The Law of One Price for African Equity Markets: A joint assessment of integration on an intra-regional basis and with the global market

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African Equity Market Integration: A joint assessment of integration on an intra-regional basis and with the major markets of Europe

Abstract: This paper examines the size and degree of price integration between major regional equity markets in Africa as well as the world market represented by London and Paris. National equity indices are used as a proxy for market prices. Vector Autoregressive and Autoregressive Distributed Lag models are used to determine the interrelationships between national indices. Both methods show similar evidence of price integration between Egypt and Tunisia and France, between South Africa and Namibia and between Kenya and Morocco, with relationships between Egypt, Kenya, South Africa and other markets much weaker. Results suggest that Nigeria is totally price segmented to the rest of Africa and world market, while prices in London and Paris affect Kenya and Egypt. Interestingly, this is not the case for South Africa, despite the adoption of the London trading system and the inclusion of South African firms in the FTSE range of indices.

JEL classifications: C32, G15, O16
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1. Introduction.

Africa's securities markets have seen unprecedented change over the last fifteen years with the rapid growth and development of existing bourses and the establishment of new markets. Despite this growth very few of the markets have been included in popular investment benchmark indices such as the Standard & Poors Frontier Market index until very recently and as such are rarely considered by emerging markets fund managers. Given the rapid development of these securities markets, and the importance of attracting capital to supplement extremely low domestic savings rates that are currently a barrier to economy wide investment, an important research area is the examination of the degree of integration of these markets both between themselves and other world equity markets. Equity market integration across borders indicates the potential for markets and assets to be included in portfolios where premiums between substitutable instruments in different markets are close to zero and prices for similar assets are equal (Levy et al, 2006). Where this is the case, there is real potential for increased risk diversification in the investment portfolios of fund managers. The Law of One Price for mutually substitutable identical assets traded in different markets is a fundamental law of economics and is an effective measure of integration. Basic assumptions of the law of one price include: that purchasing power parity holds between markets; that markets are information efficient with prices reflecting all available information; that investors adhere to the rational expectations hypothesis; and that there are no restrictions on arbitrage trading between markets so that equilibrium is achieved through asset supply and demand (Lamont and Thaler, 2003).

However, in practice perfect arbitrage rarely exists owing to transactions costs between markets. These include brokerage fees and commissions as well as payment, clearing and settlements costs, plus foreign exchange exposure where settlements commonly take three or more days. As such arbitrage would be expected to take place within bands (Levy et al, 2006) where the premium "lost" within the band is due to inter market transactions costs. Foreign ownership, capital controls and costly information acquisition all hinder potentially seamless arbitrage between markets. However liquidity and the inability to sell short are the most significant factors in hindering overseas investors from equalising prices across markets. This is particularly relevant in Africa where short sales are outlawed due to the liquidity impact of trades and the exacerbation of volatility (Pagano, 1989). The majority of markets in Africa, with the exception of Egypt and South Africa, are served only by locally owned brokerage houses and investment banks. There are serious concerns that these markets lack the human capital and experience found in the foreign investment houses in developed markets. For example, there are concerns that miss-priced assets are offered to the market through initial public offerings (IPO). In many cases, the reputation of the investment house is considered as important in the pricing of IPOs as that of the company itself (Kenny and Moss, 1998), with clear incentives for banks to misrepresent clients assets to be released on market (Chemmanur and Fulghieri, 1994). This "marketing" incentive, combined with the often local undercapitalisation of brokerage houses (Kenny and Moss, 1998) creates enormous potential for adverse selection and moral hazard where investors can not be sure of an assets true value. Undercapitalisation of the local brokerage industry also hinders the capacity to underwrite new issues and provide both liquidity and assurances to the market as well as adding to the cost of acquiring information for foreign investors.

In order to resolve some of these problems and increase liquidity in the major markets, The New Partnership for Africa's Development (NEPAD) has proposed a policy framework to encourage integration of equity markets on a regional basis, with four central hubs: South Africa, Nigeria, Kenya and Egypt. This paper considers whether the law of one price holds for assets traded in the major markets in Africa. This identifies whether markets in Africa are price integrated and if so, what feedback mechanisms exist, plus whether these markets are integrated with world equity market represented by London and Paris. The paper proceeds as follows. The next section briefly discusses the theoretical concepts of the Law of One Price. Section 3 describes the characteristics of markets in Africa, followed by details of the data and some preliminary analysis in Section 4. The models and results are in Section 5, which includes a discussion of the implications for African financial markets and any policy recommendations. The final section concludes.

2. Theoretical Considerations of Equity Market Price Integration

Three strands of the literature on the law of one price are appropriate to the measurement of financial market integration. The first uses pricing models to measure premiums or discounts between markets. However, inherent in pricing model assumptions is the joint hypothesis of market efficiency, which states that security prices contain all information available, and for weak form efficiency, that prices reflect information to the point where the marginal benefits of acting on information do not exceed the marginal costs (Fama, 1991). As a direct result of this joint-hypothesis, when pricing models produce unexpected results it is difficult to apportion anomalous results due to hidden information (Fama, 1991). Pricing models are either variations of the Capital Asset Pricing model (CAPM) or the Arbitrage Pricing model (APT). Both models are used to identify pricing or premium differences for similar asset classes across markets.

The second concerns correlations between index returns within markets with the benefits of portfolio diversification. Piesse and Hearn (2002) used cointegration to investigate financial integration based on the law of one price between the markets of Namibia, South Africa and Botswana during the 1990's. Several papers have used the same methods for developed markets, for example Corhay (1993) and a few papers have similarly studied the emerging markets of Asia and Latin America. All of these papers are subject to composition bias because of the different construction of national indices, which can only be resolved by considering closed-end country funds and the difference between fund value and the underlying held assets derived from net asset value of the fund. Another group of papers report the differences between American Depository Receipts (ADR) and General Depository Receipts (GDR) to their underlying assets (Lamont and Thaler, 2003). However, this is not appropriate in African markets as there are few liquid ADR or GDR instruments. Furthermore with the demise of the Morgan Stanley Africa Fund in 2002 (Bloomberg LP, 2007) the only closed-end funds are currently restricted to Egypt or South Africa.

A third strand of literature uses Threshold Autoregressive (TAR) models, which focus on the equivalence of the inter-market equity premium outside the bands of no-arbitrage caused by market frictions and transactions costs. Levy et al (2006) reports that financial integration increases with increased liquidity while intuitively, capital controls increase the size of the threshold band of no-arbitrage and increase segmentation.

This study extends Piesse and Hearn (2002) but within the context of the largest African markets and assesses potential overlap with world markets, represented by London and Paris. There is a risk of aggregation bias through the use of market indices as proxies for the underlying national markets, but this is unavoidable due to the lack of country funds and liquid ADR/ GDR issues. Vector Autoregressive and Vector Error Correction models, plus Autoregressive Distributed Lag models are useful in interpreting both potential price integration as well as feedback effects between markets when there is evidence of integration. This follows Harris et al (1995), where these methods are used to test the law of one price within the context of informationally efficient markets with prices incorporating all possible information. Harris et al (1995) focussed on the price history of one stock between three rival domestic exchanges within the US in a study that was free of any potential aggregation bias despite using indices

3. Securities Markets in Africa

Significant improvement in Africa's securities markets has taken place during the last decade. Since 2001, the majority of stock exchanges have websites detailing operations and almost all markets have adopted the internationally recognised International Security Identification Number (ISIN) system for asset identification. Additionally, there has been a widespread abolition of capital gains tax, and the harmonisation of corporate and securities tax regimes and accounting standards across the Southern African Development Community (SADC). Former irregular and other-the-counter market structures in many of the smaller markets have been overhauled and upgraded into well designed call-over auctions or open outcry trading floors, while larger markets such as Namibia, Johannesburg and Egypt now have computerised order matching systems. Market settlement systems have become increasingly compliant to internationally recognised G30[3] standards in order to reduce transactions costs, making individual markets more competitive in attracting order flow. The rapid pace of development of existing markets is matched by the more recent establishment of new markets in Mozambique, in 1999, Libya, in 2002, Cameroon and Gabon, in 2003, and Angola, in 2006.

However, despite these improvements, almost all African markets suffer from a persistent lack of liquidity, with few companies meeting stringent listings requirements, and low levels of market capitalization to GDP. Markets also lack completeness with many having been established in some of the poorest countries in the world with high levels of poverty emancipating many of the local population. As such there is little room for savings as income generated is spent immediately on consumption and longer term institutional investment through pension funds is hindered by extremely low life expectancy due to HIV/ AIDS (Piesse and Hearn, 2006). Stock market awareness is also a major issue where subsistence agriculture and micro-enterprises dominate the business environment and domestic savings preferences amongst rural population often can take the form of heads of livestock or commodities as opposed to either bank deposits or stock market investment. These preferences are rooted both in traditional values and beliefs as well as the fear of loss of value in monetary instruments where many countries have experienced hyperinflation and macroeconomic instability in recent history. Non- institutional and small investors also tend to be reluctant to participate in markets fearing a paucity of small-investor protection legally (Uganda: Selected Issues and Statistical Appendix, IMF, 2005).

[3] The Group of Thirty encourages standardization and improvement in global securities administration. In 1989, the following recommendations were agreed: i) Brokers should match trades on day after deal date (T+1); ii) Trade confirmation on trade day plus 2 days (T+2); iii) Central Depository for safe keeping of shares; iv) Net basis settlement of cash and stock; v) Settlement takes place as delivery vs. payment or receipt vs. payment; vi) Settlement in same day funds; vii Settlement effected on trade date plus 3 days (T+3); viii) Securities lending should be permitted; ix) International securities numbering system must be adopted (ISIN code).

< Table 1 about here >

Table I shows the ratio of domestic savings and market capitalization in relation to GDP. The latter proxies the size of stock market in relation to overall economy and is very low, with the exception of South Africa where levels of participation of markets in the economy are approaching the levels of developed OECD countries. Although many countries have now formally passed foreign direct investment bills into law and ratified securities market legislation in order to regulate the markets and provide effective investor protection, attracting foreign investors has been a persistent problem for the majority of markets in Africa. Again South Africa, and also Egypt are notable exceptions. Foreign investor wariness of investment in Sub Saharan African (SSA) markets is highlighted in a 2003 World Bank report citing investment in SSA excluding South Africa attracted only US$500 million in foreign equity investment, which represented 3.5% of worldwide flows valued at US$ 14.3 billion (African Business, 2005). Since the withdrawal of Morgan Stanley Africa Fund in 2002, only two prominent fund managers, Old Mutual (Bermuda) and Lazard Brothers (Luxembourg), retain investment funds specifically directed at Africa and these are directed only towards South Africa and Egypt respectively.

The supply side of African markets is hampered by lack of listings and paucity of investment opportunities. In 2001, the World Bank reported that 313 million people live on less than US$1 a day and subsistence agriculture and micro-enterprises tend to dominate the domestic business environment many companies lack the capital structure in order to meet listings requirements (World Bank, 2003 and Marone, 2003). Many listings are the result of state sponsored IPOs as part of the privatization of government holdings in parastatals. Privatizations have been a central theme in IMF and World Bank reform packages directed at governments in order to generate efficiencies in state controlled institutions. New listings resulting from this, and the subsequent increase in market capitalisation, does not necessarily increase market liquidity, causing domestic companies to raise capital from overseas primary equity and ADR listings or seek greater reliance on internal sources of finance.

In order to address the problems of African markets, the SADC Committee of Stock Exchanges (COSSE) members launched Project Thusanang in 1997. This has the common objective of integration of equity markets within member states with trading system centred on the larger, more established and high successful Johannesburg Stock Exchange. The motivation is to gain deepening of secondary markets and increasing liquidity that are essential to retain and attract further investment. SADC regional markets have already adopted South African listings and accounting standards, while retaining some autonomy necessary to reflect the concerns of their fragile domestic business environments. Markets in South Africa and Namibia shared a trading system from 1998, prior to their joint migration to the London Stock Exchange Shares Electronically Traded System (SETS) in 2002. The platform of this system is located in

London and stocks from both markets benefit from inclusion in FTSE Africa indices and from access to marketing opportunities on London market. Zimbabwe and Zambia have expressed some commitment to upgrade their own domestic trading systems and associated hardware in order to migrate across to the common South African sponsored FTSE SETS platform, although only Zambia shows any signs of progress.

Integration of stock markets is progressing, with the first stage taking place amongst the regional hub markets of the Northern, Southern, Eastern and Western African trading communities. In the East African Community, listings and accounting standards are harmonised and cross listings are taking place between Tanzania and Uganda and the dominant market of Kenya and a common central securities depository, CSD, will be based in Nairobi. There is a common trading area and a considerable degree of macroeconomic policy harmonisation. Integration in North Africa has only taken place between the two Egyptian domestic markets in Cairo and Alexandria, which now form the Egyptian Stock Exchange. Memorandums of Understanding have been signed between many of the sub-regions markets, where there are high levels of infrastructure including electronic trading platforms and CSD. Integration amongst countries in the more fragmented West African has been frustrated by difficulties. These include the introduction of a common currency and harmonisation of macroeconomic policy, but the process is also stalled by lack of agreement over common market regulation given the differences between Francophone countries' French civil law legal code and the English common law prevalent in Ghana and Nigeria.

4 Data and Descriptive Statistics

a) Market sample set and indices

The sample has been selected on the basis of data availability, market size and relative level of development. This excludes the smaller and highly illiquid markets which exhibit strong first order autocorrelation and severe price rigidity. Egypt, Kenya, Nigeria and South Africa are defined as markets at the centre of regional integration, in line with NEPAD policy. The nominal end of week closing values of indices are used, denominated in local currency units. Index data have been sourced directly from the local markets for Tunisia, Namibia, Nigeria, and Mauritius, and all other markets are from Datastream. US$ exchange rates are from Datastream and Bloomberg. Background information on the markets was obtained from IFC statistics database, Standard & Poors Global Markets Factbook and media publications via the internet in addition to the Nigerian Stock Exchange Factbook. The stock exchanges also provided significant amounts of supplementary information on regulation, market operations, listings and ownership.

< Figure 1 about here >

< Figure 2 about here >

The construction of domestic indices and the trading systems and times are reported in Table 2. Trading times in all markets are largely synchronous, with all countries being either one hour less or two hours more than the South African time zone. The index data are converted to a US$ equivalent using same frequency US$ exchange rates. These are then expressed in natural logarithms and differenced to create the final adjusted returns series (see Figure 2). Transforming the series to US$ equivalents in value removes the effects of domestic inflation on domestic price levels, by substituting the more stable US inflation in its place. This is based on the assumption of purchasing power parity (PPP) between US$ and local currencies. In addition, time series denominated in US$ terms are easily recognised and commonly used by overseas investors for performing market analysis for cross country portfolio investment.

< Table 2 about here >

b) Returns series analysis

Emerging stock market returns series are usually regarded as being different from those of developed markets and are characterised by significant departures from a normal distribution, particularly in measures of skewness and kurtosis. These data are no exception and the choice of end of week closing values is justified given it is of sufficiently high frequency to capture market movements while not giving rise to many additional complications inherent in very high frequency data such as daily or intra-daily (Mandelbrot, 1999). Table 3 reports descriptive statistics. Kenya and Namibia exhibit the highest level of kurtosis (10.89 and 5.27), which are much greater than that of a normal distribution (3). This departure from normality is confirmed by the Jarque-Bera statistics, which again are high for these countries (2,149.16 and 473.95). Kenya exhibits considerable skewness (1.51), and the overall departure from normality is explained by the presence of very large and significant outliers during the sample period. In a small, illiquid market there is insufficient liquidity to absorb shocks that would be relatively insignificant to a more developed market with greater depth. For Namibia, the largest outlier is on 2 August 2002 (-0.2119) and is due to the migration of trading and indices to the London Stock Exchanges SETS. For Kenya, the largest outliers are caused by variation in the US$ exchange rate and can be explained by macroeconomic fluctuations and trade balance affecting value rather than by domestic corporate events in the market. In contrast, the other markets within sample group, including those of Paris and London, all have skewness values comparable to a normal distribution centred on zero, and Jarque-Bera statistics that are within the acceptable range.

There are generally very low levels of correlation across the sample with only a few notable exceptions. There are high correlations between markets in Paris and London (>0.8) and between South Africa and Namibia (0.63), and a lower value between Tunisia and Morocco (0.3), as shown in Figure 2.

< Table 3 about here >

5. Empirical Results and Discussion

a) Unit Root tests

The unit roots tests were performed following Appendix 1a and reported in Table 4. Unit roots are detected in all series at the 95% confidence level with Dicky-Fuller representations. The sole exception is Kenya, which has one lag. The Table shows that all series are I(1) with or without a deterministic trend.

< Table 4 about here >

b) Bivariate and multivariate tests of cointegration

Bivariate vector autoregressive (VAR) models were generated for each of the three core markets, Kenya, Egypt and South Africa, plus one additional market from the sample. To minimise the risks of pre-specification bias, pulse dummy variables that may explain significant outliers have been excluded from any of the bi- or multivariate VAR and VECM models. The Johansen trace statistics are reported for each bivariate VAR system in Table 5. These results indicate considerable links between Egypt and Kenya and other markets, but far fewer relationships between South Africa and other markets. Only two possible relationships are identified between Nigeria and other markets. However, these results do not indicate the relative strength and direction of price relationships between markets.

< Table 5 about here >

Multivariate cointegration tests assess the presence of cointegration within VAR models containing two of the core regional markets, with which other markets are assumed to be integrated, plus a third market. As such trivariate VAR models were set up with South Africa, Egypt against South Africa, Kenya against Kenya, Egypt plus a third country in each case. The results are in Table 6. These results suggest that South Africa and Egypt together exhibit considerable integration when examined alongside a third market and this relationship is stronger than combinations of either South Africa or Egypt with Kenya and a third country. As such, the markets of North Africa and those of Southern Africa exhibit stronger levels of integration and statistical linkages than those of East Africa. The results of cointegration from the bivariate analysis reported in Table 5 concerning Nigeria are too inconclusive for this country to be further analysed within a multivariate context and is considered largely segmented as a result.

< Table 6 about here >

c) Granger non-Causality for cointegrating and non-cointegrating systems

The Granger non-causality for cointegrating systems, established by the vector error correction model using the bivariate VARs, demonstrates there is a single cointegrating vector. This is shown in Appendix 1 with the normalised cointegrating vector or long term relationship between variables in each case. The causality is inferred from the significance at 95% level of the F-statistic of each error correction equation for each of the two dependent variables contained within the original VAR model. The results are summarized in Figures 3 to 5 for each regional centre of market integration, that is, Egypt, Kenya and South Africa. These results suggest that South Africa has fewer common stochastic relationships with other African markets than Kenya and Egypt. However the size and significance of the bivariate Johansen trace statistics and VECM error correction terms would infer that those common relationships South Africa does have are stronger than those of Kenya and Egypt.

< Table 7 about here >

The block Granger non-causality for cointegrating and non-cointegrating systems, derived from the unrestricted bivariate VAR model are reported in Table 7. Non cointegrating index series are included as variables in their first differences and then examined for their statistical dependence on each other, included variables lagged values. Known cointegrating index series are included similarly but in the levels. The results of these tests, undertaken within a simple structural VAR framework, assess the statistical dependency on one lagged variables on another within a bivariate VAR. They largely reinforce the findings of the formal cointegrational VAR/VECM outlined in Figures 3 to 6 and Appendix 2. Block Granger-causality runs from South Africa to Namibia, Egypt and Mauritius as well as to a much lesser extent to France. Kenya has a bi-directional relationship with the UK and Egypt but block Granger-causes Mauritius, while Egypt is strongly influenced by the European markets of the UK and France but has a much weaker relationship with Namibia and South Africa. Nigeria, the most segmented country of the entire sample, slightly Granger-causes Namibia and is slightly Granger-caused by the UK. These results would infer that block Granger-causality is strongest from the regional hub markets to the satellite markets in their immediate vicinity. Mauritius, although not exhibiting any strong cointegrating relationship is a “price-taking” market influenced by Kenya, Egypt and South Africa, all of which border the Indian Ocean and Red Sea. Kenya and Egypt have a closer relationship to world capital markets, denoted here by the UK and France, than to South Africa.

< Figures 3–6 about here >

d) Impulse Response Analysis

Impulse response models measure the time taken for a VAR system to recover following a one standard deviation shock in the error term, and these are illustrated in the Figures in Appendix 2. In several cases, the Figures show that individual series take lengthy periods to recover from a shock applied to the error term of other series within the VAR framework. This provides useful inferences on the relative strength of the cointegrating relationships that exist between markets. The relationship between South Africa and Namibia, Appendix 4b, is particularly strong with recovery from a shock in the equation for Namibia taking 47 weeks. The relationship between South Africa and Kenya is weaker and takes approximately 145 weeks before recovery to a long term relationship following a shock to South Africa. The patterns for South Africa and Egypt are much weaker and more diffuse. In Appendix 2a, the relationship of Egypt to the other markets shown to be both scattered and insubstantial, with many taking over 150 weeks to recover from a shock in the Egypt series. The principal exceptions are those of the UK, where recovery takes place at 80 weeks, France at approximately 145 weeks, Morocco at 148 weeks, and Tunisia at 140 weeks. For Kenya, in Appendix 3c, there is a more stable profile than those of Egypt or Nigeria, but even then, there are periods in excess of 120 weeks necessary to recover from shocks. One interesting relationship is that between Kenya and Morocco, taking 75 weeks to recover from a shock on Kenya in the equation for Morocco. Relationships with Nigeria, Appendix 4d, are characterised as extremely weak and diffuse. Gradient functions are also subject to parameter instability inferring potential inconsistency and structural breaks within underlying series.

e) Augmented ARDL Analysis

The first stage in the ARDL methodology is to test the joint probability that all variables within the hypothesized long run error correction relationship are different from zero. An F-test is used, with a non-standard F distribution inferring two critical bounds: a lower bound, below which series are considered to be not related with no further ARDL testing necessary in the second stage, and an upper bound, above which series are automatically referred to the second stage of formal inclusion within ARDL model. Test statistics falling between the two bounds are defined to be fractionally integrated and as such are be subjected to individual unit root testing. These results, prior to inclusion in the second stage of ARDL analysis are in Table 8. The F-test statistic of each market return series is included as a dependent variable in the levels within an error correction model, with the independent variable in first differences given in Table 8. It is immediately visible that far fewer potential relationships are likely to exist between markets using this approach.

< Table 8 about here >

All pairs of series exhibiting potential relationships from Table 8 are further analysed using bivariate ARDL models, with results shown in Appendix 5. The individual bivariate analyses focussed on relationships of the four regional market integration hubs, Kenya, Nigeria, South Africa and Egypt, and are shown in Figures 7 to 10. The arrows and direction are proportional to the underlying statistically derived relationship.

< Figures 7-10 about here >

Overall, the results of the ARDL model complement those of the earlier VAR/VECM analysis. Nigeria is completely segmented from the other African markets and the world capital markets, whilst the majority of relationships that Egypt and Kenya have with other markets are very weak. The principal exceptions are the strong relationships between Kenya and Morocco, Egypt and France, and Egypt and Tunisia. Thus, Kenya is weakly integrated and influenced by the world capital markets and has risk-adjusted premiums that are minimal comparable to those on the world capital market. This offers little opportunity for Kenya to attract investment capital that could increase domestic growth. Egypt is different in being more strongly integrated with France. Furthermore, other local markets in the region would benefit from trans-Mediterranean investment and close proximity to the European Union. Egypt's close relationship to Tunisia reflects both geographical proximity and the similarities between the two markets, in terms of partial adherence to Shari'ya regulation and Islamic principals of finance as well as a common level of development and openness to foreign portfolio investment.

South Africa has a very close and well documented relationship with Namibia (Piesse and Hearn, 2002). The results of this analysis in using a more recent sample period, would infer that this relationship has become stronger. The VAR/VECM provides evidence that a 1% change in South Africa's index price level is followed by a 0.901% change in Namibia and the ARDL demonstrates a 1% change in South Africa is followed by a 0.835% change in Namibia index price levels. This is most likely the result of these markets jointly adopting the London Stock Exchange SETS electronic trading system in 2002, their common central depository system for clearing and settlement of trading and their parallel macroeconomic arrangements that follows their membership of the Common Monetary Area (CMA). Furthermore, over 70% of Namibian stocks are dual listed on the Johannesburg exchange (Irving, 2005), significantly enhancing the joint price discovery process. There is only a weak relationship between South Africa and Kenya with Kenya "price taking" or being influenced Granger-causally by the South African market.

These result provide strong support that integration is taking place within distinct geographical regional hubs, notably Kenya, Nigeria, Egypt and South Africa. Smaller "satellite" markets such as Namibia, in relation to South Africa, and Tunisia, in relation to Egypt, are price influenced Granger-causally through their relationships with the larger hub markets. Because of Egypt's position in the Mediterranean basin, this market is more strongly integrated with the world capital markets than Kenya. However, Kenya is unique in exhibiting a strong relationship with Morocco in the north. This relationship, together with the relative strength found through other cointegrating relationships, is hard to explain as there are no obvious reasons for these two markets to have common trends as they share no cross listed stocks and have different trading systems. One explanation is that both markets share a similar level of development, but this is a fairly flimsy connection, although intra-market price discovery mechanisms due to local investment banking firms providing liquidity to the market and the pricing IPO's is likely to be similar despite the obvious differences in market microstructure.

6. Conclusions and Policy Implications

Overall there little evidence of price integration between Africa's equity markets. The principal exceptions being Namibia and South Africa, and Egypt and Tunisia respectively, where both component markets in each case share similar macroeconomic and trade arrangements. The relationship between Namibia and South Africa has already been reported by Piesse and Hearn (2002) while Egypt and Tunisia benefit from close proximity to European Union, EU, in terms of macroeconomics and preferential trading arrangements as well as a similar immediate environment in the distinctive Maghreb North African region. Egypt also shares a cointegrating relationship with Paris further demonstrating the overlap between the EU and North Africa. Egypt's markets are more open to the world market and many local investment banks are either owned or involved in joint ventures with established European counterparts. The relationship between Kenya and Morocco is harder to explain although both markets may share similar industrial sector participation in exchange indices while also having similar relationships to Europe and the world capital market.

Overall equity market integration tends to take place between markets that are linked through other shared exogenous macroeconomic and trading arrangements. Generally there is very little price integration between the continents markets which is indicative of poor information flows both within and between markets. Suggestions of a continent wide mutual fund to remedy issues caused by poor information flows and lack of liquidity would likely be subject to serious problems of persistent mis-pricing between fund's net asset value of underlying assets and the value of fund itself. A combination of broker undercapitalization and short sales constraints in almost all of the continents markets hinders investors ability to arbitrage away persistent price differences of assets between markets. The reluctance of domestic regulators over the removal of short sales constraints which if removed could increase the chances of market crashes seen in Asia and Latin America are at same time responsible for enforcing the persistence of price differences between markets rendering them vulnerable to potential arbitrageurs who can overcome the informational and transaction cost differences between markets. While these markets carry little value in global terms the current regulations should work, but are likely to fail when these markets grow in importance and value terms vis-à-vis with the rest of the world.

References

African Business (2005) African Business current affairs magazine, London: IC Publications.

Bloomberg LP (2007) Financial data vending system and news service. New York: Bloomberg LLP

Corhay, A., Rad, A.T. and Urbain, J.P. (1993), Common Stochastic Trends in European Stock Markets, *Economics Letters*, **42**, pp.385–90.

Chemmanur, T. J, and Fulghieri, P. (1994) Investment Bank Regulation, Information Production, and Financial Intermediation. *The Journal of Finance*, **49**(1), 57-79

Dickey, D. A. and Fuller, W. A. (1979) Distribution of the Estimators for Autoregressive Time Series with a unit root. *Journal of the American Statistical Association*, **74**

Fama, E. F (1991). Efficient Capital Markets: II. *The Journal of Finance*, **46**(5), pp.1575-1617.

Harris, deB. F. H, McInish, T. H, Shoesmith, G. L, and Wood, R. A. (1995). Cointegration, Error Correction, and Price Discovery on Informationally Linked Security Markets. *The Journal of Financial and Quantitative Analysis*, **30**(4), pp.563-579.

Irving, J. (2005). Regional Integration of Stock Exchanges in Eastern and Southern Africa: Progress and Prospects. IMF Working Paper WP/05/122. Washington, DC: International Monetary Fund

Johansen, S (1989) Statistical Analysis of Cointegrating Vectors. *Journal of Economic Dynamics and Control*, **21**

Johansen, S (1991) Estimation and Hypothesis testing of cointegrating vectors in Gaussian Vector Autoregressive Models. *Econometrics*, **59**

Kenny, C and Moss, T (1998) Stock Markets in Africa: Emerging Lions or White Elephants? *World Development*, **26**(5), pp.829-843

Lamont, O and Thaler, R. H. (2003) Anomalies: The Law of One Price in Financial Markets. *The Journal of Economic Perspectives*, **17**(4), pp.191-202

Levy, E, Sergio, Y, van Horen, S. N. (2006). International Financial Integration through the Law of One Price. World Bank Policy Research Paper 3897, April 2006. Washington, DC: World Bank

Marone, H. (2003) Small African Stock Markets – The Case of the Lusaka Stock Exchange. IMF Working Paper WP/03/6. Washington, DC: International Monetary Fund

Pagano, M. (1989). Endogenous Market Thinness and Stock Price Volatility. *The Review of Economic Studies*, **56**(2), pp.269-287

Pesaran, M. H. and Shin, Y. (1995) An autoregressive distributed lag modelling approach to cointegration analysis. DAE Working Paper No. 9514, Dept. of Applied Economics, University of Cambridge.

Pesaran, M. H., Shin, Y. and Smith, R. (1996) Testing for the existence of a long-run relationship. DAE Working Paper No. 9622, Dept. of Applied Economics, University of Cambridge.

Piesse, J and Hearn, B (2002) Equity Market Integration versus Segmentation in Three Dominant Markets of the Southern African Customs Union: Cointegration and Causality tests. *Applied Economics*, **34**(14), pp.1711-1722

Piesse, J and Hearn, B (2006) Is there a role for micro-markets in sub-Saharan Africa? A Study of the Swaziland stock exchange. Kings College London Department of Management Research paper series, Research paper: 44

Uganda: Selected Issues and Statistical Appendix (2005), IMF Country Report: 05/172. Washington, DC: International Monetary Fund

Table 1. Summary of trading statistics on national stock markets in sample group

Country		*Gross domestic savings (% of GDP)*	*Market capitalization of listed companies (% of GDP)*	*Stocks traded, turnover ratio (%)*	*Stocks traded, total value (% of GDP)*
Egypt, Arab Rep. (1888/1903)	1996	10.82	20.99	22.18	3.64
	2000	11.69	28.87	34.74	11.18
	2003	15.23	32.84	13.73	3.98
Morocco (1929)	1996	16.22	23.77	5.86	1.18
	2000	17.44	32.70	9.22	3.28
	2003	19.72	30.08	6.45	1.59
Tunisia (1969)	1996	23.51	21.75	1.45	1.43
	2000	23.75	14.54	23.29	3.22
	2003	21.02	9.84	7.16	0.66
Nigeria (1960)	1996	34.87	10.09	2.59	0.20
	2000	33.43	10.08	7.29	0.63
	2003	31.80	16.26	10.99	1.47
Kenya (1954)	1996	13.19	19.98	0.28	0.72
	2000	5.68	12.24	3.58	0.45
	2003	8.26	29.06	7.41	1.45
South Africa (1887)	1996	18.80	168.37	10.88	18.93
	2000	18.51	160.13	33.90	60.53
	2003	18.57	167.46	44.80	64.30
Namibia (1992)	1996	15.10	13.55	11.50	1.17
	2000	14.03	9.11	4.51	0.64
	2003	15.39	7.20	0.74	0.04
Mauritius (1988)	1996	23.79	40.35	2.29	1.87
	2000	24.17	30.06	5.01	1.70
	2003	25.33	37.43	6.22	1.90

Source: Compiled by author from IFC statistics database

Table 2. Summary of institutional and trading arrangements on national stock markets within sample group

Market	Trading Hours	Trading Arrangement	Index	Details of Index Construction
Egypt (Cairo and Alexandria)	Listed Securities Market (On the Exchange): 11-30am – 15-30pm	Electronic order matching system for Cairo and Alexandria Stock Exchanges (CASE) – The CASE Trading System, or CTS	Two Indices: "CASE 30 Index" and "Dow Jones CASE Egypt Titans 20 Index"	**CASE 30 Price Index** is designed and calculated by CASE. CASE started disseminating its index on 2 February 2003 via data vendors, its publications, web site, newspapers etc. The start date of the index was on 2/1/1998 with a base value of 1000 points. CASE 30 Price Index includes the top 30 companies in terms of liquidity and activity. CASE 30 is a price index i.e. it measures the return on investment from the change in market value of the stock (capital appreciation/depreciation) only. CASE 30 Price Index is weighted by market capitalization and adjusted by the free float. Adjusted Market capitalization of a listed company is the number of its listed shares multiplied by the closing price of that company multiplied by the percent of freely floated shares. For a company to be included in CASE 30 Index, it must have at least 15% free float. This ensures market participants that the index constituents truly represent actively traded companies and that the index is a good and reputable barometer for the Egyptian market.
Kenya	10-00am – 12-00noon	Open Outcry (commenced by sounding of a bell)	NSE All Share and NSE 20 Share Index	**NSE 20 Share Index:** Geometric mean of the top twenty companies traded on exchange. Index recalculated according to algorithm at end of each trading session. **NSE All Share** is market capitalization weighted and takes account of all lines of stock on market.
Mauritius	9-00am – 11-30am	Open Outcry	SEMDEX (All Share)	**SEMDEX All Share**: The SEMDEX reflects capitalisation based on each listed stock that is weighted in accordance to its shares in the total market. In its computation, the current value of the SEMDEX is expressed in relation to a base period, which was chosen to be 5 July 1989, when Index was 100.
Morocco		Electronic order matching system	**MASI®** (Moroccan All Shares index) AND **MADEX®** (Moroccan Most Active shares Index)	**Two Main Indices**: The **MASI®** (Moroccan All Shares index), and the **MADEX®** (Moroccan Most Active shares Index). Each are recalculated at the end of each trading session and are weighted in accordance to market capitalization.
Namibia	9-00 am – 4-00 pm	Electronic (JET) trading link	NSX All Share	**NSX All Share**: Capital weighted average with base period in 1992 at start of index – 100.

All trading hours quoted are in local time. Nigeria is –1 hours less than South Africa, Kenya and Mauritius are +1 and +2 hours ahead of South Africa. Source: Compiled by authors from Datastream and respective national stock exchange

Table 2 (continued). Summary of institutional and trading arrangements on national stock markets

Market	Trading Hours	Trading Arrangement	Index	Details of Index Construction
Nigeria	11-00am to 13-00pm	Call Over trading system was replaced in April 1999 by Automated Trading System (ATS) which serves as an electronic order matching system.	NSE All Shares Index	**NSE All Share Index**: The Exchange maintains an All-share Index formulated in January 1984. Only common stocks (ordinary shares) are included in the computation of the index. The index is value-relative and is computed daily.
South Africa	8-25 am – 9-00 am: Pre-Opening electronic call auction. 9-00 am – 4-00 pm: Continuous Trading. 4-00 pm – 6-00 pm: Run-Off.	JSE SETS Electronic Trading system (SETS trading system has been in place at the London Stock Exchange and replaced the former JET system in 2002)	JSE/Actuaries Index	**JSE/Actuaries Index**. The price index is formed as the total market capitalisation divided by the market divisor. The market divisor is defined as the base value of capitalisation, and is attached to all corporate actions on market in an attempt to adjust these actions to keep overall index constant. Any capital structure changes need to be accommodated in the index divisor. Indices are under effectively constant review in terms of potential corporate actions.
Tunisia	9-00am to 10-00am: Pre-opening// 10-00am – 11-30am Trading Session	Electronic order matching system	BVMT Index	**BVMT Index**. Market Capitalization weighted index of all companies traded on exchange.

All trading hours quoted are in local time. Nigeria is –1 hours less than South Africa, Kenya and Mauritius are +1 and +2 hours ahead of South Africa. Source: Compiled by authors from Datastream and respective national stock exchanges

Table 3. End of Week Index Returns Series (Natural Log of USD converted Returns) - Sample Statistics for markets with time series from January 1998 to January 2006

Descriptive Statistics	Kenya	South Africa	Mauritius	Namibia	Nigeria	Egypt	Morocco	Tunisia	UK (FTSE)	France (CAC 40)
Skewness	1.51577	-0.51501	0.48765	-0.38070	-0.00668	0.16860	0.27101	0.77442	0.22914	0.06306
Kurtosis	10.89512	1.34121	4.03929	5.27813	2.98123	2.99417	3.21346	2.36045	2.07111	1.24018
Std Dev	0.02629	0.03801	0.01356	0.04106	0.02766	0.04263	0.02170	0.01656	0.02177	0.02793
Max Value	0.20307	0.12783	0.06458	0.23588	0.09994	0.20972	0.10864	0.08027	0.08790	0.09824
Min Value	-0.11442	-0.13859	-0.06531	-0.21290	-0.12790	-0.19255	-0.08336	-0.04368	-0.10351	-0.10866
Mean	0.00023	0.00314	0.00102	0.00203	0.00182	0.00313	0.00106	0.00091	-0.00057	-0.00139
Median	-0.00246	0.00580	0.00004	0.00393	0.00060	0.00172	0.00023	-0.00017	-0.00300	-0.00360
Jarque-Bera Statistic	2,149.16	47.02	286.95	473.94	146.45	149.69	175.51	132.50	73.53	24.75
Correlation coefficients	**Kenya**	**South Africa**	**Mauritius**	**Namibia**	**Nigeria**	**Egypt**	**Morocco**	**Tunisia**	**UK**	**France**
Kenya	1.0000									
South Africa	0.0646	1.0000								
Mauritius	0.1266	0.0051	1.0000							
Namibia	0.0442	0.6391	-0.0651	1.0000						
Nigeria	0.0182	0.0231	0.1150	0.0067	1.0000					
Egypt	0.0387	0.1828	0.1112	0.1137	0.0252	1.0000				
Morocco	0.0243	0.1255	0.1553	0.0732	0.0142	0.1290	1.0000			
Tunisia	0.0178	0.1385	0.0840	0.0708	0.0322	0.0891	0.3023	1.0000		
UK (FTSE)	-0.0271	-0.0299	-0.0135	-0.0089	0.0150	0.0534	0.0525	0.0361	1.0000	
France (CAC 40)	-0.0428	-0.0332	0.0040	-0.0164	-0.0380	0.0235	0.0628	0.0488	0.8071	1.0000

Source: Compiled by authors from respective national stock exchanges. Number of Observations: 422. The null hypotheses for the mean, median, skewness, excess kurtosis are that they are all respectively zero.

Table 4. Unit Root tests

Variable	Level		First Differences	
	Test Statistic	Lags	Test Statistic	Lags
y_{Kenya}	-0.61990	1	-16.6091**	Dickey Fuller
$y_{Nigeria}$	0.035596	Dickey Fuller	-18.3025**	Dickey Fuller
$y_{South\ Africa}$	0.82872	Dickey Fuller	-18.9833**	Dickey Fuller
$y_{Namibia}$	-0.060735	Dickey Fuller	-18.2545**	Dickey Fuller
$y_{Mauritius}$	0.80185	Dickey Fuller	-15.8701**	Dickey Fuller
y_{Egypt}	1.7245	Dickey Fuller	-19.8052**	Dickey Fuller
$y_{Morocco}$	0.068341	Dickey Fuller	-19.1689**	Dickey Fuller
$y_{Tunisia}$	-0.59721	Dickey Fuller	-19.3604**	Dickey Fuller
y_{UK}	-1.0928	Dickey Fuller	-19.9344**	Dickey Fuller
y_{France}	-1.1524	Dickey Fuller	-19.8006**	Dickey Fuller

Variable	Level with trend		First Differences with trend	
	Test Statistic	Lags	Test Statistic	Lags
y_{Kenya}	-0.66494	1	-17.1864**	1
$y_{Nigeria}$	-2.8115	Dickey Fuller	-18.3280**	Dickey Fuller
$y_{South\ Africa}$	-1.7963	Dickey Fuller	-19.1836**	Dickey Fuller
$y_{Namibia}$	-2.2324	Dickey Fuller	-18.4776**	Dickey Fuller
$y_{Mauritius}$	-0.77477	Dickey Fuller	-16.1622**	Dickey Fuller
y_{Egypt}	0.64624	Dickey Fuller	-20.5747**	Dickey Fuller
$y_{Morocco}$	0.16148	Dickey Fuller	-19.3804**	Dickey Fuller
$y_{Tunisia}$	-1.4051	Dickey Fuller	-19.3666**	Dickey Fuller
y_{UK}	-0.79477	Dickey Fuller	-20.0245**	Dickey Fuller
y_{France}	-1.1532	Dickey Fuller	-19.7982**	Dickey Fuller

SBC informational criterion used in all cases to assess lag length. 95% Confidence Interval H_0: I(1) in Levels/ First Differences = -2.8634, H_0: I(1) in Levels with Trend/ First Differences with Trend = -3.4145.
** indicates hypothesis of unit root rejected at the 95% confidence interval.

Table 5. Bivariate VAR cointegration tests

	Johansen trace test statistics	
	H_0: r = 0	H_0: r ≤ 1
Panel A: comparisons with Egypt		
UK (1)	34.1492**	13.7209*
France (1)	32.6414**	13.5926*
Morocco (1)	30.6358**	3.0145
Tunisia (1)	31.0648**	8.3969
Nigeria (1)	29.4446**	9.4611
Kenya (2)	31.6918**	3.7247
Namibia (1)	29.7091**	10.6186*
Mauritius (1)	35.7949**	3.5654
South Africa (1)	30.0483**	11.9222*
Panel B: comparisons with South Africa		
UK (1)	17.2526	1.7707
France (1)	20.8036	3.1437
Morocco (1)	15.1657	6.1791
Tunisia (1)	16.8542	3.2348
Egypt (1)	30.0483**	11.9222*
Nigeria (1)	17.8035	2.4343
Kenya (1)	24.1082*	4.5029
Namibia (2)	25.6031**	4.6747
Mauritius (2)	13.3012	5.4382
Panel C: comparisons with Kenya		
UK (1)	40.8725**	6.6641
France (1)	37.6529**	9.2982
Morocco (1)	49.2144**	7.8252
Tunisia (1)	28.0860**	4.3301
Egypt (1)	31.6918**	3.7247
Nigeria (1)	25.7482*	7.5964
Namibia (1)	26.8607**	4.3851
Mauritius (2)	19.2143	4.8008
South Africa (1)	24.1082*	4.5029
Panel D: comparisons with Nigeria		
UK (1)	14.6146	2.0422
France (1)	15.2110	2.0897
Morocco (1)	18.7351	5.6243
Tunisia (1)	16.7782	2.7262
Egypt (1)	29.4446**	9.4611
Kenya (1)	25.7482*	7.5964
Namibia (1)	17.7968	3.3043
Mauritius (1)	20.9345	7.8742
South Africa (1)	17.8035	2.4343

Notes to Table 5 and 6..If r denotes the number of significant vectors, then the Johansen trace statistics test the hypotheses of at most one and zero cointegrating vectors, respectively. ** indicates significance at 5% level. * indicates significance at 10% level. Figures in parentheses indicate number of lags in VAR models. Lag length of models chosen on basis of SBC informational criterion.

Table 6. Multivariate VAR cointegration tests

	Johansen trace test statistics		
	H_0: r = 0	H_1: r ≤ 1	H_0: r ≤ 2
Panel A. Group A: Egypt, South Africa, Additional Country			
UK (1)	49.3684**	25.4120**	10.9118*
France (1)	48.9803**	29.3566**	11.6793*
Morocco (1)	49.3145**	18.4479	3.6175
Tunisia (1)	48.5362**	25.8660**	11.0631*
Nigeria (1)	44.3173**	22.2840	9.4422
Kenya (1)	53.4745**	15.4807	2.6599
Namibia (1)	69.9551**	32.8279**	15.7148*
Mauritius (1)	63.3836**	20.7786	3.3468
Panel A. Group B: Egypt, South Africa, Tunisia, Namibia, UK, France			
Lag length: 1		95% Quantile critical values	90% Quantile critical values
H_0: r = 0	186.7896**	115.8500	110.6000
H_0: r ≤ 1	110.5360**	87.1700	82.8800
H_0: r ≤ 2	72.0591**	63.0000	59.1600
H_0: r ≤ 3	45.0872**	42.3400	39.3400
H_0: r ≤ 4	24.7079*	25.7700	23.0800
H_0: r ≤ 5	7.5488	12.3900	10.5500
	Johansen trace test statistics		
	H_0: r = 0	H_1: r ≤ 1	H_0: r ≤ 2
Panel B. Group A: South Africa, Kenya, Additional Country			
UK (1)	60.5389**	23.1171*	9.3802
France (1)	53.3005**	23.2695*	6.7345
Morocco (1)	58.8650**	15.9463	4.3801
Tunisia (1)	43.4868**	19.1619	4.6056
Egypt (1)	53.4745**	15.4807	2.6599
Nigeria (1)	39.1693**	13.9960	6.2445
Namibia (1)	67.2022**	21.1540	5.5851
Mauritius (2)	33.3141	17.3174	5.0382
	Johansen trace test statistics		
	H_0: r = 0	H_1: r ≤ 1	H_0: r ≤ 2
Panel C. Group A: Egypt, Kenya, Additional Country			
UK (1)	82.0320**	37.2788**	7.6445
France (1)	70.1340**	26.7727**	9.0540
Morocco (1)	77.4323**	26.3745**	5.0157
Tunisia (1)	57.8326**	14.6179	3.3935
South Africa (1)	53.4745**	15.4807	2.6599
Nigeria (1)	59.9907**	14.2921	4.0781
Namibia (1)	53.1309**	13.4357	2.6278
Mauritius (2)	44.4608**	12.8243	3.6606
Panel C. Group B: Egypt, Kenya, UK, France, Morocco			
Lag length: 2		95% Quantile critical values	90% Quantile critical values
H_0: r = 0	135.7298**	87.1700	82.8800
H_0: r ≤ 1	75.7421**	63.0000	59.1600
H_0: r ≤ 2	40.5133**	42.3400	39.3400
H_0: r ≤ 3	19.8865	25.7700	23.0800
H_0: r ≤ 4	6.5598	12.3900	10.5500

See notes in Table 5.

Table 7. Block Granger non-Causality

	Causation	Kenya	South Africa	Egypt	Nigeria
Kenya	----/---- >	--	--	--	--
	< ----/----	--	--	--	--
South Africa	----/---- >	0.87226[.350]	--	--	--
	< ----/----	0.4532E-3[.983]	--	--	--
Egypt	----/---- >	6.7664[.009]	0.63291[.426]	--	--
	< ----/----	4.0027[.045]	8.4505[.004]	--	--
Nigeria	----/---- >	0.068914[.793]	1.3488[.245]	0.072975[.787]	--
	< ----/----	0.8530E-3[.977]	1.5021[.220]	0.0088857[.925]	--
Mauritius	----/---- >	2.0031[.157]	0.0090640[.924]	0.083262[.773]	0.57784[.447]
	< ----/----	22.9908[.000]	6.2315[.013]	3.2050[.073]	0.019224[.890]
Namibia	----/---- >	0.99626[.318]	0.22496[.635]	2.4469[.118]	0.44061[.507]
	< ----/----	0.32337[.570]	19.9564[.000]	2.1940[.139]	2.2617[.133]
Morocco	----/---- >	0.073176[.787]	0.26291[.608]	0.093040[.760]	0.11495[.735]
	< ----/----	1.2804[.258]	0.016184[.899]	0.0014954[.969]	0.78841[.375]
Tunisia	----/---- >	7.9451[.005]	0.58131[.446]	0.053472[.817]	0.15939[.690]
	< ----/----	1.7357[.188]	0.30798[.579]	2.0755[.150]	0.34842[.555]
UK	----/---- >	3.1766[.075]	1.0865[.297]	6.9244[.009]	2.8576[.091]
	< ----/----	3.8742[.049]	0.017309[.895]	1.0231[.312]	0.025567[.873]
France	----/---- >	0.33374[.563]	0.91016[.340]	7.7418[.005]	1.0663[.302]
	< ----/----	1.2092[.271]	3.2854[.070]	1.8001[.180]	0.3324E-4[.995]

Notes: Figures within square parentheses are standard errors. The number of Lags in all unrestricted VAR models was 1.

Table 8. ARDL F-statistics for bivariate pair-wise combinations

	Dependent Variable	Kenya	South Africa	Egypt	Nigeria
Kenya	----/---- >	--	--	--	--
	< ----/----	--	--	--	--
South Africa	----/---- >	4.6376[.032] (UB)**	--	--	--
	< ----/----	0.33205[.565]	--	--	--
Egypt	----/---- >	0.094201[.759]	0.75577[.385]	--	--
	< ----/----	2.7494[.098] (LB-UB)*	13.8290[.000] (UB)**	--	--
Nigeria	----/---- >	5.9221[.015] (UB)**	1.0414[.308]	11.6340[.001] (UB)**	--
	< ----/----	0.92378[.337]	0.23340[.629]	0.61074[.435]	--
Mauritius	----/---- >	0.96780[.326]	0.57325[.449]	12.8136[.000] (UB)**	0.13799[.710]
	< ----/----	0.44615[.505]	1.4091[.236]	0.72746[.394]	2.6084[.107]
Namibia	----/---- >	1.0481[.307]	2.8367[.093] (LB-UB)*	10.0900[.002] (UB)**	0.038027[.845]
	< ----/----	0.31842[.573]	4.4891[.035] (UB)**	0.40033[.527]	1.3455[.247]
Morocco	----/---- >	0.67252[.413]	0.31509[.575]	4.3640[.037] (UB)**	0.91266[.340]
	< ----/----	2.7993[.095] (LB-UB)*	4.7762[.029] (UB)**	0.80077[.371]	4.9692[.026] (UB)**
Tunisia	----/---- >	0.088067[.767]	0.86381[.353]	5.9513[.015] (UB)**	0.52903[.467]
	< ----/----	0.79568[.373]	2.6224[.106]	0.52586[.469]	0.32514[.569]
UK	----/---- >	6.5360[.011] (UB)**	0.65485[.419]	0.014730[.903]	0.65741[.418]
	< ----/----	4.8676[.028] (UB)**	4.0626[.044] (LB-UB)**	2.3567[.126]	1.6983[.193]
France	----/---- >	3.4187[.065] (LB-UB)**	0.40743[.524]	0.9149E-4[.992]	0.40598[.524]
	< ----/----	6.1880[.013] (UB)**	3.2127[.074] (LB-UB)**	3.2675[.071] (LB-UB)**	0.10008[.752]

*90% Critical Value bound. **95% Critical Value bound. LB represents Lower Bound of F-statistic critical values, UB represents Upper Bound of F-statistic critical values. LB-UB represents a value falling between bands. Three lags were chosen in all cases for the differenced variables in equation 19.

Figure 1. Stock Market Indices (Natural Log of levels denominated in local currency)

Figure 1a: Natural Log of Stock Market Indices for South Africa, Mauritius and Namibia

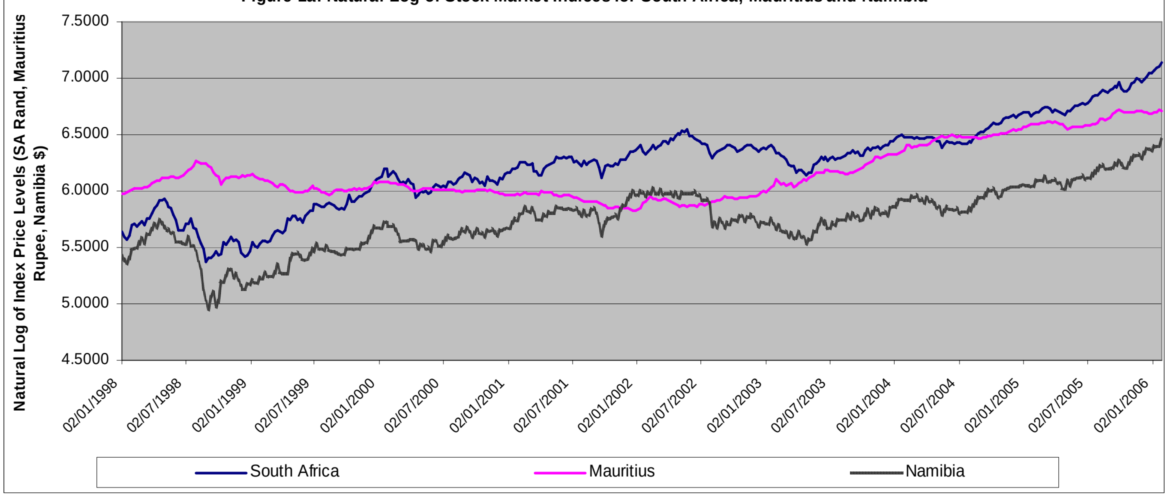


Figure 1b: Natural Log of Stock Market Indices for Nigeria and Kenya

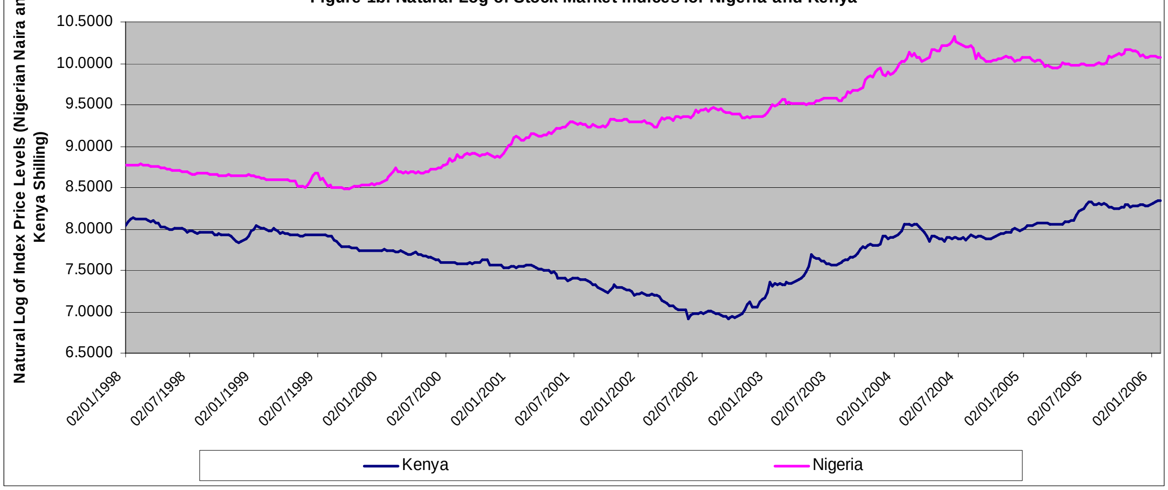
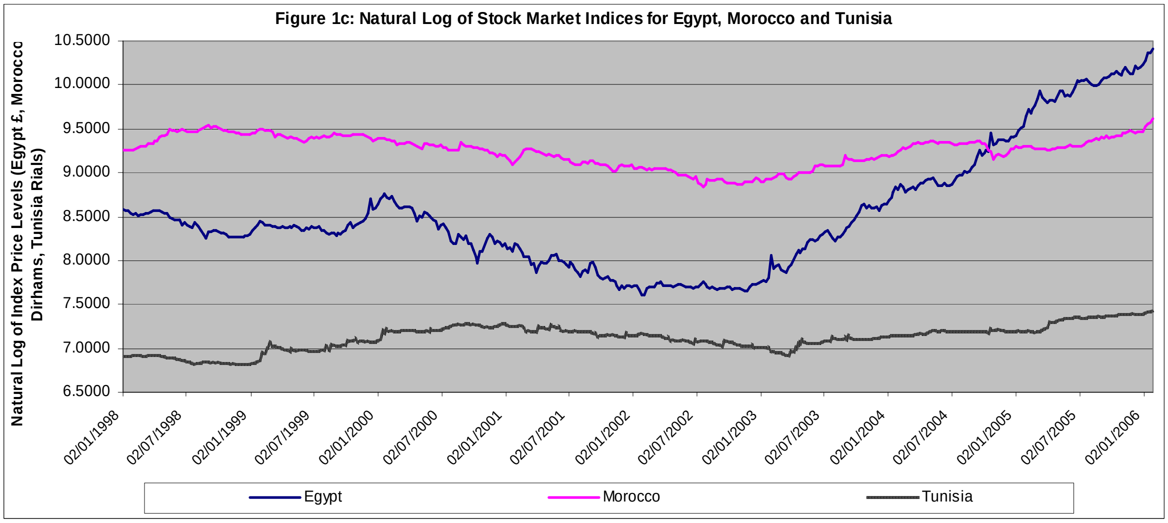
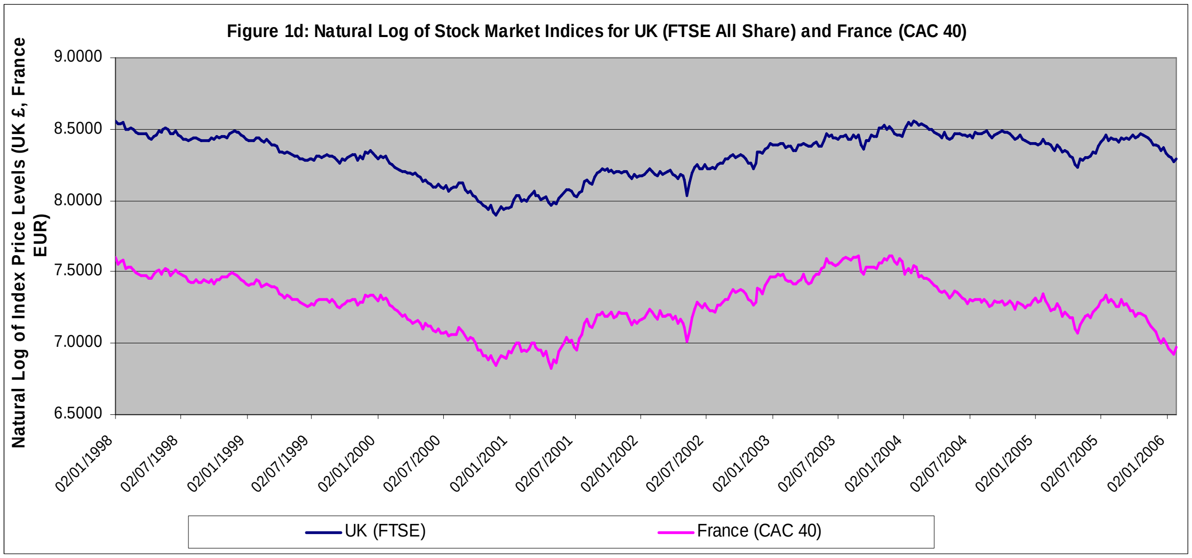


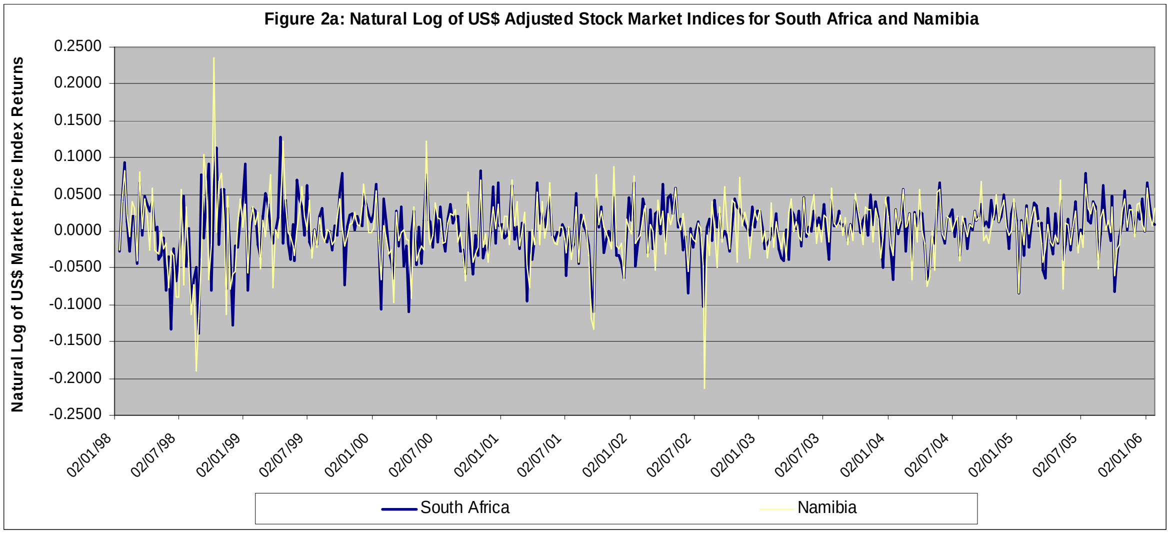
Figure 1c: Natural Log of Stock Market Indices for Egypt, Morocco and Tunisia

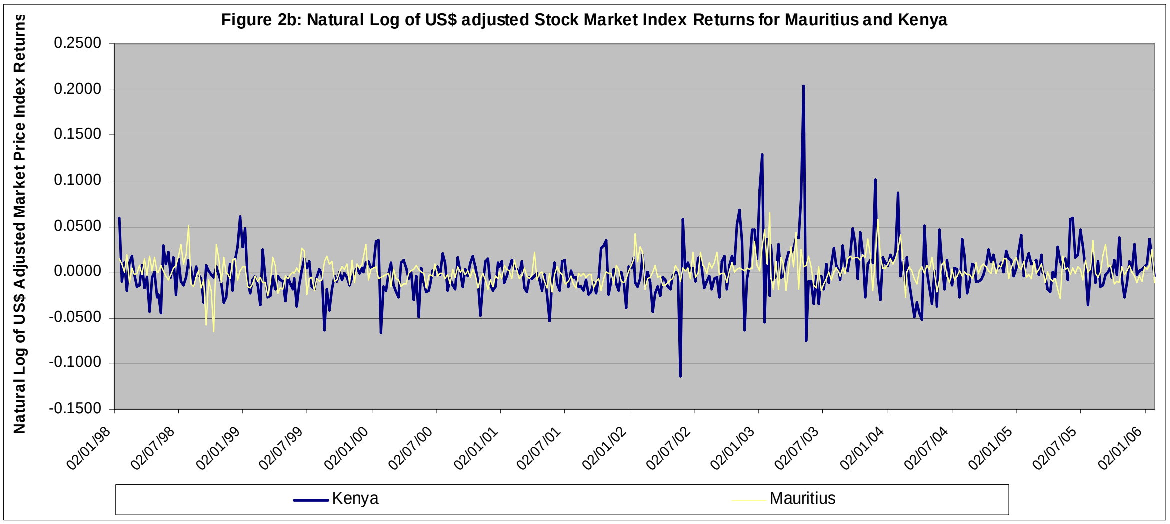




Source: Compiled by authors from national exchanges and Datastream

Figure 2. Stock Market Returns (Natural Log of US$ adjusted Returns)





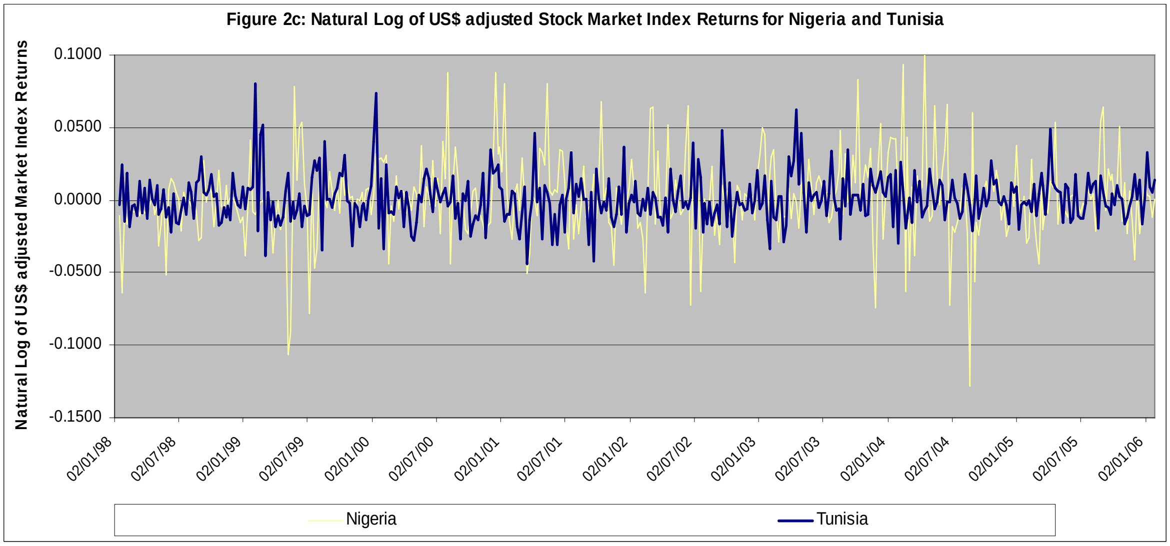


Figure 2d: Natural Log of US$ adjusted Stock Market Index Returns for Morocco and Egypt

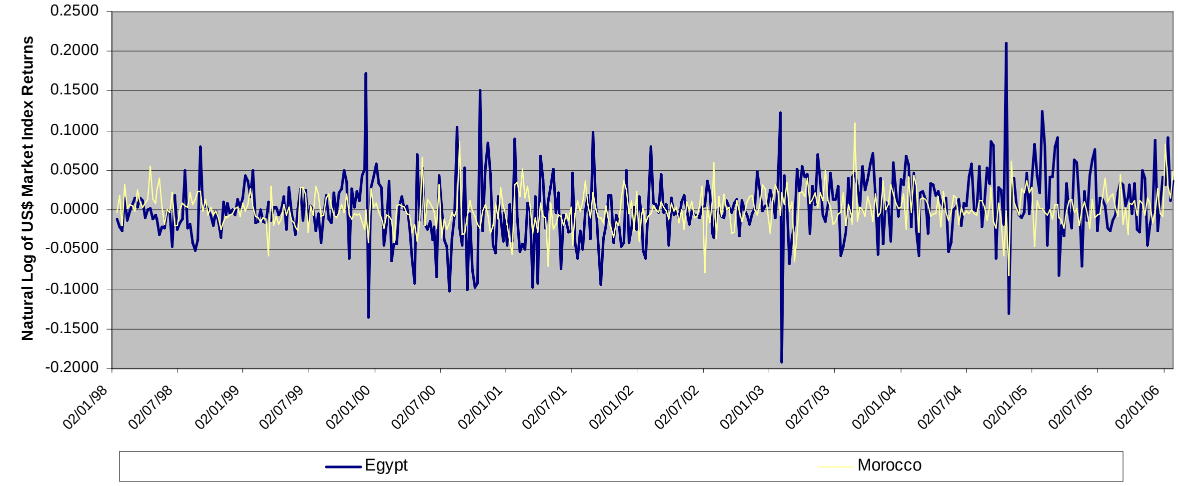
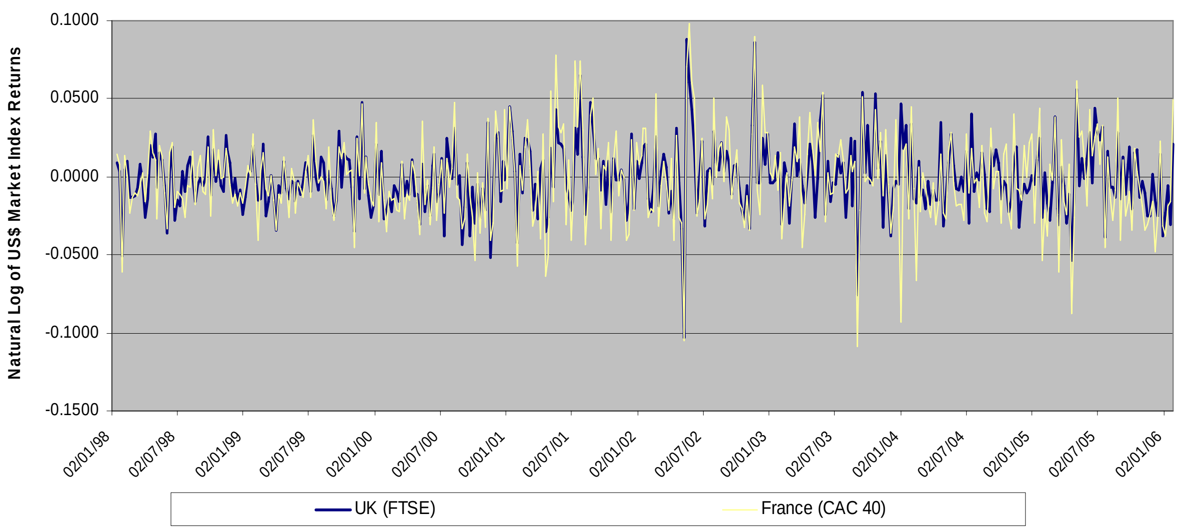


Figure 2e: Natural Log of US$ adjusted Stock Market Indices for UK and France



Source: Compiled by authors from national stock exchanges and Datastream

Figure 3. Integration and Granger Causality for Egypt

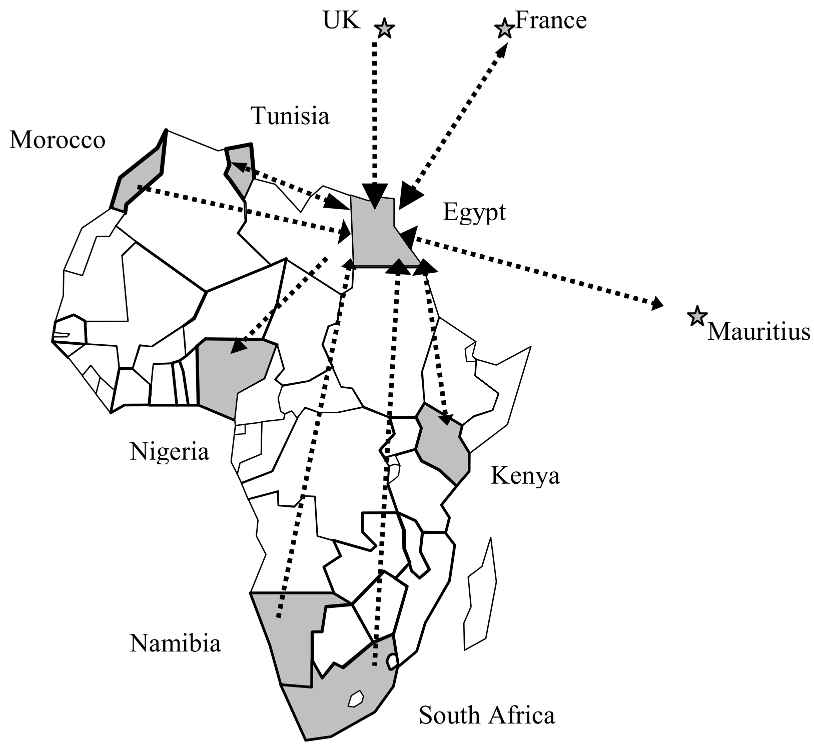


Figure 4. Integration and Granger Causality for Kenya

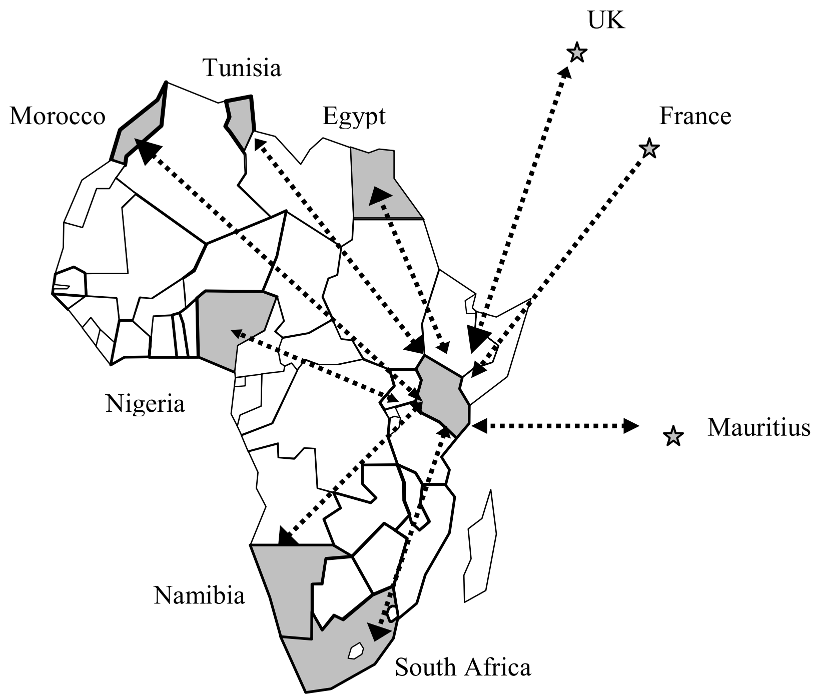


Figure 5. Integration and Granger Causality for South Africa

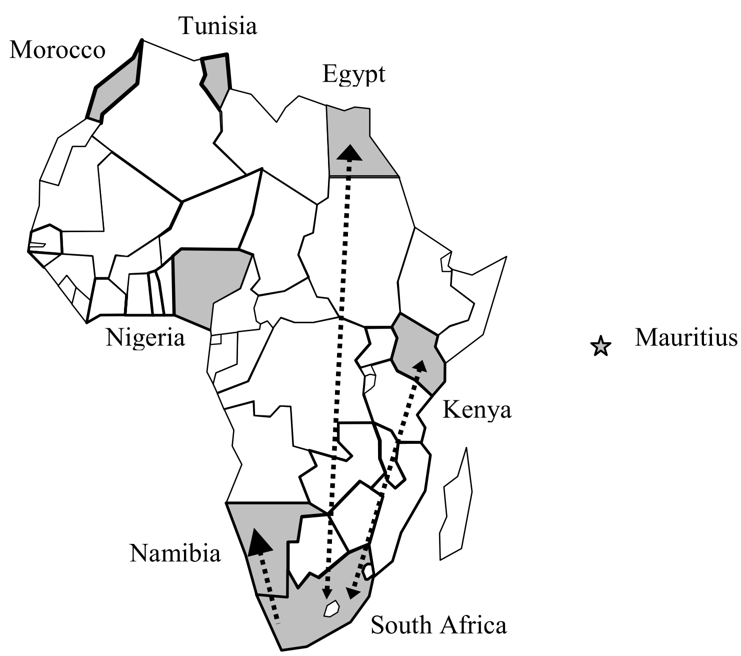


Figure 6. Integration and Granger Causality for Nigeria

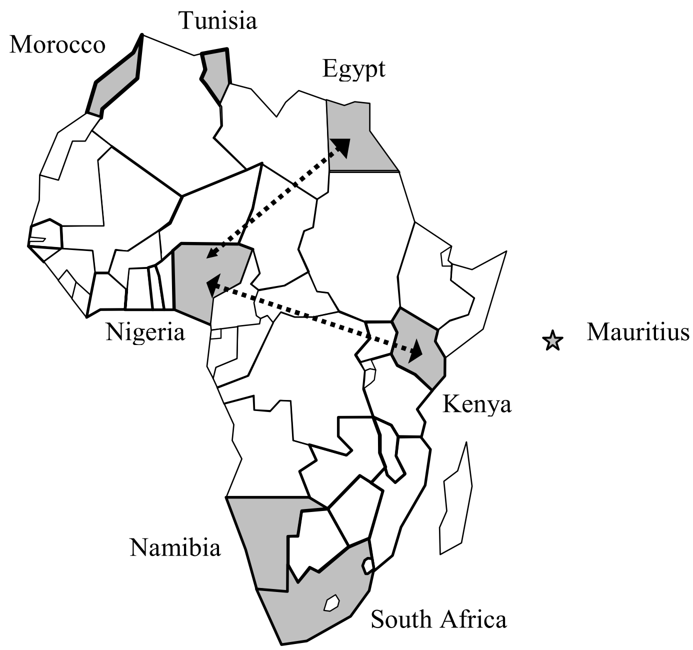


Figure 7. ARDL Long term relationships for Egypt

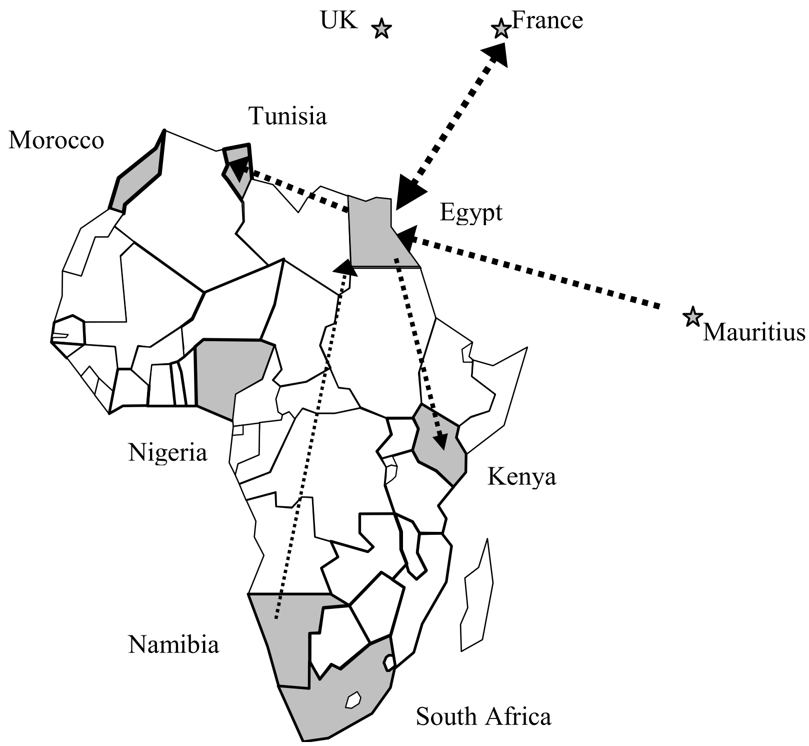


Figure 8. ARDL Long term relationships for Kenya

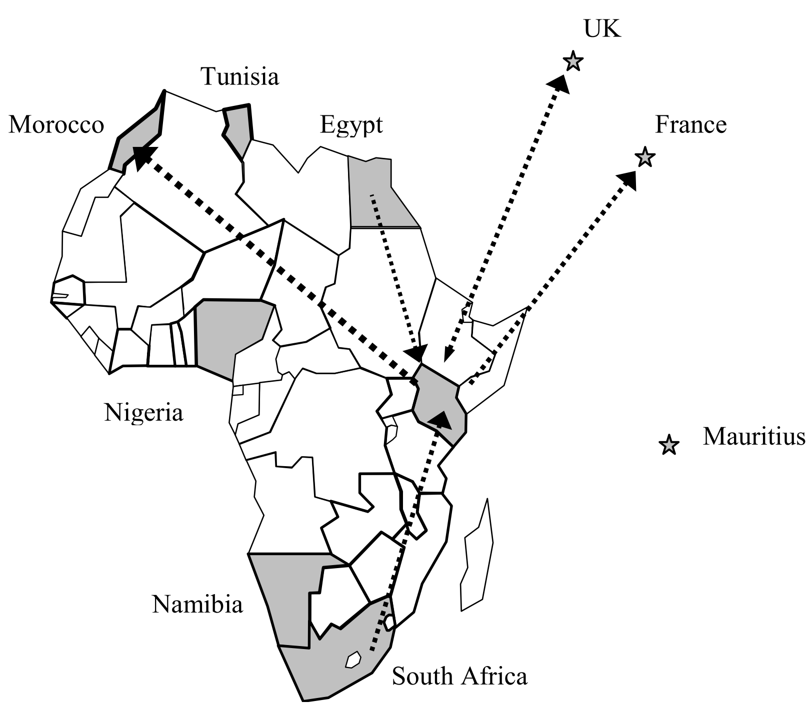


Figure 9. ARDL Long term relationships for South Africa

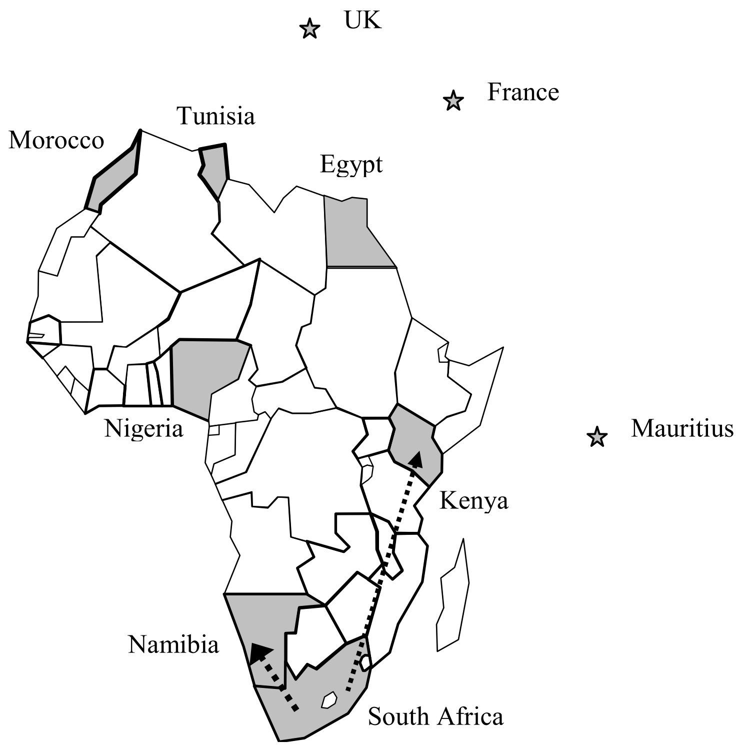
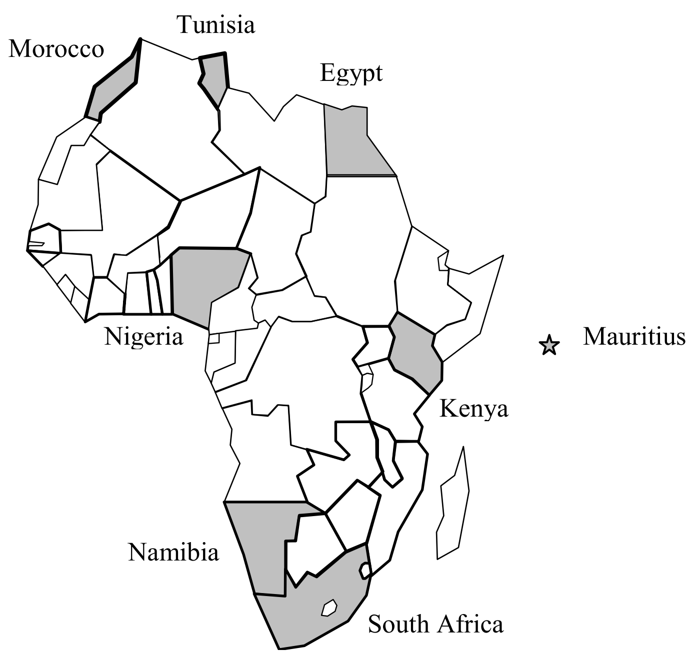


Figure 10. ARDL Long term relationships for Nigeria



Appendix 1. Econometric Methods

A general-to-specific approach is used within both rival VAR and ARDL empirical methodologies. Empirical triangulation is used employing both methodologies to contrast results and better analyse inter-relationships between markets within sample group. VAR methodology and testing for presence of a common cointegrating vector between series relies on pre-testing series for the presence of a stochastic martingale, or unit root. ARDL methodology is more sensitive in assessing long term relationships between series and has two distinct stages. The first involves the application a non-parametric F-test on all the variables within the long term error correction model. At this stage the series are either deemed to be non-integrated, and as such not cointegrated, fractionally integrated, and as such subject to unit root testing before further analysis, or integrated. Dependent on results from this initial stage formal ARDL methodology is employed to shed light on the nature of the long term cointegrating relationship.

Appendix 1a) Testing for the presence of Unit Roots

Unit Root testing is essential to determine whether a time series is difference stationary or first-difference stationary. If the time series contains a stochastic martingale (stochastic trend) which after differencing is removed giving a zero order series then the original time series is said to be first order integrated, or I(1). Following the original work of Dickey and Fuller (1979) the test used in order to assess the presence of a stochastically generated unit root in a series incorporating a deterministic trend, where the null hypothesis of a unit autoregressive root is H_0: $\varphi = 1$, against alternate hypothesis of H_1: $\varphi < 1$ is defined:

$$y_t = \alpha + (1-\varphi)\delta t + \varphi y_{t-1} + \sum_{i=1}^{p+1} \varphi_i y_{t-i} + \varepsilon_t, t = 1,...,n \qquad (1)$$

Where y_t is the time series, δ_t is the deterministic trend and ά is the non-zero drift constant. Correspondingly the test for first differences, with new null hypothesis is H_0: $\rho = 1 - \varphi = 0$, is defined:

$$\Delta y_t = \alpha + \rho\delta t - \rho y_{t-1} + \sum_{i=1}^{p} \gamma\Delta y_{t-i} + \varepsilon_t, t = 1,...,n \qquad (2)$$

The test equations without deterministic trend are as above but without the $(1 - \varphi)\delta t$ term in equation 1 and ρy_{t-1} in equation 2. The first three terms in each test equation capture the stochastically generated Autoregressive or AR component and the Dickey-Fuller term, designated by the summation term, accommodates error autocorrelation and as such represents the moving average term in the overall

Autoregressive Moving Average, or ARMA, time series. The appropriate lag length of test models are assessed from the Aikaike Information Criterion (AIC) and Swartz Bayesian Criterion (SBC) which assess comparative models according to informational content. The critical values for the test statistic, φ, originate from the Dickey-Fuller distribution and do not adhere to standard normality assumptions.

Appendix 1b) Cointegration using a Vector Autoregressive process

The multivariate estimation methods originate from the inaugural work of Johansen (1989, 1991) in this area and are all based on the basic augmented vector autoregressive (AVAR) model, of order p, as defined below:

$$z_t = a_0 + a_1 t + \sum_{i=1}^{p} \Phi_i z_{t-i} + \Psi w_t + u_t \text{ , t = 1,2,….,n} \quad (3)$$

Where z_t is a m x 1 vector of jointly determined (endogenous) variables, t is a linear time trend, w_t is a q x 1 vector of exogenous variables, and u_t is an m x 1 vector of unobserved disturbances assumed to satisfy the assumptions of *iid*, homoskedasticity, serially uncorrelated, orthogonality, normality with strict adherence to a multivariate normal distribution and finally stability.

Cointegrating VAR models are underlined by the general vector error correction model (VECM) as defined:

$$\Delta y_t = a_{0y} + a_{1y} t - \prod{}_y z_{t-1} + \sum_{i=1}^{p-1} \Gamma_{iy} \Delta z_{t-i} + \Psi_y w_t + u_{ty} \quad (4)$$

where $z_t = (y_t x_t)'$

This model distinguishes between four categories of variables, namely:

1. y_t which is an m_y x 1 vector of jointly determined (or endogenous) *I(1)* variables
2. x_t which is an m_x x 1 vector of *I(1)* exogenous variables
3. w_t which is a q x 1 vector of *I(0)* exogenous variables
4. Intercepts and deterministic linear trends

The implicit VAR model for the *I(1)* exogenous variables, x_t, is given by

$$\Delta x_t = a_{0x} + \sum_{i=1}^{p-1} \Gamma_{ix} \Delta x_{t-i} + \Psi_x w_t + v_t \quad (5)$$

and assumes the x_t's are not themselves cointegrated. Although (5) does not explicitly contain a deterministic trend, the levels of x_t will be trended due to the coefficients, a_{0x}.

Combining equations (3) and (4) results in following:

$$\Delta z_t = a_0 + a_1 t - \prod z_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta z_{t-i} + \Psi w_t + u_t \quad (6)$$

where $u_t = (u_{ty} v_t)'$, $a_0 = (a_{0y} a_{0x})'$, $a_1 = (a_{1y} 0)'$

$\Pi = (\Pi_{0y} 0)$, $\Gamma_i = (\Gamma_{iy} \Gamma_{ix})'$, $\Psi = (\Psi_y \Psi_x)'$

which is a restricted vector error correction form of the original AVAR model (1). The intercept and the trend coefficients, a_{0y} and a_{1y} are m_y x 1 vectors. Π_y is the long-run multiplier matrix of order m_y x m, where m = $m_x + m_y$, Γ_{1y}, Γ_{2y}, ..., $\Gamma_{p-1,y}$ are m_y x m coefficient matrices capturing the short-run dynamic effects, and Ψ_y is the m_y x q matrix of coefficients on the *I(0)* exogenous variables. Under the assumption that rank(Π_y) = r, i.e. when there exists r cointegrating relations among the variables in z_t, then:

$$\prod_y = \alpha_y \beta'$$

where $ά_y$ and β and m_y x m and m x r matrices, each with full column rank r. The stochastic trace statistics and eigenvalue tests then determine the number of cointegrating vectors.

Appendix 1c) Granger-causality for cointegrating and non-cointegrating systems

Drawing on Johansen (1991), Granger causality for a system of I(1) variables and a common cointegrating vector can be determined through the transformation of original AVAR (3) into a bivariate VECM in expression (7) where each y_{it} term is a sub-element of the z_t variable in (3).

$$\Delta y_{1t} = \alpha_0 + (y_{1t-1} - \gamma y_{2t-1}) + \sum_{i=1}^{k} \alpha_{1i} \Delta y_{1t-1} + \sum_{i=1}^{k} \alpha_{2i} \Delta y_{2t-1} + \varepsilon_{1t} \qquad (7i)$$

$$\Delta y_{1t} = \beta_0 + (y_{1t-1} - \gamma y_{2t-1}) + \sum_{i=1}^{k} \alpha_{1i} \Delta y_{1t-1} + \sum_{i=1}^{k} \alpha_{2i} \Delta y_{2t-1} + \varepsilon_{1t} \qquad (7ii)$$

where the $(y_{1t-1} - \gamma y_{2t-1})$ represents a drift error correction process for the entire system to re-stabilise following short term deviations from the long term cointegrating trend vector.

The corresponding measure of causality for an AVAR system of non-cointegrated variables is known as "block Granger non-causality". The null hypothesis that coefficients of a subset of jointly determined variables in the AVAR are equal to zero is tested using the log-likelihood ratio statistic. Statistically it provides a measure of the ability of one set of lagged values of a variable in predicting another set of lagged values of a second variable within the model. Assuming $z_t = \left(z_{1t}{}', z_{2t}{}' \right)'$, where z_{1t} and z_{2t} are m_1 x 1 and m_2 x 1 subsets of z_t, and m = $m_1 + m_2$. The block decomposition is then given by equation (8):

$$z_{1t} = a_{10} + a_{11} + \sum_{i=1}^{p} \Phi_{i,11} z_{1,t-j} + \sum_{i=1}^{p} \Phi_{i,12} z_{2,t-j} + \Psi_1 w_t + u_{1t} \qquad (8i)$$

$$z_{2t} = a_{20} + a_{21} + \sum_{i=1}^{p} \Phi_{i,21} z_{1,t-j} + \sum_{i=1}^{p} \Phi_{i,22} z_{2,t-j} + \Psi_2 w_t + u_{2t} \qquad (8ii)$$

The hypothesis that the subset z_{2t} does not "Granger-cause" cause z_{1t} is defined by:

$$H_G : \Phi_{12} = 0$$

where $\Phi_{12} = (\Phi_{1,12}, \Phi_{2,12}, ..., \Phi_{p,12})$. The standard F-test with associated χ^2 distribution can be used to test null hypothesis that all coefficients are jointly equal to zero.

Appendix 1d) Impulse Response analysis on cointegrating systems

Impulse response functions assess the time profile of the effect of shocks on the future states of a dynamical system, defined as the AVAR in (3). The orthogonalized impulse response (IR), as outlined by Sims (1981) works with the m x m coefficient matrices, A_i, in the infinite moving average representation of (3):

$$z_t = \sum_{j=0}^{\infty} A_j u_{t-j} + \sum_{j=0}^{\infty} B_j w_{t-j} \qquad (9)$$

where the matrices, A_j, are computed using recursive relations:

$$A_j = \Phi_1 A_{j-1} + \Phi_2 A_{j-2} + ... + \Phi_p A_{j-p}, \ j = 1, 2, \ldots.$$

with $A_0 = I_m$, and $A_j = 0$, for $j<0$, and $B_j = A_j\Psi$, for j = 1, 2, ...

Following Sims(1981) in using the Cholesky decomposition of u_t the covariance matrix of the shocks, i.e. Σ,

$$\Sigma = TT'$$

where T is the lower triangular matrix. The moving average representation can be rewritten:

$$z_t = \sum_{j=0}^{\infty} (A_j T)(T^{-1} u_{t-j}) + \sum_{j=0}^{\infty} B_j w_{t-j}$$

$$= \sum_{j=0}^{\infty} A_j^* \varepsilon_{t-j} + \sum_{j=0}^{\infty} B_j w_{t-j} \qquad (10)$$

where $A_j^* = A_j T$, and $\varepsilon_t = T^{-1} u_t$

which is transformed into:

$$E(\varepsilon_t \varepsilon_t^{'}) = T^{-1} E(u_t u_t^{'}) T^{'-1} = T^{-1} \sum T^{'-1} = I_m \qquad (11)$$

and the new errors, $\acute{\varepsilon}_t$, obtained using the transformation matrix, T, are contemporaneously uncorrelated and have unit standard errors. As such the shocks $\acute{\varepsilon}_t$ are orthogonal to each other. The orthogonalized IR function of a unit shock (equal to one standard error) at time t to the ith orthogonalized error, namely $\acute{\varepsilon}_{it}$, on the *jth* variable at time t + N is given by the *jth* element of:

Orthogonalized IR function to the *ith* variable $= A_N^* e_i = A_N T e_i$

where e_i is the m x 1 selection vector,

$$OI_{ij,N} = e_j^{'} A_N T e_i \text{, i, j = 1, 2, ... , m} \tag{12}$$

The number of time periods taken for the system to recover from a single shock is itself a measure of the strength of cointegrating vector between two variables.

Appendix 1e) Autoregressive distributed lag approach

The use of the augmented autoregressive distributed lag (ARDL) approach is beneficial as it avoids issues associated with pre-testing bias in designating time series as either I(0) or I(1) within the estimation strategy associated with standard cointegration models that assess long term relationships between time series. The formal augmented ARDL, as outlined in Pesaran and Shin (1995) is defined

$$\phi(L, p) y_t = \sum_{i=1}^{k} \beta_i (L, p) x_{it} + \delta^{'} w_t + u_t \tag{13}$$

where

$$\phi(L, p) = 1 - \phi_1 L - \phi_2 L^2 - ... - \phi_p L^p,$$

and (14)

$$\beta_i (L, q_i) = \beta_{i1} + \beta_{i1} L + \beta_{i2} + ... + \beta_{iqi} L_i^q, i = 1,2,..., k$$

and where L is a lag operator such that $LY_t = y_{t-1}$, and w_t is an s x 1 vector of deterministic I(0) variables including the intercept term, dummy variables, time trends or exogenous I(1) variables with fixed lags.

ARDL models are estimated by first collecting OLS estimates of equation 13 for all possible values of p = 0, 1, 2,…,m; q_i = 0, 1, 2, …, m; and i = 1, 2, …, k, that is, for a total of the $(m+1)^{k+1}$ different ARDL models. The choice of one of the $(m+1)^{k+1}$ estimated models is made on informational grounds using one of four common model selection tests: R^2, the AIC, SBC, or the Hannan-Quinn criterion (HQC).

The ECM that corresponds to the model selected can be obtained by rewriting equation 13 in terms of the lagged levels and the first differences of $y_t, x_{1t}, x_{2t},..., x_{kt}$, and w_t. Substituting these lagged and differenced terms into equation 13 and rearranging gives

$$\Delta y_t = -\phi\left(1, \hat{p}\right) EC_{t-1} + \sum_{i=1}^{k} \beta_{i0} \Delta x_{1t} + \delta^{'} \Delta w_t - \sum_{j=1}^{\hat{p}-1} \phi^* y_{t-j} - \sum_{i-1}^{k} \sum_{j=1}^{\hat{q}_{i-1}} \beta_{ij}^* \Delta x_{i,t-j} + u_t \tag{15}$$

Where the error correction term, EC_t, is defined

$$EC_t = y_t - \sum_{i=1}^{k} \theta_i x_{it} - \hat{\psi}' w_t \tag{16}$$

Where the long run coefficients for the response of y_t to a unit change in x_{it} are estimated by

$$\hat{\theta}_i = \frac{\hat{\beta}_i(1, \hat{q}_i)}{\hat{\varphi}(1, p)} = \frac{\hat{\beta}_{i0} + \hat{\beta}_{i1} + \ldots + \hat{\beta}_{i\hat{q}i}}{1 - \hat{\phi}_1 - \hat{\phi}_2 - \ldots - \hat{\phi}_p} \tag{17}$$

and where $\hat{p}$ and $\hat{q}_i$, i = 1, 2, …, k are the selected estimated values of p and q_i, i = 1, 2, …, k. Similarly, the long run coefficients associated with the deterministic/ exogenous variables with fixed lags are estimated by

$$\hat{\psi} = \frac{\hat{\delta}\left(\hat{p}, \hat{q}_1, \hat{q}_2, \ldots, \hat{q}_k\right)}{1 - \hat{\phi}_1 - \hat{\phi}_2 - \ldots - \hat{\phi}_{\hat{p}}} \tag{18}$$

and where $\hat{\delta}\left(\hat{p}, \hat{q}_1, \hat{q}_2, \ldots, \hat{q}_k\right)$ denotes the OLS estimate of δ for the selected ARDL model.

Formal ARDL estimation requires two distinct stages. The first concerns the use of the F-statistic in testing the significance of the variables contained within the error correction form of the underlying ARDL model. The F-statistic is non-standard and critical values are obtained from Pesaran et al. (1996) which are tabulated in accordance to the number of different regressors and whether the ARDL model contains an intercept or time trend. These are further differentiated into an upper and lower bands of critical values. The upper band assumes all variables in underlying ARDL model are I(1), lower band assumes all variables are I(0), while those values in-between bands are fractionally integrated and require further formal unit root testing before the uptake of these variables into the second stage of ARDL model and error correction specification. The simplified error correction version of ARDL(p, q) model for a bivariate system is a variation of equation 15, as outlined below

$$\Delta y_{1t} = \delta' \Delta w_t + \sum_{i=1}^{p} \beta_i \Delta y_{1t-i} + \sum_{i=1}^{p} \beta_i \Delta y_{2t-i} + \delta_1 y_{1t} + \delta_2 y_{2t} + u_t \tag{19}$$

where $\delta' \Delta w_t$ is a vector of constant and time trend

The hypothesis to be tested is the null of "non-existence" of the long-run relationship defined by

$$H_0 : \delta_1 = \delta_2 = 0$$

against $H_1: \delta_1 \neq \delta_2 \neq 0$

The second stage of estimation concerns the estimation of parameters within ARDL model and the long run coefficients in equations 13, 15 and 16.

Appendix 2: Granger non-Causality for cointegrating systems and Vector Error Correction Models

Appendix 2a) Vector Error Correction models for Egypt

Egypt – UK
Vector: 1.00EGYPT - 4.5915UK - 0.0052076TREND

Dependent Variable is Δy_{Egypt}

Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	-0.54106	0.14123 (-3.8312[.000])
ECM(-1)	-0.016874	0.004379 (-3.8534[.000])

ECM(-1) = 1.0000*y_{Egypt} - 4.5915*y_{UK} - 0.0052076*Trend
F(3,419)= 14.8484[.000]

Dependent Variable is Δy_{UK}

Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	0.13931	0.074091 (1.8802[.061])
ECM(-1)	0.0043003	0.0022973 (1.8718[.062])

ECM(-1) = 1.0000*y_{Egypt} - 4.5915*y_{UK} - 0.0052076*Trend
F(3,419)= 3.5038[.062]

Egypt – France
Vector: 1.00EGYPT - 3.0728FRANCE - 0.0030661TREND

Dependent Variable is Δy_{Egypt}

Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	0.16746	0.044530 (3.7607[.000])
ECM(-1)	0.011176	0.0030242 (3.6954[.000])

ECM(-1) = 1.0000*y_{Egypt} - 3.0728*y_{France} 0.0030661*Trend
F(1,419)= 13.6560[.000]

Dependent Variable is Δy_{France}

Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	0.082796	0.029816 (2.7769[.006])
ECM(-1)	0.0055282	0.0020249 (2.7301[.007])

ECM(-1) = 1.0000*y_{Egypt} - 3.0728*y_{France} 0.0030661*Trend
F(1,419)= 7.4535[.007]

Egypt – Morocco
Vector: 1.00EGYPT - 3.6320MOROCCO - 0.0066086TREND

Dependent Variable is Δy_{Egypt}

Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	-0.26779	0.051326 (-5.2175[.000])
ECM(-1)	-0.013808	0.0026144 (-5.2814[.000])

ECM(-1) = 1.0000*y_{Egypt} - 3.6320*$y_{Morocco}$ - 0.0066086*Trend
F(1,419)= 27.8931[.000]

Dependent Variable is $\Delta y_{Morocco}$

Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	-0.033237	0.027090 (-1.2269[.221])
ECM(-1)	-0.0017473	0.0013799 (-1.2663[.206])

ECM(-1) = 1.0000*y_{Egypt} - 3.6320*$y_{Morocco}$ - 0.0066086*Trend
F(1,419)= 1.6035[.206]

Egypt – Tunisia
Vector: 1.00EGYPT - 6.4711UK - 0.0061643TREND

Dependent Variable is Δy_{Egypt}

Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	0.48681	0.12375 (3.9338[.000])
ECM(-1)	0.01341	0.0034302 (3.9095[.000])

ECM(-1) = 1.0000*y_{Egypt} - 6.4711*$y_{Tunisia}$ + 0.0061643*Trend
F(1,419) 15.2841[.000]

Dependent Variable is $\Delta y_{Tunisia}$

Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	0.15014	0.048402 (3.1020[.002])
ECM(-1)	0.0041376	0.0013417 (3.0840[.002])

ECM(-1) = 1.0000*y_{Egypt} - 6.4711*$y_{Tunisia}$ + 0.0061643*Trend
F(3,2103) 9.5109[.002]

Egypt - Kenya
Vector: 1.00EGYPT - 1.8958KENYA - 0.0073579TREND

Dependent Variable is Δy_{Egypt}

Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	-0.0091658	0.0032232 (-2.8437[.005])
$\Delta y_{Egypt}(1)$	0.070501	0.077154 (0.91377[.361])
$\Delta y_{Kenya}(1)$	-0.029498	0.048411 (-0.60933[.543])
ECM(-1)	-0.012546	0.0026015 (-4.8225[.000])

$\Delta y_{Kenya}(1) = y_{Kenya}(-1) - y_{Kenya}(-2)$
$\Delta y_{Egypt}(1) = y_{Egypt}(-1) - y_{Egypt}(-2)$
ECM(-1) = 1.0000* y_{Egypt} - 1.8958*y_{Kenya} - 0.0073579*Trend
F(3,419)= 9.1859[.000]

Dependent Variable is Δy_{Kenya}

Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	-0.0036853	0.0020264 (-1.8187[.070])
$\Delta y_{Egypt}(1)$	0.064878	0.030436 (2.1316[.034])
$\Delta y_{Kenya}(1)$	0.16084	0.048506 (3.3159[.001])
ECM(-1)	-0.0037548	0.0016355 (-2.2958[.022])

ECM(-1) = 1.0000* y_{Egypt} - 1.8958*y_{Kenya} - 0.0073579*Trend
F(3,416)= 9.4421[.000]

Egypt - Nigeria
Vector: 1.00EGYPT -3.2160NIGERIA + 0.0061800TREND

Dependent Variable is $\Delta y_{Nigeria}$

Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	0.047322	0.012020 (3.9368[.000])
ECM(-1)	0.5890E-3	0.1577E-3 (3.7339[.000])

ECM(-1) = 1.0000*y_{Egypt} - 26.3409*$y_{Nigeria}$ + 0.18203*Trend
F(1,419)= 13.9416[.000]

Dependent Variable is Δy_{Egypt}

Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	0.021951	0.0079615 (2.7571[.006])
ECM(-1)	0.2679E-3	0.1045E-3 (2.5640[.011])

ECM(-1) = 1.0000*y_{Egypt} - 26.3409*$y_{Nigeria}$ + 0.18203*Trend
F(1,419)= 6.5743[.011]

Egypt - Namibia

Vector: 1.00EGYPT + 0.15064NAMIBIA - 0.6392E-3TREND

	Dependent Variable is Δy_{Egypt}	
Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	-0.016140	0.0052589 (-3.0691[.002])
ECM(-1)	0.0050573	0.0012783 (3.9563[.000])
	$ECM(-1) = 1.0000*y_{Egypt} - 1.6186*y_{Namibia} - 0.013801*Trend$	
	F(1,419)= 15.6520[.000]	
	Dependent Variable is $\Delta y_{Namibia}$	
Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	-0.0092682	0.0052160 (-1.7769[.076])
ECM(-1)	0.0029405	0.0012679 (2.3192[.021])
	$ECM(-1) = 1.0000*y_{Egypt} - 1.6186*y_{Namibia} - 0.013801*Trend$	
	F(1,419)= 5.3786[.021]	

Egypt - Mauritius

Vector: 1.00EGYPT - 3.1674MAURITIUS -0.0029261TREND

	Dependent Variable is Δy_{Egypt}	
Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	-0.036213	0.0079479 (-4.5563[.000])
ECM(-1)	-0.014936	0.0029249 (-5.1064[.000])
	$ECM(-1) = 1.0000*y_{Egypt} -3.1674 *y_{Mauritius} - 0.0029261*Trend$	
	F(1,419)= 26.0758[.000]	
	Dependent Variable is $\Delta y_{Mauritius}$	
Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	-0.0071296	0.0026337 (-2.7071[.007])
ECM(-1)	-0.0030911	0.9692E-3 (-3.1892[.002])
	$ECM(-1) = 1.0000*y_{Egypt} -3.1674 *y_{Mauritius} - 0.0029261*Trend$	
	F(1,419)= 10.1713[.002]	

Egypt – South Africa

Vector: 1.00EGYPT + 0.0071486SOUTH AFRICA - 0.1123E-3TREND

	Dependent Variable is Δy_{Egypt}	
Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	-0.013876	0.0046863 (-2.9610[.003])
ECM(-1)	0.0047985	0.0011976 (4.0067[.000])
	$ECM(-1) = 1.0000* y_{Egypt} - 1.6207*y_{South\ Africa} + 0.016381*Trend$	
	F(1,419)= 16.0535[.000]	
	Dependent Variable is $\Delta y_{South\ Africa}$	
Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	-0.0055918	0.0042980 (-1.3010[.194])
ECM(-1)	0.0024299	0.0010984 (2.2122[.027])
	$ECM(-1) = 1.0000* y_{Egypt} - 1.6207*y_{South\ Africa} + 0.016381*Trend$	
	F(1,419)= 4.8939[.027]	

Appendix 2b) Vector Error Correction models for South Africa

South Africa – Egypt
Vector: 1.00SOUTH AFRICA -0.61702EGYPT -0.010107TREND

Dependent Variable is $\Delta y_{South\ Africa}$

Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	-0.0055918	0.0042980 (-1.3010[.194])
ECM(-1)	-0.0039381	0.0017802 (-2.2122[.027])

$ECM(-1) = 1.0000*y_{South\ Africa} - 0.61702*y_{Egypt} - 0.010107*Trend$

F(1,419)= 4.8939[.027]

Dependent Variable is Δy_{Egypt}

Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	-0.013876	0.0046863 (-2.9610[.003])
ECM(-1)	-0.0077769	0.0019410 (-4.0067[.000])

$ECM(-1) = 1.0000*y_{South\ Africa} - 0.61702*y_{Egypt} - 0.010107*Trend$

F(1,419)= 16.0535[.000]

South Africa – Kenya
Vector: 1.00SOUTH AFRICA -0.44087KENYA -0.0050532TREND

Dependent Variable is $\Delta y_{South\ Africa}$

Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	0.030476	0.0096361 (3.1627[.002])
ECM(-1)	-0.016073	0.0055319 (-2.9055[.004])

$ECM(-1) = 1.0000*y_{South\ Africa} - 0.44087*y_{Kenya} - 0.0050532*Trend$

F(3,2103) 8.4417[.004]

Dependent Variable is Δy_{Kenya}

Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	0.022918	0.0066969 (3.4222[.001])
ECM(-1)	-0.013179	0.0038446 (-3.4280[.001])

$ECM(-1) = 1.0000*y_{South\ Africa} - 0.44087*y_{Kenya} - 0.0050532*Trend$

F(1,419) 11.7511[.001]

South Africa – Namibia
Vector: 1.00SOUTH AFRICA - 0.90351NAMIBIA - 0.0010693TREND

Dependent Variable is $\Delta y_{South\ Africa}$

Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	-0.031534	0.018927 (-1.6661[.096])
ECM(-1)	0.054435	0.029696 (1.8330[.068])

$ECM(-1) = 1.0000*y_{South\ Africa} - 0.90351*y_{Namibia} - 0.0010693*Trend$

F(1,419)= 3.3601[.068]

Dependent Variable is $\Delta y_{Namibia}$

Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	-0.10122	0.019939 (-5.0764[.000])
ECM(-1)	0.16258	0.031285 (5.1968[.000])

$ECM(-1) = 1.0000*y_{South\ Africa} - 0.90351*y_{Namibia} - 0.0010693*Trend$

F(1,419)= 27.0072[.000]

Appendix 2c) Vector Error Correction models for Kenya

Kenya – UK
Vector: 1.00KENYA - 2.8766UK + 0.0012977TREND

Dependent Variable is Δy_{Kenya}

Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	0.28542	0.063745 (4.4776[.000])
ECM(-1)	0.014087	0.0031498 (4.4724[.000])

$ECM(-1) = 1.0000*y_{Kenya} - 2.8766*y_{UK} + 0.0012977*Trend$

F(1,419)= 20.0028[.000]

Dependent Variable is Δy_{UK}

Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	0.20082	0.052581 (3.8192[.000])
ECM(-1)	0.0098938	0.0025982 (3.8079[.000])

$ECM(-1) = 1.0000*y_{Kenya} - 2.8766*y_{UK} + 0.0012977*Trend$

F(1,419)= 14.5004[.000]

Kenya – France
Vector: 1.00KENYA - 3.1385FRANCE + 0.0036923TREND

Dependent Variable is Δy_{Kenya}

Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	0.15936	0.035467 (4.4933[.000])
ECM(-1)	0.0085165	0.0018987 (4.4853[.000])

$ECM(-1) = 1.0000*y_{Kenya} - 3.1385*y_{France} + 0.0036923*Trend$

F(1,419)= 20.1180[.000]

Dependent Variable is Δy_{France}

Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	0.11205	0.037830 (2.9619[.003])
ECM(-1)	0.0059232	0.0020252 (2.9247[.004])

$ECM(-1) = 1.0000*y_{Kenya} - 3.1385*y_{France} + 0.0036923*Trend$

F(1,419)= 8.5537[.004]

Kenya – Morocco
Vector: 1.00KENYA -1.6431 MOROCCO + 0.8180E-3TREND

Dependent Variable is Δy_{Kenya}

Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	0.16937	0.055262 (3.0649[.002])
ECM(-1)	0.021551	0.0070456 (3.0587[.002])

$ECM(-1) = 1.0000*y_{Kenya} - 1.6431*y_{Morocco} + 0.8180E-3*Trend$

F(1,419) 9.3559[.002]

Dependent Variable is $\Delta y_{Morocco}$

Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	0.25317	0.043590 (5.8079[.000])
ECM(-1)	0.032154	0.0055575 (5.7856[.000])

$ECM(-1) = 1.0000*y_{Kenya} - 1.6431*y_{Morocco} + 0.8180E-3*Trend$

F(1,419) 33.4734[.000]

Kenya – Tunisia
Vector: 1.00KENYA - 5.7505TUNISIA + 0.0071887TREND

Dependent Variable is Δy_{Kenya}		
Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	0.28656	0.071330 (4.0174[.000])
ECM(-1)	0.0082892	0.0020657 (4.0127[.000])

$$ECM(-1) = 1.0000*y_{Kenya} - 5.7505*y_{Tunisia} + 0.0071887*Trend$$
F(1,419)= 16.1017[.000]

Dependent Variable is $\Delta y_{Tunisia}$		
Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	0.12391	0.044306 (2.7966[.005])
ECM(-1)	0.0035632	0.0012831 (2.7770[.006])

$$ECM(-1) = 1.0000*y_{Kenya} - 5.7505*y_{Tunisia} + 0.0071887*Trend$$
F(1,419)= 7.7116[.006]

Kenya – Egypt
Vector: 1.00KENYA - 0.53760EGYPT + 0.0039896TREND

Dependent Variable is Δy_{Kenya}		
Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	-0.0044097	0.0018942 (-2.3280[.020])
ECM(-1)	0.010123	0.0029520 (3.4292[.001])

$$ECM(-1) = 1.0000*y_{Kenya} - 0.53760*y_{Egypt} + 0.0039896*Trend$$
F(1,419)= 11.7593[.001]

Dependent Variable is Δy_{Egypt}		
Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	-0.0081143	0.0029492 (-2.7514[.006])
ECM(-1)	0.023638	0.0045960 (5.1431[.000])

$$ECM(-1) = 1.0000*y_{Kenya} - 0.53760*y_{Egypt} + 0.0039896*Trend$$
F(1,419)= 26.4514[.000]

Kenya – Nigeria
Vector: 1.00KENYA + 552.0845NIGERIA - 3.2741TREND

Dependent Variable is Δy_{Kenya}		
Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	0.036411	0.011498 (3.1667[.002])
ECM(-1)	-0.1959E-4	0.6215E-5 (-3.1530[.002])

$$ECM(-1) = 1.0000*y_{Kenya} + 552.0845*y_{Nigeria} - 3.2741*Trend$$
F(1,419)= 9.9416[.002]

Dependent Variable is $\Delta y_{Nigeria}$		
Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	0.036242	0.011976 (3.0261[.003])
ECM(-1)	-0.1872E-4	0.6473E-5 (-2.8916[.004])

$$ECM(-1) = 1.0000*y_{Kenya} + 552.0845*y_{Nigeria} - 3.2741*Trend$$
F(1,419)= 8.3611[.004]

Kenya – Namibia
Vector: 1.00KENYA - 2.0263NAMIBIA + 0.0069469TREND

Dependent Variable is Δy_{Kenya}

Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	0.022941	0.0065953 (3.4783[.001])
ECM(-1)	0.0080819	0.0023182 (3.4863[.001])

$ECM(-1) = 1.0000*y_{Kenya} - 2.0263*y_{Namibia} + 0.0069469*Trend$
$F(1,419) = 12.1542[.001]$

Dependent Variable is $\Delta y_{Namibia}$

Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	0.035517	0.010245 (3.4666[.001])
ECM(-1)	0.012042	0.0036012 (3.3440[.001])

$ECM(-1) = 1.0000*y_{Kenya} - 2.0263*y_{Namibia} + 0.0069469*Trend$
$F(1,419) = 11.1824[.001]$

Kenya - South Africa
Vector: 1.00KENYA - 2.2683SOUTH AFRICA + 0.011462TREND

Dependent Variable is Δy_{Kenya}

Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	0.022918	0.0066969 (3.4222[.001])
ECM(-1)	0.0058103	0.0016950 (3.4280[.001])

$ECM(-1) = 1.0000*y_{Kenya} - 2.2683*y_{South\ Africa} + 0.011462*Trend$
$F(1,419) = 11.7511[.001]$

Dependent Variable is $\Delta y_{South\ Africa}$

Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	0.030476	0.0096361 (3.1627[.002])
ECM(-1)	0.0070859	0.0024388 (2.9055[.004])

$ECM(-1) = 1.0000*y_{Kenya} - 2.2683*y_{South\ Africa} + 0.011462*Trend$
$F(1,419) = 8.4417[.004]$

Appendix 2d) Vector Error Correction models for Nigeria

Nigeria – Egypt
Vector: 1.00NIGERIA -0.037964EGYPT -0.0069107TREND

Dependent Variable is $\Delta y_{Nigeria}$

Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	0.021951	0.0079615 (2.7571[.006])
ECM(-1)	-0.0070565	0.0027521 (-2.5640[.011])

$ECM(-1) = 1.0000*y_{Nigeria} - 0.037964*y_{Egypt} - 0.0069107*Trend$

F(1,419)= 6.5743[.011]

Dependent Variable is Δy_{Egypt}

Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	0.047322	0.012020 (3.9368[.000])
ECM(-1)	-0.015515	0.0041551 (-3.7339[.000])

$ECM(-1) = 1.0000*y_{Nigeria} - 0.037964*y_{Egypt} -0.0069107*Trend$

F(1,419)= 13.9416[.000]

Nigeria – Kenya
Vector: 1.00NIGERIA + 0.0018113KENYA - 0.0059304TREND

Dependent Variable is $\Delta y_{Nigeria}$

Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	0.036242	0.011976 (3.0261[.003])
ECM(-1)	-0.010334	0.0035738 (-2.8916[.004])

$ECM(-1) = 1.0000*y_{Nigeria} + 0.0018113*y_{Kenya} – 0.0059304*Trend$

F(1,419)= 8.3611[.004]

Dependent Variable is Δy_{Kenya}

Regressor	Coefficient	Standard Errors (T-Ratio)
Intercept	.036411	0.011498 (3.1667[.002])
ECM(-1)	- 0.010818	0.0034310 (-3.1530[.002])

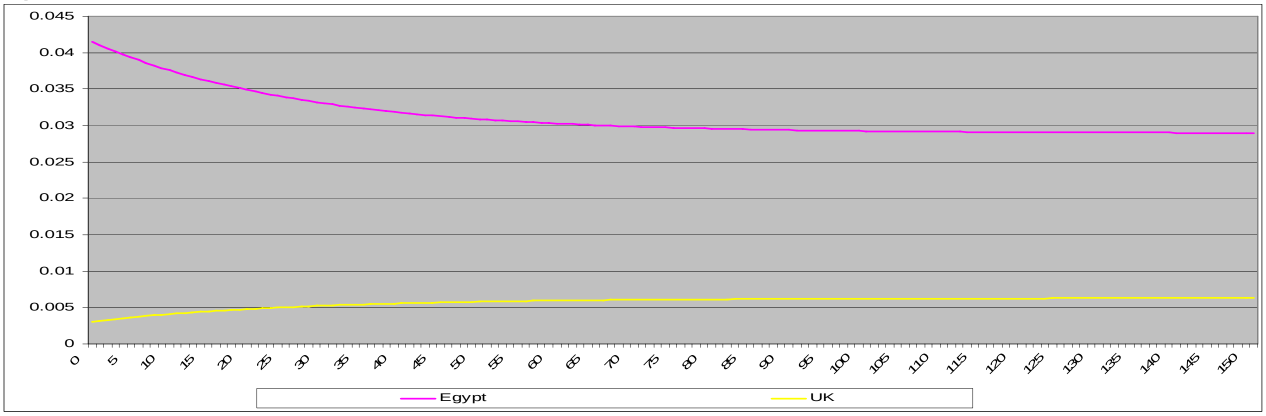
$ECM(-1) = 1.0000*y_{Nigeria} + 0.0018113*y_{Kenya} -0.0059304*Trend$

F(1,419)= 9.9416[.002]

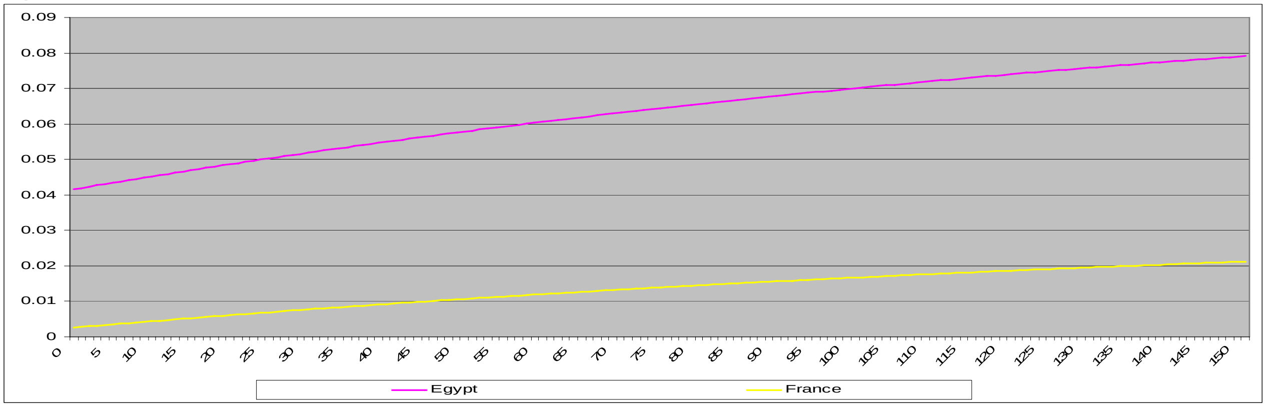
Appendix 3. Impulse Response functions for Bivariate cointegrating systems

Appendix 3a) Orthogonalized Impulse Response(s) to one S.E. shock in the equation for Egypt (Levels)

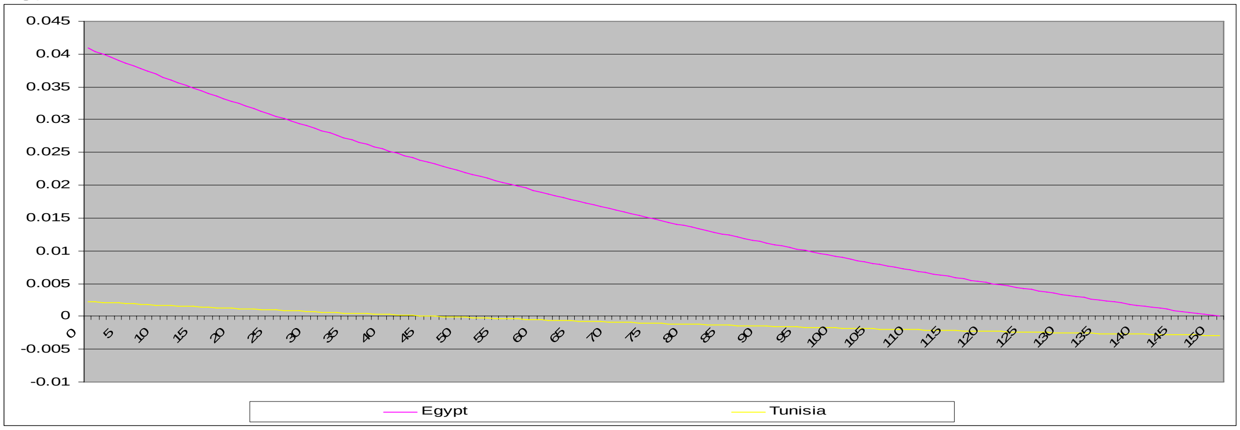
Egypt – UK



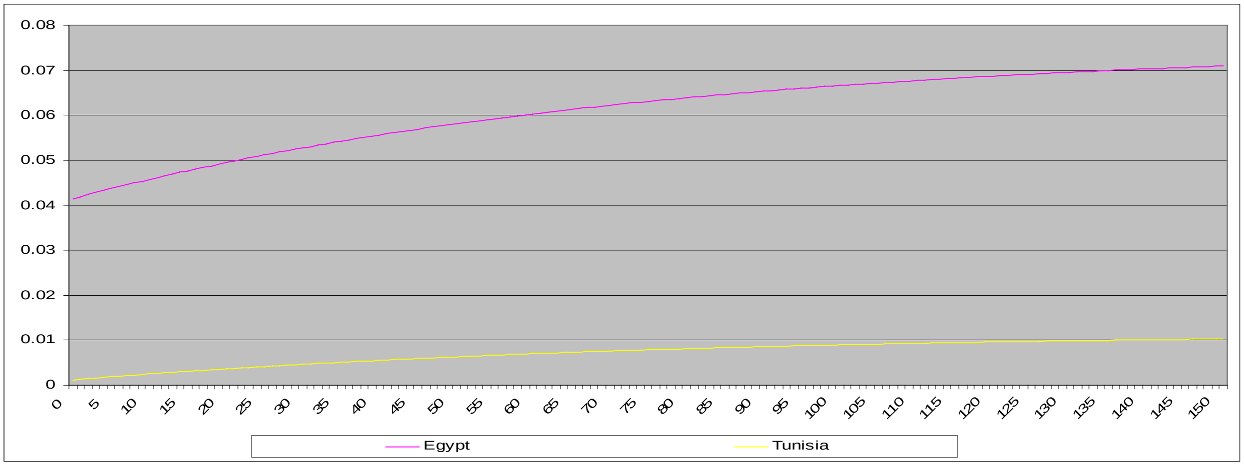
Egypt – France



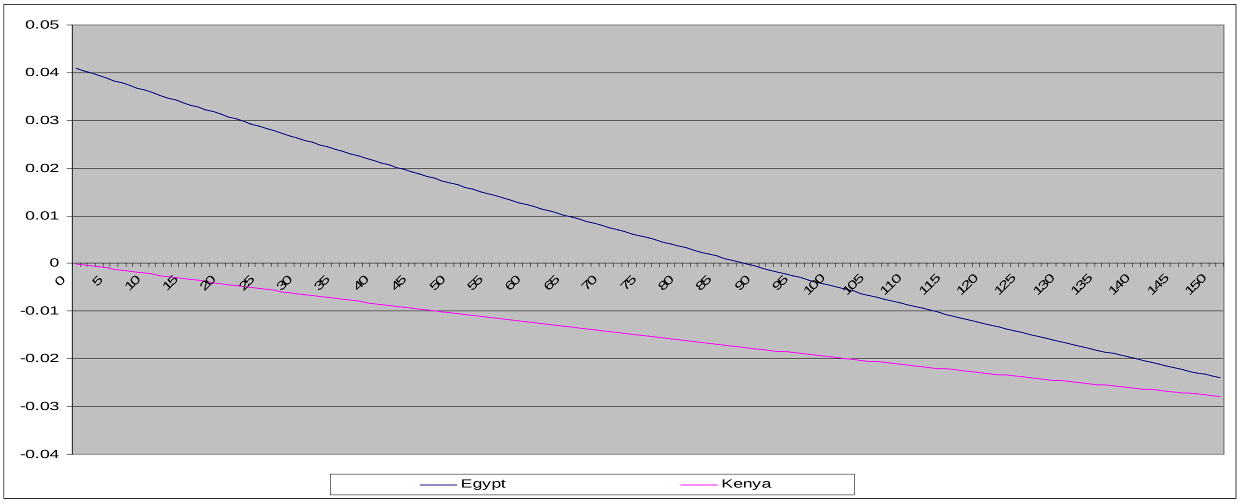
Egypt – Morocco



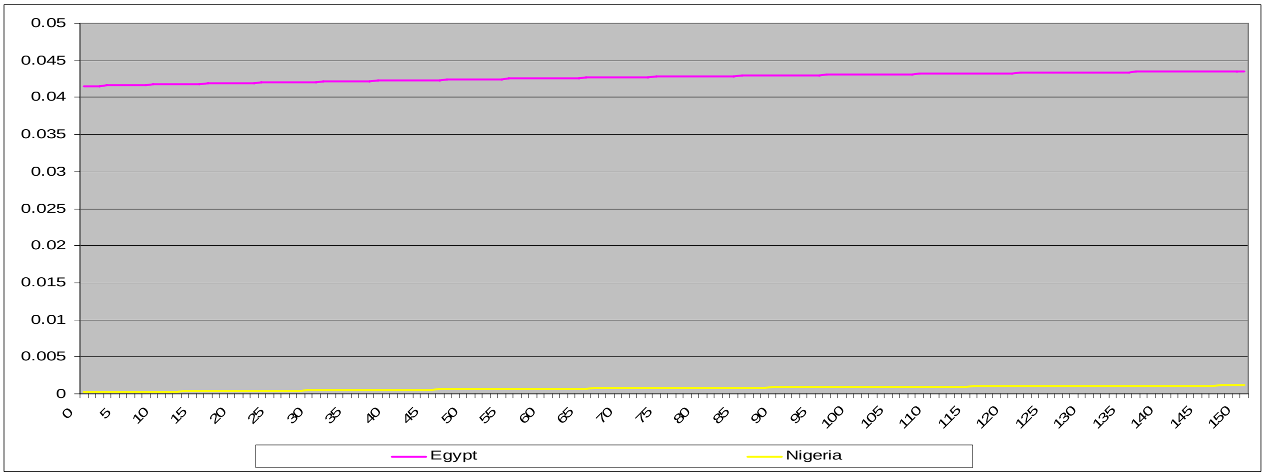
Egypt – Tunisia



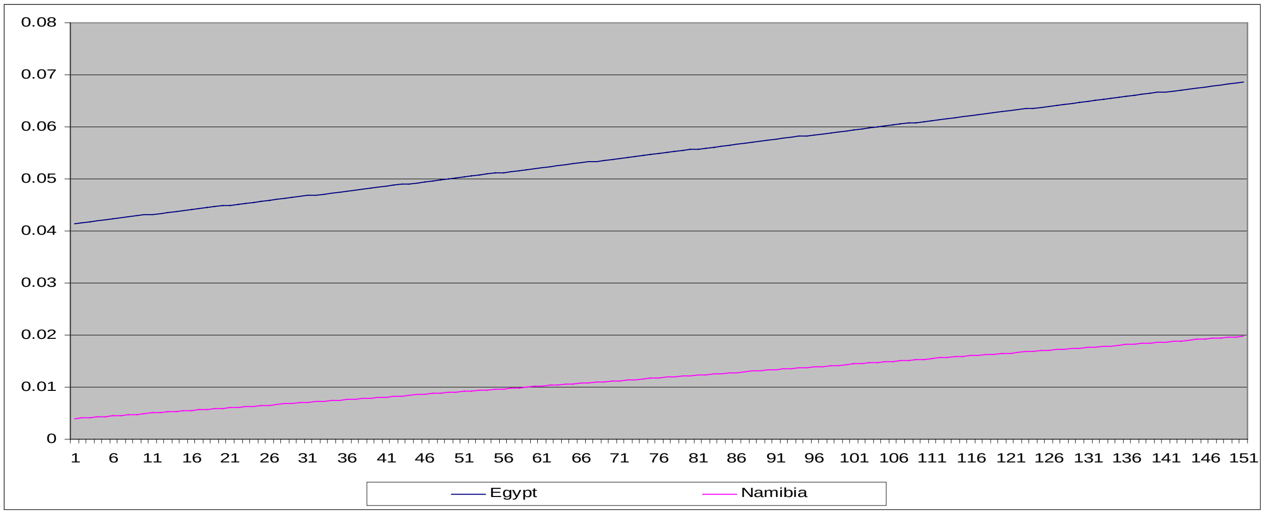
Egypt – Kenya



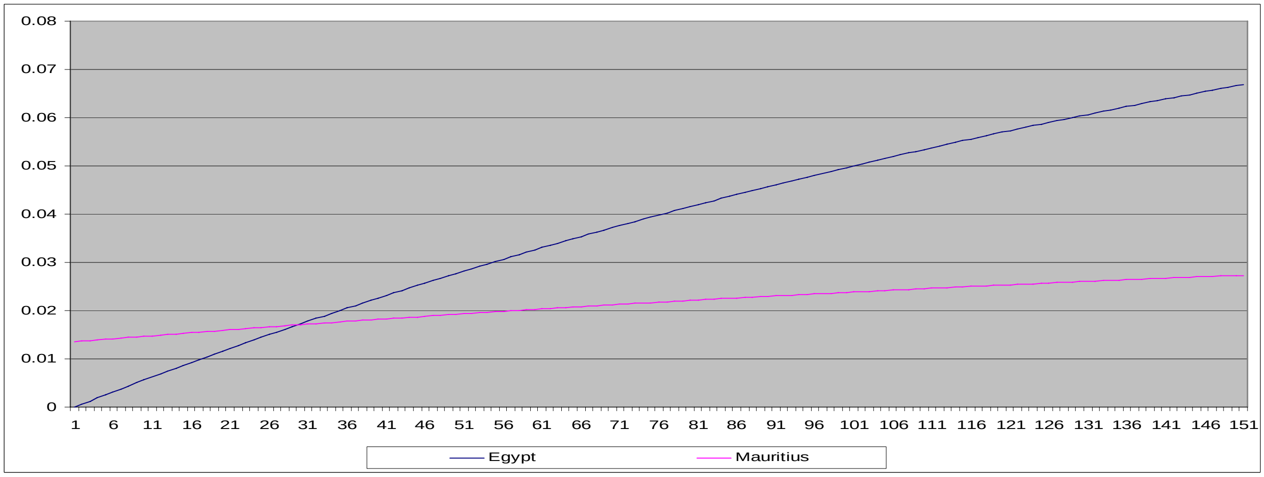
Egypt - Nigeria



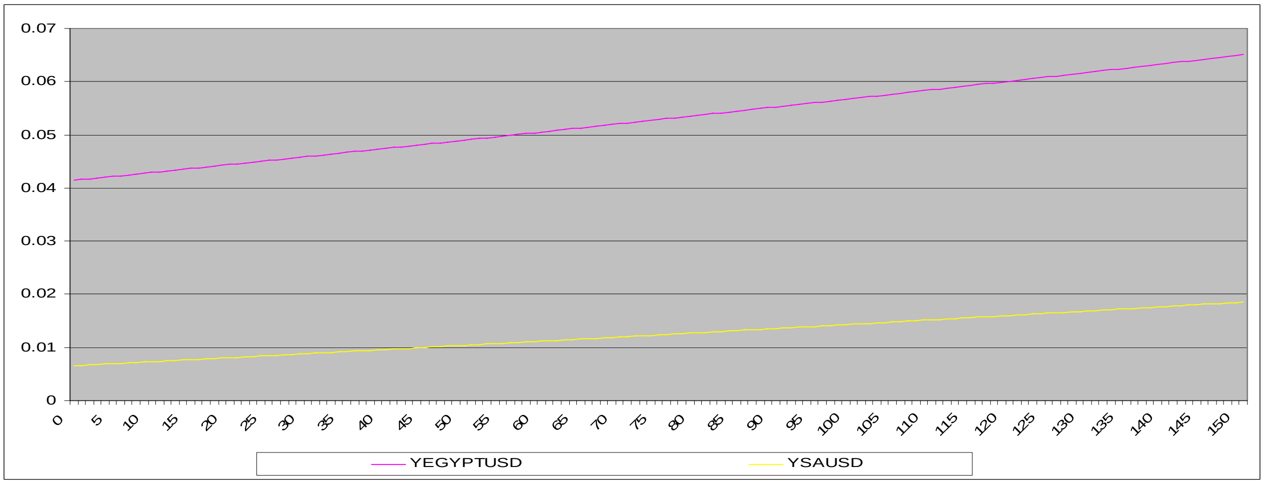
Egypt - Namibia



Egypt - Mauritius

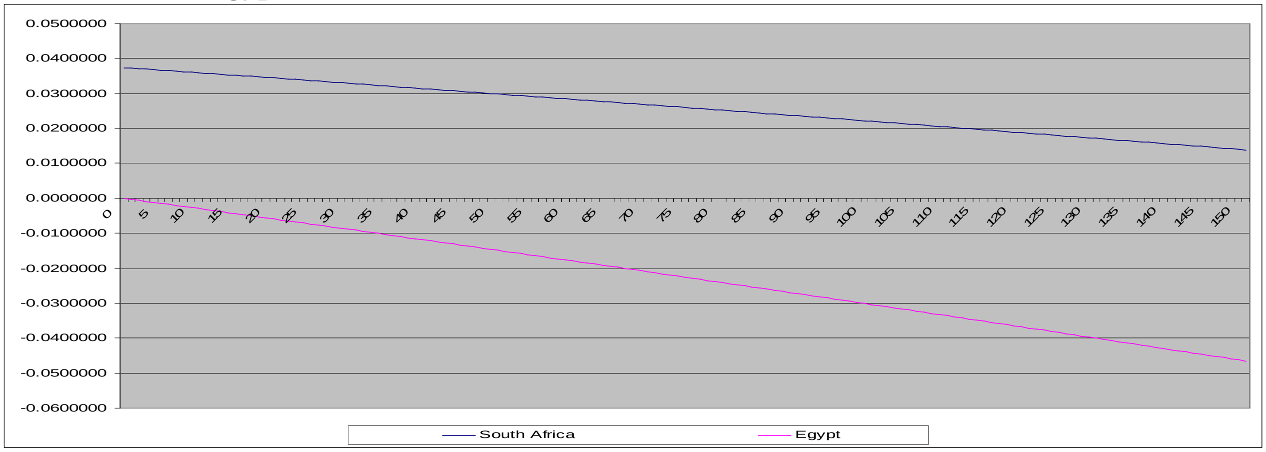


Egypt – South Africa

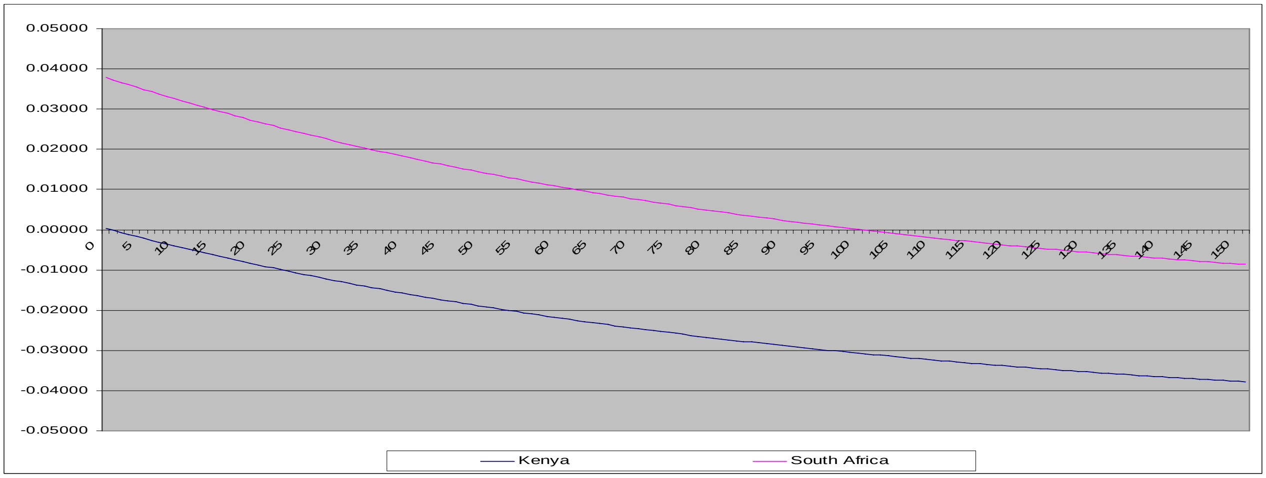


Appendix 3b) Orthogonalized Impulse Response(s) to one S.E. shock in the equation for South Africa (Levels)

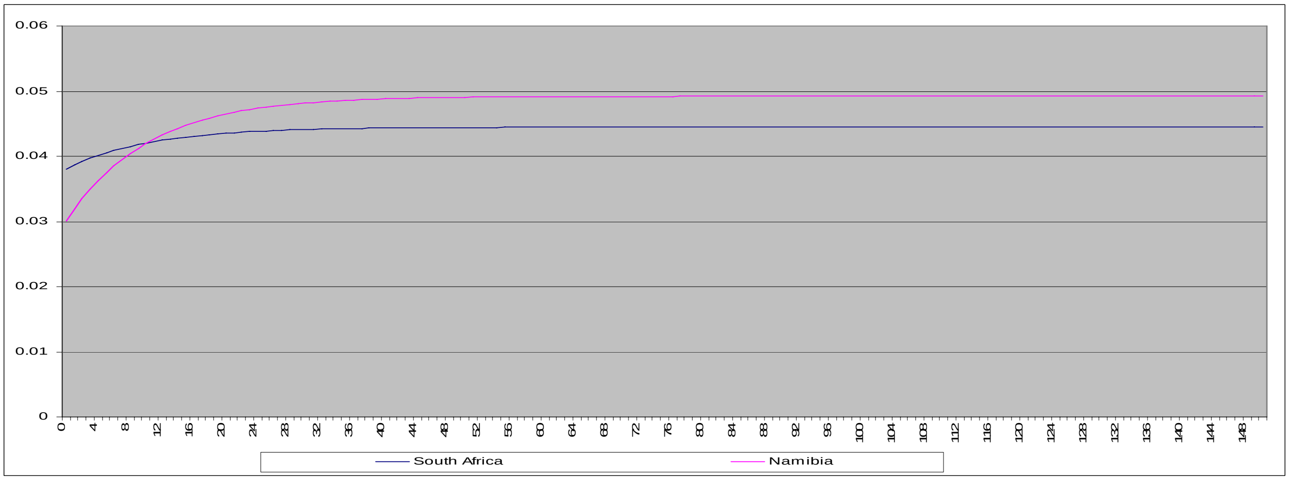
South Africa – Egypt



South Africa – Kenya

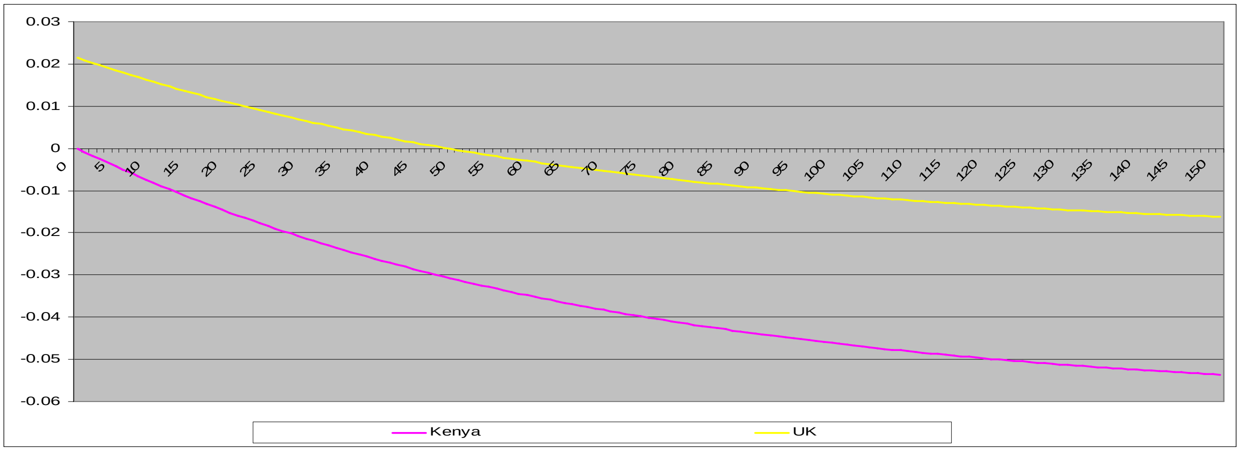


South Africa – Namibia

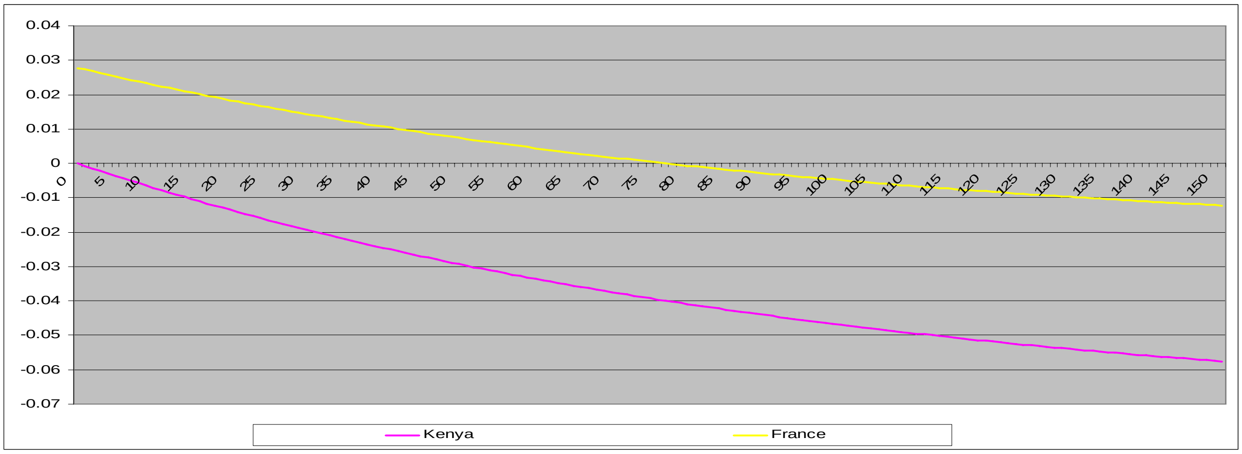


Appendix 3c) Orthogonalized Impulse Response(s) to one S.E. shock in the equation for Kenya (Levels)

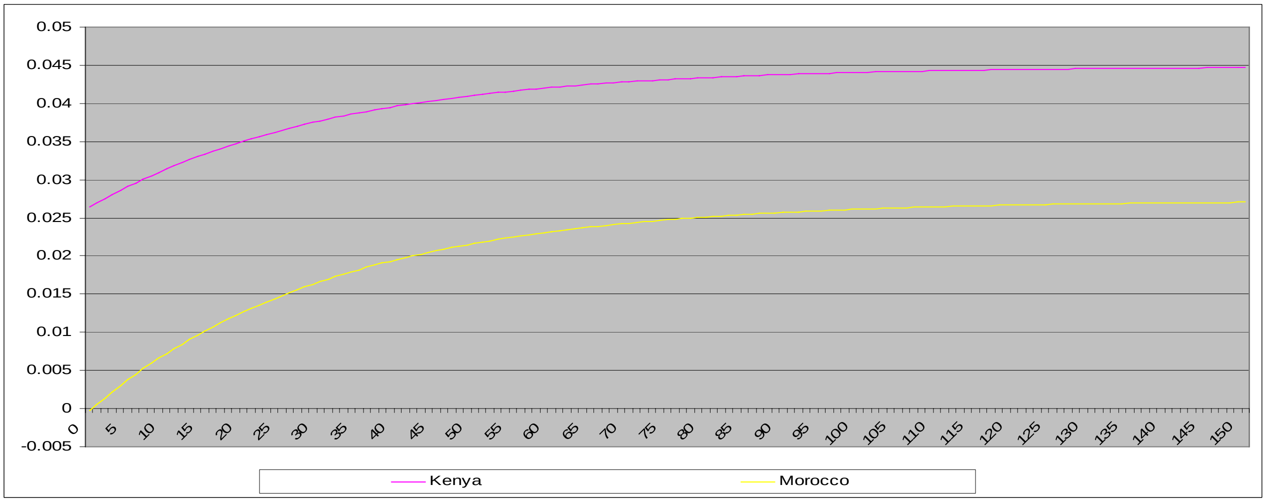
Kenya – UK



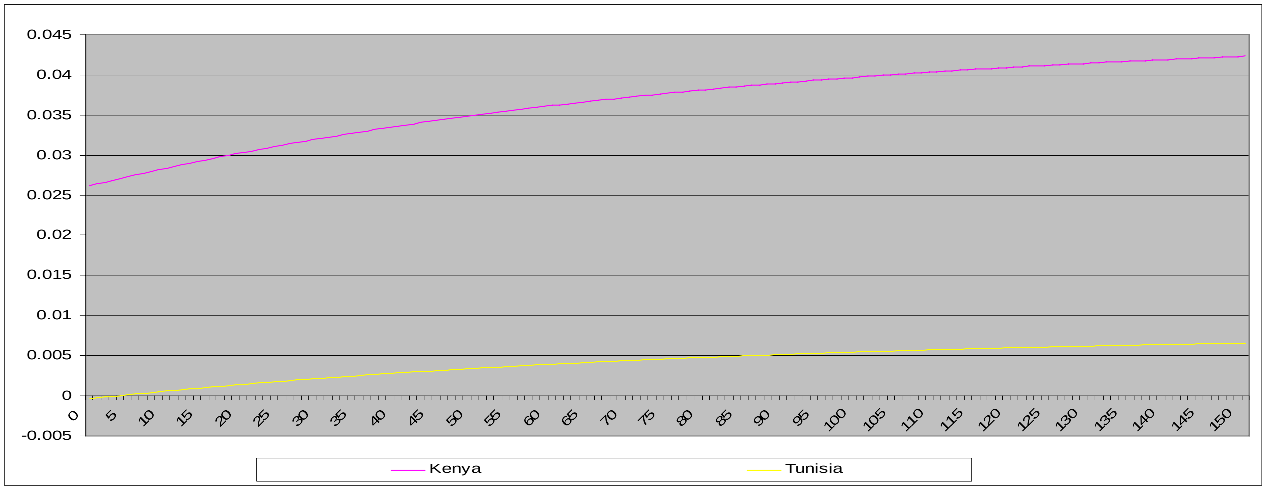
Kenya – France



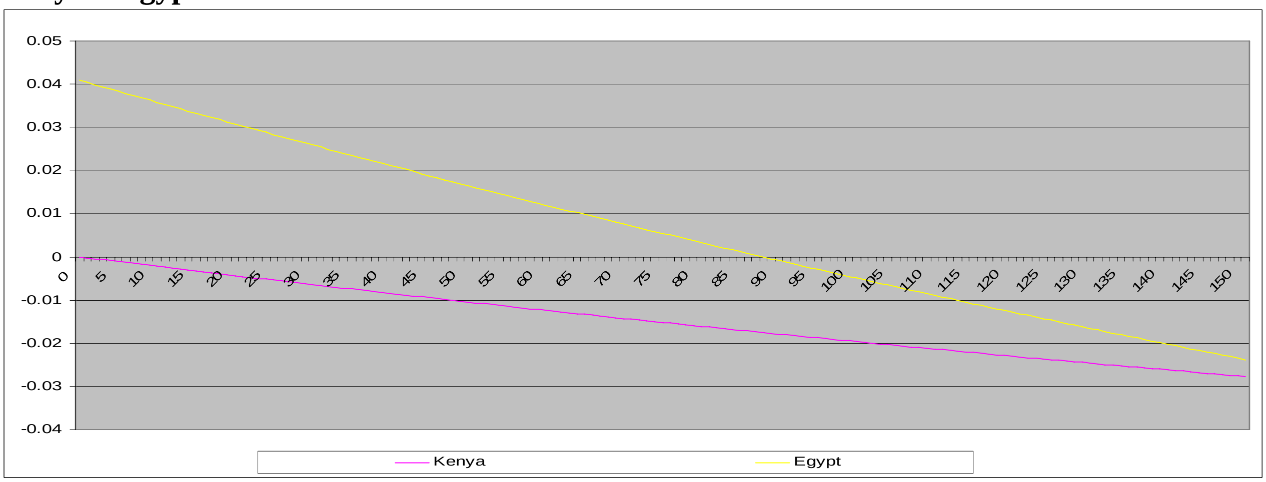
Kenya – Morocco



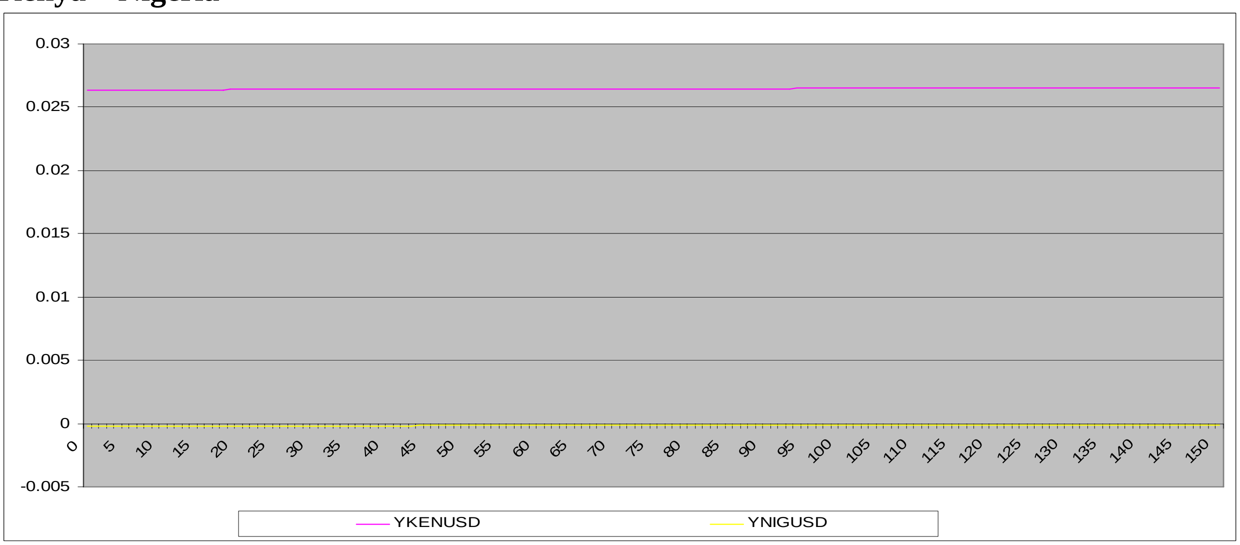
Kenya – Tunisia



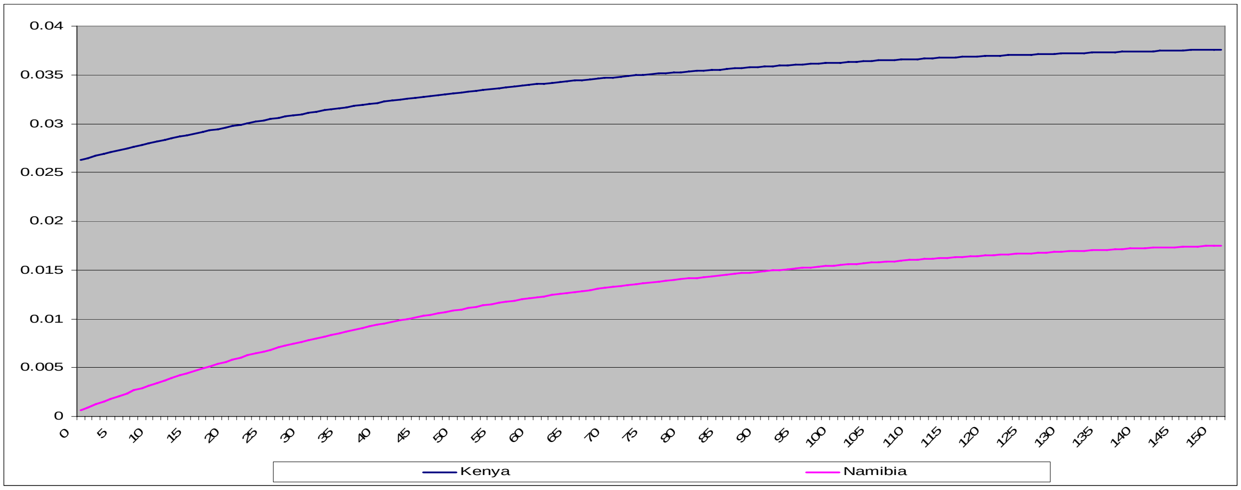
Kenya – Egypt



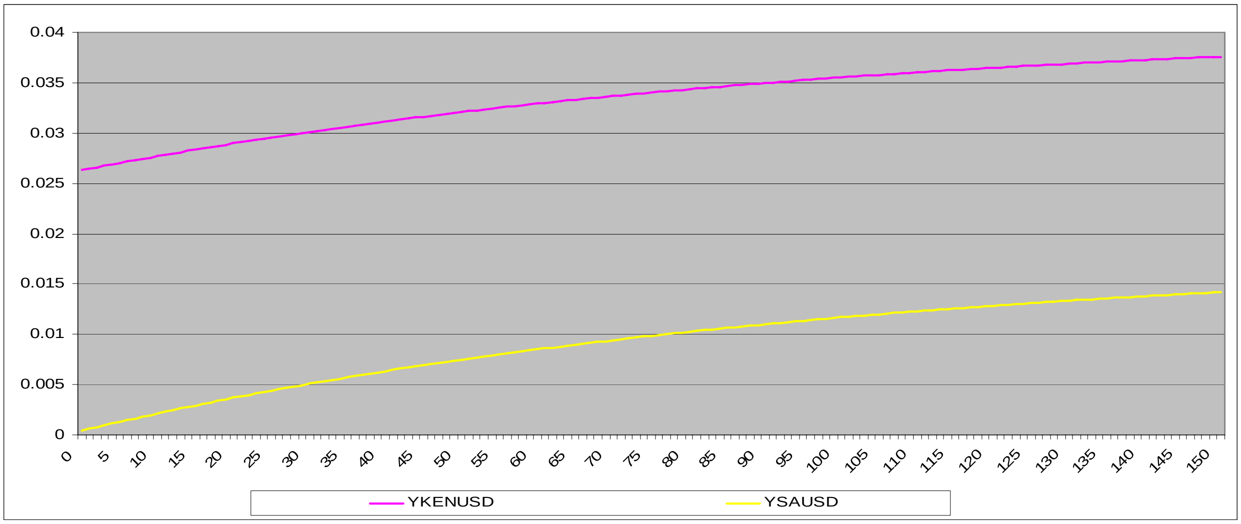
Kenya – Nigeria



Kenya – Namibia

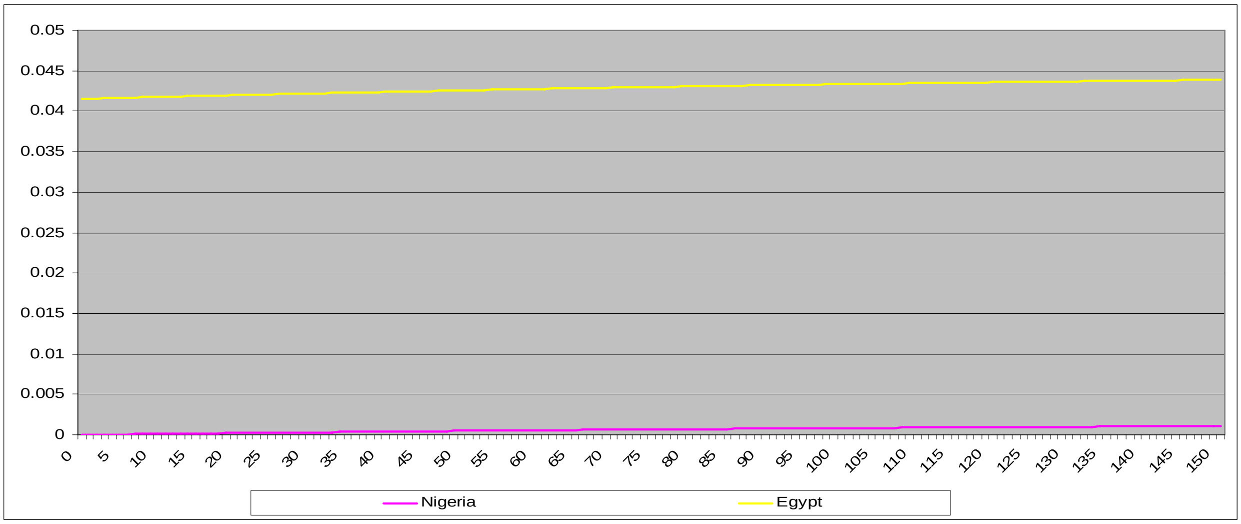


Kenya - South Africa

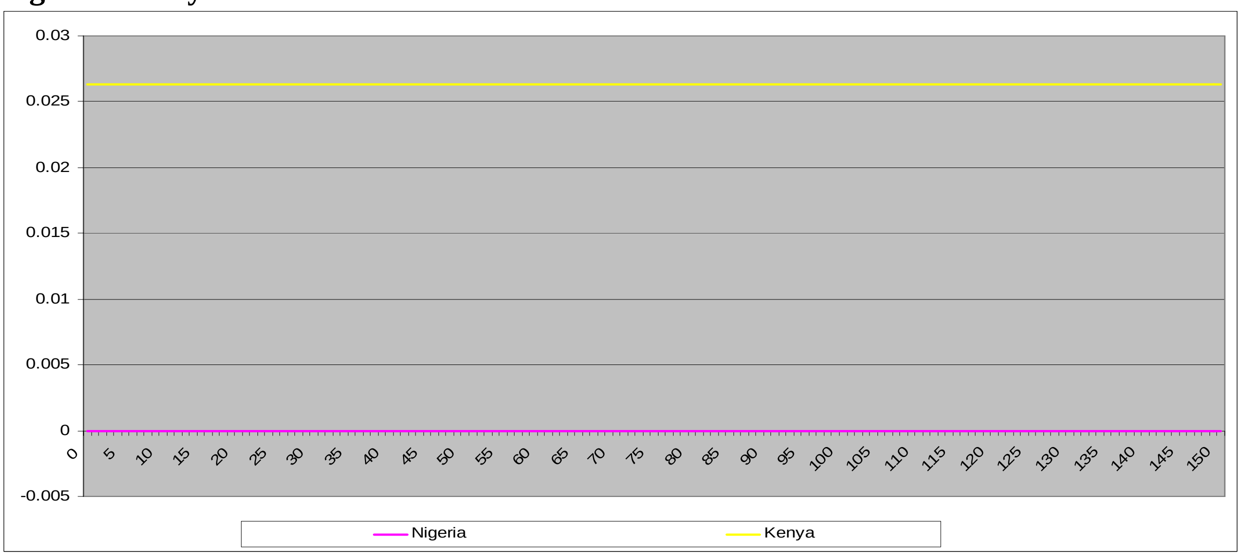


Appendix 3d) **Orthogonalized Impulse Response(s) to one S.E. shock in the equation for Nigeria (Levels)**

Nigeria – Egypt



Nigeria – Kenya



Appendix 4. Bivariate ARDL models

Appendix 4a) Bivariate ARDL models for relationships centred on Egypt

Egypt – Nigeria

	Dependent Variable is Δy_{Egypt}	
Regressor	Coefficient	Standard Errors (T-Ratio)
Δ Nigeria	0.016713	0.0049216 (3.3959[.001])
Δ Intercept	-.089353	0.027660 (-3.2304[.001])
ECM(-1)	0.0022997	0.0034040 (0.67560[.500])
$\Delta y_{Egypt} = y_{Egypt} - y_{Egypt(-1)}$		
$\Delta y_{Nigeria} = y_{Nigeria} - y_{Nigeria\ (-1)}$		
ECM = $y_{Egypt} + 7.2673 y_{Nigeria}$ -38.8533*Intercept		
F(2, 415) = 7.3000		
Adjusted R-Squared = 0.029330		
Estimated Long-run coefficients using ARDL(1,0) error correction model (N=415)		
Dependent variable is Egypt		
$y_{Nigeria}$	-7.2673	11.5683 (-0.62821[.530])
Intercept	38.8533	50.8735 (0.76372[.445])

Nigeria - Egypt

	Dependent Variable is $\Delta y_{Nigeria}$	
Regressor	Coefficient	Standard Errors (T-Ratio)
Δ Egypt	-0.0017829	0.0022491 (-.79271[.428])
Δ Intercept	0.0092210	0.018197 (.50673[.613])
ECM(-1)	0.0011615	0.0032854 (.35354[.724])
$\Delta y_{Egypt} = y_{Egypt} - y_{Egypt(-1)}$		
$\Delta y_{Nigeria} = y_{Nigeria} - y_{Nigeria\ (-1)}$		
ECM = $y_{Nigeria} - 1.5349 y_{Egypt}$ + 7.9387*Intercept		
F(2, 415) = 0.32091		
Adjusted R-Squared = -0.0032677		
Estimated Long-run coefficients using ARDL(1,0) error correction model (N=415)		
Dependent variable is Egypt		
y_{Egypt}	1.5349	4.1761 (.36755[.713])
Intercept	-7.9387	33.8070 (-.23483[.814])

Egypt – Mauritius

	Dependent Variable is Δy_{Egypt}	
Regressor	Coefficient	Standard Errors (T-Ratio)
Δ Mauritius	0.066482	0.014369 (4.6268[.000])
Δ Intercept	-0.069791	0.023759 (-2.9375[.003])
ECM(-1)	-0.016633	0.0058003 (-2.8677[.004])

$\Delta y_{Egypt} = y_{Egypt} - y_{Egypt(-1)}$

$\Delta y_{Mauritius} = y_{Mauritius} – y_{Mauritius (-1)}$

ECM = y_{Egypt} - 3.9969 $y_{Mauritius}$ + 4.1958*Intercept

F(2, 415) = 12.2731

Adjusted R-Squared = 0.051294

Estimated Long-run coefficients using ARDL(1,0) error correction model (N=415)

Dependent variable is Egypt

$y_{Mauritius}$	3.9969	0.82762 (4.8293[.000])
Intercept	-4.1958	2.3106 (-1.8159[.070])

Mauritius - Egypt

	Dependent Variable is $\Delta y_{Mauritius}$	
Regressor	Coefficient	Standard Errors (T-Ratio)
Δ Mauritius1	0.17459	0.048814 (3.5766[.000])
Δ Mauritius2	0.075937	0.049755 (1.5262[.128])
Δ Mauritius3	0.16636	0.049242 (3.3785[.001])
Δ Egypt	0.039037	0.015579 (2.5057[.013])
Δ Intercept	0.0058149	0.0076274 (.76237[.446])
ECM(-1)	0.0011296	0.0050472 (.22381[.823])

$\Delta y_{Egypt} = y_{Egypt} - y_{Egypt(-1)}$

$\Delta y_{Mauritius} = y_{Mauritius} – y_{Mauritius (-1)}$

ECM = $y_{Mauritius}$ -1.0858y_{Egypt} + 5.1477*Intercept

F(2, 415) = 9.9503

Adjusted R-Squared = 0.094957

Estimated Long-run coefficients using ARDL(4,1) error correction model (N=415)

Dependent variable is Mauritius

y_{Egypt}	1.0858	3.4690 (0.31300[.754])
Intercept	-5.1477	25.9657 (-0.19825[.843])

Egypt - Namibia

	Dependent Variable is Δy_{Egypt}	
Regressor	Coefficient	Standard Errors (T-Ratio)
Δ Namibia	0.038466	0.010589 (3.6324[.000])
Δ Intercept	-0.082060	0.026053 (-3.1497[.002])
ECM(-1)	-0.0085803	0.0050987 (-1.6828[.093])
$\Delta y_{Egypt} = y_{Egypt} - y_{Egypt(-1)}$		
$\Delta y_{Namibia} = y_{Namibia} - y_{Namibia\ (-1)}$		
ECM = y_{Egypt} - 4.4830$y_{Namibia}$ + 9.5638*Intercept		
F(2, 415) = 8.1374		
Adjusted R-Squared = 0.033099		
Estimated Long-run coefficients using ARDL(1,0) error correction model (N=415)		
Dependent variable is Egypt		
$y_{Namibia}$	4.4830	1.8842 (2.3792[.018])
Intercept	-9.5638	6.9293 (-1.3802[.168])

Namibia - Egypt

	Dependent Variable is $\Delta y_{Namibia}$	
Regressor	Coefficient	Standard Errors (T-Ratio)
Δ Egypt	0.0080427	0.0050871 (1.5810[.115])
Δ Intercept	-0.0056729	0.025979 (-.21837[.827])
ECM(-1)	-0.012908	0.010754 (-1.2004[.231])
$\Delta y_{Egypt} = y_{Egypt} - y_{Egypt(-1)}$		
$\Delta y_{Namibia} = y_{Namibia} - y_{Namibia\ (-1)}$		
ECM = $y_{Namibia}$ - 0.62305 y_{Egypt} + 0.43947 *Intercept		
F(2, 415) = 1.2508		
Adjusted R-Squared = 0.0012015		
Estimated Long-run coefficients using ARDL(1,0) error correction model (N=415)		
Dependent variable is Egypt		
y_{Egypt}	0.62305	0.32664 (1.9075[.057])
Intercept	-0.43947	2.2170 (-0.19822[.843])

Egypt - Morocco

Dependent Variable is Δy_{Egypt}		
Regressor	Coefficient	Standard Errors (T-Ratio)
Δ Morocco	0.022904	0.015138 (1.5131[.131])
Δ Intercept	-0.14662	0.076198 (-1.9242[.055])
ECM(-1)	-0.0013427	0.0056990 (-0.23560[.814])
$\Delta y_{Egypt} = y_{Egypt} - y_{Egypt(-1)}$		
$\Delta y_{Morocco} = y_{Morocco} - y_{Morocco\ (-1)}$		
ECM = y_{Egypt} - 17.0584$y_{Morocco}$ + 109.1979*Intercept		
F(2, 415) = 2.6455		
Adjusted R-Squared = 0.0078303		
Estimated Long-run coefficients using ARDL(1,0) error correction model (N=415)		
Dependent variable is Egypt		
$y_{Morocco}$	17.0584	63.5305 (0.26851[.788])
Intercept	-109.1979	431.6378 (-0.25299[.800])

Morocco - Egypt

Dependent Variable is $\Delta y_{Morocco}$		
Regressor	Coefficient	Standard Errors (T-Ratio)
Δ Egypt	0.0056147	0.0028955 (1.9391[.053])
Δ Intercept	0.044364	0.039361 (1.1271[.260])
ECM(-1)	-0.011905	0.0077882 (-1.5286[.127])
$\Delta y_{Egypt} = y_{Egypt} - y_{Egypt(-1)}$		
$\Delta y_{Morocco} = y_{Morocco} - y_{Morocco\ (-1)}$		
ECM = $y_{Morocco}$ -.47162y_{Egypt} -3.7265*Intercept		
F(2, 415) = 1.8844[.153]		
Adjusted R-Squared = 0.0042239		
Estimated Long-run coefficients using ARDL(1,0) error correction model (N=415)		
Dependent variable is Egypt		
y_{Egypt}	0.47162	0.17853 (2.6418[.009])
Intercept	3.7265	1.2228 (3.0476[.002])

Egypt - Tunisia

	Dependent Variable is Δy_{Egypt}	
Regressor	Coefficient	Standard Errors (T-Ratio)
Δ Tunisia	0.055637	0.027752 (2.0048[.046])
Δ Intercept	-0.36270	0.16420 (-2.2089[.028])
ECM(-1)	-0.0022523	0.0051482 (-0.43750[.662])
$\Delta y_{Egypt} = y_{Egypt} - y_{Egypt(-1)}$		
$\Delta y_{Tunisia} = y_{Tunisia} – y_{Tunisia\ (-1)}$		
ECM = y_{Egypt} - 24.7020$y_{Tunisia}$ + 161.0325*Intercept		
F(2, 415) = 3.5167		
Adjusted R-Squared = 0.011927		
Estimated Long-run coefficients using ARDL(1,0) error correction model (N=415)		
Dependent variable is Egypt		
$y_{Tunisia}$	24.7020	47.6226 (0.51870[.604])
Intercept	-161.0325	323.5187 (-0.49775[.619])

Tunisia - Egypt

	Dependent Variable is $\Delta y_{Tunisia}$	
Regressor	Coefficient	Standard Errors (T-Ratio)
Δ Egypt	0.0049696	0.0019779 (2.5126[.012])
Δ Intercept	0.13514	0.064117 (2.1077[.036])
ECM(-1)	-0.024661	0.010814 (-2.2805[.023])
$\Delta y_{Egypt} = y_{Egypt} - y_{Egypt(-1)}$		
$\Delta y_{Tunisia} = y_{Tunisia} – y_{Tunisia\ (-1)}$		
ECM = $y_{Tunisia}$ -.20152y_{Egypt} -5.4799*Intercept		
F(2, 415) = 3.3043		
Adjusted R-Squared = 0.010931		
Estimated Long-run coefficients using ARDL(1,0) error correction model (N=415)		
Dependent variable is Egypt		
y_{Egypt}	0.20152	0.057743 (3.4899[.001])
Intercept	5.4799	0.39989 (13.7037[.000])

Egypt – France

	Dependent Variable is Δy_{Egypt}	
Regressor	Coefficient	Standard Errors (T-Ratio)
Δ France	-0.018432	0.016272 (-1.1328[.258])
Δ Intercept	0.070851	0.097817 (.72433[.469])
ECM(-1)	0.0094947	0.0046984 (2.0208[.044])
$\Delta y_{Egypt} = y_{Egypt} - y_{Egypt(-1)}$		
$\Delta y_{France} = y_{France} – y_{France\ (-1)}$		
ECM = y_{Egypt} -1.9413y_{France} + 7.4622*Intercept		
F(2, 415) = 2.1388		
Adjusted R-Squared = 0.0054321		
Estimated Long-run coefficients using ARDL(1,0) error correction model (N=415)		
Dependent variable is Egypt		
y_{France}	1.9413	1.2294 (1.5790[.115])
Intercept	-7.4622	8.9251 (-.83609[.404])

France - Egypt

	Dependent Variable is Δy_{France}	
Regressor	Coefficient	Standard Errors (T-Ratio)
Δ Egypt	0.011755	0.0029638 (3.9662[.000])
Δ Intercept	0.21588	0.062670 (3.4446[.001])
ECM(-1)	-0.040761	0.010343 (-3.9407[.000])
$\Delta y_{Egypt} = y_{Egypt} - y_{Egypt(-1)}$		
$\Delta y_{France} = y_{France} – y_{France\ (-1)}$		
ECM = y_{France} - 0.28840y_{Egypt} - 5.2962*Intercept		
F(2, 415) = 9.2152		
Adjusted R-Squared = 0.037908		
Estimated Long-run coefficients using ARDL(1,0) error correction model (N=415)		
Dependent variable is Egypt		
y_{Egypt}	0.28840	0.056862 (5.0718[.000])
Intercept	5.2962	0.39693 (13.3428[.000])

Appendix 4b) Bivariate ARDL models for relationships centred on Kenya

Egypt - Kenya

	Dependent Variable is Δy_{Egypt}	
Regressor	Coefficient	Standard Errors (T-Ratio)
ΔKenya	0.010852	0.0090068 (1.2048[.229])
ΔIntercept	-0.032326	0.023493 (-1.3760[.170])
ECM(-1)	-0.2036E-3	0.0059027 (-.034498[.972])

$\Delta y_{Egypt} = y_{Egypt} - y_{Egypt(-1)}$

$\Delta y_{Kenya} = y_{Kenya} - y_{Kenya(-1)}$

ECM = y_{Egypt} - 53.2916y_{Kenya} - 158.7507*Intercept

F(2, 415) = 2.2236

Adjusted R-Squared = 0.0058345

Estimated Long-run coefficients using ARDL(1,0) error correction model (N=415)

Dependent variable is Egypt

y_{Kenya}	53.2916	1508.3 (.035333[.972])
Intercept	-158.7507	4680.9 (-.033915[.973])

Kenya – Egypt

	Dependent Variable is Δy_{Kenya}	
Regressor	Coefficient	Standard Errors (T-Ratio)
ΔKenya1	0.18864	0.048099 (3.9218[.000])
ΔEgypt	0.0059889	0.0035838 (1.6711[.095])
ΔIntercept	-0.0089554	0.014282 (-.62703[.531])
ECM(-1)	-0.0096854	0.0055156 (-1.7560[.080])

$\Delta y_{Egypt} = y_{Egypt} - y_{Egypt(-1)}$

$\Delta y_{Kenya1} = y_{Kenya(-1)} - y_{Kenya(-2)}$

$\Delta y_{Kenya} = y_{Kenya} - y_{Kenya(-1)}$

ECM = y_{Kenya} - 0.61834y_{Egypt} + 0.92463*Intercept

F(2, 415) = 6.1506

Adjusted R-Squared = 0.035731

Estimated Long-run coefficients using ARDL(2,0) error correction model (N=415)

Dependent variable is Kenya

y_{Egypt}	0.61834	.21189 (2.9182[.004])
Intercept	-0.92463	1.4921 (-0.61968[.536])

Kenya – South Africa

Dependent Variable is Δy_{Kenya}		
Regressor	Coefficient	Standard Errors (T-Ratio)
Δ Kenya1	0.16731	0.048272 (3.4660[.001])
Δ South Africa	0.010782	0.0035876 (3.0053[.003])
Δ Intercept	-0.026813	0.015410 (-1.7399[.083])
ECM(-1)	-0.0056425	0.0032879 (-1.7161[.087])
$\Delta y_{South\ Africa} = y_{South\ Africa} - y_{South\ Africa(-1)}$		
$\Delta y_{Kenya1} = y_{Kenya(-1)} - y_{Kenya(-2)}$		
$\Delta y_{Kenya} = y_{Kenya} - y_{Kenya(-1)}$		
$ECM = y_{Kenya} - 1.9108 y_{South\ Africa} + 4.7519$ *Intercept		
$F(2, 415) = 8.3085$		
Adjusted R-Squared = 0.049953		
Estimated Long-run coefficients using ARDL(2,0) error correction model (N=415)		
Dependent variable is Kenya		
$y_{South\ Africa}$	1.9108	1.0623 (1.7987[.073])
Intercept	-4.7519	4.5422 (-1.0462[.296])

South Africa - Kenya

Dependent Variable is $\Delta y_{South\ Africa}$		
Regressor	Coefficient	Standard Errors (T-Ratio)
Δ Kenya	0.0026001	0.0049046 (.53014[.596])
Δ Intercept	-0.015988	0.022776 (-.70198[.483])
ECM(-1)	0.0023974	0.0053416 (.44881[.654])
$\Delta y_{Egypt} = y_{Egypt} - y_{Egypt(-1)}$		
$\Delta y_{Kenya} = y_{Kenya} - y_{Kenya(-1)}$		
$ECM = y_{Egypt} + 1.0846\ y_{Kenya} - 6.6689$ *Intercept		
$F(2, 415) = 0.38404$		
Adjusted R-Squared = -0.0029630		
Estimated Long-run coefficients using ARDL(1,0) error correction model (N=415)		
Dependent variable is South Africa		
y_{Kenya}	53.2916	1508.3 (.035333[.972])
Intercept	-158.7507	4680.9 (-.033915[.973])

Kenya – Nigeria

	Dependent Variable is Δy_{Kenya}	
Regressor	Coefficient	Standard Errors (T-Ratio)
Δ Kenya1	0.16402	0.048428 (3.3869[.001])
Δ Nigeria	0.0089792	0.0029658 (3.0275[.003])
Δ Intercept	-0.029910	0.016110 (-1.8567[.064])
ECM(-1)	-0.0032408	0.0030872 (-1.0497[.294])
$\Delta y_{Nigeria} = y_{Nigeria} - y_{Nigeria(-1)}$		
$\Delta y_{Kenya1} = y_{Kenya(-1)} - y_{Kenya(-2)}$		
$\Delta y_{Kenya} = y_{Kenya} - y_{Kenya(-1)}$		
ECM = y_{Kenya} - 2.7707$y_{Nigeria}$ + 9.2295*Intercept		
F(2, 415) = 8.3549		
Adjusted R-Squared = 0.050254		
Estimated Long-run coefficients using ARDL(2,0) error correction model (N=415)		
Dependent variable is Kenya		
$y_{Nigeria}$	2.7707	2.6807 (1.0336[.302])
Intercept	-9.2295	12.2331 (-0.75447[.451])

Nigeria - Kenya

	Dependent Variable is $\Delta y_{Nigeria}$	
Regressor	Coefficient	Standard Errors (T-Ratio)
Δ Kenya	-.0038467	.0033256 (-1.1567[.248])
Δ Intercept	.011001	.017042 (.64556[.519])
ECM(-1)	.8998E-3	.0031586 (.28486[.776])
$\Delta y_{Nigeria} = y_{Nigeria} - y_{Nigeria\ (-1)}$		
$\Delta y_{Kenya} = y_{Kenya} - y_{Kenya(-1)}$		
ECM = $y_{Nigeria}$ - 4.2753y_{Kenya} + 12.2271*Intercept		
F(2, 415) = .67570		
Adjusted R-Squared = -.0015578		
Estimated Long-run coefficients using ARDL(1,0) error correction model (N=415)		
Dependent variable is Nigeria		
y_{Kenya}	4.2753	14.9196 (.28655[.775])
Intercept	-12.2271	58.4774 (-.20909[.834])

Kenya – Morocco

	Dependent Variable is Δy_{Kenya}	
Regressor	Coefficient	Standard Errors (T-Ratio)
Δ Kenya1	0.18859	0.049145 (3.8373[.000])
Δ Morocco	-0.2215E-3	0.015699 (-.014109[.989])
Δ Intercept	0.0082043	0.080978 (.10131[.919])
ECM(-1)	-0.0019254	0.0090247 (-.21334[.831])
$\Delta y_{Morocco} = y_{Morocco} - y_{Morocco\ (-1)}$		
$\Delta y_{Kenya1} = y_{Kenya(-1)} - y_{Kenya(-2)}$		
$\Delta y_{Kenya} = y_{Kenya} - y_{Kenya(-1)}$		
ECM = y_{Kenya} + 0.11504$y_{Morocco}$ - 4.2611*Intercept		
F(2, 415) = 5.1848		
Adjusted R-Squared = .029227		
Estimated Long-run coefficients using ARDL(2,0) error correction model (N=415)		
Dependent variable is Kenya		
$y_{Morocco}$	-0.11504	8.6621 (-.013281[.989])
Intercept	4.2611	60.4757 (.070460[.944])

Morocco - Kenya

	Dependent Variable is $\Delta y_{Morocco}$	
Regressor	Coefficient	Standard Errors (T-Ratio)
Δ Kenya	0.038272	0.0067361 (5.6817[.000])
Δ Intercept	0.30009	0.061178 (4.9052[.000])
ECM(-1)	-0.061772	0.011781 (-5.2435[.000])
$\Delta y_{Morocco} = y_{Morocco} - y_{Morocco(-1)}$		
$\Delta y_{Kenya} = y_{Kenya} - y_{Kenya(-1)}$		
ECM = $y_{Nigeria}$ - 0.61958y_{Kenya} - 4.8581 *Intercept		
F(2, 415) = 16.1454		
Adjusted R-Squared = 0.067720		
Estimated Long-run coefficients using ARDL(1,0) error correction model (N=415)		
Dependent variable is Morocco		
y_{Kenya}	0.61958	0.043691 (14.1808[.000])
Intercept	4.8581	0.14854 (32.7046[.000])

Kenya – UK

	Dependent Variable is Δy_{Kenya}	
Regressor	Coefficient	Standard Errors (T-Ratio)
Δ Kenya1	0.15865	0.048982 (3.2390[.001])
Δ UK	-0.032919	0.011684 (-2.8174[.005])
Δ Intercept	0.24964	0.086738 (2.8781[.004])
ECM(-1)	0.0071010	0.0044654 (1.5902[.113])
$\Delta y_{UK} = y_{UK} - y_{UK\,(-1)}$		
$\Delta y_{Kenya1} = y_{Kenya(-1)} - y_{Kenya(-2)}$		
$\Delta y_{Kenya} = y_{Kenya} - y_{Kenya(-1)}$		
ECM = y_{Kenya} - 4.6359 y_{UK} + 35.1561*Intercept		
F(2, 415) = 7.9301		
Adjusted R-Squared = 0.047489		
Estimated Long-run coefficients using ARDL(2,0) error correction model (N=415)		
Dependent variable is Kenya		
y_{UK}	4.6359	2.0571 (2.2536[.025])
Intercept	-35.1561	17.1136 (-2.0543[.041])

UK - Kenya

	Dependent Variable is Δy_{UK}	
Regressor	Coefficient	Standard Errors (T-Ratio)
Δ Kenya	.014582	.0035454 (4.1129[.000])
Δ Intercept	.22584	.069018 (3.2722[.001])
ECM(-1)	-.033064	.0092418 (-3.5777[.000])
$\Delta y_{UK} = y_{UK} - y_{UK(-1)}$		
$\Delta y_{Kenya} = y_{Kenya} - y_{Kenya(-1)}$		
ECM = y_{UK} - 0.44102y_{Kenya} -6.8303*Intercept		
F(2, 415) = 8.9634		
Adjusted R-Squared = .036789		
Estimated Long-run coefficients using ARDL(1,0) error correction model (N=415)		
Dependent variable is UK		
y_{Kenya}	.44102	.091384 (4.8260[.000])
Intercept	6.8303	.31018 (22.0207[.000])

Kenya – France

	Dependent Variable is Δy_{Kenya}	
Regressor	Coefficient	Standard Errors (T-Ratio)
Δ Kenya1	.17885	.048467 (3.6901[.000])
Δ France	-.013194	.0079445 (-1.6608[.098])
Δ Intercept	.093970	.053382 (1.7603[.079])
ECM(-1)	.6636E-3	.0034898 (.19017[.849])

$\Delta y_{France} = y_{France} - y_{France(-1)}$

$\Delta y_{Kenya1} = y_{Kenya(-1)} - y_{Kenya(-2)}$

$\Delta y_{Kenya} = y_{Kenya} - y_{Kenya(-1)}$

ECM = y_{Kenya} - 19.8817y_{France} + 141.5967*Intercept

F(2, 415) = 6.1388

Adjusted R-Squared = 0.035651

Estimated Long-run coefficients using ARDL(2,0) error correction model (N=415)

Dependent variable is Kenya

y_{France}	19.8817	99.5181 (.19978[.842])
Intercept	-141.5967	725.8492 (-.19508[.845])

France - Kenya

	Dependent Variable is Δy_{France}	
Regressor	Coefficient	Standard Errors (T-Ratio)
Δ Kenya	.013590	.0036417 (3.7318[.000])
Δ Intercept	.14180	.055934 (2.5352[.012])
ECM(-1)	-.025614	.0082634 (-3.0997[.002])

$\Delta y_{France} = y_{France} - y_{France(-1)}$

$\Delta y_{Kenya} = y_{Kenya} - y_{Kenya(-1)}$

ECM = y_{France} -.53057y_{Kenya} -5.5361*Intercept

F(2, 415) = 8.3071

Adjusted R-Squared = .033860

Estimated Long-run coefficients using ARDL(1,0) error correction model (N=415)

Dependent variable is France

y_{Kenya}	.53057	.16834 (3.1518[.002])
Intercept	5.5361	.56351 (9.8243[.000])

Appendix 4c) Bivariate ARDL models for relationships centred on South Africa

Egypt – South Africa

Dependent Variable is Δy_{Egypt}		
Regressor	Coefficient	Standard Errors (T-Ratio)
Δ South Africa	0.20475	0.052580 (3.8939[.000])
Δ Intercept	-0.071866	0.024790 (-2.8990[.004])
ECM(-1)	-0.0053594	0.0042914 (-1.2489[.212])
$\Delta y_{Egypt} = y_{Egypt} - y_{Egypt(-1)}$		
$\Delta y_{South\ Africa} = y_{South\ Africa} - y_{South\ Africa(-1)}$		
ECM = y_{Egypt} - 4.8890$y_{South\ Africa}$ + 13.4093*Intercept		
F(2, 415) = 16.0425		
Adjusted R-Squared = 0.065201		
Estimated Long-run coefficients using ARDL(1,1) error correction model (N=415)		
Dependent variable is Egypt		
$y_{South\ Africa}$	4.8890	3.1849 (1.5351[.126])
Intercept	-13.4093	13.2593 (-1.0113[.312])

South Africa - Egypt

Dependent Variable is $\Delta y_{South\ Africa}$		
Regressor	Coefficient	Standard Errors (T-Ratio)
Δ Egypt	0.17256	0.044315 (3.8939[.000])
Δ Intercept	-0.0035496	0.022987 (-0.15442[.877])
ECM(-1)	-0.0034830	0.0066488 (-0.52385[.601])
$\Delta y_{Egypt} = y_{Egypt} - y_{Egypt(-1)}$		
$\Delta y_{South\ Africa} = y_{South\ Africa} - y_{South\ Africa(-1)}$		
ECM = $y_{South\ Africa}$ - 0.85954y_{Egypt} + 1.0191*Intercept		
F(2, 415) = 7.9815		
Adjusted R-Squared = 0.030149		
Estimated Long-run coefficients using ARDL(1,1) error correction model (N=415)		
Dependent variable is South Africa		
y_{Egypt}	0.85954	1.2243 (.70204[.483])
Intercept	-1.0191	7.6470(-.13327[.894])

South Africa - Namibia

	Dependent Variable is $\Delta y_{South\ Africa}$	
Regressor	Coefficient	Standard Errors (T-Ratio)
Δ Namibia	-0.10318	0.033522 (-3.0779[.002])
Δ Intercept	0.70829	0.031169 (22.7240[.000])
ECM(-1)	0.0043377	0.015853 (.27362[.785])
$\Delta y_{Namibia} = y_{Namibia} - y_{Namibia(-1)}$		
$\Delta y_{South\ Africa} = y_{South\ Africa} - y_{South\ Africa(-1)}$		
$ECM = y_{South\ Africa} -.85027 y_{Namibia} -1.9986{*}Intercept$		
F(2, 415) = 178.4552[.000]		
Adjusted R-Squared = 0.56030		
Estimated Long-run coefficients using ARDL(1,1) error correction model (N=415)		
Dependent variable is South Africa		
$y_{Namibia}$	0.85027	2.4162 (.35191[.725])
Intercept	1.9986	12.1710 (.16421[.870])

Namibia – South Africa

	Dependent Variable is $\Delta y_{Namibia}$	
Regressor	Coefficient	Standard Errors (T-Ratio)
Δ South Africa	0.78445	0.034521 (22.7240[.000])
Δ South Africa1	0.17285	0.034652 (4.9883[.000])
Δ Intercept	0.0055264	0.016683 (.33125[.741])
ECM(-1)	-0.031672	0.012730 (-2.4880[.013])
$\Delta y_{Namibia} = y_{Namibia} - y_{Namibia(-1)}$		
$\Delta y_{South\ Africa1} = y_{South\ Africa(-1)} - y_{South\ Africa(-2)}$		
$\Delta y_{South\ Africa} = y_{South\ Africa} - y_{South\ Africa(-1)}$		
$ECM = y_{Namibia} - 0.83581 y_{South\ Africa} - 0.17449{*}Intercept$		
F(2, 415) = 197.9298[.000]		
Adjusted R-Squared = 0.58581		
Estimated Long-run coefficients using ARDL(1,1) error correction model (N=415)		
Dependent variable is Namibia		
$y_{South\ Africa}$	0.83581	0.11552 (7.2350[.000])
Intercept	0.17449	0.49947 (.34934[.727])

South Africa - Morocco

	Dependent Variable is $\Delta y_{South\ Africa}$	
Regressor	Coefficient	Standard Errors (T-Ratio)
Δ Morocco	.21562	0.086485 (2.4932[.013])
Δ Intercept	-0.014483	0.055070 (-.26298[.793])
ECM(-1)	0.0017235	0.0052694 (.32708[.744])
$\Delta y_{Morocco} = y_{Morocco} - y_{Morocco(-1)}$		
$\Delta y_{South\ Africa} = y_{South\ Africa} - y_{South\ Africa(-1)}$		
ECM = $y_{South\ Africa}$ + 0.83556$y_{Morocco}$ - 8.4029*Intercept		
F(2, 415) = 3.3575		
Adjusted R-Squared = 0.0088304		
Estimated Long-run coefficients using ARDL(1,1) error correction model (N=415)		
Dependent variable is South Africa		
$y_{Morocco}$	-0.83556	6.2251 (-0.13423[.893])
Intercept	8.4029	39.9979 (0.21008[.834])

Morocco – South Africa

	Dependent Variable is $\Delta y_{Morocco}$	
Regressor	Coefficient	Standard Errors (T-Ratio)
Δ South Africa	0.0080559	0.0029376 (2.7423[.006])
Δ Intercept	-0.0059086	0.031204 (-0.18935[.850])
ECM(-1)	-0.0039616	0.0047575 (-0.83272[.405])
$\Delta y_{Morocco} = y_{Morocco} - y_{Morcco(-1)}$		
$\Delta y_{South\ Africa} = y_{South\ Africa} - y_{South\ Africa(-1)}$		
ECM = $y_{Morocco}$ -2.0335$y_{South\ Africa}$ + 1.4914*Intercept		
F(2, 415) = 3.7646		
Adjusted R-Squared = 0.013086		
Estimated Long-run coefficients using ARDL(1,1) error correction model (N=415)		
Dependent variable is Morocco		
$y_{South\ Africa}$	2.0335	2.3015 (0.88354[.377])
Intercept	-1.4914	9.5570 (-0.15606[.876])

South Africa - UK

Dependent Variable is $\Delta y_{South\ Africa}$		
Regressor	Coefficient	Standard Errors (T-Ratio)
Δ South Africa1	.050453	.042024 (1.2006[.231])
Δ South Africa2	.13780	.042223 (3.2636[.001])
Δ UK	.91815	.073224 (12.5389[.000])
Δ Intercept	-.0058356	.084193 (-.069313[.945])
ECM(-1)	-.8967E-3	.0044445 (-.20176[.840])

$\Delta y_{UK} = y_{UK} - y_{UK(-1)}$

$\Delta y_{South\ Africa} = y_{South\ Africa} - y_{South\ Africa(-1)}$

$\Delta y_{South\ Africa1} = y_{South\ Africa(-1)} - y_{South\ Africa(-2)}$

$\Delta y_{South\ Africa} = y_{South\ Africa(-2)} - y_{South\ Africa(-3)}$

$ECM = y_{South\ Africa} -1.5621 y_{UK} + 6.5076*Intercept$

$F(4, 413) = 41.0631[.000]$

Adjusted R-Squared = 0.27636

Estimated Long-run coefficients using ARDL(3,1) error correction model (N=415)

Dependent variable is South Africa

y_{UK}	1.5621	12.2002 (.12804[.898])
Intercept	-6.5076	97.7854 (-.066550[.947])

UK – South Africa

Dependent Variable is Δy_{UK}		
Regressor	Coefficient	Standard Errors (T-Ratio)
Δ South Africa	.29296	.024147 (12.1323[.000])
Δ Intercept	.050648	.048594 (1.0423[.298])
ECM(-1)	-.0069007	.0060623 (-1.1383[.256])

$\Delta y_{UK} = y_{UK} - y_{UK(-1)}$

$\Delta y_{South\ Africa} = y_{South\ Africa} - y_{South\ Africa(-1)}$

$ECM = y_{UK} -.21738 y_{South\ Africa} -7.3396*Intercept$

$F(2, 415) = 74.8169[.000]$

Adjusted R-Squared = .26016

Estimated Long-run coefficients using ARDL(1,1) error correction model (N=415)

Dependent variable is Morocco

$y_{South\ Africa}$	.21738	.36488 (.59574[.552])
Intercept	7.3396	1.5760 (4.6571[.000])

South Africa - France

Dependent Variable is $\Delta y_{South\ Africa}$		
Regressor	Coefficient	Standard Errors (T-Ratio)
Δ South Africa1	0.085863	0.042796 (2.0063[.045])
Δ South Africa2	0.11962	0.042817 (2.7937[.005])
Δ France	0.68441	0.058217 (11.7563[.000])
Δ Intercept	0.7037E-3	0.065767 (.010701[.991])
ECM(-1)	-0.8796E-3	0.0047764 (-.18416[.854])
$\Delta y_{France} = y_{France} - y_{France(-1)}$		
$\Delta y_{South\ Africa} = y_{South\ Africa} - y_{South\ Africa(-1)}$		
$\Delta y_{South\ Africa1} = y_{South\ Africa(-1)} - y_{South\ Africa(-2)}$		
$\Delta y_{South\ Africa} = y_{South\ Africa(-2)} - y_{South\ Africa(-3)}$		
ECM = $y_{South\ Africa}$ - 0.70009y_{France} - 0.80004*Intercept		
F(4, 413) = 36.4996[.000]		
Adjusted R-Squared = 0.25269		
Estimated Long-run coefficients using ARDL(3,1) error correction model (N=415)		
Dependent variable is South Africa		
y_{France}	0.70009	10.1965 (.068660[.945])
Intercept	0.80004	75.4768 (.010600[.992])

France – South Africa

Dependent Variable is Δy_{France}		
Regressor	Coefficient	Standard Errors (T-Ratio)
Δ South Africa	0.35624	0.031434 (11.3327[.000])
Δ Intercept	0.077050	0.048590 (1.5857[.114])
ECM(-1)	-0.012412	0.0072348 (-1.7155[.087])
$\Delta y_{France} = y_{France} - y_{France(-1)}$		
$\Delta y_{South\ Africa} = y_{South\ Africa} - y_{South\ Africa(-1)}$		
ECM = y_{France} - 0.25938$y_{South\ Africa}$ - 6.2080*Intercept		
F(2, 415) = 67.0813[.000]		
Adjusted R-Squared = 0.23928		
Estimated Long-run coefficients using ARDL(1,1) error correction model (N=415)		
Dependent variable is Morocco		
$y_{South\ Africa}$	0.25938	0.25815 (1.0048[.316])
Intercept	6.2080	1.1052 (5.6168[.000])

Appendix 4d) Bivariate ARDL models for relationships centred on Nigeria

Nigeria – Morocco

	Dependent Variable is $\Delta y_{Nigeria}$	
Regressor	Coefficient	Standard Errors (T-Ratio)
Δ Morocco	-0.0064826	0.0057586 (-1.1257[.261])
Δ Intercept	0.043728	0.041111 (1.0636[.288])
ECM(-1)	0.7344E-3	0.0031420 (.23374[.815])
$\Delta y_{Nigeria} = y_{Nigeria} - y_{Nigeria(-1)}$		
$\Delta y_{Morocco} = y_{Morocco} - y_{Morocco(-1)}$		
ECM = $y_{Nigeria}$ -8.8270$y_{Morocco}$ + 59.5409*Intercept		
F(2, 415) = .64037[.528]		
Adjusted R-Squared = -0.0017278		
Estimated Long-run coefficients using ARDL(1,1) error correction model (N=415)		
Dependent variable is Egypt		
$y_{Morocco}$	8.8270	37.7525 (0.23381[.815])
Intercept	-59.5409	273.9690 (-0.21733[.828])

Morocco - Nigeria

	Dependent Variable is $\Delta y_{Morocco}$	
Regressor	Coefficient	Standard Errors (T-Ratio)
Δ Nigeria	0.0059178	0.0024428 (2.4226[.016])
Δ Intercept	-0.022033	0.032319 (-0.68174[.496])
ECM(-1)	-0.5755E-3	0.0045087 (-0.12764[.898])
$\Delta y_{Morocco} = y_{Morocco} - y_{Morocco(-1)}$		
$\Delta y_{Nigeria} = y_{Nigeria} - y_{Nigeria(-1)}$		
ECM = $y_{Morocco}$ -10.2829$y_{Nigeria}$ + 38.2850*Intercept		
F(2, 415) = 2.9388		
Adjusted R-Squared = 0.0092129		
Estimated Long-run coefficients using ARDL(1,1) error correction model (N=415)		
Dependent variable is South Africa		
$y_{Nigeria}$	10.2829	80.2861 (0.12808[.898])
Intercept	-38.2850	353.1725 (-0.10840[.914])