South Africa's stock market integration with developed and emerging markets

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DRAFT: DO NOT QUOTE

1. INTRODUCTION

The recent global financial crisis has once again emphasized the importance of understanding the nature and degree of capital market integration, as well as changes in capital market integration over time. In the literature, several implications of stock market integration are emphasized. This includes the impact on global diversification possibilities. Stock market integration is regarded as a mixed blessing. The positive implications of a larger investor base and consequent higher liquidity levels are counterbalanced by vulnerability to global economic events. It is thus not surprising that a large part of the literature reflect concerns about increased exposure to global crises, with several studies focusing on contagion effects from the 1998 East Asian crisis.

In contrast to the 1998 investment environment, emerging markets are currently being perceived as comparatively low risk, high return investment destinations. Practitioners in the financial industry emphasize their somewhat better fiscal and monetary disciplines than their larger developed siblings. Growth prospects for emerging markets are perceived to be significantly better, among other things, due to more favourable demographics. In this investment environment, knowledge about the nature of stock market integration among the major emerging markets is of critical importance.

In the emerging market stock market integration literature, most studies focus on the regional stock markets of East Asia and Latin America. Similarly, in the case of the Johannesburg Securities Exchange (JSE), several studies empirically investigate stock market integration between the JSE and other stock markets in Southern Africa. This study makes an important contribution by extending the existing

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empirical literature on emerging stock market integration. Most notably, our sample period includes the recent global financial crisis. We focus on the integration of the JSE, classified by FTSE as an "advanced emerging market" with major emerging and developed stock markets.

The aim of this paper is to empirically investigate the nature of integration of the JSE with major emerging stock markets, as well as any possible changes in the level of integration of the JSE into world capital markets since 1994 and 1997. We address questions such as the following: With which countries stock markets are we integrated? Did these countries change over time? Did the nature of the long run relationship between them change over time? How did the current global financial crisis impact on the nature and extent of integration of the JSE with other markets?

2.   DEFINTIONS OF INTEGRATION

Stock market integration is part of a broader process of economic and financial market integration. Broadly speaking, such integration refers to increased interactions and strengthened links between economies and financial markets. Economic and financial integration is both "a process and as a state of affairs (Eatwell, Milgate and Newman 1987:43). Considered as a process, stock market integration refers to measures designed to eliminate investment barriers between different countries and stock markets. Viewed as a state of affairs, it represents the "absence of various forms of discrimination between national economies".

Whereas capital market segmentation is associated with various investment barriers, stock market integration is associated with the process of the removal of these barriers. Most notably, these barriers consist of formal (legal) restrictions on foreign buying of local securities or restrictions on domestic citizens to invest in foreign assets or both. The removal of formal investment barriers (usually referred to as stock market liberalization) is a necessary but not sufficient condition for stock market integration.

In the literature, a number of criteria have been developed to evaluate the degree of financial integration. The criteria can be broadly classified in two categories, namely quantity- and price-based measures. The quantity-based category includes

measurements of openness and restrictiveness in financial transactions, including capital flows. A greater degree of openness (or a lesser degree of restrictiveness) is associated with greater economic integration.

The price-based category consists of tests derived from price differentials in financial markets. A greater degree of economic integration is implied by a smaller price differential. Formally, stock market integration implies that the same asset pricing relationships apply in all countries and the expected return of a country portfolio should solely be determined by the country's exposure to world covariance risk. Expected return on country portfolio is then determined only by exposure to world covariance risk. In contrast, segmentation implies that the risk-return relation in each national market is determined primarily by domestic factors. Empirical studies that employ the price-based measure of integration usually employ different versions of the capital asset pricing model (CAPM), including the international CPAM (i-CAPM) and various beta models.

Cointegration analysis is an alternative way to empirically investigate the nature and extent of the financial integration of stock markets. A cointegration model distinguishes between the nature of long-run and of short-run linkages among financial markets, and captures the interaction between them as well. According to Gonzalo and Granger (1995), the evidence of cointegration among national stock indices implies equilibrium constraints, which preclude the cointegrated indices from diverging too much in the long run. Such constraints emerge because these indices share common stochastic trends or driving forces underlying their mutual growth over extended time horizons. In contrast, a lack of cointegration suggests that stock markets have no long-run link and stock prices in different markets can diverge without constraint or without a trend. Stock market integration implies that the markets are exposed to similar risk factors and thus a common risk premium (Algren and Antell 2002). If a stock market is integrated, events in the international macroeconomic environment and stock market then become a very important ingredient in pricing of domestic securities. This was dramatically illustrated by developments in global stock markets in late 2008.

A large part of the capital market integration literature (especially the part focused on capital market liberalization) focus on the benefits of capital market liberalization and consequent integration of stock markets. When a market becomes financially integrated, companies can access a large new pool of investors, enhancing stock price liquidity. The cost of equity may decline and more investment projects are then viable. The result is increased growth and employment. For example Bekaert, Harvey and Lumsdaine (2002) suggest that global integration seems to be associated with a lower cost of capital, improved credit ratings, real exchange rate appreciation and increased economic growth. However, as mentioned, stock market integration can be a mixed blessing. The above mentioned potential benefits can be counterbalanced by increased vulnerability to global financial shocks. The spread of a crisis depends heavily on the degree of financial market integration. The more integrated markets are, the higher could be the contagious effects of a shock to another country.

Increased global stock market integration can also reduce global diversification possibilities. When emerging markets were first becoming a viable asset class in the early 1990s, Harvey (1995) suggested that part of their initial appeal was their low correlations with developed markets. It was assumed that they would then serve neatly as a hedge in a global portfolio. As early as 1995, Harvey showed that emerging market correlations with developed markets were changing through time, as they became more integrated into the global financial system. Several other studies also indicate reduced diversification benefits. This was highlighted during recent financial crisis. One of the main characteristic of the crisis that started in late 2008 was that it was a broad based crisis, with correlations rising between equities of different countries.

3.   PREVIOUS EMPIRICAL STUDIES

This paper does not intent to provide a comprehensive discussion of the pervious empirical literature on stock market integration; however the focus will be on studies done in an emerging market context.

The majority of the emerging market stock market integration literature focuses on the East Asian market. For example, Pretorius (2002) noted that regional stock

market interdependence in the emerging markets in Asia seems to be a widely accepted fact. However, the empirical evidence on the interaction of the Asian markets with major developed markets is mixed. This is evident from the results of several studies that focus on dynamic nature of impact of 1997/98 crisis. The results of studies by Kolari and Min (2002), and Sheng and Tu (2000) suggest that both long-run cointegration and short-run causal linkages strengthened during the crisis. Kolari and Min note that these markets have generally been more integrated after the crisis than before the crisis. The study also found that the U.S stock market exerted substantial influence on most Asian stock markets in all sample periods, irrespective of the inclusion or exclusion of crisis periods. Sheng and Tu (2000) reported no cointegration in the year before the Asian financial crisis but one cointegrating vector during the crisis between the United States and many Asian stock markets.

In contrast, the results of Ibrahim (2006) suggest a reduced role of the global financial forces after the 1998 East Asian crisis. Although his main focus is to empirically investigate the impact of capital controls on the integration of the Malaysian market after the crisis and the imposition of capital controls, his results have wider applications for the integration of Association of Southeast Asian countries (ASEAN) capital markets in general. Using vector auto regression (VAR) analysis, his results show a reduction in the responses of ASEAN markets to international disturbances after the crisis. His results also suggest that regional market developments remained an important force in driving the dynamics of the Malasyan capital market.

Raj and Dhal (2008) investigated the nature of the financial integration of India's stock market with global and major regional markets, using daily and weekly data for the period 1993 to March 2008. Using correlation analysis and cointegration analysis, they found empirical evidence of a change in stock market integration over time. Their results also show the differential impact of regional and global stock markets on the Indian market. More specifically, they found evidence of a strengthening of the integration of India's stock market with global and regional markets during the more recent period since 2003, as was evident from correlation analysis. They also found that the Indian market's dependence on global markets,

such as the United States and the United Kingdom, is substantially higher than on regional markets such as Singapore and Hong Kong.

Their study includes a limited analysis on the impact of the recent global financial crisis on financial market integration. They compare a sample period that ends in December 2007 with an extended sample period that included January 2008 to 31 March 2008. Their results indicate that the crisis did impact on the integration of India's stock markets with the global markets, in the sense that the cointegration rank tests were stronger for the extended sample period. There was nonetheless a weakening of India's long-run integration, as evidenced by the coefficients of the cointegrating vector in respect of global and regional markets. The results from variance decomposition analysis suggest larger spillovers from global markets during the crisis period. The bulk of the increase was due to the impact of global markets such as the United States (8 per cent) and the United Kingdom (5 per cent).

The majority of literature on the integration of the JSE focuses either on the initial liberalization process or integration with regional markets. The initial liberalization research focus on three series of events, namely the major political changes that was introduced by the announcement of the unbanning of the African National Congress (ANC) in February 1990, the lifting of financial and economic sanctions in 1992 and the JSE's "big bang" and inclusion in the IFC Emerging Markets Global and Investable Indices in 1995.

In this regard, Makina and Negash (2005) examined the problem of dating stock market liberalization on the JSE. They tested for structural breaks in daily data in order to identify the date of liberalization of the JSE. Their finding indicates structural breaks in February 1990 and December 1992, earlier than official liberalization date of JSE of March 1995. They conclude that this suggests that political and economic risks were the more binding constraints to foreign investment than legal barriers.

Forbes and Rigobon (2002) showed that during the 1997 Asian crisis, no emerging market suffered contagion, including South Africa. The results of Collins and Biepke (2002) contradict the Forbes and Rigobon results for South Africa. They found that, along with Egypt, South Africa is one of the most integrated countries in Africa with

regard to its financial markets. Based on their degree of integration, Egypt and South Africa were the most affected by contagion during the Asian crisis. These results are not entirely unexpected, given that these two are the largest and most traded markets in Africa, and therefore are likely to be the most integrated with global capital flows.

Goldberg and Veitch (2009) examine the importance of economic factors in a time-varying beta model of country risk before and after the occurrence of financial integration for South Africa's stock market over the period 1993–2008. They find that post-financial integration, South Africa's beta rises and fundamental economic factors cease to be significant in determining its variation, a result consistent with an integrated financial market.

Hearn and Piesse (2002) empirically investigate to what extent the South African and Namibian equity markets are integrated, using cointegration analysis as well as an extended ARDL model. The authors concluded that the South African and Namibian equity markets are in fact integrated.

Chinzara and Aziakpono (2009) analysed returns and volatility linkages between South Africa and the following equity markets: Australia, China, German, Japan, the UK and the United States, using daily data for the period 1995 to 2007. They examine return and volatility linkages between the South African and world equity markets using VAR and univariate GARCH models. Their results show the existence of both returns and volatility linkages between South Africa and some of the markets studied. Australia followed by United States and China respectively are three markets that significantly explain the variations in South African returns. Despite the fact that some of the South African companies are cross-listed on the LSE, the UK stock market does not seem to significantly explain variations in either returns or volatility of the South African market.

Based on a priori grounds and empirical evidence, it is reasonable to expect that the degree of capital market integration varies over time. Due to South Africa's isolation and subsequent reintroduction into world markets a changing pattern of integration is

to be expected. The next section discusses changes that have made the integration of the JSE into world markets possible.

4. EMPIRICAL ANALYSIS

4.1 Data description

The stock market data was downloaded from the Datastream data base of Thompson Reuters. The aim was to compile the largest possible sample of available stock market prices that could be deemed representative of the world. For that reason the sample includes the all share index of all the countries, as well as the different equity sub sectors, which was available per country. Datastream provides indices for the all share (total market) per country as well as the following sub sectors: Oil and Gas; Basic Materials (Chemicals and Resources); Industrial; Consumer goods; Health care; Consumer services; Telecom; Utilities; Financial; and Technology. Apart from South Africa, the following countries are included in the sample: Argentina, Australia, Austria, Belgium, Brazil, Canada, Chile, China, Colombia, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Greece, Hong Kong, Hungary, India, Indonesia, Ireland, Israel, Italy, Japan, South Korea, Luxembourg, Malaysia, Mexico, Netherlands, New Zealand, Norway, Pakistan, Peru, Phillipines, Poland, Portugal, Romania, Russian Federation, Singapore, Spain, Sri Lanka, Sweden, Switzerland, Taiwan, Thailand, Turkey, United Kingdom, United States and Venezuela,

A complete list of the countries, sub sectors and starting dates of the data is included as Appendix 1. South Africa is one of 17 countries for which Datastream provides index values since 1973. With Russia an important member of the emerging markets grouping: BRICS, the researcher deemed it necessary to include Russia in the study. Since stock market data on most emerging markets is only available from the 1990s, and data on the Russian Federation only since February 1998, the time period for the study start on 18 May 1998 (the starting date for data on the Oil and Gas subsector of China). Finance subsector Russia only from 20 April)

The raw data was obtained in daily format and then converted into weekly by taking the average of the five observations of the week. Weekly returns were calculated as the log difference between successive weekly averages. A total of 691 weekly

observations is included spanning the period May 1998 (week starting 18 May 1998) until August 2011 (week starting 8 August 2011). These 691 observations span across 50 countries and total of 451 stock market indices. The market capitalisation of the listed companies in these 50 countries together accounted for 95.98% of the world market capitalisation in 2010 - measured in US dollars.

4.2   Factor analysis

4.2.1 Identifying the number of factors

Bai and Ng (2002) proposed the use of panel criteria to statistically determine the number of factors needed to approximate a large number of related time series. Before their 2002 study most of the earlier work assumed what number of factors would be appropriate. In 2010 Alessi, Barogozzi and Capasso proposed an improved information criteria to determine the number of factors. They claimed that their method is more robust in situations where the common factors explain a relative small portion of the variance and idiosyncratic factors explain a larger portion of the variance.

Apart from the original sample size of 451 stock market indices described initially, this study will also employ two sub-samples of stock market indices in looking for common factors explaining stock market returns. In the two sub-samples all available stock market indices for the South African stock market is first combined with all available indices from developed markets and then with all available indices from the emerging markets.

The sub-group of developed markets consists of a total of 264 individual indices combining South Africa with Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Hong Kong, Ireland, Israel, Italy, Japan, South Korea, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Singapore, Spain, Sweden, Switzerland, United Kingdom and United States. In the emerging markets sub-group South African stock market indices are combined with all available emerging market indices – a total of 160 indices. The countries included are: Brazil, Chile, China, Colombia, Czech Republic, Hungary, India, Indonesia, Malaysia, Mexico, Pakistan, Peru, Phillipines, Poland, Russian Federation, Taiwan, Thailand and Turkey.

Table 1 summarizes the calculated Bai and Ng (2002) critical values for determining the number of common factors in each of the samples. For all three cases a minimum of 10 factors are indicated. Cognisant of the critique against the Bai and Ng method and its tendency to overestimate the number of factors, the variance explained will be considered.

Table 1: Critical values

|	PC_{P1}	PC_{P2}	PC_{P3}	IC_{P1}	IC_{P2}	IC_{P3}	Cumulative variance	Variance explained
				Critical values for All Indices				
1	0.66218	0.66308	0.65877	-0.40691	-0.40507	-0.41391	0.34689	0.34689
2	0.64082	0.64262	0.63399	-0.43567	-0.43199	-0.44968	0.37832	0.03143
3	0.62381	0.62650	0.61357	-0.45963	-0.45411	-0.48064	0.40539	0.02707
4	0.61258	0.61617	0.59893	-0.47552	-0.46815	-0.50353	0.42667	0.02128
5	0.60423	0.60872	0.58716	-0.48758	-0.47838	-0.52260	0.44507	0.01840
6	0.59862	0.60401	0.57814	-0.49564	-0.48459	-0.53766	0.46072	0.01565
7	0.59418	0.60047	0.57029	-0.50230	-0.48941	-0.55132	0.47520	0.01448
8	0.59128	0.59846	0.56396	-0.50673	-0.49200	-0.56275	0.48814	0.01295
9	0.58924	0.59732	0.55851	-0.51004	-0.49347	-0.57307	0.50022	0.01207
10	0.58770	0.59667	0.55356	-0.51293	-0.49452	-0.58296	0.51180	0.01158
				Critical values for Developed market indices				
1	0.56864	0.56929	0.56618	-0.55586	-0.55416	-0.56223	0.44117	0.44117
2	0.54122	0.54253	0.53630	-0.59894	-0.59555	-0.61169	0.47925	0.03808
3	0.52185	0.52381	0.51447	-0.63084	-0.62576	-0.64997	0.50928	0.03003
4	0.51255	0.51517	0.50271	-0.64482	-0.63805	-0.67032	0.52922	0.01994
5	0.50523	0.50849	0.49292	-0.65623	-0.64776	-0.68810	0.54718	0.01796
6	0.50029	0.50421	0.48553	-0.66372	-0.65356	-0.70197	0.56275	0.01557
7	0.49683	0.50141	0.47961	-0.66899	-0.65713	-0.71361	0.57684	0.01409
8	0.49399	0.49922	0.47430	-0.67385	-0.66030	-0.72485	0.59032	0.01347
9	0.49257	0.49845	0.47043	-0.67620	-0.66095	-0.73358	0.60236	0.01205
10	0.49207	0.49861	0.46747	-0.67708	-0.66014	-0.74084	0.61349	0.01113
				Critical values for Emerging market indices				
1	0.71666	0.71731	0.71432	-0.31727	-0.31567	-0.32301	0.29762	0.29762
2	0.67687	0.67817	0.67218	-0.36162	-0.35842	-0.37311	0.35280	0.05518
3	0.64840	0.65037	0.64137	-0.39428	-0.38947	-0.41151	0.39663	0.04383
4	0.62511	0.62773	0.61573	-0.42302	-0.41661	-0.44598	0.43527	0.03865
5	0.60670	0.60997	0.59497	-0.44720	-0.43918	-0.47591	0.46903	0.03376
6	0.59238	0.59631	0.57831	-0.46722	-0.45760	-0.50167	0.49869	0.02966
7	0.57973	0.58432	0.56332	-0.48722	-0.47599	-0.52741	0.52669	0.02799
8	0.56859	0.57383	0.54983	-0.50733	-0.49451	-0.55326	0.55317	0.02648
9	0.56424	0.57014	0.54314	-0.51490	-0.50047	-0.56657	0.57284	0.01967
10	0.56144	0.56799	0.53799	-0.52081	-0.50478	-0.57822	0.59097	0.01813

Source: Author's own calculations in Matlab

As was expected the first factor in all three cases explains the highest share of variance: 34.7%, 44.1% and 29.8% respectively. The second factor displays an eigenvalue of more than 0.05 only in the emerging markets group. For the sake of consistency two factors will therefore be extracted from all three samples.

4.2.2 Extracting common factors

Employing relevant Matlab coding two common factors were extracted from each of the three samples. Figure 1 depicts the three different first factors extracted from the three samples of stock market index returns.

Figure 1: First Factor extracted from all three samples
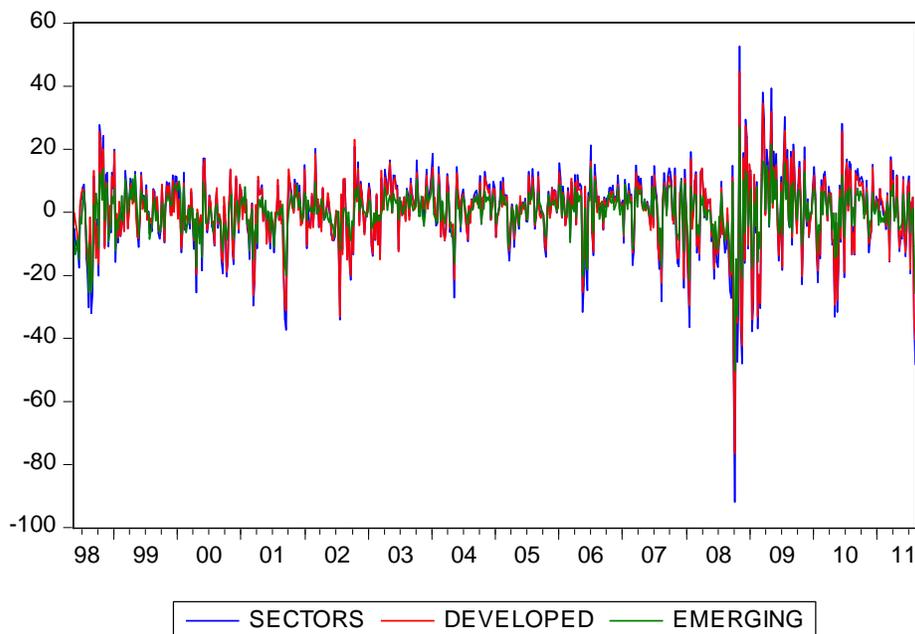
SECTORS: Factor 1 extracted from overall sample of 451 stock market indices
DEVELOPED: Factor 1 extracted from sample of 264 developed stock market indices
EMERGING: Factor 1 extracted from sample of 160 emerging stock market indices

From figure 1 it is evident that the common factor in explaining movements in stock market returns is relative stable regardless of the choice of countries included in the sample. The three first factors closely resemble each other with the same turning points even though the magnitudes may differ. The correlations in Table 2 confirm the resemblance observed in Figure 1.

Table 2: Correlation between factors

	Factor 1 from all indices	Factor 1 from developed indices	Factor 1 from emerging indices
Factor 1 from all indices	1.000000	0.990433	0.936916
Factor 1 from developed indices	0.990433	1.000000	0.882023
Factor 1 from emerging indices	0.936916	0.882023	1.000000

Source: Author's own calculations

Factor 1 extracted from the sample of emerging market indices displays a correlation of 0.882 with factor 1 from the sample of developed indices. This is in contrast with the correlation of 0.990 between factor 1 from the sample of developed indices and factor 1 from the overall sample of stock market indices. The first common factor extracted from the emerging markets sample is expected to be biased towards sentiments in emerging stock markets, while the first factors extracted from the other two samples are expected to be an indication of developed stock market movements.

Figure 2 portrays the second factor from each sample. The similarities observed in Table 2 are not present among the second factors. Except for a period towards the end of 2008, the three extracted variables display varying periods of high and low volatility. They also display differing overall trends.

Figure 2: Second factor extracted from all three samples

SECTORS2

DEVELOPED2
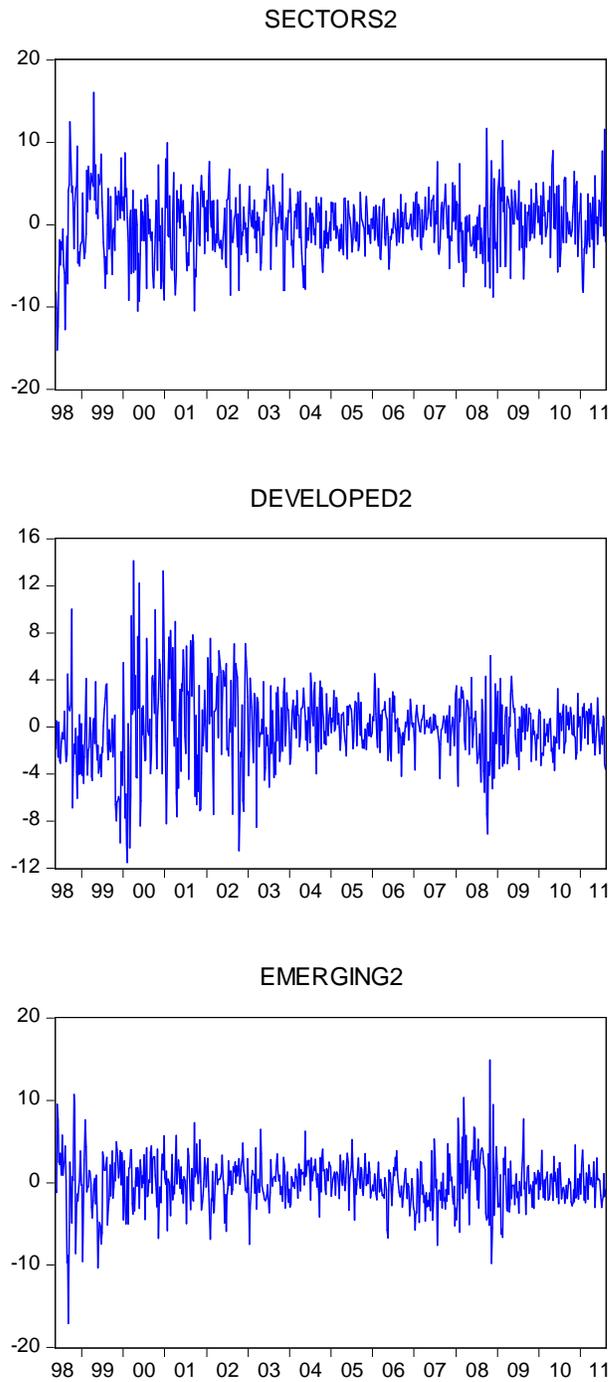
EMERGING2

SECTORS2:   Factor 2 extracted from overall sample of 451 stock market indices
DEVELOPED2: Factor 2 extracted from sample of 264 developed stock market indices
EMERGING2:   Factor 2 extracted from sample of 160 emerging stock market indices
Source: Author's own calculations in Matlab

Table 3 reports the correlations among the second factors that were extracted from each sample. There is no relationship between the second factors from the sample

of developed markets and the sample of emerging markets. The low negative correlation also has a probability of 0.8352. The highest correlation is between factor 2 from the overall sample and factor 2 from the emerging markets sample.

Table 3: Correlation between factors

	Factor 2 from all indices	Factor 2 from developed indices	Factor 2 from emerging indices
Factor 2 from all indices	1.000000		
Factor 2 from developed indices	-0.290115	1.000000	
Factor 2 from emerging indices	-0.491959	-0.007928	1.000000

Source: Author's own calculations

4.2.3 Identifying common factors

In this section an attempt is made to identify the factors extracted from each sample. The already calculated weekly returns for individual countries are included as potential candidates – together with weekly returns calculated for certain groups of countries. Three individual countries are considered: the UK, the US and Germany. Among the groups of countries are: all developed countries, developed countries excluding the US, emerging markets, the BRIC grouping of countries. One more indicator is added. In order to isolate the effect of the emerging markets, the difference is calculated between weekly returns of emerging markets and returns of developed markets excluding the US. This "spread" variable is expected to be an isolated indicator of movements on the emerging markets. Since movements on the developed markets definitely impact on emerging markets, this variable represents the pure and isolated movement in emerging markets.

Table 4: Correlations among factors and stock market indicators

	1st factor extracted from each sample			2nd factor extracted from each sample		
	SECTORS	DEVELOPED	EMERGING	SECTORS2	DEVELOPED2	EMERGING2
WRETUK	**0.895875**	**0.912856**	**0.78059**	-0.154561	-0.005515	0.106143
WRETUS	0.807811	0.822845	0.70955	-0.042828	-0.263553	**0.131479**
WRETBD	0.892021	0.912417	0.77162	-0.1919	-0.147582	0.111391
WRETDV	0.929013	0.943665	0.817553	-0.062827	-0.17408	**0.090889**

WRETEF	**0.954526**	**0.969139**	0.83747	-0.079933	-0.103716	0.04851
WRETEK	0.928614	0.883952	**0.964545**	**0.271893**	-0.072893	-0.030004
WRETBC	0.844631	0.796944	0.892478	0.206406	-0.034062	0.045449
DIFFEKEF	0.280503	0.172187	0.532631	**0.645266**	0.023088	-0.133391

WRETUK: Weekly return on UK stock market
WRETUS: Weekly return on US stock market
WRETBD: Weekly return on German stock market
WRETDV: Weekly return for Developed stock markets
WRETEF: Weekly return for Developed stock markets excluding the US market
WRETEK: Weekly return for Emerging stock markets
WRETBC: Weekly return for stock markets of BRIC countries
DIFFEKEF: Difference between weekly returns on emerging and developed stock markets (-US)
Source: Author's own calculations in Matlab

Focusing on the two factors extracted from the main sample of 451 indices, it is evident that the common driving force behind global stock markets is the stock market performance of the developed markets, excluding the US (WRETEF). Considering individual countries, factor 1 is more correlated with movements in the UK market than with movements in the US market. With a correlation of 0.65 with the emerging markets specific variable, factor 2 from the main sample is likely to represent movements in the emerging stock markets.

Factor 1 from the sample of developed market indices, just like factor 1 from the main sample, displays the highest correlation with returns from the developed markets, excluding the US. This is not surprising given the 0.99 correlation between factor 1 from the main sample and factor 1 from the developed markets. Factor 2 from the developed market sample can, however, not safely be attributed to movements in the emerging markets. Out of all the potential variables the highest correlation points towards a negative correlation with movements on the US markets. The identity of this second factor is something to be determined as part of future research and falls outside the scope of this study.

Considering individual countries, factor 1 from the emerging markets sample also has the highest correlation with the UK – just like the previous two cases. However, considering the country groups, the highest correlation is with the emerging markets (WRETEK). The 0.53 correlation with the emerging markets specific variable, further confirms that the main driver of stock market returns in emerging market countries is movements in stock markets of these emerging countries. The high correlations

between this factor 1 and the previous two also indicate that movements in developed stock markets do have a significant influence on emerging stock markets. Correlations between factor 2 of the emerging markets sample and other variables are low, but there is some indication that it can be linked to movements in developed stock markets – with the US the main influence from an individual country.

4.2.4 SA stock market integration

The next step after the extraction of the common factors, is to determine whether the South African stock market is integrated with the stock markets of the rest of the world. In this regard the co-movement of South African stock market returns with the extracted common factors is investigated.

4.2.4.1   Variance share

As part of the Matlab output, the variance share is reported for every stock market series included in the sample. The variance share indicates what percentage of variance in the specific stock market returns is explained by the extracted common factors. Each of the three different samples that were employed, rendered its own reported variance share related to the South African market. The variance share from the overall, all inclusive, sample is 0.6205 – indicating that the two common factors extracted from the overall sample explains 62.05% of the variation in the weekly returns on the South African stock market. The variance share reported from the sample where South Africa was grouped with the developed markets, is 0.5964. Therefore the two common factors extracted from the sample of developed markets explain 59.64% of the weekly variation on the South African market. The highest variance share was reported from the sample of emerging stock market indices – that also included South Africa. Together the two common factors from the emerging markets sample explain 66.63% of the weekly variation on the South African stock market.

Two main conclusions can be drawn from the three reported variance share percentages. First, it can be concluded that the South African stock market is integrated with the stock markets of the rest of the world – since between 59.64% and 66.63% of the variation in weekly stock market returns can be explained by common factors extracted from samples representative of the global stock market.

Alternatively it can be concluded that between 40.36% and 33.37% of the weekly variation on the South African stock market can be attributed to idiosyncratic or country specific factors.

The second main conclusion is that the common factors extracted from the sample of emerging markets explain more of the variation in South African stock market returns than common factors extracted from the overall sample or the common factors from the developed markets. This also provides an answer to the main research question: With which countries are we integrated. The initial analysis from the descriptive statistics, see section4.4, placed the performance of the South African stock market somewhere between the developed and emerging markets. With a variance share of 0.6663 the South African market is more integrated with the emerging stock markets that with the developed stock markets. The following sections will analyse these two main findings further.

4.2.4.2 Regressions over whole sample period

In extending the mere interpretation of the variance share, various regressions were run in EViews – over the whole sample period as well as for rolling periods of 24 weeks each. These regressions will shed more light on the contributions of the different factors.

Table 5 provides a summary of the regressions regressing standardised weekly returns on the South African stock market on the two common factors from each of the three samples. The three R^2 values correspond with the reported variance share values in the previous section – as was expected.

Table 5: Regressing South African weekly returns on common factors

	Estimated coefficient	prob
All Indices		
Constant	5.89E-12	1.0000
Factor 1	0.062828	0.0000
Factor 2	0.014415	0.1107
R^2	0.620500	
Adj R^2	0.619396	

Developed		
Constant	1.21E-13	1.0000
Factor 1	0.071125	0.0000
Factor 2	0.026795	0.0090
R^2	0.596409	
Adj R^2	0.595236	
Emerging		
Constant	7.04E-12	1.0000
Factor 1	0.116516	0.0000
Factor 2	0.047404	0.0000
R^2	0.666320	
Adj R^2	0.665350	

All regressions estimated with HAC standard errors & covariance

Source: Author's own calculations

Table 5 adds information on the statistical significance of the common factors. The first factor to be extracted from each of the three samples, is highly statistically significant – with a probability nearing zero. The estimated coefficient of the first factor from the emerging markets sample, compared to the first factor from the other two samples, is the highest of the three. Again compared to the results of the other two samples, the second factor from the emerging markets sample is statistically the most significant and displays the highest estimated coefficient. The size and statistical significance of the estimated coefficients confirms the superiority of the common factors from the emerging markets sample in explaining the variation of weekly returns on the South African stock market.

4.2.4.3 Rolling regressions

Considering the dynamic nature of stock market integration, 24-week rolling regressions were estimated to establish whether the relationships identified in Table 5 above are stable over time. (The same rolling regressions were estimated over a 36-week rolling period – see Appendix 4. The evidence in Appendix 4 points towards the robustness of the findings regardless of the length of the rolling period.) Appropriate programming in EViews allowed for the sample period to be rolled over the whole period – each time including a changing sample of 24 weeks. The programming also resulted in reported values of R^2, estimated coefficients of the two factors as well as corresponding t-statistics. The estimated values are reported on the specific date at the end of the 24-week period.

Figure 3: estimated R^{2}s from rolling correlations across three samples
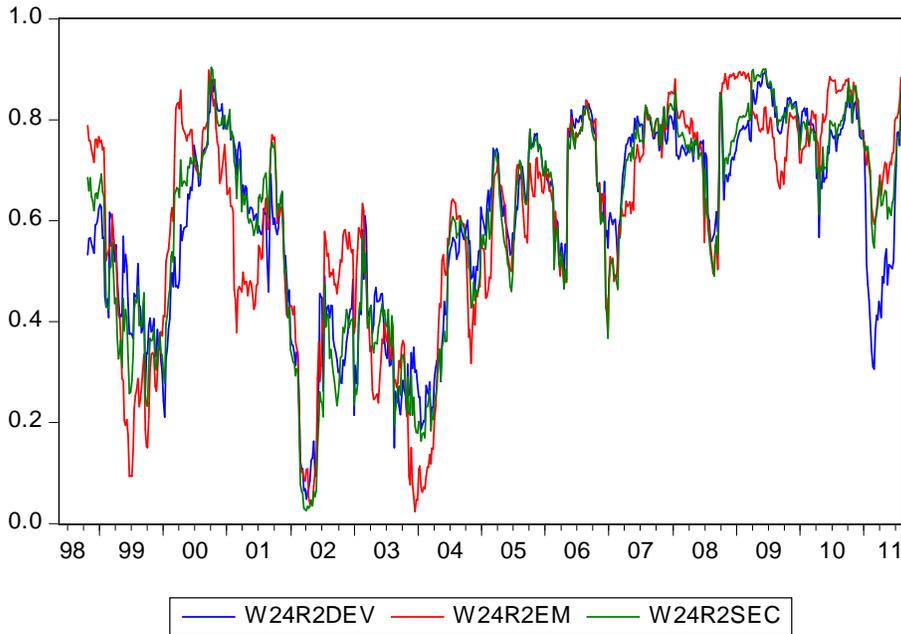
W24R2DEV: R^2 from group of developed markets – 24 week period
W24R2EM: R^2 from group of emerging markets – 24 week period
W24R2SEC: R^2 from combined group of developed and emerging markets – 24 week period
Source: Author's own calculations

Figure 3 trace the integration of the South African stock market with global markets over the sample period of almost 13 years. These 13 years seem to be divided into two distinct periods. The first, more volatile period, runs from mid 1998 until mid 2004. The general trend is downward – indicating lower levels of integration over time. The second distinguishable period, from mid 2004 onwards, displays an increasing trend of R^{2}s. The South African stock market appears to be more integrated with global markets since mid 2004. The general trend in integration remains unaffected by the specific sample of countries.

Two distinct features of Figure 3 beg for further explanation and analysis. The first question arises around the dominance of a specific group/ sample for a certain 24-week period. For instance, what happened during those periods where the R^2 based on the emerging markets common factors is so much higher/ lower than the R^{2}s of the other two regressions and vice versa? The second question relates to the periods of lesser integration. Would it be possible to identify certain country specific

(idiosyncratic) reasons why the performance of the South African stock market deviated from the global markets during specific periods?

Specific periods of dominance

Out of the 668 R^2 values obtained from the rolling regressions, the R^2 from the emerging markets sample was the highest in 284 weeks, the R^2 from the developed markets sample was the highest in 278 weeks and the R^2 from the overall sample was the highest in only 106 weeks. In an attempt to identify certain periods of clear dominance regarding the explanatory power of the extracted common factors, continuous periods of at least 18 weeks dominated by the same sample was identified.

Table 6: Periods of dominance

Emerging market factors	Developed market factors	All indices/ whole sample
10/26/1998 – 2/22/1999	4/5/1999 – 8/23/1999	3/30/2009 – 9/28/2009
12/13/1999 – 6/19/2000	2/5/2001 – 6/18/2001	
7/8/2002 – 2/24/2003	3/3/2003 – 6/16/2003	
4/26/2004 – 9/27/2004	10/27/2003 – 4/19/2004	
12/3/2007 – 6/2/2008	10/4/2004 – 3/7/2005	
10/6/2008 – 3/23/2009	12/11/2006 – 7/9/2007	
3/8/2010 – 11/1/2010	6/9/2008 – 9/29/2008	
2/14/2011 – 8/8/2011	10/5/2009 – 3/1/2010	

Source: Author's own calculations

Table 6 thus indicates the starting and ending date of periods of at least 18 consecutive weeks where the R^2 from a specific sample was the highest. There was a total of eight such periods related to both the emerging markets and developed markets samples, while the overall sample dominated for one single stretch only.

Table 7: Descriptive stats for periods of dominance

SECTORS	WRETSA	WRETDV	WRETEF	WRETEK
Mean	3.214283	0.011357	0.012800	0.016922
Median	4.340214	0.014943	0.018669	0.014648
Maximum	16.49151	0.056041	0.058060	0.085601
Minimum	-7.662093	-0.033750	-0.032806	-0.034380
Std. Dev.	6.019924	0.023106	0.023057	0.030745

DEVELOPED				
Mean	0.292590	0.001332	0.001297	0.003306
Median	1.210384	0.004154	0.003518	0.005636
Maximum	8.562272	0.051975	0.037354	0.049995
Minimum	-19.71545	-0.077950	-0.084763	-0.084324
Std. Dev.	4.275391	0.017629	0.018663	0.022822
EMERGING				
Mean	-0.689615	-0.002143	-0.002836	-0.001698
Median	-0.124466	0.000620	0.000901	0.002081
Maximum	22.07569	0.070746	0.081703	0.118657
Minimum	-38.36571	-0.152869	-0.145575	-0.197069
Std. Dev.	6.794227	0.028265	0.029183	0.033735
WHOLE SAMPLE				
Mean	-0.038750	0.000315	0.000309	0.001565
Median	0.663665	0.002869	0.003011	0.004559
Maximum	22.07569	0.070746	0.081703	0.118657
Minimum	-38.36571	-0.152869	-0.145575	-0.197069
Std. Dev.	5.258674	0.021597	0.022604	0.027593

WRETSA: Weekly return on South African stock market
WRETDV: Weekly return for Developed stock markets
WRETEF: Weekly return for Developed stock markets excluding the US market
WRETEK: Weekly return for Emerging stock markets
Source: Author's own calculations

Table 7 summarises selected descriptive statistics for the weekly returns on the South African stock market as well as for three groups of countries. The statistics were calculated for the whole sample period, as well as for the periods where one of the three samples dominated. During the 27 weeks of dominance by the overall sample, all four the mean returns and all four the median returns were positive and much higher than the respective returns for the whole sample period. The standard deviations were also higher that for the overall period.

The 176 weeks of developed market dominance appear to be almost a more subtle version of the one first described. Again the mean returns are all positive, and all above the means – but only slightly higher than the mean values. However, this time around the standard deviations are all below the standard deviations for the whole period – indicating a more stable period with less volatility.

The descriptive statistics for the 216 weeks of emerging market dominance makes for interesting reading. All the mean returns are negative, all the median returns are well below the medians for the whole period, all the standard deviations are higher

than for the whole period, all the standard deviations are the highest of all the sample periods and last but not least, the periods of emerging market dominance include the respective minimum values and maximum values for all four countries/ groups of countries. Therefore, the common factors extracted from the emerging markets sample best describe movements on the JSE during periods of overall negative returns and high volatility - as reflected in the high standard deviations and respective minimum and maximum values. This finding corresponds with that of De Beer and Pretorius (2012: developed markets and fall with emerging markets".

Idiosyncratic behaviour

From Figure 3 a few periods can be identified during which the South African stock market was less integrated with the global markets than before (or in future). In the search for the reasons behind this observation or explanations for these periods of idiosyncratic behaviour, this study relied heavily on various Annual Economic Reports – published annually by the South African Reserve Bank and the Bank's official summary and explanations of movements/ developments on the JSE.

Towards the end of 1998 and during 1999: During this period the all share index on the JSE was down while indices of developed and emerging markets were increasing. The Annual Economic Report of 1999 mentioned the "acquisition of offshore assets by South African banks" and later also the expansion of foreign interests by South African companies. Another reason for the poorer performance of the JSE during this time was uncertainty before the next general elections and concerns about the value of the rand (South African Reserve Bank, 1999: 36).

Mid 2001 – mid 2002: This was a turbulent period on the JSE with high volatility. A graphical comparison of movements of the JSE all share index and share prices of developed and emerging markets clearly portray how movements on the JSE were opposite to movements on global markets: the JSE all share index would grow while the general world trend would be downward – only for these trends to be reversed during the next period. One characteristic of this period was the outflow of portfolio investment. This can be attributed to the relaxation of exchange controls, allowing South Africa firms and individuals to invest more money abroad and to increase the annual amount spent on repaying foreign debt. Except for the potential impact of

local citizens, foreigners were also net sellers of South African shares during this period. The SARB Quarterly Bulletin of September 2002 (2002: 46) lists the selling of resource shares by foreigners as a reason for lower share prices on the JSE. These sales were partly in response to proposals around empowerment contained in the then draft Mining Charter of the Minerals and Petroleum Resources Development Bill. One last reason for lower share prices was a lower dollar price of gold at the time.

Mid 2003 – mid 2004: During this period prices on the JSE experienced negative growth, while developed and emerging markets stock prices were generally growing. Losses on the JSE were attributed to lower international commodity prices as well as a stronger rand that impacted negatively on export-orientated companies and dual-listed companies (SARB, 2004). Share prices of mining companies in the gold industry fell with 38% and platinum with 28% after the Chinese government announced measures to limit their economic growth.

End 2006: During the last quarter of 2006 share prices on the JSE dropped significantly more than share prices for the emerging markets group while share prices for developed markets increased. The reason for the lower South African share prices were listed as declining resource share prices after a period of strong growth, higher interest rates and concerns about inflation together with a general negative sentiment towards emerging markets (SARB 2006).

2008: The world markets were in turmoil after the collapse of the Lehman Brothers in 2008 – explaining the temporary lower levels of integration. Although correlations increase during crisis periods, crises do impact on the explanatory power of common factors during periods of uncertainty. The higher levels of integration with the emerging markets compared to the developed markets can be explained by the recovery on the South African and emerging stock markets towards the end of 2008 – which was not the case for the developed markets.

End 2010 start 2011: During this period integration with the developed markets declined significantly and to a lesser degree as integration with the emerging markets. Turnover on the JSE increased after the European sovereign debt

problems of mid-2010 and the total market capitalization on the JSE reached a new highest level (SARB 2011). During this time the JSE (in US$ terms) outperformed the Morgan Stanley Capital International (MSCI) World Index.

As a summary the following reasons can explain why the JSE deviated from global stock markets – as is evident from lower R^2s obtained from the rolling regressions. Especially during the initial part of the study sample, certain country specific factors were identified. Relaxed exchange controls led to an outflow of portfolio investments through the selling of South African shares and the purchase of foreign shares. This led to lower share prices – that was not mirrored elsewhere in the world. Political uncertainty related to the second round of democratic elections in the country also had an impact on the JSE that could not be explained by global factors. Later in the study period the dependence of/ sensitivity for movements in share prices of resources led to lower levels of integration. The JSE would therefore react relative more to developments in resource prices than global markets. During the last part of the study period weaknesses in developed stock markets (Lehman Brothers collapse, debt crisis in Europe to a lesser extend) has resulted in foreigners preferring to buy emerging markets stocks. This also led to lower levels of integration with developed markets and greater synchronisation with emerging stock markets.

Estimated coefficients and t-stats of rolling regressions
Figure 4 trace the statistical significance of the three factor 1's (measured in t-statistics) over time. There are striking similarities – although not unexpected – between Figures 4 and 3.

The two obvious outliers in Figure 4 indicate a marked increase in the explanatory power of the first factor extracted from the emerging markets sample. These periods, mid 2006 and the end of 2010, was described in the previous section on idiosyncratic behaviour. During both periods there was a divergence between developed and emerging markets – with the South African stock market following trends in the emerging markets. It is therefore not unexpected that the main factor extracted from the emerging markets sample is more significant in explaining movements on the JSE.

Figure 4: Statistical significance of factor 1 coefficients over time
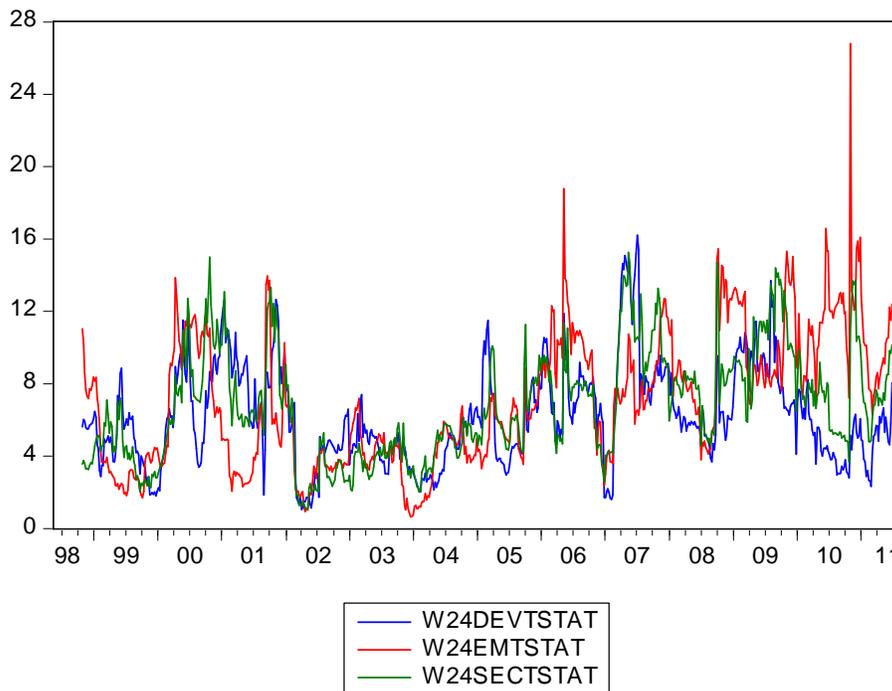
W24DEVTSTAT: t-statistic of factor 1 when standardised JSE returns were regressed on two factors from group of developed markets – 24 week period
W24EMTSTAT: t-statistic of factor 1 when standardised JSE returns were regressed on two factors from group of emerging markets – 24 week period
W24SECTSTAT: t-statistic of factor 1 when standardised JSE returns were regressed on two factors from combined group of developed and emerging markets – 24 week period
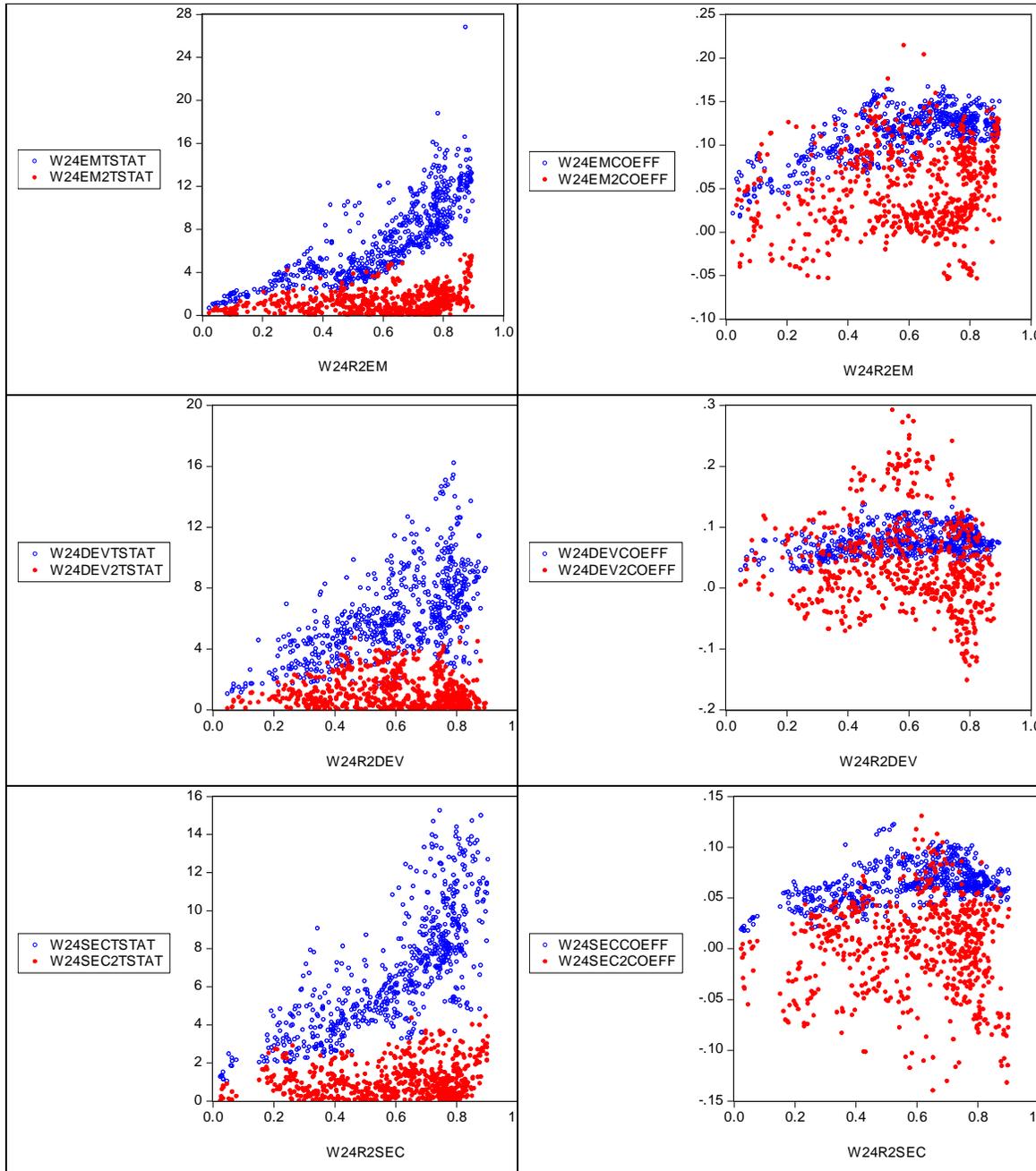Source: Author's own calculations

Lower explanatory power during 1999, 2002, 2003 and 2006 is also reflected in Figure 3 and explained in the previous section. During 2010 and 2011 the explanatory power of the main factor from the developed markets sample declined – a trend that was also observed in Figure 3. A graph similar to Figure 4 focusing on the explanatory power of factor 2 did not render significant results and was therefore excluded from this chapter.

The relationship between the R^2s of the rolling regressions and the t-statistics of the estimated coefficient of the first factor was highlighted for some periods in the previous section. Figure 5 provides, for all three samples, a graphical portrayal of the relationship between the R^2s of the rolling regressions and the t-statistics of the estimated coefficients of both factors (on the left hand side) and the relationship

between the R^2s of the rolling regressions and the size of the estimated coefficients of both factors (on the right hand side).

Figure 5: The relationship between R^2s, estimated coefficients and t-statistics

Source: Author's own calculations

From the left hand side panels it is clear that the major contribution of overall explanatory power of the regressions results from the statistical significance of the

first factor. There is a clear positive relationship between the R^2s of the rolling regressions and the t-statistics of the estimated coefficients of the first factor. A potential relationship between the R^2s and the t-statistics of the estimated coefficients of the second factor, is not that pronounced. On the right hand side of the panels the relationship between the R^2s and the size of the estimated coefficients is not that strong. There is almost no relationship between the R^2s and the size of the estimated coefficients of the second factor.

5.   CONCLUSION

The South African stock market is integrated with global stock markets as between 59.64% and 66.63% of the variation in weekly stock market returns can be explained by common factors extracted from samples representative of the global stock market. The common factors extracted from the sample of emerging markets explain more of the variation in South African stock market returns than common factors extracted from the overall sample or the common factors from the developed markets, therefore the South African market is more integrated with the emerging stock markets that with the developed stock markets. Furthermore, the common factors extracted from the emerging markets sample best describe movements on the JSE during periods of overall negative returns and high volatility.

Certain country specific factors can explain why the JSE deviated from global stock markets: relaxed exchange controls, political uncertainty, movements in resource prices (the JSE reacts relative more to developments in resource prices than global markets), weaknesses in developed stock markets (foreigners preferring to buy emerging markets stocks during the financial crisis – leading to lower levels of integration with developed markets and greater synchronisation with emerging stock markets).

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