democratic Republic of |
| **Benin**, **Burkino Faso**, Cape Verde, **Cote d'Ivoire**, the Gambia, Ghana, Guinea, **Guinea-Bissau**, Liberia, **Mali**, **Niger**, | Congo*, **Republic of Congo**, **Equatorial Guinea**, **Gabon**, Rwanda*, Sao Tome and Principe |
| Nigeria, **Senegal**, Sierra Leone, **Togo** | |

**Bold** and *Italics* indicate membership in CFA and CMA Zones respectively
* indicate membership in more than one REC

Part of the problem facing the integration of RECs is the inclusion of some countries in more than one community (Angola, Botswana, Burundi, Democratic Republic of Congo, Malawi, Mauritius, Namibia, Seychelles, Swaziland, Rwanda, Zambia and Zimbabwe are all members of more than one REC). Different communities, at this stage at least, have created different timetables for the harmonisation of trade policies and dissolution of tariff and non-tariff barriers so that membership in multiple communities will complicate and confuse the

harmonisation process. It would be preferable, earlier rather than later, to streamline the system of RECs to ensure there is no duplication of effort in terms of conflicting country membership.

# 2 Literature Review

## 2.1 Objectives

When considering the proposal of a Single African currency, embodied in the commitment by the African Union (AU), it is necessary to evaluate the existing literature for relevant theoretical and empirical implications. The objective of this literature review is therefore twofold: Firstly, from a theoretical point of view, to provide a notion of the necessary and sufficient criteria for the creation and success of a single (African) currency. Secondly, to be able to assess these criteria with specific reference to African countries (or a sub-set thereof), an evaluation of previously employed empirical methodologies is necessary to determine the nature of the investigation employed for this study.

Much of the theoretical literature is presented and developed from the seminal work of Mundell (1961) and relates to the generalised concept of an "Optimal Currency Area" (OCA). Mundell's (1961) work was further supplemented by important offerings from McKinnon (1963) and Kenen (1969). This body of work laid the theoretical foundations for many of the new developments and empirical work that began to emerge some 10 or 15 years later. This emergence of empirical applications was partly due to increasing mathematical sophistication on the part of scholars, and perhaps more importantly to the increasing political movements of the European Community towards a proposed single European currency. Subsequently much of the empirical literature reviewed here will be regarding the creation of a single European Currency rather than an African currency. This will not adversely affect the study however, since evaluation of the empirical literature is undertaken to assess and define appropriate empirical methodologies for the current study rather than gain any insight into the success or otherwise of a possible (now real) European Currency area. When concluding this review of

the empirical literature I will also comment on the few studies that have been made concerning regional and continental monetary integration in Africa.

Having made the distinction between theoretical criteria and empirical methodology, it follows that the literature review should also take on these distinctions. The theoretical beginnings and framework of OCA analysis will be reviewed initially and the development of a so-called "new" theory of optimal currency areas will logically follow. These theoretical evaluations will then be enhanced by an assessment of the various methodologies that have been employed to operationalise the theory. The empirical section will conclude with a brief overview of studies that I have found relating directly to African monetary union. From this I will be able to define those criteria that are relevant in an analysis of optimal currency areas and use these criteria, along with an appropriate methodology, to test the costs and benefits of the proposed African single currency.

## 2.2 Theoretical Beginnings of Optimal Currency Area Theory

It is widely regarded that a theoretical discussion of Optimal Currency Areas (OCA) begins with the seminal work by Mundell (1961) and I shall not break with tradition here. Mundell began by asking the pertinent question "What is the appropriate domain of a currency area?" (Mundell 1961: 657) and recent history has proven his belief that this is not a purely academic question. By way of hypothetical examples, Mundell explains how changes in consumption patterns under sticky price assumptions can have different economic outcomes dependant on the location and nature of the changes and the monetary and exchange rate policy pursued.

If the changes in consumption patterns coincide with national and currency boundaries, for example an increase in demand for Country A goods compared with Country B goods, then a system of flexible exchange rates relating the two independent currencies maintains the

external balance of both countries, relieving inflation pressure in Country A and reducing unemployment in Country B.

However, if the changes in consumption patterns do not coincide with national and currency boundaries then a flexible exchange rate is able to maintain external balance but is ineffective in alleviating the related problems of inflation and unemployment. Mundell uses the US and Canada as an example. If the West of these countries is characterised by the production of lumber products and the East is characterised by car manufacturing, then a shift in demand towards cars results in deficit in the West and a surplus in the East. The Eastern region will suffer inflation, the Western region unemployment. Monetary policy in both countries can be directed towards relieving inflation in the East at the expense of higher unemployment in the West or vice-versa, or the inflation-unemployment burden can be shared between the regions.

The main outcome of this example is to demonstrate that the optimal currency areas in this case are the regions of East and West. With currencies arranged along these lines, exchange rate flexibility will allow external and internal balance between the two regions. It also serves to demonstrate that factor mobility (primarily labour mobility) can maintain internal balance in the presence of regional demand changes. This occurs through the movement of factors of production away from the deficit region as workers migrate to the surplus region – simultaneously relieving unemployment and wage-inflation respectively.

Mundell's arguments give rise to several key conclusions: Firstly, the presence of asymmetric demand movements within a currency area (that is a currency area composed of multiple regions) creates the inverse problems of inflation and unemployment regardless of the external exchange rate regime adopted. Secondly, factor mobility, particularly labour

mobility, both geographical and industrial can compensate for regional differences within a multi-region currency area and as such can replace a system of individual regional currencies. Thirdly, there are important limiting factors, unrelated to the stabilisation arguments forwarded by Mundell, which prevent a system of purely regional currency areas. These relate to convenience of money as a medium of exchange, transactions and valuations costs associated with currency exchange, the problem of thin exchange markets with regard to speculation and finally the increasing implausibility of the assumption of money illusion as the number of currencies (and therefore imported goods) increases. Importantly, he also brings attention to Scitovsky's conclusion that a "common currency… [in this case in Western Europe] …would induce a greater degree of capital mobility" (Scitovsky cited in Mundell 1961). The importance of capital markets, and the possible catalysing effect a common currency may have on them, is expanded upon later in the review.

McKinnon (1963) furthered the theory of OCAs by considering the implications of differing sizes and structures of economies on the optimal exchange rate regime. Primarily, where economies are relatively open, variable exchange rates have a significant effect on internal price levels since the ratio of tradables to non-tradables is high and devaluation increases the cost of tradables. Given the conflicting aims of employment maximisation, external balance and internal price stability, an open economy with variable exchange rates may be able to control the former two but the rising cost of tradables will impact on the latter aim: thus open economies have less to lose from moving from variable exchange rates to a single currency.

McKinnon also highlights the importance of size and credibility effects in creating and maintaining currency liquidity and capital efficiency. Where countries are small a fixed exchange rate mechanism may help to maintain liquidity and prevent capital flight. However

the fixing of the exchange rate must be convincing: it must be credible otherwise domestic savers will attempt to invest in more liquid foreign currencies creating a situation of capital flight which reduces the investment potential of the domestic economy. This seems rather characteristic of many smaller African countries and other less developed countries; suggesting that the irrevocable fixing of exchange rates implied by a single currency could provide a solution to the problem of illiquidity in smaller countries. The notion of credibility and its achievement are important in "new" OCA theory too, most notably in the application of work by Barro and Gordon (1983) concerning central bank credibility. This shall be considered in due course.

Kenen (1969) considers the arguments put forward by Mundell (1961) and McKinnon (1963) and furthers the debate by highlighting the importance of product diversification in determining the effects and outcomes of changes in demand patterns. Assuming demand movements that are not business cycle induced falls in demand – i.e. that they represent a relatively random process - Kenen asserts that a well diversified economy will have less need to resort to exchange rate fluctuations to maintain internal stability. Furthermore, in a well diversified economy, unemployment will not be affected as much by a movement in export demand as a single product economy, nor will related movements in investment. In concluding Kenen also highlights the importance of the range and ability in using policy instruments, in particular monetary and fiscal control. The implications for developing countries are that: "being less diversified and less well equipped with policy instruments, [they] should make more frequent changes or perhaps resort to full flexibility [of the exchange rate]." (Kenen 1969: 54).

The Werner Report, published in October of 1970, accompanied by an increased move towards an international system of flexible exchange rates during the early 1970's, gave increased impetus to a more rigorous theoretical dialogue, termed by Mongelli (2002) as the "cost-benefit phase" subsequent to the "pioneering phase" of OCA theory seen above. Work by Corden (1972), Ishiyama (1975) and Tower and Willett (1976) are said to characterise this phase, with a greater emphasis of weighing the specific pros and cons of monetary integration in comparison with other exchange rate arrangements, occasionally with particular reference to the European Project. Whilst the work reviewed above tended to give vague indications of when monetary integration would be most beneficial, or more accurately when the loss of exchange rate controls would be less detrimental, the "cost-benefit" type analysis sought to clarify the varying costs and expand on the benefits discussed in previous work. I shall not discuss these contributions in any detail, but will indicate where they have enhanced or changed the dominant view on optimal currency areas.

Corden (1972) highlights several oversights in the preceding arguments of OCA theory. Notably, though monetary integration increases the price stability of an economy, and the improvement increases with the openness of an economy (see the discussion of McKinnon above), exchange rates can play an "insulating role". Previous arguments assumed stable foreign prices and micro-orientated supply and demand shifts but where shocks "originate abroad and are of a macro nature" (Corden 1972: 18), exchange rate fluctuations are able to insulate the domestic currency from foreign shocks, increasing its liquidity. Thus the benefits to be gained from monetary integration are dependent on the assumptions made concerning the disturbances to the system: where the disturbances are structural micro shocks to the domestic economy, McKinnon's argument for monetary integration applies according to

Corden. But where they represent foreign macro movements in costs and prices, increased openness may increase the costs of monetary integration.

This point is reaffirmed by Ishiyama (1975) who defends the ability of small countries to control domestic shocks and strongly argues against monetary integration, concluding that "the theory of optimal currency areas is primarily a scholastic discussion which contributes little to practical problems of exchange rate policy and monetary reform".

Corden also clarifies the arguments of Mundell (1961) concerning the role of money illusion in determining the effectiveness of exchange rate movements in maintaining internal balance. This role for flexible exchange rates is based on the assumptions of real wage flexibility and money wage inflexibility. If real-wage flexibility is not present, as may be the case in an extremely open economy, the assumption of money illusion becomes difficult to accept, thus reducing the effectiveness of the exchange rate in maintaining price control.

Tower and Willett (1976) discuss in great detail several broad areas of importance in determining the costs and benefits of the economy. They arrive at a graphical synthesis that summarises the relative net benefits of a system of flexible exchange rates compared with those of a currency area. This can be seen here in Figure 9A (Tower and Willet 1976: 77). They show that as the degree of openness increases, the benefits of a currency area (UA) rise whilst the benefits of a flexible exchange rate (UB) fall. The determinants of UA and UB are diverse and relate to previously discussed concepts such as source and magnitude of disturbances, effectiveness of monetary policy induced adjustment, labour and capital mobility and price flexibility. Using these curves it is then possible to assign a level at which adoption of a single currency area would outweigh the status quo of floating exchange rate.

They also concede that alternative assumptions (Tower and Willett 1976: 78 with reference to Figure 9B: 77) may result in multiple equilibria where over some range of openness, the benefits of a currency area may actually be falling. However, this does not alter Tower and Willett's conclusion that very open economies would benefit from adopting a currency area, whilst very closed economies should operate a system of fixed exchange rates.

### 2.2.1 Summary of Traditional OCA Theory

From this overview of what might be termed as traditional OCA theory it is worthwhile summarising the main factors that the theory highlights should be considered when planning monetary integration between two or more counties. I shall then continue with a discussion of the development of the "new" theory of optimal currency areas.

- Asymmetry of Shocks. Relating to other points summarised here, increased asymmetry of shocks increases the cost of giving up the dual adjustment mechanisms of exchange rate movements and interest rate changes. However, these costs can be reduced as shall be summarised below.
- Factor Mobility. Increased movement of factors within the area reduces the inflation-unemployment trade-off that would otherwise be eliminated through adjustments in exchange rates or interest rates.
- Price and Wage Flexibility. Increased flexibility of nominal prices and wages reduces the need for exchange rate adjustment to restore external balance, reducing the loss created by a move to monetary integration.
- Size and Openness of Countries. Increased openness, relating the proportion of non-tradables to tradables in the economy, increases the variation of the domestic price under flexible exchange rates, reducing liquidity and the possibility for money illusion. Clearly,

smaller economies, having less diversified structures and higher external reliance are necessarily more open.

- Source of Shocks. The preceding argument holds, unless the exchange rate is adjusting to shocks of an external nature. Where this occurs, exchange rate flexibility is said to "insulate" the domestic economy from foreign instability.
- Product Diversification. Increased diversification, particularly in the tradables sector reduces the effect of negative asymmetric shocks through offsetting positive changes in other industries.
- Production Structures. Similar production structures between economies reduces the likelihood of asymmetric shocks, reducing the need for exchange and interest rate movements and thus reducing the loss from losing such instruments.
- Inflation Convergence. Reduces the need for exchange rate movements that would be unavailable under monetary integration
- Fiscal Integration. Not discussed explicitly here, increases in fiscal integration may be able to smooth out the effects of asymmetric shocks through fiscal transfers.

Clearly, as Tavlas (1993) points out in his summary of traditional OCA characteristics, and what is becoming increasingly obvious in the European Union, is that political factors are also important in determining the formation and success of a single currency area. However, for the purposes of this literature review, I shall constrain myself currently to economic factors[2].

Given that the costs of undergoing monetary integration consist of losing the ability to adjust to asymmetric shocks through exchange rate movements (or adjustments given a more more rigid but none-the-less flexible exchange rate system) or interest rate movements, much of the

[2] Tavlas (1993) suggests Mintz (1970) and Cohen (1993) as insightful readings on the political aspects of monetary and economic integration.

early literature seems focused on the reduction of losses rather than a discussion of benefits. The above characteristics relate largely to the effectiveness of exchange rates and the possibility for adjustment through alternative means. The reduction of losses it seems was the main area for concern during the early development of OCA theory. The benefits were assumed implicitly: reductions in transactions costs and exchange rate uncertainty, increased liquidity and trade, economies of scale concerning currency reserves, and the general notion that monetary integration should improve allocative efficiency. New OCA theory, using theoretical developments from various economic branches, both reduced the two main costs of monetary integration and highlighted other important benefits to be gained.

## 2.3 New OCA Theory

The 1980's produced very little academic literature concerning OCA theory (Bayoumi and Eichengreen 1998) but provided important theoretical developments in other areas of economics. The broad ranging nature of work contributing to "New" OCA theory necessitates some element of separation. The literature review will therefore pursue the new elements seen below.

BOX 3: ELEMENTS OF NEW OCA THEORY

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|---|---|
| 1. The Monetarist Critique | 3. The disputed role of the exchange rate |
| 2. Credibility, time consistency and policy rules | 4. Endogeneity of OCA criteria |

### 2.3.1 The Monetarist Critique of the Phillips Curve

The previous analysis made by the early contributors to OCA theory maintained that monetary policies could be used to achieve the desired trade off between inflation and unemployment, as given by the Phillips Curve. Thus, monetary integration, which necessarily requires the abandonment of national monetary policy to a centralised body, exerts a cost in so much as nation states are unable to fine-tune the economy to the desired balance of inflation and unemployment. The Monetarist Critique, exemplified by Lucas (1972) and

Friedman (1968), asserts that in the long run, monetary policies are ineffective in controlling unemployment. The Phillips Curve becomes vertical in the long run since unemployment is related to the Natural Rate of Unemployment (NRU) and inflation can be controlled without detrimental effects on the level of long run unemployment.

These developments were primarily based on notions of expectations formation, whereby rational economic agents are able to costlessly obtain and use information to form expectations of future inflation and thus negotiate in terms of real rather than nominal wages and prices. Theory was enhanced by the prevalent economic problems in Western countries, where inflation and unemployment were simultaneously and persistently high. Though the Phillips Curve may still exist in the short run the major implication for OCA theory is that the perceived costs of monetary integration are reduced.

Since monetary policy is ineffective in balancing unemployment and inflation in the long run, the costs of monetary integration are reduced though there remain important cases and issues surrounding the notion of monetary neutrality when considering currency unions.

BOX 4: ISSUES ASSOCIATED WITH MONETARY NEUTRALITY AND CURRENCY UNIONS

- Setting of monetary targets
- Problems of asymmetric and symmetric monetary systems
- Choice of leader in asymmetric systems
- Considerations of seigniorage effects
- Behavioural differences between countries which demand different policy choices
- Possibility of increased asymmetry due to regional specialisation

### 2.3.2 Credibility, Time Consistency and Policy Rules

Strikingly, whereas traditional OCA theory had viewed convergence of inflation rates as a prerequisite for the formation of a monetary union, modern theory demonstrates how

monetary integration may be more beneficial when the divergence of inflation rates is high; provided that the central bank created adopts a credible policy stance of optimal inflation. This is because the high inflation country can achieve a low inflation reputation overnight by surrendering itself to the control of the low inflation central bank with no cost to the low inflation country. This result is mainly based on expectations theory and most importantly the debate between discretionary and fixed policy rules. This work was developed by Kydland and Prescott and subsequently Barro and Gordon (1983) and De Grauwe (1989, 2000).

In their seminal essay, Kydland and Prescott (1977) explore the use of optimal control theory in various economic situations, and highlight its failures in the presence of rational economic agents who maintain and adjust their expectations for the future. Where such 'rational expectations' exist, a policy rule can result in an improved social outcome over the use of optimal control theory as embodied in discretionary policy. Kydland and Prescott (1977) argue that optimal control theory is only applicable where decisions are based on past and present information. In dynamic economic situations this is not the case since rational economic agents form, and act upon, expectations of future policy changes. Discretionary policy thus leads to a "game" between policy makers and agents which can be either divergent or convergent in relation to a stable policy-outcome mix, but in all cases socially sub-optimal.

Barro and Gordon (1983) extend the work of Kydland and Prescott (1977) to show the importance of time consistent policy rules in determining credible and therefore achievable inflation outcomes from monetary policy. They use an expectations formation framework to show that an irrevocable policy rule is preferred over discretionary monetary policy to maintain an optimal mix of unemployment and inflation. This mix is argued to be zero inflation and unemployment equal to the NRU. Discretionary policy, set in each time period, creates incentives for surprise inflation to reduce the short run unemployment level according

to the preferences of the policy maker; but such reductions come at the cost of higher inflation and lower credibility in the long run.

This problem of time inconsistency can be overcome through a system of policy rules which are perceived to be fixed, or where the costs of breaking those rules outweigh the gains from "surprise" inflation. De Grauwe (2000) extends the argument to an open economy model to show that Barro and Gordon's analysis is also applicable to exchange rate policy. Promises to maintain a fixed exchange rate will not be credible unless the cost of reneging exceeds the gains from imposing a surprise devaluation: Monetary integration represents a convincing solution to this problem and enables a lower inflation equilibrium than would otherwise pertain.

Such insights clearly have far reaching implications for OCA theory since monetary integration embodies a set of policy rules that "tie the hands", both in terms of monetary and exchange rate policy, of domestic policy makers, enhancing the reputation of high-inflation countries. In such countries, the loss of monetary and exchange rate control will in part constitute a benefit as they will be able to achieve lower inflation rates over the long run, without any cost to employment levels. Clearly, there remains a cost in relinquishing control of exchange rate policy since the ability to manage external equilibrium is removed. However there is also a growing body of literature within the new theory that suggests that exchange rates are less effective than traditional theory would suggest in maintaining external balance (see 2.3.3 below).

### 2.3.3 The Role of the Exchange Rate Disputed

The development of the portfolio-balance model of exchange rates has called into question the flow type model adopted by traditional OCA theory. Given that foreign and domestic

assets are imperfect substitutes, the current account enacts exchange rate changes through the movement of wealth and the effect on the risk premia associated with holding foreign assets. Where perfect foresight is present, correction of the current account is lagged and dependant upon the distribution and changes in wealth. Without perfect foresight it is possible to reach a situation of speculative bubbles where exchange rate movements do not react to, and fail to correct, external imbalance. In both cases the exchange rate does not adjust smoothly or instantly to correct external imbalances.

There are further theoretical arguments that assert that exchange rates enact corrections only imperfectly and over a longer time period than assumed in traditional OCA theory. These involve interactions of the portfolio-balance model with the notion of Ricardian Equivalence to create a situation whereby economic agents react to negate the movement of exchange rates, since they foresee the future return of such exchange rates to the original point. Also considered to increase the time-lag of exchange rate effects is company policy, as described by the Sunk Costs model of industrial relations, whereby firms will be reluctant to react to exchange rate movements in the short term if this may increase or maintain profitability in the long run.

These arguments reaffirm the conclusions made by other strands of new OCA theory that the loss of the exchange rate as a policy tool may be less detrimental than originally thought. As well as the reduction in perceived losses, the elimination of exchange rate uncertainty has been cited throughout the literature as a benefit of monetary integration, through which countries are able to achieve welfare gains and growth improvements. However, both theoretical and empirical developments proved this belief to be misplaced, as the effect of exchange rate certainty is ambiguous and difficult to quantify.

In particular, De Grauwe (2000) highlights the body of work initiated by Poole (1970) that uses an IS-LM model to show that fixing exchange rates (or forming a currency union) results in increased volatility in output. Reduced exchange rate uncertainty simply moves the risk to another area of the economy. Furthermore, De Grauwe (2000) highlights the one-off benefit to growth of an increase in exchange rate certainty that is indicated by Neoclassical theory and was used in the influential 'One Money, One Market' report (EC 1990). This suggests that though monetary integration will reduce risk, this effect will only have a one off effect on growth as the economy moves to a new lower risk equilibrium.

There exists a large body of literature concerning exchange rates yet the theoretical conclusions to be made here are indeterminate. On the one hand, lags in the effects of exchange rate movements reduce their effectiveness and thus reduce the costs of monetary integration. Yet on the other hand the benefits to be gained from exchange rate certainty, embedded in monetary unions, seem to be overstated by traditional OCA theory. Both the costs and benefits relating to the loss of exchange rate control have been reduced by the new OCA theory and thus the high importance of exchange rate convergence in traditional OCA criteria appears misplaced.

### 2.3.4 Endogeneity of OCA Criteria

Traditional OCA theory was primarily concerned with starting positions, with the preconditions that would enable a successful monetary union. However, the contribution by Frankel and Rose (1997) provided OCA theory with a more forward looking outlook, arguing that many of the prerequisites for monetary union, espoused by traditional theorists, are in fact reinforced by the creation of monetary union. This is in direct contrast with another popular argument from Krugman (1993) that increased economic integration increases the likelihood

of asymmetric shocks. Krugman's outcome is a result of the possibility of increased localised specialisation which increases rather than decreases the divergence of shocks between two countries, thus increasing the cost of monetary union.

Whilst Frankel and Rose (1997) believe that increased economic integration (including, most importantly, customs and monetary union and increasing factor mobility) increases convergence between nations, hence reducing the costs of monetary union in terms of loss of exchange rate control, Krugman (1993) uses evidence from North America to conclude that increased economic integration does not guarantee convergence and can lead to divergence, thus increasing the costs of monetary union.

Empirical evidence tends to suggest that Frankel and Rose's (1997) hypothesis is correct for the countries that have been studied, predominantly in the European Union. Artis and Zhang (1995) show that increasing trade links in Europe gravitated members of the European Monetary System towards a universal business cycle. Fidrmuc (2001) uses an explicit test of endogeneity to confirm Frankel and Rose's hypothesis, though with the caveat that the effect may be working through increasing structural similarities of foreign trade rather than the direct affect of increased trade, as previously proposed.

## 2.4 Theoretical Conclusions

There is clearly a large body of theoretical work available, larger than is feasible to enter into a rigorous discussion. What began as a relatively academic discussion was provided with a more practical impetus by the development of the European Project and developments in alternative fields of monetary and trade theory. Though these developments have added bredth to the theory of OCA, the central tenets remain valid to a certain degree and are used widely in the empirical literature.

What follows is an outline of the major points that are accepted in the literature, which shall prove useful in indicating the direction of this study:

BOX 5: THEORETICAL CONCLUSIONS

- Increased openness (in terms of the proportion of tradables to non-tradables) increases the net benefit of monetary union due to increased transactions costs and reduced price variability.
- Increased symmetry of shocks (as created by business cycles) reduces the cost of abandoning monetary control.
- Increased symmetry between potential members, in terms of trade shocks, reduces the cost of abandoning exchange rate control.
- Relating to points (1), (2) and (3), increased trade intensities with potential members may lower the future costs of monetary union by reducing the divergence of shocks.
- Increased factor mobility between potential members reduces the cost of monetary union by reducing the need for exchange rate fluctuations.
- Increased wage and price flexibility reduces the cost of monetary union by reducing the need for exchange rate adjustment
- Monetary integration may provide a way for high-inflation countries to achieve credibility through the adoption or creation of a credible central bank.
- Product diversification, by reducing the impact of asymmetric shocks reduces the need for counter-balancing monetary or exchange rate movements.
- Fiscal integration is necessary where factor mobility may not be perfectly mobile to perform immediate and automatic redistribution in those cases where asymmetric shocks do arise.
- If the exchange rate is not a perfect adjustment mechanism, or policy neutrality exists in the long run, as has been suggested above, then the costs of monetary union, in terms of loss of exchange rate and monetary control, fall.

## 2.5 Operationalising the OCA Criteria

There exist several key methodologies for testing OCA criteria on a broad scale. There are also a multitude of possibilities in testing the individual hypotheses postulated in the literature. Indeed, Mongelli (2002) is "struck by the very high number and diversity of studies making reference to the OCA theory". For the purposes of this paper I shall confine myself to broader based studies that have been used in the past to conclude for or against membership within a monetary union. The key methodologies that become evident in the literature are detailed in Box 6 below. Each of these shall be considered separately, their past application discussed and their relative merits for an analysis of an African monetary union assessed.

BOX 6: KEY METHODOLOGIES

- Correlation and Co-Integration
  - "Shocking" studies that isolate demand and supply movements using structural vector auto regression (SVAR) techniques.
  - Cluster analysis to give a sophisticated grouping of correlated countries.
  - Co-integration analysis to assess the level of integration of real exchange rate movement.
- Synthesis and evaluation of an "OCA Index" over time to assess the extent of exchange rate convergence.
- Gravity model estimation to isolate the trade effects of monetary and customs union.
- Macroeconomic modelling and simulation techniques to create assessments of possible trade and growth effects of alternative scenarios.

### 2.5.1 "Shocking" Studies

The application of Structural Vector Autoregression (SVAR) techniques for the analysis of monetary union was first undertaken by Bayoumi and Eichengreen (1994, among others) in relation to the EMU and other possible single currency areas. First, the SVAR techniques

developed by Blanchard and Quah (1989) are implemented to isolate demand and supply shocks in a selection of economies using time series data of real and nominal output growth. The correlation of these shocks is then assessed, with greater weight being placed upon supply shocks by Bayoumi and Eichengreen (1994: 23) since they are "…more likely to be invariant with respect to alternative international monetary arrangements". The method also has the strength to predict the size of disturbances and the speed of adjustment, further shedding light on the question of monetary union.

Bayoumi and Eichengreen (1994) find that several potential currency areas emerge from their analysis of supply and demand shocks. These areas are Germany and its North European neighbours, North-East Asia and South-East Asia. Suitability for monetary union was not found in the Americas and was not assessed for Africa.

The application of SVAR modelling is not particularly widespread within the literature despite its compromise between atheoretical econometric tests of correlation and assumption laden macroeconomic simulations. The "catch all" approach of assessing the asymmetry of shocks as well as the size and response to them embeds several key areas of OCA theory and is intuitively logical. However a suitably long time series is necessary to achieve worthwhile conclusions, nor is there any consideration of changing exchange regimes or structural change. In addition to the problems posed by data availability for African nations this methodology is beyond the timescale of this paper.

### 2.5.2 Correlation and Cluster Analysis

This methodology seeks to assess the similarity of a broad range of OCA properties within a group of countries in order to find subsets, or clusters, of countries that share similar characteristics and may therefore be more suitable for monetary union.

Artis and Zhang (2001) use six criteria to define their clustering of potential EMU countries: Business cycle correlation (using the methodology of Baxter and Stockman (1989) and with Germany as a base country), real exchange rate volatility, real interest rate correlation (again using Germany as the base), openness to trade, inflation convergence and labour market flexibility. Clearly this provides a very thorough examination of the EMU case. Artis and Zhang (2001: 41) argue for the Baxter and Stockman (1989) method of correlating business cycles over the Bayoumi and Eichengreen (1994) SVAR method due to the latter's theoretical assumptions. It is also worthwhile noting that cluster analysis need not involve so many criteria; Indeed Boreiko (2003) limits the variables to a selection of four in his assessment of accession EMU countries.

Correlation and cluster analysis appears to be a relatively appealing methodology and has been applied on quite a wide basis. The flexibility of criteria allows for adjustments to be made to the method, where necessary. However, cluster analysis is highly complicated process, reliant on detailed economic data which makes it unsuitable for its application to Africa where such data is scarce. Furthermore, on a less practical note, in so far as correlations in business cycles may decline over time due to changes in economic and monetary structure, this method fails to capture this effect. Instead, it represents a snapshot of the current economic climate and assesses the suitability of monetary union based upon that snapshot.

### 2.5.3 Generalised-Purchasing Power Parity Analysis

This methodology uses cointegration analysis to assess the level of similarity in the movements of the real exchange rate (in terms of a Generalised Purchasing Power Parity) relative to a central dominant country. This method was developed by Enders and Hurn

(1994) and assesses the extent to which a group of countries exhibit integration of their real exchange rates. Real exchange rates, assumed to be dependant on economic fundamentals are able to show the similarity of economies and therefore their suitability for monetary union. More formally the methodology estimates the following regression (Mkenda 2001: 34)

$$r_{12t} = \beta_0 + \beta_{13} r_{13t} + \beta_{14t} r_{14t} + ... + \beta_{1mt} r_{1mt} + \varepsilon_t$$

where,

$r_{1it}$ are the bilateral real exchange rates between country 1 (the base country) and country i in time period t,

$\beta_0$ is an intercept term,

$\beta_{1i}$ are the parameters of the co-integrating vector, and

$\varepsilon_t$ is a stationary stochastic disturbance term

Where higher cointegration of real exchange rates is present, monetary union would incur lower costs. Mkenda (2001) applies this technique to assess the suitability for three East African countries (Kenya, Tanzania, Uganda) to form a monetary union, and finds an existing cointegration between the real exchange rate movements. This suggests similar movements in the underlying economic fundamentals and therefore a lower cost incurred from monetary union. Mkenda tentatively concludes that the three countries would therefore constitute an optimal currency area though this is based on an assessment of a wide range of economic comparisons in addition to the G-PPP cointegration analysis.

It is clear that cointegration analysis alone cannot form the basis of worthwhile conclusions as the assumption that real exchange rates capture the economic fundamentals is too implausible.

This is not least because policy interventions can alter real exchange rates (through the nominal rate) without any underlying economic causes, for purely political purposes. Therefore this seems an inaccurate and inappropriate method for assessing the effects of monetary union. Moreover it represents just one facet of OCA theory.

### 2.5.4 An OCA Index

In an appealingly simple article, Bayoumi and Eichengreen (1997) construct an "OCA Index" on the basis of the following equation:

$$SD(e_{ij}) = \alpha + \beta_1 SD(\Delta y_i - \Delta y_j) + \beta_2 DISSIM_{ij} + \beta_3 TRADE_{ij} + \beta_4 SIZE_{ij}$$

This relates the variability of the nominal exchange rate with several independent variables associated with OCA theory: differences in output disturbances and dissimilarity of commodity compositions of exports to capture asymmetry of shocks and therefore the costs of monetary union; trade linkages and country size, both associated with OCA theory.

This equation is estimated and then compared against a base or "centre" country, which in Bayoumi and Eichengreen's (1997) assessment of EMU is Germany over a number of different time periods. They then compare the movement of the dependant variable, the so called OCA index, over time, using forecasts to project into the future and then diagrammatically group the countries into convergent, converging and non-converging sets.

In so far as this technique represents a good attempt to incorporate traditional OCA theory into practice, it is worthwhile. Yet the method does little more without relying on out of sample forecasting. It can show whether OCA criteria are relevant in a particular area at a particular time, through the estimation and analysis of the above equation and this estimation

could be used to assess the level of convergence in the future given forecasted independent variables, yet this out of sample forecasting is problematic and backward looking. There is an intuitive simplicity in the method however and the data demands are relatively small which might make it suitable for this study, as long as any forecasted results are treated with an appropriate level of scepticism. It is used in the forthcoming empirical section because it is an ideal methodology to investigate the problem of multiple REC membership. Considering convergence of OCA indices would give a loose indication of the most appropriate groupings for countries which currently belong to more than one REC. Without relying on out of sample forecasting this becomes the strongest asset of the OCA index methodology for this study.

### 2.5.5 Trade Effects

Based on an adjustment to standard Gravity models of trade[3] and pioneered by Rose (2000), these studies hope to isolate the trade inducing effect of monetary union from other factors that may influence the value of trade between two countries. Gravity models are found to be highly useful and robust, returning significant co-efficients on a consistent basis. Indeed Leamer and Levinsohn (1995: 1384) describe the models as having "…some of the clearest and most robust findings in economics".

Standard gravity models include parameters for national incomes and distance – both literal and figurative. Rose (2000) adds to this numerous other variables including a host of dummy variables. His estimating equation is:

$$\ln(X_{ijt}) = \beta_0 + \beta_1 \ln(Y_i Y_j)_t + \beta_2 \ln(Y_i Y_j / Pop_i Pop_j)_t + \beta_3 \ln D_{ij} + \beta_4 Cont_{ij} + \beta_5 Lang_{ij}$$
$$+ \beta_6 FTA_{ijt} + \beta_7 ComNat_{ij} + \beta_8 ComCol_{ij} + \beta_9 Colony_{ij} + \gamma CU_{ijt} + \delta V(e_{ij})_t + \varepsilon_{ijt}$$

[3] See for example McCallum (1995) for an account of why National borders matter in trade.

where the subscripts i, j and t represent countries i and j and time period respectively. The dependant variable of size of bilateral trade is regressed against the following variables: economic size, income per capita, physical distance and dummy variables for shared border, shared language, shared trade agreement, shared nationality (such as France and its overseas departments), shared coloniser, colonial relationship and most importantly, the final variables of interest are a dummy variable for the presence of a common currency between i and j and the variability of the nominal bilateral exchange rate between i and j. Rose (2000) postulates that $\gamma$ and $\delta$ are positive. Rose (2000) uses a cross-section approach at five distinct time periods as well as a pooled estimate to determine that common currency between two countries increases trade by 3 times. Rose (2002) later applied panel data techniques to investigate the time series effect of currency union membership

This strand of empirical research returns conclusive results on the whole and can make a useful contribution to assessing the benefits from monetary union. Since many of the benefits highlighted in the literature pertain to increased trade, the empirical results seem to confirm the theoretical intuitions. However, given that currency unions increase trade, the extent to which these measures can be said to capture the costs or benefits of currency union is dependant on the assumptions concerning the effects of trade and specialisation, or more directly the role of the Krugman hypothesis of increased asymmetry. Rose (1998) and Artis and Zhang (1995), among others, have shown Krugman's view to be generally incorrect and as such an assessment of trade creation can be construed as capturing many of the important benefits of monetary union. Due to the methodologies robustness and the relatively simple data demands, this methodology will be pursued in the empirical section of this study.

### 2.5.6 Macroeconomic Modelling

An increasingly popular method of analysis is the employment of complete macroeconomic models from which to run simulation exercises of various scenarios, thereby determining optimal policy strategies. The paper by Harris (1991) paved the way for the use of simulation exercises in assessing the trade impact of varying degrees of economic integration. In it Harris uses several different economic simulations to assess the medium and long run impact of the US-Canada Free Trade Arrangement.

Recently adopted by Debrun, Masson and Patillo (2002), with specific reference to Africa, this methodology involves the adoption of several key assumptions in the construction of an appropriate economic model. These assumptions regard the supply function of the economy as well as government budget and objective functions. Importantly, the Debrun-Masson-Patillo (DMP) Model identifies not only the asymmetry of shocks but the asymmetry of political distortions affecting fiscal policy. Therefore the Central Bank's preferences represent a weighted average of all members of the currency union, dependant on economic size.

The economic model is then calibrated according to empirical evidence and simulations run to determine the costs and benefits of monetary union. Masson and Patillo (2005) relate this model directly to Africa so it seems particularly relevant to this discussion; however the development of such a value laden modelling process is both non-trivial and overly complicated for the purposes of this study.

## 2.6 Major African Studies

Table 1 below lays out a brief overview of several studies that have been made concerning the suitability and possible benefits from monetary union in various areas of Africa.

TABLE 1: SUMMARY OF SELECTED AFRICAN STUDIES

| Author(s) | Pub. Date | Methodology | Area | Conclusions |
|---|---|---|---|---|
| Assane and Pourgerami | 1994 | Growth Equation | CFA and Sub Saharan Africa | CFA monetary union has enabled countries to maintain price and monetary control |
| Wane, Burkett and Guell | 1996 | Growth Equation | CFA and Sub Saharan Africa | Those within CFA experienced higher growth rates due mainly to increased efficiency of investment. |
| Bayoumi and Ostry | 1997 | VAR | Sub Saharan Africa | Little evidence for monetary union suitability in the near future. |
| Hoffmaister et al. | 1998 | VAR | Sub Saharan Africa | External macroeconomic shocks are more detrimental within the CFA area. |
| Fielding and Shields | 2001 | VAR | CFA | Correlation in price movements but not output movements. In terms of output, two subsets are apparent. |
| Mkenda | 2001 | G-PPP | East Africa (Kenya, Tanzania, Uganda) | Countries tend to face similar external shocks and can therefore be seen as an OCA |
| Benassy-Quere and Coupet | 2003 | Cluster Analysis | ECOWAS | Neither CFA nor ECOWAS are suitable for monetary union. |
| Debrun, Mason and Patillo | 2003 | Macroeconomic Modelling | ECOWAS | Success of ECOWAS dependant on the creation of credible central bank able to control individual members fiscal spending |

| | | | | |
|---|---|---|---|---|
| Fielding, Lee and Shields | 2004 | VAR | CFA | Less heterogeneity in UEMOA than in CEMAC which suggests lower costs of monetary union. Stabilisation under a CFA monetary union would prove difficult. |

Sources: As in table

The majority of the studies are centred on the CFA countries, perhaps because they have been part of a more highly integrated monetary system than the rest of Africa and the relatively good quality of relevant data. Most of the studies suggest that increased monetary integration leading to monetary union would *not* be beneficial. Several reasons are suggested from the literature. Primarily, the heterogeneity of external and internal shocks that increase the cost of abandoning exchange rate controls, and the heterogeneity of fiscal demands (as highlighted by the work of Debrun, Masson and Patillo (2003) of which I have included just one study) which would require strict, possibly asymmetric central bank arrangements to make monetary union beneficial.

Two areas that seem to be lacking in terms of methodologies that emerged leading up to EMU are the estimation of possible trade effects and an OCA index (as originally devised by Bayoumi and Eichengreen (1997)). Perhaps these failings point to possible applications within Africa (or a subset thereof).

## 2.7 Summary

It has been possible to review a small percentage of the available theoretical and empirical literature related to monetary union. Primarily this literature seeks to develop and adapt the Optimal Currency Area theory, originally conceived in the 1960's, using more rigorous theoretical, mathematical and econometric techniques. In this review I have summarised the

main theoretical principles of OCA theory as well as evaluated some of the methodologies that have most commonly been used to operationalise the theory. Finally I have described how the OCA theory has been applied to study the special case of African monetary integration.

## 2.8 The Way Ahead

This literature review has enabled me to assess the theoretical and methodological discussions surrounding OCA theory and highlight the research gaps that exist with specific reference to Africa. On the basis of this review I therefore propose to conduct two empirical tests to assess the feasibility and effect of a single currency for Africa. Firstly, I propose to construct an OCA index along the lines of Bayoumi and Eichengreen (1997) for several African regions, using various constructions. This will enable a two stage analysis of the suitability of Africa and its regions to enter into a currency union: (i) I examine whether the available data follow traditional OCA theory in so much as the estimating equation is significant. (ii) If so, then I will obtain forecasts of the independent variables that will allow me to assess the extent of convergence within the currently assigned regional economic communities.

Secondly, the study will utilise a gravity model analysis to determine the possible trade effects from various degrees of integration that exist in Africa. Africa represents a good test area for such gravity models since there are a large number of different regional agreements and arrangements that enable investigation of the effects of complete monetary union, as well as weaker forms of integration such as customs unions and monetary and political co-operation arrangements.

# 3 Econometric Investigation

This paper shall now proceed in two directions to capture two salient elements of monetary union: Firstly, a forward looking investigation that examines whether the disparate countries and regions of Africa are converging over time, using Bayoumi and Echingreen's (1997) OCA Index. Secondly, panel data investigation into the possible benefits that monetary union can bring in Africa in terms of increased trade, using Gravity model analysis. There exists some overlap within data collection for the two methodologies but for the most part these are separate investigations and will be treated as such here. Each will therefore have their own section, within which will be information on methodology, data and its limitations, regression model and results, analysis including sensitivity analysis and finally comments on any conclusion that can be made.

## 3.1 An OCA Index for Africa

The OCA Index is an attempt to operationalise the foremost theoretical criteria identified in the long literature of optimal currency areas. It seeks to relate nominal bilateral exchange rate variability with three key aspects of traditional OCA theory: Output movements, trade linkages and size. All three of these aspects are highlighted in the previous chapter as being important in determining the theoretical feasibility and practical benefit of monetary integration. Where output movements between countries are similar, the cost in losing the dual controls of exchange rate movement and interest rate control through monetary integration are reduced, enabling the new, union wide interest rate to effectively control the short term inflation-unemployment trade-off. Increased trade between countries will increase the benefits obtained through elimination of exchange rate variability. Increased trade may also lead to increasing synchronisation of exchange rate and interest rate movements, making the need for separate policy controls redundant. Smaller economies, assumed to be less diversified, have a larger proportion of tradables to non-tradables and a weaker national

currency and can therefore be considered to benefit more from the reduced exchange rate uncertainty inherent in moving to monetary integration.

### 3.1.1 Methodology

Asymmetric output movements are measured as the standard deviation of the change in the log of relative output in the two countries. Where country output movements move together, this will be relatively small; where business cycles are divergent, large. Previous studies have also included a variable concerning the relative similarity of trade compositions to capture the asymmetry of economies; however this was not possible here due to the lack of reliable dis-aggregated trade statistics for African trade.

Trade linkages are measured using bilateral trade data, measuring the average value of trade (both imports and exports) between any two pair of countries. Where bilateral trade is high, the variability of nominal exchange rates between those two countries is expected to be low.

Size is quite simply measured as the arithmetic average of the log of real GDP of the two countries in the country pair. Bayoumi and Eichengreen (1997, 1997a) anticipate this to be positively related to exchange rate variability to reflect the concept that smaller countries will benefit more from the stability of a single currency area. However, theory points towards a counter argument in that larger economies, having greater diversification and lower reliance on the tradables sector will have less need to resort to exchange rate movements and will therefore exhibit lower exchange rate variability. These competing hypotheses will be assessed from the data.

Following Bayoumi and Eichengreen (1997, 1997a) The estimating equation is therefore:

$$SD(e_{ij}) = \alpha_0 + \alpha_1 SD(\Delta y_i - \Delta y_j) + \alpha_2 TRADE_{ij} + \alpha_3 SIZE_{ij}$$

where subscripts i and j denote the two countries in the pair and the variables are defined as

$SD(e_{ij})$ is the standard deviation of the change in the logarithm of the end-year bilateral rate between countries i and j

$SD(\Delta y_i - \Delta y_j)$ is the standard deviation of the difference in the logarithm of real output between the country pair

$TRADE_{ij}$ is the average value of bilateral trade, weighted by GDP, between the two countries i and j

$SIZE_{ij}$ is the mean of the logarithm of the real GDPs of the country pair.

Variables are taken as averages over successive 10 year sample periods from 1980-2003; the regressions estimated and assessed for continuity with theory. Given intuitively consistent results, the most significant estimation period is used to predict bilateral values for the dependant variable within a pre-existing REC group (see Box 2). These predicted values are termed the "OCA Index". Where the index is relatively low, OCA characteristics predict a low level of bilateral exchange rate variability and therefore a high suitability for monetary integration. This will be conducted for the five regional blocs already apparent in Africa to assess their current levels of convergence. Where a country is a member of multiple regional groups (such as the Democratic Republic of Congo which is a member of three) they will be included in all relevant regressions and predictions to find the regional area that it is most suited according to OCA theory – i.e. the group with which it has the highest level of convergence between one time period and the next.

### 3.1.2 Data

As previously mentioned, the paucity of dis-aggregated trade data has already limited the investigation, removing the DISSIM variable used in previous studies. There are also other time and data limitations, since reliable bilateral trade data is only available after 1980 and up to 2003. Furthermore, some trade and GDP statistics are not available in certain instances for a variety of reasons. These include particularly weak economies (for example Eritrea), politically sensitive areas (Libya and Apartheid South Africa) and particularly integrated areas (the CMA single currency zone).

Data for $SD(e_{ij})$ is from the IMF International Finance Statistics (2005) and is calculated from National Currency Units per SDR since direct bilateral exchange rate figures were unavailable. $SD(\Delta y_i - \Delta y_j)$ is calculated from the World Bank Global Development Indicators (April 2005), using real GDP (in constant US dollars). The SIZE variable was calculated using the same dataset.

The bilateral trade data was sourced from the IMF Direction of Trade Statistics (DoTS) which provides information on imports and exports from both reporting and partner countries. Given this, any single country has two measurements of imports (CIF) and exports (FOB) respectively; total trade therefore has four measurements. These figures were averaged for each year to find the level of bilateral total trade in current US dollars. The composite figure was then deflated by the American CPI to find the real figures[4] and then divided by real GDP to give $TRADE_{ij}$. Bayoumi and Eichengreen (1997, 1997a) give very few details on how their trade variable was constructed. I have chosen to measure total trade here (the average of

[4] Rose and Glick (2002) admit elsewhere that this is a flawed method since fluctuations in the US dollar may affect the results. However there seems to be no alternative that would correct this systematically nor do Bayoumi and Eichengreen (1997) fully detail how they construct this variable.

imports and exports) rather than exports alone in order to overcome the relative shortage of trade statistics reported by some African nations.

### 3.1.3 Results

The regression was run on repeated ten year averages from 1990 to 2003, based upon data spanning 1981 to 2003. Reported below is a selection of those results that portrays a fair development of the relationship over time[5].

TABLE 2: OCA CRITERIA AND EXCHANGE RATE VARIABILITY FOR AFRICA

| | 1981-1990 | 1985-1994 | 1989-1998 | 1993-2002 |
|---|---|---|---|---|
| Variability of output | -0.10 (0.17) | 0.61 (0.21)* | 2.50 (0.13)* | 2.55 (0.20)* |
| Bilateral trade | -3.62 (1.93)*** | -10.65 (2.81)* | -6.98 (1.83)* | -2.17 (1.75) |
| Size | 0.010 (0.0077) | 0.080 (0.013)* | 0.077 (0.011)* | 0.048 (0.010)* |
| Observations | 705 | 809 | 985 | 1034 |
| $R^2$ | 0.0057 | 0.0464 | 0.2434 | 0.1986 |

Intercept not reported
Cross-Section OLS with robust standard errors in parentheses
* indicates significance at the 1% level, ** at the 5% level, *** at the 10%

The results above show an interesting trend over the period. Initially, OCA criteria fail to predict the level of exchange rate variability. This can be seen through the relatively low $R^2$ values and in the counter intuitive result that increased output variability between any pair of countries will result in lower exchange rate variability (for period 1981-1990). Over time however, the equation returns more conclusive and theoretically consistent results, increasing its predictive power up until the 1989-1998 period. In this period, all the variables were significant at the 1% level and consistent with our theoretical expectations; increased output variability and size increased the level of bilateral exchange rate variability whilst increased bilateral trade reduced the bilateral exchange rate variability. Whilst bilateral trade was consistently significant in most of the regressions, its significance falls over time, possibly

[5] Complete results tables are available on request.

explaining the poor performance of the regression in more recent periods. Output variability however moves in the opposite direction, becoming increasingly significant over time. Size remains the most stable of the variables, returning generally significant and positive results. Whilst this compliments Bayoumi and Eichengreen (1997, 1997a), it has very little theoretical justification since theory would suggest that increased size reduces the reliance on exchange rate movements.

The strength of the regressions in terms of their predictive power compares poorly with the results found by Bayoumi and Eichengreen (1997, 1997a). At its best this equation explains some 24% of variation in exchange rates whilst Bayoumi and Eichengreen (1997, 1997a) return an $R^2$ in the region of 50%. From this we can surmise that the criteria outlined by theory and operationalised here are less applicable in Africa specifically but may also be less relevant in developing countries in general. As yet I am unable to find other studies that investigate this relationship in developing countries with which to confirm this hypothesis. That traditional OCA theory is less applicable in developing countries is plausible however since exchange markets in these countries are less developed, with a large amount of black market and barter exchange taking place, reducing the sensitivity of exchange rate movements. Furthermore, developing countries have in the past felt it necessary to maintain greater control over exchange rate movements in order to manipulate the current account. This in itself presents an argument against monetary union in developing countries where the loss of exchange rate control might have an acute impact on the current account balance. However it also rules out a freely floating exchange rate since this may fail to respond as required by the government who may choose to optimise the exchange rate for import substitution strategies or export promotion strategies.

### 3.1.4 Sensitivity Analysis

Several alternative formulations were tested to assess the robustness of the above relationship, these were:

a) Use of US dollar exchange rates as an alternative common denominator to calculate bilateral exchange rates, sourced from the UN Common Database;

b) inclusion of average net migration figures for the two economies as a (flawed) proxy for labour mobility, net migration estimates including citizens and non-citizens from the World Bank WDI;

c) inclusion of money (M2) to GDP ratios as a proxy for the financial development of a country, from the World Bank WDI;

d) calculations over five and fifteen year averages rather than ten.

Not all of these findings were consistent with the original model or with theory in general. This gives further strength to the argument that traditional OCA theory may be inappropriate in modelling the variability of nominal bilateral exchange rates in African economies. Selected results from the sensitivity analysis are recorded below. The sensitivity results were limited to the three time periods seen below due to the availability of migration statistics.

As can be seen from the brief results reported below, the new variables provide very little in terms of consistency or predictive power. Both the money to GDP ratio and the migration variables change signs over the estimation period moving away from and towards theoretical expectations, respectively.

TABLE 3: SENSITIVITY RESULTS, SPECIAL DRAWING RIGHTS EXCHANGE RATE

| | 1981-1990 | 1986-1995 | 1991-2000 |
|---|---|---|---|
| Variability of output | -0.62 (0.17)* | 1.27 (0.21)* | 1.35 (0.10)* |
| Bilateral trade | -3.73 (1.93) | -6.97 (2.18)* | -0.95 (1.25) |
| Size | 0.069 (0.0098)* | 0.086 (0.012)* | 0.028 (0.0064)* |
| M2/GDP | -0.53 (0.092)* | -0.42 (0.060)* | 0.41 (0.027) |
| Migration | 0.27 (0.32) | -0.41 (0.31) | -0.49 (0.19)* |
| Observations | 551 | 725 | 868 |
| $R^2$ | 0.0885 | 0.1105 | 0.5510 |

Intercept not reported
Cross-Section OLS with robust standard errors in parentheses
* indicates significance at the 1% level, ** at the 5% level, *** at the 10%

TABLE 4: SENSITIVITY RESULTS, US DOLLAR EXCHANGE RATE

| | 1981-1990 | 1986-1995 | 1991-2000 |
|---|---|---|---|
| Variability of output | -0.29 (0.11) ** | 1.22 (1.94)* | 1.23 (0.10)* |
| Bilateral trade | -2.30 (1.38)*** | -8.38 (1.94)* | -2.14 (1.26)*** |
| Size | 0.044 (0.0067)* | 0.094 (0.013)* | 0.032 (0.0066)* |
| M2/GDP | -0.24 (0.061)* | -0.42 (0.070)* | 0.42 (0.027)* |
| Migration | 0.17 (0.23) | -0.45 (0.35) | -0.36 (0.19)*** |
| Observations | 551 | 725 | 868 |
| $R^2$ | 0.0654 | 0.0958 | 0.5311 |

Intercept not reported
Cross-Section OLS with robust standard errors in parentheses
* indicates significance at the 1% level, ** at the 5% level, *** at the 10%

Money and quasi money (M2) to GDP ratios are seen to be higher for more financially advanced countries and as such, increases in this ratio should be expected to decrease the level of exchange rate variability as the economy becomes able to act more efficiently within the exchange rate market. This hypothesis isn't confirmed here however, with the

money/GDP variable having an inconsistent effect on exchange rate variability regardless of timescale or common denominator used. Increasingly towards the end of the sample, the money/GDP ratio is positive and significant at the 1% level, a result that contradicts both earlier time periods and theoretical intuition.

Migration here is defined by the World Development Indicators as the estimated net migration over the proceeding 5 year period. As such the observations are limited to those seen in the tables above. I calculate the absolute migration to population (at the end of each period) ratio and then take the average over each bilateral pair of countries. This is undoubtedly a flawed proxy for labour mobility since net migration in this case may not be between the any two particular bilateral countries, but rather with the world as a whole. Furthermore these estimates are likely to be based on political conditions rather than considerations of economic migration which take place, relatively undetected, on a large scale in Africa. Despite these criticisms, given the scale of migrant labour in Africa and the poor quality of tax systems with which to identify migrant labourers, this is likely to be the best estimate of labour mobility available on such a wide scale. OCA theory suggests that increased labour mobility reduces the need for exchange rate movements as workers migrate to balance unemployment and inflation pressures. This is somewhat confirmed by the results, with labour mobility becoming negative in the later periods and indeed significant in the final period for which data is available. Increased labour mobility (as proxied for by average net migration) reduces the extent of exchange rate variability. The data however limits the conclusions to be made since there are only three time points with which to evaluate the relationship of labour mobility and exchange rate variability and in one of these the relationship is not theoretically consistent. It would therefore be rash to firmly conclude that

labour mobility has reduced exchange rate variability in Africa, although this no doubts warrants further investigation.

### 3.1.5 An OCA Index for African Regions

Given the apparent instability of the relationship between OCA criteria and exchange rate variability, both in terms of the simple and alternative (using money to GDP ratios and labour mobility) models, choosing an estimation period and model with which to calculate OCA Indices is problematic. Clearly, the alternative models add little to the power of the estimation and given their inconsistency should be disregarded at this stage. However the task of choosing a suitable year from which to create the predicted values, the so called OCA Index, remains. Based on the strong theoretical and statistical significance of the estimation, I have chosen to use the period 1991-2000 to generate predictions of the dependant variable $SD(e_{ij})$, the OCA index, for two particular years, the most recent year where full data is available, 2003, and five years previous, 1998, to give some indications of convergence exhibited within the regional groups over the recent period. The predicting equation is therefore:

$$SD(e_{ij}) = -1.21 + 2.45SD(\Delta y_i - \Delta y_j) - 4.57TRADE_{ij} + 0.065SIZE$$

It is expected that there should be some level of convergence over this period since the Abuja Treaty has called for increasing harmonisation of REC policies since 1994. I construct a table of predicted bilateral exchange rate variability for the two time periods for each REC and below assess the position of those countries which are part of more than one REC. In considering the convergence between average group indices for each country, and their involvement in other regional commitments I intend to assign these countries to the ideal REC. The convergence of countries is considered by subtracting the 1998 index from the 2003 index; larger negative values indicate a greater movement towards zero exchange rate

variability and thus convergence. The process of allocation will proceed step by step, with countries first being eliminated by their prior commitments, then by their differences in the average rate of convergence with all other countries in their REC. At each stage, the average convergence will be recalculated to take into account the previous elimination.

The first stage, based on prior commitment, assigns Namibia and Swaziland to the Southern African Development Community (SADC) based on their inclusion within the CMA single currency area, whose other members, including South Africa the centre of the CMA system, are incorporated with SADC. This removes them from the COMESA group for subsequent calculations. The process will now continue with a stepwise elimination of countries based upon the differences in their average convergence for alternative RECs.

TABLE 5: STEPWISE ALLOCATION OF COUNTRIES TO REGIONAL ECONOMIC COMMUNITIES BASED ON CONVERGENCE OF OCA INDICES

| Stage | Country with largest absolute difference | REC chosen (rejected REC) |
|---|---|---|
| 1 | Mauritius | SADC (COMESA) |
| 2 | Congo, Democratic Republic | ECCAS (COMESA, SADC) |
| 3 | Angola | SADC (COMESA) |
| 4 | Seychelles | COMESA (SADC) |
| 5 | Zambia | SADC (COMESA) |
| 6 | Burundi | ECCAS (COMESA) |
| 7 | Zimbabwe | COMESA (SADC) |
| 8 | Malawi | SADC (COMESA) |
| 9 | Rwanda | ECCAS (COMESA) |

Based on these step by step calculations of convergence, Box 7 displays the arrangements that would pertain based on these calculations. Of particular note with these REC arrangements are that Malawi remains with its mostly English speaking neighbours in the SADC and the

Democratic Republic of Congo leaves COMESA and SADC to join its border country the Republic of Congo in ECCAS. However, these groupings are based solely on the convergence of OCA indices which are in themselves questionable indicators of suitability for monetary union. Furthermore, this is a path dependant process; each successive elimination alters the outcome of subsequent analysis. Had there been alternative criteria for elimination (the absolute current value of the OCA index for example) then the nature of the groups could be very different.

BOX 7: REC ARRANGEMENTS AFTER ALLOCATION BASED ON OCA INDICES

| | |
|---|---|
| **AMU**<br>Algeria, Libya, Mauritania, Morocco, Tunisia<br><br>**SADC**<br>Angola, Botswana, *Lesotho*, Malawi, Mauritius, Mozambique, *Namibia*, *South Africa*, *Swaziland*, Tanzania, Zambia,<br><br>**ECOWAS**<br>**Benin**, **Burkino Faso**, Cape Verde, **Cote d'Ivoire**, the Gambia, Ghana, Guinea, **Guinea-Bissau**, Liberia, **Mali**, **Niger**, Nigeria, **Senegal**, Sierra Leone, **Togo** | **COMESA**<br>**Comoros**, Djibouti, Egypt, Eritrea, Ethiopia, Kenya, Madagascar, Rwanda, Seychelles, Sudan, Uganda, Zimbabwe<br><br>**ECCAS**<br>Burundi, **Cameroon**, **Central African Republic**, **Chad**, Democratic Republic of Congo, **Republic of Congo**, **Equatorial Guinea**, **Gabon**, Rwanda, Sao Tome and Principe |

**Bold** and *Italics* indicate membership in CFA and CMA Zones respectively

It is clear that in reality, determination of final REC will be based along several eclectic criteria and will be dominated by geographical, political and cultural aspects rather than just economic criteria. Even if economic criteria did play a central role, the outcome would depend on the selected economic criteria, indeed Yehoue (2005) considers a similar dynamic

technique based upon trade channels and inflation and output co-movements. Successive sorting on these criteria results in three general areas that Yehoue (2005) believes would be suitable for a currency bloc at this time. Analysis based on the OCA index, as seen in this paper, does not permit such clear cut conclusions but at the very least I have been able to organise the RECs based on the level of predicted exchange rate variability.

This construction of suitable regional economic groupings gives some suggestion as to the direction of African RECs in the near future. At the very least it is possible to conclude that streamlining of these groups is necessary to prevent any conflicting policy advice and to remove duplication of effort. Furthermore, the sooner these groups are streamlined and able to move forward, the more successful the move towards regional and complete monetary integration is likely to be. In terms of regional integration, the following section investigates the possible trade benefits that a regional currency bloc can create within Africa and which could be attained by the RECs in their move towards regional integration.

### 3.2 A Gravity Model of Intra African Trade

To investigate the possible benefits for intra-African trade that a regional currency area can create I employ gravity model analysis within a panel data framework. Previous studies have found that a currency union increases trade between its members. These studies have mainly focused on global or European countries, however, given the developing nature of most African economies it is not unreasonable to assume that the effect of a common currency will be different. It therefore follows to isolate intra-African trade within the gravity model framework to investigate the currency union effect for Africa. I expect this effect to be positive though I cannot predict whether it is larger or smaller than the effect found for European or global samples. This comparison will be an interesting conclusion of this section.

### 3.2.1 Methodology

The gravity model is fairly well used in the literature, relating bilateral trade to a number of standard variables such as geographical size, distance and wealth. Here, as in Rose and Glick (2002), we supplement the conventional gravity model with several control variables in order to isolate the effect of currency union membership on trade. The estimated equation is therefore

$$\ln(X_{ijt}) = \beta_0 + \beta_1 \ln(Y_i Y_j)_t + \beta_2 \ln(Y_i Y_j / Pop_i Pop_j)_t + \beta_3 \ln D_{ij} + \beta_4 Lang_{ij} + \beta_5 Bord_{ij} + \beta_6 REC_{ijt} + \beta_7 Land_{ij} + \beta_8 Island_{ij} + \beta_9 \ln(Area_i Area_j) + \beta_{10} ComCol_{ij} + \beta_{11} ComNat_{ijt} + \beta_{12} RTA_{ijt} + \gamma CU_{ijt} + \varepsilon_{ijt}$$

Where subscripts i and j denote countries, t denotes years and the variables are defined as:

$X_{ijt}$ denotes the average value of real bilateral trade between countries i and j at time t,

*Y* is real GDP,

*Pop* is population,

*D* is the Greater Circle Distance between i and j,

*Lang* is a binary variable which is unity if i and j have a common language,

*Bord* is a binary variable which is unity if i and j share a land border,

*RTA* is a binary variable which is unity if i and j are part of the same WTO ratified regional trade arrangement

*REC* is a binary variable which is unity if i and j are part of the same regional co-operation agreement at time t,

*Land* is the number of landlocked countries in the country pair (0, 1 or 2),

*Island* is the number of island nations in the country pair (0, 1 or 2),

*Area* is the surface land mass of the country,

*ComCol* is a binary variable which is unity if i and j were ever colonies after 1945 with the same coloniser,

*ComNat* is a binary variable which is unity if i and j were part of the same Nation at time t,

*CU* is a binary variable which is unity if i and j used the same currency at time t

$\varepsilon$ represents the range of other factors that influence bilateral trade, assumed to be well behaved.

Clearly, in assessing the case for monetary integration, the variable of interest is *CU* and the value of its coefficient, $\gamma$, will determine the extent to which monetary integration increases bilateral trade within the African continent. Further to this, I am interested in the effect of the REC's and other WTO agreed trade arrangements. For this purpose, the coefficients $\beta_6$ and $\beta_{12}$ are also of interest and will be discussed. From both theoretical intuition and past empirical research I expect all three of these coefficients to be positively and significantly related to the level of trade.

### 3.2.2 Data

The bilateral trade data was sourced from the IMF DoTS dataset, and is constructed as above (See 3.1.2). The IMF DoTS dataset extends from 1948 to 2004, however the poor quality of bilateral trade and other statistics for Africa necessitated a curtailing of the set to the period 1980 to 2003. The poor quality of statistical records is also evident in some of the poorer nations (Eritrea for example), politically sensitive countries (Libya) and well integrated areas such as the Southern African Customs Union (South Africa, Lesotho, Namibia and Swaziland). The latter case is particularly unhelpful since these countries form the CMA Area which is one of two common currency areas in Africa. This failure is likely to bias the estimate of $\gamma$, the currency union effect, downwards. The data therefore restrict the scope of the estimating equation, essentially questioning not whether currency unions in general

increase trade, but whether the CFA Franc Zone currency union increases trade. Given the data limitations this is the most thorough analysis of the currency union effect possible in Africa. The CFA Franc zone differs from the CMA zone in being linked to an external currency (the Euro) and as such I would expect the trade effect of the currency union to be different (but only in magnitude) for the two areas. However since expansion of the current CFA Franc zone is planned this analysis remains useful in indicating the possible trade effect of those countries joining the CFA Franc zone and for those countries entering into an entirely new common currency zone who wish to link the new currency to an external anchor (though considerations of which anchor remain important).

This paper departs from Rose and Glick (2002) and Rose (2000) by including those countries with zero bilateral trade. Since the model is based on log trade, those with zero trade cannot normally be included since an error is returned in the calculation. I adjust the database so that all zero trade figure are recorded as being very close to zero ($1x10^{-10}$).

The World Bank Global Development Indicators (April 2005) and the CIA World Factbook[6] were used to obtain much of the remaining data. The WB GDI provided GDP data (in constant US dollars) and population data. The CIA World Factbook provided information on location (in order to calculate the Great Circle Distance), border countries, island or landlocked status, major languages, total land area, colonisers and dates of independence.

Finally, information on regional trade arrangements (RTAs) and currency union membership were found from a variety of sources. For regional trade arrangements I collected two

[6] Found online at http://www.odci.gov/cia/publications/factbook/index.html and accessed on the 25th of July, 2005

alternative datasets. For the first, following Rose and Glick (2002), I use the WTO website[7] to find the official, WTO ratified trade agreements and the date of the enforcement. Secondly, I use information from Carrere (2004) to compile a brief history of regional economic communities (RECs) within Africa. These arrangements vary in their specific timetables but all have regional integration as there primary objective, through the harmonisation of tariff and non-tariff barriers, sectoral integration and the movement towards customs union. These two measures will be used simultaneously in the estimating equation to consider whether official or unofficial regional arrangements stimulate trade. Information on membership in a currency union was primarily sourced from Masson and Patillo (2005) who detail an historic account of currency arrangements in Africa after independence. This was supplemented by Rose and Glick (2002) who list the currency unions in their sample as well as the date of exit[8].

TABLE 6: DESCRIPTIVE STATISTICS

| | Non-Unions | Currency Unions |
|---|---|---|
| Observations | 29843 | 1981 |
| Log real trade | -2.96 | 5.10 |
| | (16.03) | (15.10) |
| Log distance | 7.68 | 6.96 |
| | (0.65) | (0.61) |
| Log product real GDPs | 43.25 | 42.97 |
| | (2.24) | (1.39) |
| Log product real GDP/capita | 12.36 | 12.25 |
| | (1.43) | (1.25) |
| Common language dummy | 0.40 | 0.94 |
| | (0.49) | (0.23) |
| Common land border dummy | 0.06 | 0.22 |

[7] See http://www.wto.org/english/tratop_e/region_e/eif_e.xls for the list of regional arrangements and dates of their enforcement.
[8] Rose and Glick (2002) compile this data primarily from the IMF's Schedule of Par Value and the IMF's Annual Report on Exchange Rate Arrangements and Exchange Restrictions as well as supplements from the New Statesman Yearbook.

| | | |
|---|---|---|
| | (0.25) | (0.41) |
| Regional trade agreement | 0.10 | 0.11 |
| | (0.30) | (0.31) |
| Regional economic | 0.26 | 0.44 |
| community | (0.44) | (0.50) |
| Number landlocked | 0.55 | 0.71 |
| | (0.63) | (0.64) |
| Number island | 0.24 | 0.018 |
| | (0.46) | (0.13) |
| Log product land areas | 24.17 | 25.16 |
| | (3.00) | (1.56) |
| Common coloniser | 0.25 | 0.84 |
| | (0.43) | (0.36) |
| Same nation | 0.00037 | 0.00 |
| | (0.019) | (0.00) |

Means with standard deviations reported in parentheses

Table 6 presents some descriptive statistics of the dataset used. Immediately it becomes apparent that those within currency unions trade more, with the 1981 trade observations involving a currency union having higher average log trade. As would be expected, those involved in currency unions are geographically (in terms of distance and shared borders) and culturally (in terms of language and colonial background) closer.

### 3.2.3 Results

Several different panel data estimation techniques were employed and analysed to investigate the effect of currency union membership on intra-African trade. The simple OLS estimates are seen in Table 7.

TABLE 7: POOLED PANEL OLS GRAVITY ESTIMATES

| | |
|---|---|
| Currency union | 3.27 |
| | (1.05)* |
| Regional trade agreement | 0.75 |

| | |
|---|---|
| | (0.61) |
| Regional economic community | 1.93 |
| | (0.77)** |
| Log distance | -3.54 |
| | (0.55)* |
| Log product real GDPs | 2.88 |
| | (0.20)* |
| Log product real GDP/capita | -0.57 |
| | (0.25)** |
| Common language | -0.080 |
| | (0.71) |
| Common land border | 5.50 |
| | (1.25)* |
| Landlocked | -1.42 |
| | (0.48)* |
| Island | -0.42 |
| | (0.78) |
| Log product land areas | -0.81 |
| | (0.16)* |
| Common coloniser | 4.22 |
| | (0.77)* |
| Observations | 27,716 |
| R2 | 0.1885 |
| RMSE | 14.465 |

Intercept not reported.
Standard errors robust to country-pair clustering recorded in parentheses.
Annual data for 52 countries, 1980-2003
* indicates significance at the 1% level, ** at the 5% level, *** at the 10%

The results are generally consistent with theory, returning expected signs on the coefficients for all variables apart from common language and GDP per capita variables. The variables of interest all return theoretically consistent results although the currency union effect was found to be much higher than in previous studies.

TABLE 8: OTHER GRAVITY EQUATION ESTIMATES OF THE CURRENCY UNION COEFFICIENT

| Estimate | Source | Year | Dataset | Estimating Technique |
|---|---|---|---|---|
| 1.21 | Rose | 2000 | 186 countries, 1970-1990 | Cross-sectional OLS |
| 1.30 | Rose and Glick | 2002 | 217 countries, 1948-1997 | Various panel data techniques |
| 1.29 | Masson and Patillo | 2005 | Rose and Glick (2002) limited to African trade only | Pooled panel data OLS |

Sources as in table

This would suggest that membership in a currency union is particularly important for intra-African trade. Remembering also that since the data only include one currency union (the CFA Franc Zone) this result could also be interpreted such that membership in the CFA Franc Zone increases trade by roughly twenty six times[9]. This seems implausible large, however without taking the point estimates literally it is clear that currency union membership increases the level of trade.

Other variables returned intuitive results: increased distance, geographic size and landlocked and island status all reduce the level of bilateral trade; increased economic size, common borders and common colonisers all increase bilateral trade as expected.

The counterintuitive results of the common language and GDP per capita variables are strange but by no means important or unexplainable. The 'common language' variable is highly

[9] Since log trade is the dependant variable, the coefficient must be transformed such that $\mathbf{e^{3.27}} = 26.31$

correlated (correlation coefficient of 0.61) with 'common colonisers'. This makes intuitive and historically sense since African countries tended to adopt their colonisers language as their official language even after independence. This explains the counter intuitive sign and insignigicance of common language in the above regression. Indeed, dropping the 'common language' variable from the regression reduces the standard error of the 'common colony' variable, suggesting there exists some relation between the two variables[10]. Furthermore the dataset was constructed using information on official languages as reported by the CIA World Factbook, yet it is unlikely that all cross border transactions were conducted in the official language. The arbitrary nature of African borders has resulted in large overlaps in languages and dialects as well as the presence of several lingua franca's. This necessarily reduces the importance and significance of the official language in determining the pattern of intra-African trade, especially when colonial origins are also considered.

There seems less theoretical justification for the apparent failure of GDP per capita. Traditional trade theory would suggest that increasing GDP per capita would increase bilateral trade since consumers move away from inferior domestic products and choose to import instead. This may not be the case when considering only intra African trade however since consumers may choose to import from non-African countries (specifically Western/Developed) due to a perceived quality difference. This result may therefore be reversed if all African trade were considered (i.e. not just intra African trade). Time limitations unfortunately prevented this extension to the analysis although it has been conducted elsewhere by Masson and Patillo (2005) using Rose and Glick's (2002) dataset. In this case, they find the GDP per capita variable to be positive and significant as suggested above.

[10] Furthermore, dropping 'common colony' gives positive and highly significant results for the 'common language' variable.

Selected cross sectional estimates of key variables confirm the results seen above with the currency union effect generally being positive and in the later periods significant.

TABLE 9: CROSS-SECTIONAL OLS ESTIMATES OF COEFFICIENTS OF INTEREST

| Year | $\gamma$ | $\beta_6$ | $\beta_{12}$ |
|---|---|---|---|
| 1980 | 3.09 | 13.86 | 3.11 |
| | (2.01) | (1.90)* | (1.41)** |
| 1985 | 5.06 | 11.80 | 3.84 |
| | (1.95)* | (1.86)* | (1.30)* |
| 1990 | 1.34 | 7.47 | 3.83 |
| | (1.89) | (2.30)* | (1.09)* |
| 1995 | 5.87 | -0.56 | -0.84 |
| | (1.36)* | (1.12) | (1.09) |
| 2000 | 3.47 | -1.97 | 2.94 |
| | (1.51)** | (1.06)*** | (1.17)** |

Controls not reported: Log distance, log product real GDPs, log product real GDP/capita, common language, common land border, number island, number landlocked, log product land areas and common coloniser.
Standard errors in parentheses
* indicates significance at the 1% level, ** at the 5% level, *** at the 10% level

As in Rose and Glick (2002) I have employed several panel data techniques to model the gravity equation detailed above to be able to further assess the currency union effect on trade as well as several other key variables of interest. These techniques model the relationship and derive the coefficients in various ways, making different assumptions and returning different results. The various merits and demerits of each approach are numerous and a detailed analysis of them would be beyond the scope and rationale of this paper, however the estimates are included to reaffirm the positive currency union effect seen in the simple pooled OLS regression seen above.

TABLE 10: POOLED PANEL GRAVITY ESTIMATES

| | Fixed Effects ("within") | Random effects GLS | Between estimator | Maximum likelihood |
|---|---|---|---|---|
| Currency Union | -1.81 | 1.27 | 3.46 | 1.15 |
| | (0.94)*** | (0.75)*** | (1.25)* | (0.76) |
| Regional trade | -2.36 | -1.07 | 3.00 | -1.13 |
| agreement | (0.32)* | (0.30)* | (1.56)*** | (0.30)* |
| Regional economic | 3.60 | 2.80 | 1.30 | 2.84 |
| community | (0.66)* | (0.49)* | (0.79)*** | (0.50)* |
| Common language | -31.21 | -0.29 | -0.13 | -0.31 |
| | (11.51)* | (0.71) | (0.72) | (0.75) |
| Common land border | (dropped) | 5.52 | 5.90 | 5.53 |
| | | (1.17)* | (1.19)* | (1.23)* |
| Log distance | -11.44 | -3.47 | -3.58 | -3.46 |
| | (9.21) | (0.47)* | (0.49)* | (0.49)* |

Controls not reported: Log product real GDPs, log product real GDP/capita, number island, number landlocked, log product land areas and common coloniser.
Standard errors in parentheses
* indicates significance at the 1% level, ** at the 5% level, *** at the 10% level

As can be seen in Table 10, the estimates for the selected variables are generally in agreement, with only the 'fixed effects' regression returning counter-intuitive results, particularly with regards to the currency union effect. The 'fixed effect' regression holds the intercept term fixed over time within groups (i.e. within each bilateral pair of countries) but is allowed to vary between groups. Rose and Glick (2002) focus on this estimation technique since it allows them to make the least "heroic assumptions" regarding the data. Given this conflicting result both within this study and with previous studies of the currency union effect, some careful analysis must be undertaken to ensure this is the correct modelling procedure before reaching any conclusions.

### 3.2.4 Sensitivity Analysis

Several perturbations in the dataset were made in order to test the robustness of the various estimations. These were:

a) inclusion of quadratic GDP and GDP per capita terms;

b) removal of all small country observations (GDP<$1 billion);

c) removal of all poor country observations (GDP per capita < $365);

d) removal of all countries where bilateral trade is a large fraction of total trade for both countries (bilateral trade >1%);

TABLE 11: CURRENCY UNION EFFECT ESTIMATES

| Variation | Obs. | Fixed effects (within) | Random effects GLS | Pooled OLS | Between estimator | Maximum likelihood |
|---|---|---|---|---|---|---|
| Quadratic output terms | 27716 | -1.81 (0.94)*** | 1.27 (0.75)*** | 3.27 (1.05)* | 3.46 (1.25)* | 1.15 (0.76) |
| No small countries | 14247 | -3.30 (1.57)** | 1.52 (1.06) | 3.06 (1.19)* | 2.20 (1.45) | 1.46 (1.07) |
| No poor countries | 6114 | -3.95 (3.60) | 1.16 (1.90) | 2.40 (2.60) | 3.53 (2.31) | 1.08 (1.94) |
| Low bilateral trade | 18730 | -1.42 (1.14) | 2.93 (0.88)* | 4.61 (1.16)* | 3.80 (1.40)* | 2.75 (0.90)* |

Controls not reported: Regional trade agreement, regional economic community, log distance, log product real GDPs, log product real GDP/capita, common language, common land border, number island, number landlocked, log product land areas and common coloniser.
Standard errors in parentheses
* indicates significance at the 1% level, ** at the 5% level, *** at the 10% level

TABLE 12: REGIONAL ECONOMIC COMMUNITY EFFECT ESTIMATES

| Variation | Obs. | Fixed effects (within) | Random effects GLS | Pooled OLS | Between estimator | Maximum likelihood |
|---|---|---|---|---|---|---|
| Quadratic output terms | 27716 | 3.60 (0.66)* | 2.81 (0.49)* | 1.93 (0.77)** | 1.30 (0.79)*** | 2.85 (0.50)* |
| No small countries | 14247 | 5.87 (0.92)* | 4.10 (0.69)* | 0.36 (1.08) | 0.59 (1.10) | 4.17 (0.70)* |
| No poor countries | 6114 | 1.36 (1.14) | 2.08 (0.88)** | 2.78 (1.70) | 3.05 (1.46)** | 2.06 (0.89)** |
| Low bilateral trade | 18730 | 5.16 (0.91)* | 4.21 (0.63) | 3.55 (0.95)* | 3.43 (0.93)* | 4.26 (0.65)* |

Controls not reported: Currency union, regional trade agreement, log distance, log product real GDPs, log product real GDP/capita, common language, common land border, number island, number landlocked, log product land areas and common coloniser.
Standard errors in parentheses
* indicates significance at the 1% level, ** at the 5% level, *** at the 10% level

In general the results are relatively consistent, returning estimates within a reasonable range for both the currency union effect and the regional co-operation effect. However, these alternative constructions have confirmed the contradictory results given by the fixed and random effects estimates seen previously. It is therefore necessary to further explore and analyse the application of each to this particular dataset. In addition it may be the case that neither of these commonly used techniques are appropriate for the special case of estimating African bilateral trade as the data limits the investigation to purely cross sectional analysis.

### 3.2.5 Fixed, Random or Cross Sectional Techniques?

The first stage of investigation, when confronted by the apparent conflict between random and fixed effects results, is the Hausman test. This is based upon the assumptions inherent within each estimation method. The key assumption to be tested is that the individual specific

random errors, $u_i$, are uncorrelated with the independent variables. This is the central assumption behind the random effects model; in the fixed effects case the unobserved individual or pair specific (or time specific) variables are allowed to be correlated with the independent variables. Under the null hypothesis, $u_i$ are assumed to be uncorrelated with the vector of included variables. Both random and fixed effects are consistent and unbiased under this assumption but the random effects estimator is BLUE (Best Linear Unbiased Estimator). Under the alternative hypothesis however, only the fixed effects estimator is consistent and unbiased. The Hausman test therefore tests the systematic difference between the random and fixed effects estimators and the test statistic is based upon this difference. The null hypothesis is therefore:

$H_0$: Difference in coefficients not systematic

The Hausman test is easily performed by STATA. The original formulations of the estimating equations were tested, although alternative formulations do not change the conclusion of the test. The test statistic returned was 306.76 far higher than the critical value of 18.31 ($chi^2$ at 5% significance) for the distribution. Therefore the null hypothesis is rejected. There exists a systematic difference between the random and fixed estimators, implying that the use of random effects estimation is misplaced and that the fixed effects estimator is more appropriate. Indeed, the random effects approach may be more appropriate if it is believed that '…sampled cross sectional units were drawn from a large population.' (Greene 2003: 293). However this is unlikely to be the case here.

Having found that the fixed effects estimation is the most appropriate panel data approach, it is now necessary to investigate the theoretically contradictory result that this estimation

creates; that a currency union reduces bilateral trade. Several alternative approaches shall be attempted in order to further understand this result before any firm conclusions are made regarding the effects of currency union on bilateral African trade.

TABLE 13: SELECTED ESTIMATES USING ALTERNATIVE PANEL DATA APPROACHES

| | Pair Fixed Effects | Time Fixed Effects | Pair and Time Fixed Effects (Two-way) |
|---|---|---|---|
| Currency Union | -1.81<br>(0.94)*** | 2.93<br>(0.38)* | -1.82<br>(0.94)*** |
| Regional trade agreement | -2.36<br>(0.32)* | -0.89<br>(0.32)* | 3.23<br>(0.67)* |
| Regional economic community | 3.60<br>(0.66)* | 2.18<br>(0.23)* | -2.98<br>(0.32)* |

Controls not reported: Log distance, log product real GDPs, log product real GDP/capita, common language, common land border, number island, number landlocked, log product land areas and common coloniser.
Standard errors in parentheses
* indicates significance at the 1% level, ** at the 5% level, *** at the 10% level

STATA typically executes fixed effects estimation as one-way individual fixed effects, or in this case pair fixed effects (since each pair of countries is treated as an individual with multiple observations over time). This approach fixes the intercepts over time within groups and allows the intercept to vary between groups. This is the preferred technique when considering the time series elements of the data as confirmed by Rose and Glick (2002: 1131): "Since the within estimator exploits variation over time, it answers the policy question of interest, namely the (time series) question "What is the trade effect of a country joining (or leaving) a currency union?"

As an alternative, a time-fixed effects estimator was used. This approach fixes the intercept within groups and accounts for the variation over time. This, as a converse to the pair fixed effects approach, is the ideal model when considering the effect of the cross sectional differences in variables. This model produces more intuitive results, returning similar estimates for the coefficients as was seen under standard OLS and random effects estimations.

This can be seen in contrast to the individual fixed effects results; where the cross sectional elements of the data are considered, currency unions have a positive trade effect; time series dependant estimation however returns counter intuitive results. This shall be explored in the following sections. Further to the time fixed effects estimation, a two-way fixed effect method was also applied, with mixed results. This technique controls for both individual (pair) and time effects. The mixed results can be due to the inclusion of the time series element into the estimation which, as has been seen, tends to return counter intuitive results.

Further inspection of the data explain why reliance on the time series elements of the data may be misplaced and therefore why cross section estimations, either in terms of pure cross sectional analysis or the use of 'between effects' panel data techniques may be preferable to individual fixed effects approaches. The data shows relatively limited movements into and out of currency unions for any one country pair. There are only five countries that joined (or left) a currency union during the estimation period.

TABLE 14: MOVEMENTS IN CURRENCY UNION MEMBERSHIP

| Country | Currency Area | Date of Entry/Exit |
|---|---|---|
| Equatorial Guinea | CFA Franc Zone | 1985 (entry) |
| Guinea Bissau | CFA Franc Zone | 1997 (entry) |
| Madagascar | CFA Franc Zone | 1982 (exit) |
| Mali | CFA Franc Zone | 1984 (entry) |
| Namibia | CMA | 1992 (entry) |

Remembering that the lack of trade data excluded all CMA area observations from the estimated sample, there are very few observations from which to assess the time series effects of currency unions. Furthermore, these entries (exits) tend to be at the beginning of the sample (particularly Mali and Madagascar), decreasing the reliance one should place on the results derived from these data. Whilst these movements are at the beginning of the period

and thus allow for any time lag effects to be taken into account, they are also immediately prior to or during the developing country debt crisis that is likely to have had an adverse effect on bilateral trade, through the effect of an uncontrolled variable (for example through forced revaluations of exchange rates and corrections of government imposed trade policies). Furthermore, the CFA Franc zone went through particular turmoil during this period, having to devalue to against a particularly strong French Franc to maintain trade competitiveness.

There exist therefore intuitive arguments against the use of individual fixed effects estimation for this dataset, since the time series variation within the sample is limited. Given these limitations the question of interest becomes "What is the trade effect of a country being (or not being) part of a currency union?" There are three alternative approaches to answering this question, all of which have already been estimated and reported here, namely: simple pooled panel OLS, time fixed effects estimation and 'between' effects estimation. The consideration of these different approaches is inconsequential however since the results generated are in broad agreement: membership in a currency union has a positive and significant impact on bilateral trade for African countries. The coefficient lies between 1.3 and 2.93, taking the cautionary estimate of 1.3, this point estimate is identical to that found by Rose and Glick (2002) and implies that trade between members in a currency union is triple that of those outside the union[11].

[11] Since log trade is the dependant variable, the coefficient has to be transformed such that $\mathbf{e}^{1.3}=3.66$

# 4 Conclusion

This study has applied the diverse theory of optimal currency areas to the special case of Africa. In particular the study was broken into two distinct sections: A literature review of existing theoretical and empirical studies and, based on that literature review and other constraints, an empirical investigation applied directly to African countries.

It was found that the theoretical literature was generally split into two areas, the traditional OCA theory that first appeared in the seminal paper of Mundell (1961); and the 'modern' theory of OCA which entailed a broader approach to OCA. This broader approach incorporated diverse areas of economics including expectations theory, monetary policy neutrality and the possibility of endogeneity. The main points to emerge from these theories were summarised. An investigation of the empirical techniques was undertaken to inform the empirical section of the study. It was found that there exists a wide range of tools for operationalising the OCA theory. For Africa in particular, various studies had applied some of these techniques with generally mixed results. Where results were positive, in favour of African monetary integration, strong caveats were applied. Based upon the data and time limitations, and the existing studies involving Africa it was decided that two empirical methodologies should be employed. Firstly, a new application of Bayoumi and Eichengreen's OCA index to assess the convergence of existing REC in order to streamline them based on predicted exchange rate variability. Secondly, an augmented gravity model analysis of intra-African trade to capture the possible trade creation effects of currency unions.

Using the convergence of predicted exchange rate variability, the OCA index defined regional economic communities, removing those countries which were members of more than one community using a path dependant stepwise elimination of duplicate countries. No firm

conclusions regarding the suitability of these regional arrangements was possible however since it was found that the OCA criteria used to predict bilateral exchange rate variability were inconsistent over time, indicating that traditional OCA theory may need some adaptation when applied to Africa. Furthermore it was argued that the ultimate arrangement of regional communities will be strongly influenced by political and cultural circumstances as well as purely economic criteria.

The gravity model of intra African trade returned more conclusive results, finding that membership in a currency union increased the level of bilateral trade. This result was robust to several different panel data techniques and specification alterations but was dependant on analysing the cross sectional differences in data. Techniques that assessed the time series element of the data returned a negative effect on trade on currency union membership. It was argued that this was due to the relatively few movements into and out of currency unions and in particular the timing of several entries into the CFA Franc zone. The scarcity of movements into and out of currency unions was in part a result of the relatively short time scale of the data available. Despite these limitations it was argued that membership in an African currency union tripled the amount of trade over non-membership. Whilst this figure was deemed implausible, it supported the hypothesis that the currency union effect on African trade was positive and significant and comparable to previous results found using a global sample.

The study highlighted several important policy implications. Firstly that traditional OCA criterion may be less relevant in Africa and that decisions based upon this traditional theory may be misplaced. This clearly warrants further investigation into the particular economic and social criteria that may influence and affect the outcome of planned regional and continental integration. Following from this it and highlighted previously, the need to streamline current

regional arrangements to avoid duplication of effort and contradictory policy measures is very important as Africa enters into the consolidation phase of the integration process.

Secondly, whilst economic criteria as assessed by other studies may not indicate the suitability of Africa as an optimal currency area, the benefits already being reaped, in terms of increased trade, by those involved in regional currency areas suggests that attempts should be made to promote convergence of economic criteria. Whilst complete monetary unification may never be economically justified it represents a good opportunity to promote the harmonisation of financial, banking and political systems which will increase the efficiency and development of African countries individually.

Clearly Africa represents a unique challenge to policy makers in many areas, in this study I have found that this applies equally to the theory of optimal currency areas. The theory was mostly developed with the European Union as a backdrop and as such certain elements ignore the important differences that exist between African and European countries. This is perhaps the most important research gap that can be identified by this paper that requires much more detailed qualitative case study approach to identify how existing OCA theory can be adapted to the case of African monetary union.

None-the-less I have been able to point to several areas of policy focus for the African nations moving towards integration. These are centrally that regional communities should be streamlined to conserve effort and promote policy harmonisation and that regional currency areas do have the potentially to raise the level of intra-African trade which are currently worryingly low.

# 5 Appendix

## 5.1 OCA Index: Definitions and Sources

| Variable | Definition | Raw Data | Source |
|---|---|---|---|
| $SD(e_{ij})$ | Standard deviation of the change logarithm of the bilateral exchange rate | National currency units per Special Drawing Rights (SDR) | IMF IFS |
| | | National currency units per US dollar | IMF IFS |
| $SD(\Delta y_i - \Delta y_j)$ | Standard deviation of the difference in the logarithm of real output between each country pair | Real GDP in constant 2000 US dollars | WB WDI |
| $TRADE_{ij}$ | Average real value of bilateral trade weighted by real GDP | Imports (CIF) and exports (FOB) from both source and destination countries. | IMF DoTS |
| | | US CPI Index | IMF IFS |
| | | Real GDP in constant 2000 US dollars | WB WDI |
| $SIZE_{ij}$ | Mean of the logarithm of real GDPs of each country pair | Real GDP in constant 2000 US dollars | WB WDI |
| $MIG_{ij}$ | Mean of the absolute net migration weighted by country population for each country pair | Estimates of net migration over successive five year periods. | WB WDI |
| | | Population estimates | WB WDI |
| $M2_{ij}$ | Mean of the M2 ratios of each country pair | Money and quasi money as a proportion of GDP | WB WDI |

## 5.2 Gravity Analysis: Definitions and Sources

| Variable | Definition | Raw Data | Source |
|---|---|---|---|
| Xijt | Log of average bilateral trade | Imports (CIF) and exports (FOB) from both source and destination countries. | IMF DoTS |
| | | US CPI Index | IMF IFS |
| Pop | Population | Population estimates | WBWDI |
| Yi | Real GDP | Real GDP in constant 2000 US dollars | WB WDI |
| Dij | Distance between any pair of countries | Geographic co-ordinates | CIA World Factbook |
| Lang | Common language dummy | Current Official language | CIA World Factbook |
| Bord | Common border dummy | Geographic data | CIA World Factbook |
| REC | Common membership of regional economic community dummy | Historical accounts | Carrere (2004) |
| RTA | Common regional trade arrangements dummy | WTO ratified agreements | WTO |
| Land | Land locked dummy | Geographic data | CIA World Factbook |
| Island | Island status dummy | Geographic data | CIA World Factbook |
| Area | Geographic Size | Geographic data | CIA World Factbook |
| ComCol | Common colonial history dummy | Historical data | CIA World Factbook |
| ComNat | Common nation dummy | Historical data | CIA World Factbook |
| CU | Common currency dummy | Historical accounts | Masson and Patillo (2005)<br>Rose and Glick (2002) |

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