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Selecting macroeconomic variables as explanatory factors of emerging stock market returns

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Abstract

Emerging stock markets have been identified as being at least partially segmented from global capital markets. As a consequence, it has been argued that local factors rather than global factors are the primary source of equity return variation in these markets. This paper seeks to address the question of whether local macroeconomic variables have explanatory power over stock returns in emerging markets. Moderate evidence is found to support this contention. Furthermore, using a principal components approach, two types of commonality in returns are examined. Evidence is found that supports commonality in the factors that drive return variation across emerging markets. A test is also conducted for identical sensitivity to a common set of extracted factors. While little evidence of common sensitivities is found when emerging markets are considered collectively, considerable commonality is found at the regional level. These results have implications for international investors as they suggest that the benefits from diversification are enhanced when the allocation of funds is spread across, rather than within, regions. © 2001 Elsevier Science B.V. All rights reserved.

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1. Introduction

A number of studies document that a relationship exists between macroeconomic variables and equity market returns. Furthermore, studies concerning multifactor models frequently incorporate macroeconomic variables as explanatory factors of the variation in equity returns. However, these studies have typically focused on developed markets. This paper extends this literature by considering the relationship in an emerging markets context. To date, the literature on multifactor models in emerging markets has focused primarily on either microeconomic effects such as dividend yields and price-to-earnings ratios or the impact of world influences such as the world equity portfolio. Generally, the literature has not examined the potential impact that macroeconomic variables may have on emerging stock market returns.

Interest in emerging markets has grown considerably over the past decade. Given political and economic structures that previously existed, little was known about these markets and international investment levels were low, in part due to costly barriers to entry. However, since the 1980s, there have been substantial changes in political and economic environments in many regions, such as China, Eastern Europe, Latin America and Russia. As a result, emerging markets now represent a feasible investment alternative for international investors and the last decade has witnessed massive capital flows in and out of emerging stock markets.[1]

Emerging stock markets (ESMs) appear to have features that distinguish them from other stock markets. Returns and risks in ESMs have been found to be higher relative to developed markets[2] (Errunza, 1983; Claessens et al., 1993; Harvey, 1995a). Furthermore, the returns achievable from emerging stock markets appear more predictable than developed markets and exhibit stronger mean reversion properties (Bekaert, 1995; Bekaert and Harvey, 1995; Harvey, 1995a), with a higher degree of autocorrelation. There is evidence to suggest that emerging stock markets are segmented from world capital markets. Moreover, Bekaert and Harvey (1995) suggest that some emerging markets exhibit time-varying integration, as they appear to be more integrated than expected based on prior knowledge of investment restrictions. Other markets appear to be quite segmented even though foreigners have relatively free access to their capital markets. Recent evidence by Goetzmann and Jorion (1999) shows that emerging markets may go through

[1] To illustrate, in 1999, the International Finance reported that the aggregate market value of emerging stock markets totalled US$2.143 billion.

[2] However, it is questionable as to whether these high and somewhat predictable returns are transitory in nature as evidenced by the substantial declines in market capitalisation in emerging markets that occurred during 1997 and 1998. In 1997, the International Finance Corporation Investable (IFCI) index fell 16%, the sharpest 1-year decline in the index's 10-year history. The IFCI Asia Index fell by 57% [Emerging Stock Markets Factbook, 1997].

several phases of 'emergence' and should not be viewed as static. A consequence of the segmented nature of these markets is that local information has increased importance (Harvey, 1995b). This feature potentially allows an international investor to enhance the mean-variance efficiency of their portfolio (Errunza, 1977; Divecha et al., 1992). However, the diversification benefits will be greatest when the factors driving return variation are uncorrelated across markets.

In this paper, two questions are investigated. First, the paper investigates the extent to which macroeconomic variables are able to explain the variation in equity returns in emerging stock markets. The paper initially investigates whether a set of pre-determined global and local macroeconomic variables have explanatory power over emerging market returns. Moderate support is found to support significant association between some of the local macroeconomic variables and returns. Second, the degree of commonality between emerging market returns is examined. To accomplish this, the common variation in a combined macroeconomic and microeconomic variable set is extracted using Principal Components Analysis (PCA). The results show that while ESMs are segmented to a degree, there is significant commonality in return variation across markets. Furthermore, little evidence of common sensitivities to the extracted factors is found when the markets are considered in aggregate, but common sensitivity is found at the regional level. These findings imply that diversification benefits may be more efficiently achieved through concentrating on factor exposures rather than the markets themselves. As such, the findings have implications for international investors and the understanding of return variation across these markets.

The paper is organised as follows. Section 2 presents a discussion of the role of macroeconomic factors in the context of ESMs and the models. Section 3 discusses the data used in the empirical tests. Section 4 analyses the results and Section 5 concludes the paper.

2. Research method

Multifactor models have been developed as an explanation for the variation in ex-post security returns above that provided by standard market models. Two main variants of the multifactor model have been proposed. The first variant implicitly assumes perfect integration, and models returns as a linear relation to a number of global risk sources (e.g. Ferson and Harvey, 1994; Dumas and Solnik, 1995; Harvey, 1995a). However, there is limited research of this type in the context of ESMs other than Harvey (1995a) who tests the relationship between ESM returns and a number of global factors. Harvey proxies these factors by using the variables world inflation, world GDP, world oil prices and a trade-weighted world exchange rate and finds that ESM returns exhibit only limited exposure to these factors.

The second type of multifactor model implicitly assumes complete segmentation whereby returns are determined solely by a number of local variables (e.g.

Chen et al., 1986; Jorion, 1991; Ely and Robinson, 1997). There are examples of this type of research that have examined the relationship between local macroeconomic variables and stock returns in ESMs, but they have done so in respect of individual markets (e.g. India–Darrat and Mukherjee, 1987; Mexico–Bailey and Chung, 1995; Philippines–Bailey and Chung, 1996; Zimbabwe–Oyama, 1997).[3]

From the above discussion, the difference between the two multifactor approaches is driven by assumptions about the level of integration. This in turn affects the selection of global versus local variables. If we accept that markets are not perfectly integrated, especially in relation to emerging markets, then it is likely that a number of factors may be relevant.

In general, consider a model of equity return variation where the market is perfectly integrated with world markets. As such, the variation of returns in each market can be modeled as a function of N-factors of a global nature.[4] Furthermore, if one global factor is employed and this factor is assumed to be the return on the world equity market, then the well-known International Market Model follows. An alternative model can also be developed for returns in a market that is perfectly segmented from world markets. The variation in equity returns in such a case is assumed to be able to be explained by K-factors, which are local in nature. However, empirical studies that have examined levels of integration have generally found that ESMs are only partially integrated (e.g. Bekaert and Harvey, 1995). Hence, neither assumption of perfect integration nor perfect segmentation is realistic. In light of these findings, both global and local factors may be important in determining equity return variation. Harvey (1995b) and Bekaert (1995) suggest that a country's integration level will determine the relative importance of the global and local factors. High (low) integration should result in high exposures to global (local) factors.[5] Generally, Eq. (1) models equity returns as a function of both N-global and K-local factors and provides the framework for the analysis in the paper:[6]

$$R_{it} = \alpha_i + \sum_{m=1}^{N} \beta_{im} F_{mt}^{\mathrm{W}} + \sum_{j=1}^{K} \gamma_{ij} F_{ijt}^{\mathrm{L}} + \varepsilon_{it} \qquad (1)$$

The empirical specification of Eq. (1) requires a determination of the relevant global and local factors. Following prior studies, a single-factor specification

[3] The research in this area is discussed in more detail in the Section 3.

[4] The purpose of this paper is to examine which factors are able to explain the variation in ESM equity returns, rather than to propose a model of expected returns. Whether the factors examined here are "priced" in a formal sense (i.e. have an associated risk premium) is beyond the scope of the paper.

[5] Bekaert (1995) finds that high exposure to the world market return is indicative of a high level of integration.

[6] A similar global and local multifactor model is considered in Bekaert (1995) and Bekaert and Harvey (1995).

$(N=1)$ is assumed for the global component in Eq. (1).[7] Specifically, it is assumed that the global factor can be represented by the return on a value-weighted world index. However, the determination of the set of local factors is more difficult given the lack of prior research in this area.

In general, the number of factors that influence equity returns has been a source of much contention. Factor analysis has been used to identify common factors in both international and domestic returns. Trzcinka (1986) finds five dominant factors within returns for a sample of US firms. Cho (1984) uses inter-battery factor analysis on a range of US industries and documents that the number of factors ranges from between two and five. Cho et al. (1986) perform a similar analysis at the international level for 11 industrial economies and report between one and five factors.

The selection of the initial factors is ultimately subject to criticism on the grounds of subjectivity and the arbitrary nature of the selection process. This is an unavoidable problem associated with this area of research (Fama, 1991). However, researchers can look to prior research and form judgments as to the relevance of various factors. The extant literature suggests that a wide range of factors may be relevant. Such variables include goods prices, money supply, real activity, exchange rates, interest rates, political risk, oil prices, the trade sector, and regional stock market indices. In order to narrow the list of possible factors, their relevance to emerging stock markets is considered and there is argument that several of the above variables are neither relevant nor appropriate. For instance, studies incorporating interest rates have found that it is not the interest rate itself that is relevant but the yield and default spread that are more likely to influence equity returns (Chen et al., 1986). Yet, in many emerging markets, there is not an active secondary market for bond issues and government paper. Furthermore, political risk indices and oil prices have been shown to be only weakly correlated with ESM returns (Harvey, 1995a; Erb et al., 1996). Regional influences are expected to be incorporated into returns only if countries are integrated regionally, but the theoretical justification for the empirical link is limited. Moreover, any such link is likely to be driven by fundamental macroeconomic factors and a regional index is only useful to the extent that it captures the underlying fundamentals.

In light of the above considerations and balancing the theoretical propositions and prior evidence, four local factors were selected and proxied by macroeconomic variables. These variables are money supply, goods prices, real activity and exchange rates. The relevance of these factors can be judged relative to the empirical results. When these variables are included with the return on a value-weighted world market index that proxies for global factors, the testable model contains five factors in total.

[7] The assumption of a single global factor is consistent with the ICAPM of Solnik (1974). This model has been applied to ESM returns in Buckberg (1995) and Harvey (1995a).

A further complication is that consideration must also be given to time delays in the production of information concerning the macroeconomic variables. In particular, the transmission and incorporation of information contained in the variables into stock market prices is not always instantaneous. It is possible that reporting delays create a lag between the observation of data concerning a macroeconomic variable and the incorporation of that information into prices. Hence, a contemporaneous model in which all variables at measured at time t, would imply an assumption of contemporaneous association. As a result, the empirical model employed in this paper lags the explanatory variables to incorporate delays in the release of information (see Harris and Opler, 1990; Schwert, 1990; Cheung et al., 1997).[8] To gauge the delays in the release of the macroeconomic data, the timeliness guides published by the International Monetary Fund (IMF) Data Dissemination Standards are used.[9] Data for the world market return and exchange rates are available on a daily basis, therefore, these variables appear contemporaneously in the model. Following IMF advice, money supply and goods prices are lagged by 1 month, and real activity by 2 months. These data are available on a monthly basis. Hence, using monthly return intervals, the model can be written as

$$R_{it} = \alpha_i + \beta_i R_{\mathrm{w}t} + \delta_i \mathrm{MS}_{it-1} + \phi_i \mathrm{GP}_{it-1} + \gamma_i \mathrm{RA}_{it-2} + \lambda_i \mathrm{ER}_{it} + \varepsilon_{it} \qquad (2)$$

where R_{it} is the realised return for the ith country at time t, $R_{\mathrm{w}t}$ is the realised return on a value-weighted world market index at time t, MS_{it-1} is the percentage change in a money supply variable for country i at time $t-1$, GP_{it-1} is the percentage change in a goods price variable for country i at time $t-1$, RA_{it-2} is the percentage change in a real activity variable for country i at time $t-2$, ER_{it} is the percentage change in a exchange rate variable for country i at time t.

Asset pricing models such as the APT employ the unexpected component (i.e. innovations) of the explanatory variables in model (2) when modeling expected returns. However, as mentioned above, the focus of this paper is upon explaining the variation in realised returns, rather than expected returns. As such the independent variables are expressed in 'raw' form. Thus, the variables contain both an expected and an unexpected component. Moreover, given the large number of markets (and variables) being examined, it is not feasible to generate expectations for each variable in every market.[10]

Macroeconomic variables similar to those in Eq. (2) have been used in a number of ESM studies. However, as mentioned previously, these studies have focused on a single market (e.g. Darrat and Mukherjee, 1987; Bailey and Chung,

[8] The regression in Eq. (2) is also run with all variables measured contemporaneously. The results are highly consistent with those reported here and are available on request.

[9] These standards are contained in the IMF's 1996/97 Annual Report.

[10] This issue is more clearly illustrated in the context of model (3) below.

1995, 1996; Oyama, 1997). There are several theoretical justifications to expect a relationship to exist between the macroeconomic variables in Eq. (2) and stock returns (e.g. Homa and Jaffee, 1971; Mandelker and Tandon, 1985; Boudoukh and Richardson, 1993).

Exploring each variable in turn, Monetary Portfolio Theory suggests that changes in money supply alter the equilibrium position of money, thereby altering the composition and price of assets in an investor's portfolio (e.g. Cooper, 1974; Rozeff, 1974). In addition, changes in money supply may impact on real economic variables, thereby having a lagged influence on stock returns (Rogalski and Vinso, 1977). Both of these mechanisms suggest a positive relationship between changes in money supply and stock returns.

Common stock is traditionally viewed as a hedge against inflation, due to the fact that equity represents a contingent claim on the realm assets of the firm. In the presence of inflation, the value of the contingent claims will be revised upward. Therefore, proportionate increases in prices should not affect the real rates of return on equity (Day, 1984). However, the monetary assets of the firm (i.e. cash, securities, receivables and debt) will be independent of fluctuations in the price level. Hence, it is only the real component of the firm that will be hedged against changes in inflation (Hong, 1977). Empirical tests have documented a negative relationship between inflation and nominal stock returns (Fama and Schwert, 1977; Gultekin, 1983). In light of the lack of agreement between the theory and evidence, it is difficult to predict the direction of the relationship between stock returns and inflation in ESMs. This is particularly so for some of the Latin American countries which have experienced periods of extremely high inflation over the sample period (e.g. Brazil).

It is widely accepted that current stock levels are positively related to future levels of real activity, as measured by GDP or industrial production. This finding seems intuitive since returns are a function of the future cash flow stream, which is highly dependent upon future economic conditions. However, a number of studies have documented a relationship between past (or current) production and stock returns (Fama, 1981; James et al., 1985; Schwert, 1990; Harris and Opler, 1990). Fama (1981) documents a relationship between concurrent measures of US stock returns and industrial production that is positive and significant. James et al. (1985) have investigated the relationship between the lagged change in US industrial production and the return on the S&P 500 index using monthly data from 1962 to 1981. They report that current stock returns are related to industrial production lagged by 2 months. Therefore, a priori, real activity is expected to be positively related to equity returns.

Under perfect purchasing power parity (PPP) conditions, exchange rates will adjust to reflect relative inflation levels, and the law of one price will be upheld. Hence, exchange rate risk will not be separately priced. However, in the short-to-medium term, deviations from PPP have been reported for a number of industrial countries (Frenkel, 1981; Adler and Lehmann, 1983). Under these conditions, deviations from purchasing power parity will be priced to the extent that they represent exchange rate risk that must be borne by investors (Jorion, 1991; Dumas and Solnik, 1995). Therefore, an exchange rate variable is included in the model.

The selection of the four local macroeconomic variables is not perfect and cases can be made for the inclusion of other factors. Moreover, the proxies almost surely contain measurement error. Hence, Eq. (2) is not proposed to be a complete model. It may be that the markets have common sensitivities but the model in Eq. (2) is not capable of establishing those sensitivities. Consequently, a further test for commonality is proposed that involves the extraction of relevant factors using principal components analysis.

This test involves three steps. First, for each market, a number of variables are identified that are able to explain a ‘significant’ portion of return variation for that market. Second, from these variables a number of factors are extracted by principal components analysis (PCA). Third, the equity returns for each market are then regressed against these factors, and a test is performed to determine to which factors the markets have similar sensitivities.

The a priori selection of variables for the PCA analysis commences with the earlier identified macroeconomic variables (i.e. money supply, goods prices, real activity and exchange rates). These variables are augmented by other variables proposed in the literature. The additional variables include a country (political) risk measure (CR), the trade sector (TS), interest rates (IR) and regional market indices (RI).[11] Furthermore, given that this method is an attempt to extract factors from the ‘relevant’ information, the microeconomic effects captured by price-to-earning ratios (PE) and dividend yields (DY) are included as these have been previously suggested as relevant (e.g. Chen, 1991). Consequently, for each market, the following regression is fitted:

$$R_{it} = \alpha_i + \beta_i R_{wt} + \delta_i \mathrm{MS}_{it} + \phi_i \mathrm{GP}_{it} + \gamma_i \mathrm{RA}_{it} + \lambda_i \mathrm{ER}_{it} + \chi_i \mathrm{CR}_{it} + \eta_i \mathrm{TS}_{it} + \varphi_i \mathrm{IR}_{it} + \kappa_i \mathrm{RI}_{it} + \mu_i \mathrm{PE}_{it} + \nu_i \mathrm{DY}_{it} + \varepsilon_{it}. \tag{3}$$

From the above regression, PCA condenses the variables in each market into a smaller set of common factors. As discussed above, the extracted factors are then used to test for commonality across markets and by region.

[11] The country risk (CR) variable is a qualitative variable supplied by Political Risk Services incorporating political risk (50%), financial risk (25%) and economic risk (25%). The country risk variable ranges from 0 (high country risk) to 100 (low country risk). The trade sector (TS) is proxied by the size of the trade sector (i.e. exports plus imports) as a proportion of GDP. For each market, the deposit rate was used for the interest rate (IR). Following Harvey (1995b), where the deposit rate was unavailable, an interest rate was selected that was the most unregulated. The regional index (RI) is an equally weighted index formed excluding that particular market’s returns computed for each of Latin America, Asia and Europe.

3. Data

There is no clear definition of what constitutes an 'emerging stock market'. Stock markets are classified as emerging through the listing adopted by the International Finance Corporation (in IFC Emerging Markets Factbook, 1997). The IFC provide data on 27 emerging markets.[12] Seven markets are excluded due to a lack of data. Thus, this study incorporates 20 of these markets including six Latin American countries (Argentina, Brazil, Chile, Colombia, Mexico and Venezuela), eight Asian countries (India, Indonesia, Malaysia, Pakistan, Philippines, South Korea, Taiwan and Thailand), three European countries (Greece, Portugal and Turkey), one Middle Eastern country (Jordan) and two African countries (Nigeria and Zimbabwe).

The emerging market return data are obtained from the IFC. The sample period spans January 1985 through December 1997. Although return data are available for some markets as early as 1976, this earlier data may be influenced by a 'back-filling' bias.[13] All return data are calculated on a monthly interval, include both dividend and capitalisation adjustments, and are expressed in continuously compounded form. In addition, all returns are measured in US dollars to negate the influence of domestic inflation. Hence, returns denominated in this form only retain US inflation and are consistent across markets. Expressing the returns in US dollars has the additional implication that returns are viewed from the perspective of an international investor rather than a local investor.

The proxy chosen for the world market index is the MSCI World Index (as used in Harvey (1995a) and Buckberg (1995)). Data for the money supply, goods price and real activity series are supplied by the International Monetary Fund.[14,15,16] Money supply is measured as the narrow stock of money (M1). The goods price series are measured as the domestic consumer price index derived from household expenditure surveys. The real activity series is measured as the industrial production index covering mining, quarrying, manufacturing, electricity, gas and water

[12] The study requires at least 5 years of data. The excluded markets are China, Czech Republic, Hungary, Peru, Poland, South Africa and Sri Lanka.

[13] In constructing the database, the IFC selected stocks that were available at January 1985 and reconstructed the country indices for the prior years to 1976. The potential survivorship bias created by this procedure is discussed in Harvey (1995a).

[14] Taiwan is not a member of the IMF and, hence, data on the macroeconomic variables for this market were obtained from government publications.

[15] The precise data are from the International Financial Statistics produced by the IMF referenced as line 34 (money supply), line 64 (goods prices) and line 66 (real activity).

[16] The macroeconomic variables are not seasonally adjusted, as these types of data are generally unavailable in emerging markets. Moreover, as in Chen (1991), the use of seasonally unadjusted data avoids the use of future data which is an important consideration for any ex-ante implications that may be drawn.

compiled using the Laspeyres formula.[17] The exchange rate series for each market are obtained from Datastream and are computed as a trade-weighted index.[18] Each series is sampled monthly to correspond with the return interval. Both Dickey–Fuller and Phillips–Perron unit root tests are used to examine the stationarity of each series.[19] Time tends were included where significant. Both the return data and the percentage change in the macroeconomic variables are stationary for all countries.

However, a study of this type has the potential to be affected by correlation among the variables The use of changes, rather than levels, as in this study, mitigates this potential problem. Nevertheless, correlations among the explanatory variables are examined prior to the analysis. The correlation matrix of the macroeconomic variables indicates that there is little evidence of multicollinearity.[20] The full correlation matrix is large and, hence, the average correlation for each variable pair across the 20 markets is the main focus.[21] The aggregated average correlations across all markets for each macroeconomic variable pair are exchange-rate/real activity (0.02), exchange rate/money supply (0.04), exchange rate/goods prices (0.10), money supply/real activity (0.02), money supply/goods prices (0.05) and good prices/real activity (−0.02). Of note, these average correlations are all close to zero.

4. Results

Table 1 reports the results from fitting the model as described in Eq. (2) to each of the 20 emerging markets. A least squares procedure was used, with the standard errors being adjusted where necessary for serial correlation and/or heteroskedasticity using the Newey–West procedure. The results indicate that ESMs show little sensitivity to the return on the world market index, consistent with previous findings (e.g. Harvey, 1995a). Only 10 markets display a significant coefficient on the world market. Of note these coefficients are positive as suggested by the ICAPM, indicating that increases in emerging market returns are associated with increases in returns on the world market index.

[17] For some countries an industrial production index was unavailable and a manufacturing production index was used instead, obtained from local government publications.

[18] The exchange rate for the national currency against the US dollar was used where the index series was unavailable. In cases where the exchange rate was pegged against the US dollar (e.g. Argentina in the 1990s) the variable is excluded from the analysis for that period.

[19] More weight was given to the Phillips–Perron unit root tests as this test has been shown to be more reliable than Dickey–Fuller tests in the presence of large amounts of heteroskedasticity (Banerjee et al., 1993).

[20] Of the 120 correlations, there are only 22 values that exceed an absolute value of 0.2 and only four cases where the absolute value exceeds 0.5.

[21] Recall that there are four local variables for each of 20 markets.

The exchange rate variable is clearly the most influential macroeconomic variable, with the returns for twelve markets being significantly related to this variable.[22] The signs of the coefficients on the exchange rate variable are predominantly negative, which is consistent with the analysis being conducted from an international investor's perspective. For instance, a devaluation of the domestic currency will result in an increase in US dollar denominated returns. This result is consistent with work of Adler and Dumas (1983) who argue that deviations from PPP necessitate the inclusion of an exchange rate factor. The remaining macroeconomic variables all perform relatively poorly. The money supply variable is significant in six markets (mainly positive as expected), whereas real activity and goods prices are each significant in only one market. The final column of Table 1 contains an F-test of the null hypothesis that all of the coefficients on the macroeconomic variables (i.e. money supply, goods prices, real activity and exchange rate) are jointly equal to zero. Failure to reject the null suggests that the model fails to perform better than the single global factor International Market Model. This null hypothesis is rejected for 10 of the 20 markets. Hence, in summary the evidence does not support conclusively either the global (single) factor model or the local multi-factor model. The R^2 values range considerably from almost no explanatory power to a high of 38% in the case of Indonesia. Notably, the higher explanatory power tends to occur in the Asian markets. The results indicate a degree of uniqueness across markets.[23]

Overall, the results in Table 1 suggest that the macroeconomic variables representing goods prices and real activity have only limited ability to explain the variation in returns. Money supply has greater importance, while the most significant variables are the exchange rate and the return on the world market index.

From the analysis to date, the identification of the relevant macroeconomic variables appears to be a difficult task. Given that neither the global factor nor the local factors are clearly supported (as evidenced by the range in F-tests in Table 1), it appears that each market should be treated differently. However, several explanations for this result are possible. First, our proxies may be poor. Second, while care has been taken to account for information lags these adjustments will not be precise. Information lags and the degree of market efficiency with respect to the release and incorporation of information content will vary across markets. Third, the model may be mis-specified and almost certainly suffers from omitted factors (as supported by the relatively low R^2 values in Table 1). These criticisms

[22] The regression was also performed using returns expressed in local dollars. Under this analysis, the exchange rate variable remained significant for eight markets. This result suggests that the relationship between returns and exchange rate changes in these markets is robust to the currency denomination of returns.

[23] Recall that the model in Eq. (2) was also run with all variables measured contemporaneously and the results are highly consistent with those reported here.

Table 1

Macroeconomic model estimated on monthly returns by country from February 1985 to December 1997

This table reports the results of the regression model in Eq. (2). Standard errors are adjusted for heteroskedasticity and/or autocorrelation. The variables are defined as: R_{wt}–World Market Return, MS–Money Supply, GP–Goods Price, RA–Real Activity and ER–Exchange Rate. T-statistics appear in parentheses and are tests of the null hypothesis that the coefficient is equal to zero. N/A indicates that data were not available. The F-test is for the restriction that $\delta_i = \phi_i = \gamma_i = \lambda_i = 0$.

Country	Sample start	α_i	β_i	δ_i	ϕ_i	γ_i	λ_i	Adj. R^2	F-test
Argentina	February 1985	0.020	−0.100	0.131	0.047	0.036	−0.065	0.00	1.49
		(0.86)	(−0.15)	(0.48)	(0.41)	(0.23)	(−1.37)		[0.21]
Brazil	February 1985	0.000	0.822*	0.255*	−0.052	−0.033	−0.137	0.03	1.24
		(0.01)	(2.14)	(2.11)	(−0.40)	(−0.18)	(−1.12)		[0.30]
Chile	February 1985	0.023*	0.204	0.164*	0.473	0.085	1.128*	0.14	3.45*
		(2.52)	(1.37)	(2.35)	(0.86)	(1.52)	(2.97)		[0.01]
Colombia	February 1987	0.030	0.080	0.237	−0.666	−0.069	0.008	−0.01	0.77
		(1.47)	(0.47)	(1.54)	(−0.76)	(−0.77)	(0.02)		[0.54]
Greece	February 1985	0.022*	0.480*	0.143	−1.131	0.207	0.241	0.03	1.23
		(2.02)	(1.98)	(0.95)	(−1.22)	(1.45)	(0.75)		[0.30]
India	February 1985	0.000	−0.189	0.335	1.215	0.035	−0.567*	0.01	1.54
		(0.04)	(−0.94)	(1.13)	(1.18)	(0.33)	(−1.99)		[0.19]
Indonesia	January 1990	0.014	0.676*	−0.434*	−1.09	N/A	−1.716*	0.38	16.60*
		(1.00)	(2.84)	(−2.01)	(−0.78)		(−6.68)		[0.00]
Jordan	February 1985	0.006	0.171	0.036	0.034	−0.052	−0.397*	0.03	1.78
		(1.31)	(1.76)	(0.19)	(0.12)	(−1.30)	(−2.09)		[0.13]
Korea	February 1985	0.005	0.680*	0.018	−1.136	−0.044	−1.163*	0.32	14.56*
		(0.49)	(4.11)	(0.19)	(−0.83)	(−0.40)	(−7.57)		[0.00]

Malaysia	January 1989	−0.010	0.708*	0.357	1.754	0.088	1.922*	0.36	5.00*
		(−1.37)	(4.64)	(2.21)	(0.96)	(1.14)	(4.12)		[0.00]
Mexico	February 1987	0.002	0.717*	0.075	1.243*	−0.013	−0.855*	0.28	32.81*
		(0.15)	(2.51)	(0.66)	(2.06)	(−0.10)	(−10.51)		[0.00]
Nigeria	February 1985	0.024*	0.068	−0.114	0.061	−0.318	1.189*	0.26	60.22*
		(2.88)	(0.24)	(−0.79)	(0.21)	(−1.07)	(13.28)		[0.00]
Pakistan	February 1985	0.004	0.124	0.657*	0.074	−0.003	−0.504*	0.02	2.98*
		(0.47)	(0.87)	(2.45)	(0.15)	(−0.05)	(−2.10)		[0.02]
Philippines	January 1987	0.002	0.835*	−0.027	0.972	−0.155	1.775*	0.19	4.71*
		(0.16)	(3.67)	(−0.15)	(0.88)	(−1.10)	(3.64)		[0.00]
Portugal	February 1990	0.001	0.867*	0.052	−0.348	0.369*	0.116	0.36	1.16
		(0.09)	(6.87)	(0.41)	(−0.29)	(2.03)	(0.62)		[0.33]
Taiwan	February 1992	−0.004	1.033*	−0.271	1.012	−0.164	−0.211	0.07	1.46
		(−0.24)	(2.75)	(−0.21)	(0.91)	(−1.39)	(−1.15)		[0.23]
Thailand	January 1989	−0.007	0.906*	0.032	−0.457	0.128	−0.705	0.12	0.58
		(−0.56)	(3.06)	(0.19)	(−0.28)	(0.78)	(−1.16)		[0.68]
Turkey	April 1987	0.065	0.204	0.368*	−0.312	−0.211	−1.092*	0.14	6.22*
		(1.91)	(0.51)	(2.27)	(−0.58)	(−1.15)	(−3.93)		[0.00]
Venezuela	February 1988	0.027	−0.161	0.141	−0.621	N/A	−0.141	−0.01	1.09
		(1.40)	(−0.54)	(0.90)	(−1.37)		(−0.90)		[0.36]
Zimbabwe	January 1991	−0.006	0.548	−0.060	0.198	0.132	−0.503*	0.01	3.06*
		(−0.26)	(1.66)	(−0.41)	(0.29)	(1.46)	(−2.25)		[0.03]

* Indicates significance at the 5% level.

Table 2

Macroeconomic and microeconomic model estimated on monthly returns by country from February 1991 to December 1997

This table reports the results of the regression model in Eq. (3). The variables are: R_{wt}–World Market Return, MS–Money Supply, GP–Goods Price, RA–Real Activity, ER–Exchange Rate, CR–Country Risk, TS–Trade Sector, IR–Interest Rate, RI–return on equally weighted Regional Index, PE–Price-to-Earnings Ratio and DY–Dividend Yield. Standard errors are adjusted for heteroskedasticity and/or autocorrelation. The abbreviations for the markets are: AG–Argentina, BR–Brazil, CL–Chile, CB–Colombia, GR–Greece, IN–India, ID–Indonesia, JO–Jordan, KO–South Korea, MY–Malaysia, MX–Mexico, NG–Nigeria, PK–Pakistan, PH–Philippines, PT–Portugal, TW–Taiwan, TH–Thailand, TK–Turkey, VE–Venezuela and ZI–Zimbabwe. *T*-statistics appear in parentheses and are tests of the null hypothesis that the coefficient is equal to zero. N/A indicates that data were not available.

	α_i	β_i	δ_i	ϕ_i	γ_i	λ_i
AG	−0.006	0.695	0.103	0.627	0.265	N/A
	(−0.47)	(1.61)	(0.43)	(0.94)	(1.19)	
BR	−0.000	0.955*	0.095	0.281*	0.130	−0.333*
	(−0.01)	(2.56)	(1.38)	(2.05)	(0.73)	(−2.93)
CL	0.011*	0.261	0.019	−1.162*	−0.134	1.817*
	(2.29)	(1.88)	(0.31)	(−2.11)	(−1.67)	(6.83)
CB	0.016*	0.022	0.230*	−0.116	0.037	0.301*
	(3.74)	(0.19)	(4.12)	(−0.22)	(0.58)	(2.08)
GR	−0.005	0.481*	0.021	−0.468	0.059	0.761*
	(−0.79)	(3.49)	(0.29)	(−1.18)	(1.17)	(3.28)
IN	0.000	0.057	0.164	0.540	0.118*	−0.705*
	(0.02)	(0.50)	(1.15)	(1.15)	(2.00)	(−5.91)
ID	0.009	0.264	0.146	−1.250	N/A	−1.196*
	(1.43)	(1.72)	(1.22)	(−1.28)		(−4.62)
JO	0.006	0.222	−0.218	0.129	−0.027	N/A
	(1.15)	(1.74)	(−0.97)	(0.34)	(−0.59)	
KO	−0.014	0.212	−0.071	1.258	0.292	−0.852*
	(−1.18)	(0.77)	(−0.52)	(0.64)	(1.26)	(−4.61)
MY	0.005	−0.107	−0.083	1.466	−0.111	1.259*
	(1.33)	(−1.06)	(−1.16)	(1.60)	(−1.55)	(5.62)
MX	0.016	0.321	0.002	−0.404	0.449	−0.712*
	(1.40)	(1.25)	(0.02)	(−0.76)	(1.59)	(−10.18)
NG	−0.004	0.088	0.407	0.061	−0.138	N/A
	(−0.14)	(0.11)	(0.66)	(0.14)	(−0.64)	
PK	−0.001	0.194	0.218*	0.393	−0.03	−0.682*
	(−0.08)	(1.08)	(2.00)	(0.63)	(−0.64)	(−3.79)
PH	0.005	0.165	0.046	0.161	−0.050	1.352*
	(0.67)	(1.15)	(0.37)	(0.18)	(−0.51)	(5.81)
PT	−0.003	0.593*	0.033	1.387	−0.395*	0.332*
	(−0.44)	(4.13)	(0.30)	(1.10)	(−2.43)	(2.00)
TW	−0.005	0.017	0.456	0.105	−0.026	N/A
	(−0.82)	(0.18)	(1.52)	(0.24)	(−0.46)	
TH	0.003	−0.120	0.049	−1.242	−0.094	−0.054
	(0.31)	(−0.54)	(0.47)	(−1.26)	(−0.67)	(−0.33)
TK	−0.006	−0.025	−0.101	1.126*	0.055	−1.167*
	(−0.33)	(−0.08)	(−0.90)	(2.85)	(0.39)	(−6.55)
VE	−0.015	0.133	0.025	0.150	N/A	−0.235
	(−0.40)	(0.37)	(0.19)	(0.12)		(−0.67)
ZI	0.002	0.055	0.049	−0.135	0.007	−0.783*
	(0.19)	(0.29)	(0.42)	(−0.45)	(0.12)	(−5.99)

* Indicates significance at the 5% level.

χ_i	η_i	φ_i	κ_i	μ_i	ν_i	Adj. R^2
−0.077	−0.186	−0.090	0.530*	0.057	0.024	0.30
(−0.10)	(−0.89)	(−1.07)	(2.30)	(1.85)	(0.25)	
1.371	−0.265*	−0.102	0.644*	0.005	−0.078*	0.43
(1.75)	(−2.51)	(−1.60)	(3.13)	(1.82)	(−2.67)	
0.445	0.095	−0.028	0.053	0.547*	−0.201*	0.78
(0.89)	(1.55)	(−1.25)	(0.86)	(8.89)	(−3.79)	
0.127	N/A	−0.089	−0.046	0.246*	−0.398*	0.78
(0.75)		(−1.19)	(−0.75)	(5.33)	(−4.67)	
0.772	N/A	−0.384*	0.331*	0.075*	−0.002	0.70
(1.56)		(−2.14)	(2.37)	(2.56)	(−0.72)	
0.111	−0.070	−0.002	0.119*	0.745*	−0.075*	0.91
(0.79)	(−1.56)	(−0.31)	(2.25)	(21.13)	(−2.30)	
−0.145	−0.055	−0.008	0.309*	0.556*	−0.015	0.80
(−0.25)	(−0.63)	(−0.74)	(2.08)	(4.34)	(−1.23)	
0.016	−0.007	N/A	0.010	0.197*	N/A	0.14
(0.13)	(−0.35)		(0.26)	(3.56)		
−0.094	−0.164	−0.147	0.331*	0.075*	−0.002	0.49
(−0.14)	(−1.09)	(−1.54)	(2.37)	(2.56)	(−0.72)	
−0.329	0.090*	0.082*	0.096	0.732*	−0.113*	0.92
(−1.41)	(2.58)	(2.03)	(1.48)	(9.62)	(−3.36)	
1.259*	0.027	−0.115*	0.346*	0.070*	−0.133*	0.65
(2.63)	(0.20)	(−2.64)	(2.42)	(4.56)	(−2.92)	
0.600)	N/A	N/A	0.521	0.051	−0.311	−0.01
(0.82)			(1.39)	(0.33)	(−1.16)	
0.382	0.029	0.001	0.077	0.486*	−0.270*	0.73
(1.42)	(0.74)	(0.17)	(1.17)	(5.21)	(−3.85)	
−0.153	0.116*	0.082	0.263*	0.535*	−0.038	0.75
(−0.95)	(2.19)	(1.52)	(2.28)	(3.79)	(−1.14)	
−0.462	−0.005	0.039	0.119*	0.216*	−0.084*	0.52
(−1.20)	(−0.20)	(1.03)	(2.92)	(2.63)	(−2.44)	
0.531	0.020	0.030	0.161*	0.673*	−0.003	0.83
(1.04)	(0.43)	(0.68)	(2.65)	(12.81)	(−1.49)	
0.000	0.118	−0.032	0.870*	0.035*	−0.347*	0.70
(0.00)	(1.54)	(−1.47)	(6.51)	(2.92)	(4.04)	
0.377	0.120	0.198*	0.457*	0.549*	−0.083	0.72
(1.46)	(0.95)	(2.80)	(2.18)	(6.78)	(−1.89)	
0.511	0.120	−0.045	0.237	0.069	−0.241*	0.12
(1.08)	(1.73)	(−0.46)	(1.25)	(1.79)	(−2.32)	
0.245	N/A	−0.153	−0.078	0.754*	N/A	0.64
(0.43)		(−1.55)	(−1.09)	(6.66)		

are inherently difficult to address, and indeed the latter criticism applies to multifactor studies in general. Hence, an alternative approach is now examined to further investigate whether the variation in returns can be explained by similar factors.

The model in Eq. (2) is now augmented with additional macroeconomic and microeconomic factors (representing country risk, trade sector, interest rates, a regional index, dividend yield and price-to-earnings ratio) as in Eq. (3). These factors represent a wider information set from which the PCA can draw upon. The purpose of the PCA is to condense the variables that explain the return variation in each market into a smaller set of common factors. All variables from Eq. (3) are initially included in the analysis.[24]

The results from fitting Eq. (3) are presented in Table 2.[25] The global factor loses much of its significance when compared to Table 1. The significance of the macroeconomic variables is spread with the exchange rate again exhibiting the greatest occurrence of significance. The results also indicate the presence of a regional factor with the returns on the regional market index being significant and positive in a number of markets.[26] However, it is the microeconomic variables that stand out in Table 2. The price-to-earnings variable is significant and positive in 16 markets. This supports previous evidence that these ratios have been found to increase greatly with financial liberalisation and increased capital flows (Bekaert, 1995; Buckberg, 1995; Bekaert and Harvey, 2000). Similarly the dividend yield is significant in 10 markets and is consistently negative. The model provides quite high explanatory power with an average adjusted R^2 of 60%. However, we do not place emphasis on the results in Table 2 due to the large number of variables, the potential impact of multicollinearity on the t-statistics and the obvious criticism of data mining. Rather, Table 2 provides the background for the PCA analysis.

The traditional PCA approach uses the deviations from the mean cross-product (or covariance) matrix of the variables. Using this approach causes the composition and extraction of components to be heavily biased towards those variables with the greatest variability (Nunally, 1978). The descriptive statistics generated for the variable set indicate a large disparity in both mean and variance.[27] The PCA is, therefore, performed using the correlation matrix, which has an effect

[24] While the importance of each variable varies between markets, the loss in efficiency from including less relevant variables is expected to be much less than the loss from excluding relevant variables. After performing the PCA, less relevant variables should have only small loadings on the significant factors.

[25] When estimating the regression in Eq. (3), some data are unavailable in the early years, hence, the sample size is reduced.

[26] Recall that the returns on each market are excluded from the construction of the regional index for that market so to avoid induced correlation.

[27] This is especially evident when comparison is made between the goods price (high variability) and exchange rate (low variability) variables in Latin America markets.

equivalent to normalising all of the variables. This procedure effectively gives each variable an equal weighting in the data matrix, independent of their variance, and avoids loading on those variables with the largest standard deviation. The components are rotated using the varimax method as suggested by Kaiser (1958) to facilitate interpretation. The PCA is conducted using data on the entire variable set as in Eq. (3), with the objective of obtaining a set of factors that is common to all markets. The screen plot is used to identify the factors and consequently four principal components are selected. The variable loadings on the four components are reported in Table 3.

By averaging the factor loadings on each variable, interpretation can be given to the general economic forces represented by each component. Both real activity and the size of the trade sector load positively onto the first component. This suggests that the first component may proxy for the level of economic activity. The second component has high positive loadings on both money supply and the trade sector, perhaps being representative of consumption. The third component appears to relate to country risk and, hence, might be thought of as a political risk influence. The various world and regional indices load heavily onto the fourth component. The microeconomic variables of price-to-earnings and dividend yield also load heavily onto this component, consistent with the findings of Bekaert (1995) and Buckberg (1995) that microeconomic effects may be sensitive to

Table 3
Principal component loadings from the economic variable set from February 1991 to December 1997
This table reports the factor loadings obtained from a principal components analysis of 20 emerging markets using the variable set in Eq. (3). The variables are: MS–Money Supply, GP–Goods Price, RA–Real Activity, ER–Exchange Rate, WI–World Market Return, CR–Country Risk, IR–Interest Rate, TS–Trade Sector, PE–Price–Earnings ratio, DY–Dividend Yield, LAREG, ASREG, EUREG and OTHREG are equally weighted regional indices for Latin America, Asia, Europe and a combined Middle East/Africa region, respectively. The loadings are calculated by taking the average of the correlations between the variables and principal components.

	PC_1	PC_2	PC_3	PC_4
MS	−0.10	0.36	−0.05	0.06
GP	−0.03	−0.09	0.03	0.06
RA	0.43	0.00	−0.04	−0.05
ER	0.03	−0.01	0.00	−0.04
WI	−0.13	0.01	−0.09	0.37
CR	−0.02	−0.01	0.24	0.04
IR	−0.01	0.05	−0.07	−0.11
TS	0.52	0.24	0.03	−0.14
PE	−0.01	0.02	0.05	0.30
DY	0.08	0.02	0.09	−0.30
LAREG	−0.01	0.08	0.01	0.60
ASREG	−0.02	0.12	0.41	0.73
EUREG	−0.12	−0.06	−0.32	0.39
OTHREG	−0.46	−0.10	0.26	0.13

Table 4

Regression of returns on principal components by country from February 1991 to December 1997

This table reports the regression of monthly returns on 20 emerging markets grouped by region on four extracted principal components. The components are obtained from a principal components analysis of 20 emerging markets using the variable set in Eq. (3). The variables are: MS–Money Supply, GP–Goods Price, RA–Real Activity, ER–Exchange Rate, WI–World Market Return, CR–Country Risk, IR–Interest Rate, TS–Trade Sector, PE–Price–Earnings ratio, DY–Dividend Yield, LAREG, ASREG, EUREG and OTHREG are equally weighted regional indices for Latin America, Asia, Europe and a combined Middle East/Africa region, respectively. Standard errors are adjusted for heteroskedasticity. *T*-statistics appear in parentheses and are tests of the null hypothesis that the coefficient is equal to zero.

$R_{it} = \alpha_i + \beta_{1i}\mathrm{PC}_{1t} + \beta_{2i}\mathrm{PC}_{2t} + \beta_{3i}\mathrm{PC}_{3t} + \beta_{4i}\mathrm{PC}_{4t} + \varepsilon_{it}$

	α_i	β_{1i}	β_{2i}	β_{3i}	β_{4i}	Adj. R^2
Latin America						
Argentina	0.025	0.003	0.097*	0.062*	0.116*	0.11
	(1.86)	(0.11)	(4.07)	(2.38)	(3.31)	
Brazil	0.026*	−0.079*	0.066	0.047	0.155*	0.20
	(2.06)	(−3.21)	(1.52)	(1.29)	(4.42)	
Chile	0.015*	−0.060*	0.019	0.056*	0.077*	0.28
	(2.38)	(−3.73)	(1.16)	(4.48)	(3.30)	
Colombia	0.024*	−0.053	0.067*	0.065*	0.030	0.14
	(2.64)	(−1.92)	(2.22)	(2.77)	(0.85)	
Mexico	0.013	−0.011	0.052	0.045	0.105*	0.09
	(1.21)	(−0.43)	(1.45)	(1.25)	(2.59)	
Venezuela	0.000	−0.027	0.045*	0.037	−0.001	0.02
	(0.02)	(−0.83)	(1.96)	(1.21)	(−0.02)	
Asia						
India	0.004	−0.058*	0.039	0.068*	0.113*	0.22
	(0.43)	(−2.13)	(1.48)	(2.98)	(2.79)	
Indonesia	−0.011	−0.073*	0.000	0.181*	0.136*	0.45
	(−1.25)	(−4.41)	(0.00)	(3.70)	(3.55)	
South Korea	−0.017*	−0.032	−0.060*	0.151*	0.080*	0.34
	(−1.98)	(−1.81)	(−2.59)	(4.31)	(2.64)	

Malaysia	−0.002	−0.028	0.041	0.158*	0.049	0.39
	(−0.28)	(−1.27)	(1.69)	(4.91)	(1.41)	
Pakistan	0.010	−0.034	0.093*	0.073*	0.043	0.17
	(1.04)	(−1.66)	(3.43)	(3.13)	(1.28)	
Philippines	0.006	−0.037*	0.060*	0.156*	0.060*	0.41
	(0.80)	(−1.98)	(2.39)	(6.91)	(1.99)	
Taiwan	0.007	−0.047*	0.080*	0.109*	0.030	0.22
	(0.71)	(−2.32)	(2.17)	(3.37)	(0.96)	
Thailand	−0.012	−0.045*	0.063*	0.178*	0.125*	0.43
	(−1.41)	(−2.23)	(2.67)	(4.68)	(3.61)	
Europe						
Greece	0.002	−0.079*	0.035*	−0.013	0.090*	0.29
	(0.29)	(−4.36)	(2.19)	(−0.60)	(4.01)	
Portugal	0.011	−0.027	0.032*	−0.016	0.058*	0.15
	(1.95)	(−1.78)	(2.15)	(−1.20)	(2.96)	
Turkey	0.004	−0.054	0.113*	−0.081*	0.077	0.08
	(0.27)	(−1.27)	(3.41)	(−2.47)	(1.19)	
Other (Africa and Middle East)						
Jordan	0.009*	−0.015*	0.021*	0.007	0.014	0.03
	(2.25)	(−2.01)	(2.01)	(0.51)	(0.98)	
Nigeria	0.014	−0.171*	−0.010	0.026	−0.124	0.15
	(0.73)	(−1.99)	(−0.23)	(0.68)	(−1.42)	
Zimbabwe	−0.007	−0.044	−0.088*	0.131*	0.001	0.20
	(−0.66)	(−1.52)	(−2.32)	(2.95)	(0.01)	

* Indicates significance at the 5% level.

market liberalisations.[28] However, as with any PCA, the comments offered here are speculative.

The principal components extracted above can be used to identify commonality in the emerging market returns. Two forms of commonality are of interest. The first form of commonality is whether the set of common factors is able to consistently explain return variation across markets. Rejection of this form of commonality implies that the variables required to describe equity return variation are market-specific, or at least they are uncorrelated across markets. The second form of commonality is whether the sensitivities to the components are identical across markets. This form of commonality implies common returns, on average, across markets.

Table 4 contains the results from a regression of the returns against the four identified principal components. The R^2 values are relatively high, which suggests that there may be some commonality in the determinants of returns. That is, the factors that are able to explain return variation are common to most markets, or at least correlated across markets. The model fit ranges from a low of 2% in Venezuela to 45% in Indonesia, and is generally around or above 20%. The results also indicate a number of significant coefficients, particularly for the Asian markets.

These results suggest that while emerging markets are typically viewed as being unique, as indeed our earlier analysis also suggests, a set of four principal components is able to consistently explain equity return variation across the markets under examination.

However, the commonality in the determinants of the returns does not suggest that the sensitivity to the factors is the same for every market. Returns will differ between markets to the extent that they exhibit different sensitivities to each of the principal components. That is, the returns could still exhibit different sensitivity to the common factors. These return differences will be evident if for any principal component, the null hypothesis that each market has identical coefficients on that component is rejected.

Table 5 contains the results from an F-test of identical sensitivity across markets to each principal component. No commonality is evident when all markets are considered collectively. However, common sensitivity to the components is evident when regions are examined. The Latin American markets display the strongest regional commonality. These markets have similar coefficients on three of the four components, namely the first, second and third components. The returns for the Asian countries exhibit similar sensitivity to the first and perhaps the fourth components. Commonality is most evident for European markets, where there are similar coefficients for each of the four components. Surprisingly given

[28] Bekaert (1995) and Buckberg (1995) find that price-to-earnings ratios increase while dividend yields decrease around capital market liberalisation dates.

Table 5
F-test of identical and zero sensitivity to principal components by region
This table reports the results from two *F*-tests across 20 emerging markets grouped by region. Tests of identical sensitivity and zero sensitivity are performed for each of the four extracted principal components. The components are obtained from a principal components analysis of 20 emerging markets using the variable set in Eq. (3). The variables are: MS–Money Supply, GP–Goods Price, RA–Real Activity, ER–Exchange Rate, WI–World Market Return, CR–Country Risk, IR–Interest Rate, TS–Trade Sector, PE–Price–Earnings ratio, DY–Dividend Yield, LAREG, ASREG, EUREG and OTHREG are equally weighted regional indices for Latin America, Asia, Europe and a combined Middle East/Africa region, respectively. *P*-values are in square brackets.

Stock markets	Test of identical sensitivity				Test of zero sensitivity			
	PC_1	PC_2	PC_3	PC_4	PC_1	PC_2	PC_3	PC_4
Emerging stock markets	2.141*	2.486*	4.633*	3.048*	6.232*	4.585*	12.988*	6.885*
(20 markets)	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Latin America	1.371	0.577	0.072	2.201*	6.352*	2.910*	3.353*	5.501*
(six markets)	[0.23]	[0.72]	[0.99]	[0.05]	[0.00]	[0.01]	[0.00]	[0.00]
Asia (eight markets)	0.566	3.64*	2.78*	1.92	4.578*	5.078*	17.928*	7.604*
	[0.78]	[0.00]	[0.01]	[0.06]	[0.00]	[0.00]	[0.00]	[0.00]
Europe (three markets)	1.044	1.989	1.243	0.199	7.276*	2.682*	0.971	5.323*
	[0.35]	[0.14]	[0.29]	[0.82]	[0.00]	[0.05]	[0.41]	[0.00]
Other (three markets)	7.893*	2.208	2.834	3.128*	6.247*	3.322*	4.844*	1.603
	[0.00]	[0.11]	[0.06]	[0.05]	[0.00]	[0.02]	[0.00]	[0.19]

* Indicates the null hypothesis of identical coefficients is rejected at the 5% level.

Table 6
Pooled regression of returns on principal components by region from February 1991 to December 1997
This table reports the pooled regression of monthly returns on 20 emerging markets grouped by region on four extracted principal components. The components are obtained from a principal components analysis of 20 emerging markets using the variable set in Eq. (3). The variables are: MS–Money Supply, GP–Goods Price, RA–Real Activity, ER–Exchange Rate, WI–World Market Return, CR–Country Risk, IR–Interest Rate, TS–Trade Sector, PE–Price–Earnings ratio, DY–Dividend Yield, LAREG, ASREG, EUREG and OTHREG are equally weighted regional indices for Latin America, Asia, Europe and a combined Middle East/Africa region, respectively. Standard errors are adjusted for heteroskedasticity. *T*-statistics appear in parentheses and are a test of the null hypothesis that the coefficient is equal to zero.
$R_{it} = \alpha_i + \beta_{1i}\mathrm{PC}_{1t} + \beta_{2t}\mathrm{PC}_{2t} + \beta_{3i}\mathrm{PC}_{3t} + \beta_{4i}\mathrm{PC}_{4t} + \varepsilon_{it}$

	α_i	β_{1i}	β_{2i}	β_{3i}	β_{4i}	Adj. R^2
Emerging stock markets	0.006 *	−0.049 *	0.038 *	0.072 *	0.062 *	0.20
(20 markets)	(2.37)	(−6.51)	(4.43)	(7.12)	(5.81)	
Latin America (six markets)	0.017 *	−0.038 *	0.058 *	0.052 *	0.080 *	0.11
	(3.61)	(−3.22)	(4.37)	(4.29)	(4.59)	
Asia (eight markets)	−0.002	−0.044 *	0.040 *	0.134 *	0.079 *	0.33
	(−0.64)	(−5.81)	(3.11)	(8.78)	(6.15)	
Europe (three markets)	0.006	−0.053 *	0.060 *	−0.037 *	0.075 *	0.12
	(0.89)	(−3.15)	(4.17)	(−2.27)	(3.07)	
Other (three markets)	0.005	−0.076 *	−0.026	0.055	−0.037	0.16
	(0.67)	(−2.35)	(−1.02)	(1.82)	(−0.97)	

* Indicates significance at the 5% level.

the odd mix of the 'Other' group, it exhibits similar sensitivity to the second and third components. One implication of these findings is that international investors may be better off by diversifying across regions, rather than markets.

A problem with the above findings is that while similar sensitivities to some factors is found, this commonality could indeed be commonality of no sensitivity. That is, the results may be a product of the poor explanatory power of the four principal components which would result in each of these markets displaying no sensitivity to each of the components. To investigate this possibility, Table 5 also reports an F-test of whether the sensitivity to a given factor is jointly zero across all countries.[29] Failure to reject the null implies that the factor is independent of the country returns. This hypothesis is rejected in all but two cases being the third component for the European region and the fourth component for the 'Other' region. These results support a model comprising four components. The findings also illustrate the generality of the four components, in that they are significantly related to returns in each of the four regions considered.

The finding of commonality has important implications for international investors. Diversification benefits are greatest when the factors driving returns in each country are uncorrelated. However, for international investors, the observed commonality represents a limit to the diversification benefits available from investing in emerging markets, despite their apparent uniqueness. Moreover, the commonality within regions but not across the aggregated group of all markets suggests that diversification across regions, but not within regions, is a sound strategy.

The final test involves a pooled regression of returns on the extracted principal components. The purpose here is to examine the explanatory power of the extracted components over realised returns grouped by region. The results presented in Table 6 are quite compelling. For the aggregated set of markets and for each of the three main regions (Latin America, Asia and Europe) there are significant coefficients on all four components. This result provides supportive evidence that regional factors appear particularly relevant. Table 6 further supports the proposition that the commonality in exposures is non-zero. In the case of the 'Other' group, there is significance on only one component. This latter result is expected given the earlier results and the fact that this group comprises the residual and non-regional markets.

5. Conclusions

A number of studies have found that a relationship exists between macroeconomic variables and equity market returns. This paper extends the literature by

[29] See Kan and Zhang (1999) for a discussion of the implications of including 'useless' factors in a multivariate regression.

considering the relationship within an emerging markets context. A multifactor model is proposed that incorporates both global and local factors, thus, recognising the partially segmented nature of emerging markets. Global factors are proxied by the world market return and local factors by a set of macroeconomic variables. The variables employed are money supply, goods prices, real activity and exchange rates. Some evidence is found that shows these variables are significant in their association with emerging equity returns above that explained by the world factor. When a larger set of variables is considered the explanatory power of the model substantially improves such that it is able to explain a large amount of the return variation for most emerging markets. The microeconomic effects of price-to-earnings and dividend yield are most apparent. This evidence appears to point to a model where local factors are most relevant.

The paper then makes use of this set of variables to investigate the degree of commonality between emerging equity market returns. Principal components are extracted and returns for each market are regressed against each component. The results show that emerging market returns indeed have similar sensitivities to a number of these factors. Commonality is particularly evident when regions are considered.

The finding of commonality in sensitivities across markets has implications for international investors as it suggests a limitation to diversification, concentrated particularly at the regional level. These results are relevant when it is considered that many investors gain access to emerging markets via portfolios (i.e. mutual funds). The findings suggest that investors should diversify across specialised regional funds. That is, the benefits from diversification are enhanced when the allocation of funds is spread across, rather than within, regions. Furthermore, models that seek to explain return variation should not only consider a country's level of integration with world financial markets, but should also cater for a country's level of regional integration.

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