Exchange rates risk and equity portfolio diversification.

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Abstract.

This thesis identifies and fills certain gaps in the empirical literature on the relationship between exchange rates and stock prices, and equity portfolio diversification, with the aim of providing useful information for academics, private investors, currency risk hedgers, and policy-makers. Firstly, it analyses granger-causal links between exchange rates and stock prices even at a level of stock market disaggregation not previously considered, taking into consideration a number of factors that may influence the lead/lag results. Secondly, the thesis considers whether exchange rate movements actually contribute to systematic or undiversifyable risks in national equity markets, particularly assessing the implications (thus far) of the single European currency (the euro) on the risk premiums of major equity markets, given the general perception that the EMU should reduce exchange rate and equity market risks. Several studies have advocated cross-border equity investments as a tool for reducing equity portfolio risks, despite inherent problems including exchange rate risks. Finally therefore, this thesis contributes to the literature on the diversification of equity portfolio risks by assessing the potential of home-based diversification in three developed European equity markets as an alternative to international portfolio diversification, and the potential benefits of eurozone diversification.

The evidence suggests the existence of time-varying granger-causal links between exchange rates and stock prices in most countries, although the lead/lag structure for each country may differ when the stock market index is disaggregated, contradicting theoretical models. Although the EMU does not appear to have reduced the exchange rate risk premium in key member states, the same cannot be said about the equity market premium, which has reduced in three of the four member countries investigated. Finally, it appears that the potential of diversifying within the European equity market is such that any extra benefit from international equity acquisitions for diversification purposes is statistically and economically insignificant.

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To my Lord Jesus Christ

&

my family

Introduction

The need to reduce uncertainties, arising from exchange rate fluctuations, which plague cross-border flows of goods and services, has been at the forefront of international economic cooperation for nearly two centuries. In this arena, international efforts have largely focused on fixing the rate of exchange among national currencies of participating countries at pre-determined levels. From the middle of the nineteenth century, the United States of America and most developed countries of the time fixed exchange rates under the Gold Standard – a system where central banks peg price of gold by being willing to trade domestic currency for gold or vice versa with anyone at that official price. Following the outbreak of the First World War, many of these countries abandoned the Gold Standard because it prevented them from increasing the supply of money crucial to their abilities to finance war efforts. After the war, many countries briefly rejoined the Gold Standard until it was finally abandoned because it tended to amplify the effects of the Great Depression of the early 1930s i.e. economic shocks were easily transmitted across countries making it difficult to maintain internal balances, amidst other reasons.

The rapid expansion in international trade that characterised the aftermath of the Second World War resuscitated the need for new cooperation in curtailing exchange rates volatility. These new efforts gave birth to the Bretton Woods System or Reserve Currency Standard – a regime in which different currencies were pegged to the US dollar, and the dollar alone was pegged to gold. Although it allowed more flexibility than the Gold Standard, the Bretton Woods System came under speculative pressure from the late 1960s as a result of unsustainable US economic policy, and finally collapsed in 1973. The adoption of free floating exchange rate regimes by many industrialised countries in 1973, coupled with an expanding international trade due to an increasing tendency of domestic firms to conduct their business on a global scale, ushered in a new era of increased exchange rate risk and volatility. Volatile exchange rates hurt companies by making it difficult to set prices, control costs, and predict revenues. Such a weaker or more uncertain profit outlook may depress the stock prices of companies whilst spurring investors to demand higher risk premiums, which boosts the cost of financing business investment.

Over the last three decades, there has also been a large increase in cross-border capital flows as a result of: privatisation (or deregulation) in economies that had been tightly controlled by governments and relaxation of restrictions on foreign ownership of domestic firms; declining political risks worldwide; and advances in information technology that enable investors to make well-informed investment decisions on the international scene. This massive international flow of capital undoubtedly plays an important role in the determination of the values of various national currencies, just as exchange rates volatility can quickly wipe out the value of investors' international portfolios. Consequently, the interests of academics, investors, and policy-makers in understanding the interactions between stock and foreign exchange markets have rekindled in recent times.

Perhaps nothing highlights the importance of this understanding better than the Asian financial crisis of 1997/98, in which stock prices and exchange rates plunged in unison, sending shock waves throughout the world's financial markets. Knowledge of the dynamics between these two financial variables may enable some practitioners to profit from arbitrage especially during such severe financial crises. Moreover, such knowledge may aid portfolio managers in planning effective hedging strategies, and could be useful to financial policy makers who seek to prevent such economic mishaps from occurring.

This thesis uniquely contributes to a growing body of empirical evidence on some issues on the relationship between exchange rates and stock prices, and equity diversification in light of exchange rate risks and increased global equity movements.

Firstly, since the collapse of the Bretton Woods System, the bulk of the literature focused on identifying the sensitivity of the value of firms, and to a much lesser extent the entire stock market, to exchange rate fluctuations, despite economic theory (e.g. portfolio models of exchange rates determination) that recognises the potential implications of equity price movements for exchange rates. Attempts have been made to investigate a two-way link between the two markets in the past, using granger-causality models. However, given their mixed evidence and use of stock market index data, an intrinsic assumption in previous work (e.g. Granger et al, 2000) is that all stock prices within a national market have a common response to currency movements and vice-versa. Although this assumption may be attributed to the theoretical models of exchange rates dynamics that define the relationship, it is not necessarily plausible. For instance, empirical evidence suggests that exchange rate exposure patterns may be industry-specific (e.g. Bodnar & Gentry, 1993) and that industry-related factors may explain movements in national equity markets (Roll 1992). Thus in addition to market level analysis, this thesis contributes to the literature by investigating stock prices / exchange rate dynamics at a level of stock market disaggregation not previously considered. The thesis addresses the following question: is the direction of causality between exchange rates and stock prices (if any) influenced by industry factors (i.e. industry-specific), or controlled by common macroeconomic factors (i.e. market-specific) as suggested by theoretical models? The findings should convey better information to the potential users. For instance, if the direction of causality is industry-specific, policy could be industry-tailored. In addition, this study takes into account the potential impact of international equity movements (given the globalisation trend in equity markets), and currency specification issues on the exchange rate-equity causal links in individual national markets, unlike in prior studies.

Secondly, this thesis considers whether exchange rate movements actually contribute to systematic or undiversifyable risks in national equity markets. Again a number of studies have been carried out on this issue, using asset pricing models (e.g. Antoniou et al, 1998a and 1998b). This study uniquely contributes to the literature by extending the application of an asset pricing model that allows a number of macroeconomic variables (some not previously considered) to be potential contributors to equity systematic risks to different national markets. Our originality centres on analysing the equity market effects of the latest international effort in curtailing the hazard of exchange rate uncertainties: the European Economic and Monetary Union (EMU) and the adoption of the single euro currency, on a wide scope. By analysing the behaviour of both exchange rates and total equity market risk premia over the period January 1989 to August 1993, Antoniou et al (1998a) assessed the benefits of the UK's membership of the exchange rate target zones of the European Monetary System (EMS), following the European Commission's view that such exchange rates arrangement should lower exchange rate risks and hence the total equity market premium. Since the collapse of the EMS in 1993, the *currency landscape* of Europe has evolved dramatically, metamorphosising into the recent EMU. Although the economic objective of the EMU is similar to that of the EMS – to control exchange rates variability hence reducing currency risks, the EMU is a unique exchange rate regime accomplished in two important phases: the irreversible fixing of exchange rates of participating member states at pre-specified levels in January 1999, followed by the adoption of a single currency – the euro, in January 2002. To what extent therefore has the EMU achieved the objective of reducing currency and total equity market risk premia in participating countries? Given lack of empirical evidence on this issue so far, this thesis fills an important gap in the literature by providing some answers to the question. Moreover, analysing the behaviours of the exchange rates and total equity market premia from the initiation of the EMU presents a classic opportunity to assess their responses to the two different exchange rate regimes (or phases) of the EMU described earlier. Has the creation of the '*super eurozone economy*' fulfilled another important mission: fostering economic integration among participating members? This thesis also addresses this question. A new method of testing correlation among variables over time is employed to assess the level of integration among European equity markets following the EMU in comparison with other non-EMU markets.

Finally, this thesis contributes to the literature on the diversification of equity portfolio risks. Several studies (e.g. Solnik, 1974) have advocated cross-border equity investments as a tool for reducing equity portfolio risks, despite inherent problems including exchange rate risks. In recent times, the characteristics of developed equity markets have changed. Not only are these equity markets becoming more susceptible to international factors partly due to a large number of domestic firms doing business on a global scale, but foreign equity assets are also being cross-listed. Consequently, can investors enjoy more benefits by diversifying within their domestic equity market than previously thought? Only one previous study – Errunza et al (1999), has investigated the potential of 'home diversification', albeit from the perspective of the US investor, in a restrictive manner. This thesis undertakes a much wider assessment of the potential diversification benefits of domestic equity assets vis-à-vis international investments from the perspective of three European investors, taking into account important equity market conditions not considered in the previous study. In addition, an empirical assessment of the potential of euro area-wide diversification – a notion which, until now, existed mainly in theory, is made.

Chapter One discusses previous empirical work in the areas this thesis makes significant contributions. Section I discusses the empirical methodology and findings of studies on the exchange rate exposure of firms focusing on the various issues that significantly affect the outcome of such tests, and those of studies that investigate a two-way causal relationship between exchange rate changes and stock market movements; Section II discusses the literature on the pricing of exchange rate risk in equity markets from the perspective of the Capital Asset Pricing Model (CAPM) and the Arbitrage Pricing Theory (APT); and, Section III focuses on empirical work on the implications of exchange rates fluctuations on an internationally diversified portfolio, the effectiveness of hedging instruments, and findings on the potential of home diversification.

In Chapter Two, Granger (1969) causality tests are used to exploit the bi-directional relationship between exchange rates and stock market indices of six developed countries – Australia, Germany, Hong Kong, Japan, Singapore, and the United States during various sub-periods from January 1976 to December 2001. Evidence of significant causal links would enhance predictability in the variables. In addition, the stock market indices are disaggregated into broad industry portfolios. This disaggregation provides an opportunity to also investigate whether the direction of causality between stock prices and exchange rates in each country is industry-specific, or market-specific. The robustness of results is assessed when changes to exchange rates base currency and effects of global stock market movements are considered. The results show significant time-varying causal links between exchange rates and stock market indices in the six countries. There is also some evidence that the direction of causality may differ significantly from that suggested by the market index when industry data is examined. Importantly, the direction of the causality may also depend on the exchange rate reference currency and global equity market movements.

Chapter Three investigates the claim by the European Union that a single currency, as under the EMU, would eliminate exchange rate uncertainty, reduce equity market risks, and hence the cost of financing business investments in participating countries.

The Arbitrage Pricing Theory (APT) is used to model the return-generating structure in the equity markets of four *eurozone* countries – France, Germany, Italy, and the Netherlands; and those of the USA and the UK over the period January 1980 to June 2002. The APT allows us to test if unexpected movements in exchange rates and other macroeconomic variables that may directly affect the value of firms, as suggested by the present value model of share prices, contribute to systematic risks in these equity markets. Therefore, the empirical validity of the APT as an asset pricing model is once again called into question. ARIMA models and Kalman Filters are used to derive the unexpected movements in the macroeconomic factors, thereby assessing the impact of innovation decomposition techniques on the APT results. By recursively estimating the APT model over most of the sample period, it is possible to produce point to point estimates of exchange rate risk and the equity market premiums such that by plotting these points on a graph, one is better able to observe and explain any variations and assess the impact of the EMU on both premiums. In addition, the newly developed Dynamic Conditional Correlation (DCC) of Engle (2002) is used to assess the level of equity market integration i.e. the dynamic correlation between changes in equity market premium.

The results, which are robust to the technique of innovations generations, indicate that exchange rates risks are significantly priced in most equity markets. The APT model performs reasonably well in explaining the equity market returns. It appears that the exchange rate risk premium in the larger European countries (France and Germany) increased sharply with more volatility after the commencement of the euro, such that any observed reduction in the total equity market premium, as in the case of France, emanates from the stabilization effects of the EMU on other macroeconomic factors and not exchange rates as expected. This stabilisation effect is prominent in the currency risk premiums of the smaller countries – Italy in particular. Whilst the UK post-January 1999 risk premia have reduced considerably, the US market appears to be largely unaffected by the EMU. Results from the DCC analyses suggest that although there is a general rise in the level of equity market integration, it is not possible to attribute this rise strictly to EMU factors.

Chapter Four appraises the potential benefits of domestic equity diversification in the European countries – the UK, Germany, and France, as an alternative to international portfolio diversification given implicit exchange rates risks and other factors that may complicate the latter, over the period January 1994 to March 2004. Size-based equity indices, industry portfolios, stocks of multinational companies, country funds (where available), and stocks of foreign companies listed on the respective European equity markets, are used to construct domestic equity portfolios that mimic each of thirty-seven foreign equity indices. Unconditional correlation analysis is applied to test the abilities of each of the European investors to mimic these foreign indices with the domestically available equity assets. Various mean-variance spanning tests – Huberman & Kandel (1987) OLS-based test, Ferson et al (1993) GMM-based test, Kan & Zhou (2001) step-down procedure, and the De Roon et al (2001) test, are all applied to assess the possibility of exhausting the benefits of international diversification by domestically available equity assets. The Dynamic Conditional Correlation analysis is again employed to investigate any potential time-variation in the ability to mimic foreign indices. This study investigates any potential 'extra' benefits of eurozone sectoral diversification vis-à-vis member country sectoral diversification, and more importantly, assesses whether these extra benefits are declining over time as country-specific risk factors *supposedly* decline.

The results indicate that it is possible to mimic foreign indices with domestic equity assets more than previously thought, such the diversification gains over and above that attainable with domestic equities may be statistically and economically insignificant in the case of the UK investor, whilst eurozone diversification is more attractive for French and German investors. Despite the fact that the abilities of the European investors to mimic the equity indices of most of the foreign countries have generally increased, the extra benefit of eurozone diversification does not appear to be reducing.

Finally in this thesis, the findings are summarised and some suggestions for future research are offered.

Chapter 1

A Review of Literature.

This chapter discusses the theory and some empirical findings on the issues addressed in this thesis. Section I appraises literature on the exchange rate exposure of stock prices, on both firm-level and stock market level, in the context of linear regression models and bivariate causality tests. Section II discusses the findings from studies applying various asset pricing models to assess the significance of the exchange rate risk premium in both domestic and international equity markets. Section III presents some findings on the implications of exchange rate movements on an internationally diversified portfolio and the effectiveness of strategies to mitigate adverse exchange rate effects, and, the potential benefits of intra-country diversification as a means of eliminating exchange rate risks and other factors detrimental to a portfolio diversified across countries. Section IV summarises and concludes the chapter.

Section 1.1: The relationship between Exchange Rate and Stock Prices.

The work of Adler & Dumas (1984) set the foundation for research on the effects of exchange rates on stock prices (henceforth called the '*traditional approach*') especially at a micro-economic level. Adler & Dumas (1984) defined the effects of exchange rate changes on the value of a firm as the *exchange rate exposure* of stock returns.[1] Loudon (1993) identifies three different types of exchange rates exposure to which firms are susceptible under such an independently floating exchange rates regime. These are translation exposure (the sensitivity of home currency book values and accounting earnings to changes in exchange rates, arising from foreign currency investing and financing activities); transaction exposure (the sensitivity of the home currency future settlement value of the firm's existing contracts denominated in foreign currency to exchange rates changes); and lastly, operating exposure (the sensitivity of the home currency economic value of the firm to changes in exchange rates), reflecting the responsiveness of the price and cost competitiveness of firms to

[1] Per Adler & Dumas (1984), the exchange rate exposure of firm i, γ_I, is defined as the correlation between the firm's stock returns and the changes in the exchange rate, conditioning on the average stock market return rate.

fluctuations in currency values.[2] The combined effect of transaction exposure and operating exposure is usually referred to as economic exposure (see Sercu & Uppal, 1995). Although not tested empirically, Adler & Dumas (1984) suggest that the exposure can be measured through the regression coefficient of the change in the value of the firm on the change in the exchange rates, i.e. estimating a model, usually in the form:

$$R_{it} = \beta_{0i} + \beta_{1i} E_{st} + \beta_{2i} R_{st} + \varepsilon_{it}, \quad t = 1 \ldots T \tag{1.1}$$

where R_{it} is the stock return of a company, E_{et} is the rate of change in the exchange rate, R_{st} is the market return. The coefficient β_{1i} and β_{2i} capture the exchange rates exposure and market movements respectively.

The model in equation (1.1) above is essentially an augmentation of the 'market model' of returns with exchange rates information. Given its extensive use in the literature, this model can be referred to as the '*empirical anchor*' of the traditional approach.

In general, the empirical testing of the model has not been successful in identifying significant exchange rates exposure of stock prices, contrary to theory. This thesis discusses these studies and their findings by taking a critical look at few important issues that may affect the results of poor exposure coefficients and also make empirical testing '*Herculean tasks*', to say the least.

Complexities in the use of firm-level and industry data.

Most studies focus on identifying the exchange rates exposure of firms that have significant involvement in foreign markets, especially multinational corporations (hereafter MNCs), even though domestic market-oriented firms are also exposed to exchange rates risk, given the definition of operational exposure as discussed earlier. Using monthly equity data for 287 US-headquartered MNCs from January 1971 to December 1987, Jorion (1990) finds that although evidence suggests that exchange rates exposure is positively and reliably correlated with the degree of foreign

[2] Operating exposure suggests that domestic oriented firms (i.e. firms with no foreign involvement) are also susceptible to exchange rate risks.

involvement[3], most exposure coefficients are small relative to their standard errors (except in a few cases) and time-varying. Loudon (1993) tests the exchange rates exposure of monthly stock returns of 141 Australian firms over the period January 1984 to December 1989 and finds that only 9 companies had significant exposure.[4] Bartov & Bodnar (1994) find no significant correlation between stock returns of US firms with large foreign currency dealings and contemporaneous changes in the dollar over the period 1978 – 1989. Choi & Prasad (1995) show that only sixty one firms of 409 US MNCs analysed in their study had significant exposure coefficients during the period 1978 – 1989, even though the null hypotheses that exposure coefficients are zero for all firms is rejected at the one percent level of significance.[5] Using returns data of 213 US MNCs over the period 1979 to 1988, Chow et al (1997) reports that five MNCs have significant exposure coefficients, but the exposure coefficients of other firms become more significant as the returns horizon lengthens from one to sixty, suggesting *long-term* exchange rate effects on stock returns.[6] He & Ng (1998) find that only twenty five percent of 171 Japanese MNCs experienced economically significant currency exposures from January 1976 to December 1993. Doukas et al (2003) also finds that only seventeen of 62 Japanese MNCs had significant exposures (mainly positive) over the period January 1975 to December 1995, even though over 21% of all 1079 Japanese firms had significant exposures. From January 1990 to February 1997, Nydahl (1999) finds that twelve of 47 Swedish MNCs had significant exchange rate exposures. Dominguez & Tesar (2001) reports significant exposure coefficients ranging from 19% to 38% of firms in eight countries.[7] The insignificance of the exposure coefficient may not be surprising in light of evidence from Gao (2000) that exchange rates affect firms' profitability through two different channels (foreign sale and foreign production) which may be offsetting to one another such that the exposure variable captures only the overall (weak) effect. He finds evidence that

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[3] See also He & Ng, (1998) and Doukas et al (2003).

[4] Twenty three of these 141 firms are multinationals, and only one of these had significant exposure coefficient.

[5] Jorion (1990) also rejects the null hypothesis that all exposure coefficients are equal and zero at 1% level of significance.

[6] Chow et al (1997) find that 190 out of the 213 MNCs had significant exposures (five percent significance level) at the sixty-month horizon. Their methodology differs slightly from that proposed in Adler & Dumas (1994). They use a four factor model in which trade-weighted exchange rates, dividend yield, default premium, and term premium are regressors.

[7] The eight countries covered in their study are Chile, France, Germany, Italy, Japan, the Netherlands, Thailand, and the UK, using weekly returns data for an average of 300 firms and at least 20 industries in each country, from 1980 to 1999.

exchange rate depreciations are positively correlated to foreign sales and negatively (or uncertain) correlated to foreign production, even though the total effect of exchange rate news on the stock returns of US manufacturing MNCs is found to be quite small and insignificant.

Empirical studies suggest that industry characteristics explain some of the variation in stock returns.[8] The macroeconomic models of Dornbusch (1973, 1987) propose theories on the implications of exchange rates fluctuations on wages, goods, and asset prices in non-traded goods industries differently from traded goods industries. Dornbusch (1974) suggest a positive relation between the value of firms in non-traded goods industry and domestic currency appreciations. On the other hand, firms in the traded goods industry are susceptible to changes in relative input and output prices and are thus more exposed to exchange rates changes, although the relationship depends on whether they are exporters (positive relation) or importers (negative relation). Therefore, firms within the same industry of a country may respond similarly to exchange rates fluctuations. Results in Dominguez & Tesar (2001) suggests that there is a large increase in the number of significant exposure coefficients found in some countries when data is based on industry portfolios as opposed to firm-level data.[9] Using Australian industrial indices, Loudon (1993) found evidence that resource stock (gold, other metals, solid fuels, gas & oil, etc) and industrial stocks (building materials, chemicals, banking and finance, etc) respond differently to fluctuations in exchange rates. When currency appreciates, industrial stocks tend to perform better (i.e. rise in prices) whereas resource stocks perform better when currency depreciates. Bodnar & Gentry (1993) suggest that exposures should be large for an industry heavily involved in a single activity, such as exporting or importing, but they may be small for industries that undertake combinations of activities. It is this last point that also complicates the use of industry data. Firms within an industry need not have homogenous exposures, as found in Khoo (1994).[10] Individual firms within the industry are exposed in opposite ways, such that the aggregation of their returns will therefore average out the individual exposure effects.

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[8] See for instance Roll (1992) and Griffin & Karolyi (1998)

[9] For example 31% (22%) of Japanese (German) firms have significant exchange rate exposure coefficients compared to 61% (65%) of Japanese (German) industries with significant exposures over the period 1980 – 1999.

[10] Khoo (1994) finds that firms in the mining industry of Australia have different exposures (significant or not) to exchange rates changes.

Only eleven of thirty-nine USA industry portfolios (four of nineteen in Canada, and seven of twenty in Japan) are found to have significant exposure coefficients in Bodnar & Gentry (1993) from 1979 – 1988, even though the joint test that all industry exposures are zero for each country is rejected at five percent level of significance.

Methodology Issues.

By definition, the coefficient of the exchange rates variable in equation (1.1) β_{1i} measures a firm's exposure to exchange rates movements, after taking into account the overall stock market's exposure to currency fluctuations, β_{2i}. As pointed out by Bodnar & Wong (2001), models that include the market portfolio control for market-wide factors that are correlated with exchange rate changes, thus estimate *'residual'* exposure. Residual exposure and total exposure will differ, to the extent that the market portfolio has a significant exposure. Therefore, if the null hypothesis that the coefficient β_{1i} is equal to zero cannot be rejected, it suggests that the firm has the same exchange rates exposure as the market portfolio, and not necessarily that the firm has no exposure. The bulk of studies that test the exchange rate exposure include a regressor market portfolio as in equation (1.1). Therefore, results in Jorion (1990), Bodnar & Gentry (1993), Bartov & Bodnar (1994), Khoo (1994), Choi & Prasad (1995), He & Ng (1998), Nydahl (1999), DiIorio & Faff (2000), Gao (2000), Bodnar & Wong (2000), Dominguez & Tesar (2001) that suggest weak links between exchange rate changes and stock returns of firms and industry portfolios based on the statistical significance of this *residual* exposure, must be interpreted with care, especially when some of the aforementioned papers report significant coefficients of market returns.[11] Note however that Jorion (1990) also estimates an alternative version of equation (1.1) in which market returns are removed from the model thereby permitting the estimation of *'total'* exposure, finding that there are no significant differences in results.[12]

Exchange rates data.

In investigating the relationship, a question that naturally pops to the mind of the researcher is: what exchange rates? Does one use a trade-weighted index, or does one

[11] For instance Khoo (1994) finds that the coefficients of market returns are statistically significant for seventy seven of the 98 Australian firms.

[12] In fact, Jorion (1990) notes that the correlation of results under the two versions is as high as 0.96.

use exchange rates vis-à-vis a specific base currency, or does one even include a set of bilateral exchange rates as regressors? Using an aggregation of many exchange rates (trade weights) results in loss of information of domestic currency movements (see Vassalou, 2000) and is tantamount to assuming that all firms have equivalent exposures across currencies (see Loudon, 1993), thereby lacking power if the nature of firm exposure does not correspond to the exchange rates (and their relative weights) included in the basket. Dominguez & Tesar (2001) provides empirical evidence on the weakness of trade-weighted exchange rates to capture exchange rates exposure of firms and industries in the eight countries. They find substantial increases in the number of firms and industries with significant (at 5% level) exposure coefficients when exchange rates are vis-à-vis the US dollar or any other base currency (based on direction of trade data) as opposed to trade-weighted exchange rates.[13] Therefore, it may not be surprising that papers like Jorion (1990), Bodnar & Gentry (1993), Bartov & Bodnar (1994), Choi & Prasad (1995),[14] He & Ng (1998), Gao (2000), and Bodnar & Wong (2001) that use exchange rates trade-weighted (TW) indices[15] report weak links between exchange rates and stock returns[16]. Note however that the results of Doukas et al (2003) are not significantly affected by the use of either a bilateral exchange rate or a multilateral (trade weighted) exchange rate.

In general, one should expect a variation in the exposure of individual firms and industries to various exchange rates as found in Khoo (1994),[17] such that use of a single bilateral exchange rates (e.g. vis-à-vis the US dollar) may not be adequate to capture exchange rates effects of stock prices. In the investigation of the sensitivity of the returns of twenty four Australian industry portfolios to changes in Australian dollar/US dollar exchange rate over the period January 1988 to December 1996,

[13] For instance only 5% of Chilean firms are significantly exposed to trade-weighted exchange rates fluctuations, as opposed to the 19% of firms exposed to dollar rates (or some other bilateral rates). In addition, 26% (65%) of German industries are significantly exposed to trade-weighted (bilateral rates) exchange rates changes.

[14] Choi & Prasad (1995) use both nominal and real trade weighted exchange rates, finding no significant differences in their results.

[15] In fact, most studies that empirically test the effects of exchange rates changes on US stock prices use TW exchange rates data.

[16] Note that the study is only identifying a potential impact of TW indices on the significance of exposure coefficients, and not suggesting that use of TW indices exclusively led to insignificant exposures.

[17] In addition to exchange rates vis-à-vis the US dollar, Khoo (1994) includes the currencies of other large countries (yen, mark, sterling, rand, etc) as regressors for each company, provided the currencies are not highly correlated. The coefficients (their signs and statistical significances) of the various base currencies vary at the firm and industry level.

DiIorio & Faff (2000) find little evidence of a contemporaneous relationship using both daily and monthly data.[18] Dominguez & Tesar (2001) provides evidence that any test that restricts the measurement of exposure to a single exchange rate (whether it is trade-weighted or a bilateral rate) is likely to bias downwards i.e. increasing the likelihood of insignificant exposure coefficients. However, the danger in the inclusion of multiple bilateral exchange rates as regressors in the model will be multicollinearity.[19]

Exchange rates innovations

Jorion (1990) notes that the empirical model in equation (1.1) is only appropriate if changes in stock prices and exchange rates are unanticipated. On the basis that the stock market is efficient i.e. only unanticipated shocks to a firm's expected future cash flows will affect abnormal returns since anticipated changes are immediately taken into consideration by forward-looking investors in their pricing of the firm's securities, exchange rates exposure should be measured as the results from changes in operating cash flows caused by an *unexpected* change in exchange rates (Eiteman et al, 1992). Priestley (1996) demonstrates the importance of the methodology for deriving *innovations* or *news* on the statistical significance of currency risk prices in equity markets.[20] Some studies in international finance like Messe & Rogoff (1983) suggest that fluctuations in nominal exchange rate are virtually unpredictable[21] and as such most studies testing exchange rates exposure discussed so far (excluding Choi & Prasad, 1995, and Gao, 2000), use the *rate of change* in exchange rates to proxy for the innovations or 'news'. However, Priestley (1996) shows that 'rate of change' methodology does not meet the basic white noise requirements of serially uncorrelated components (innovations) in exchange rates data, and is also unstable.[22] Moreover, Bekaert & Hodrick (1992) shows evidence of increasing predictability in the foreign exchange markets. As a result, the exchange rates data in the previous studies may be less appropriate thus affecting the significance of the exposure

[18] Using daily data, only two industries showed statistically significant sensitivity to fluctuations of the AUD/USD exchange rate. Results using monthly data were less significant.

[19] See Khoo (1994) and Vassalou (2000) for further explanations.

[20] Note that there is a difference between the sensitivity of equity returns to exchange rates and the pricing of currency risks in equity returns (see subsequent chapters).

[21] Messe (1990) states that the proportion of monthly exchange rates changes that models can explain is essentially zero.

[22] Priestley (1996) suggests the use of signal extraction or Kalman Filters to derive innovations.

coefficients. On the other hand, Choi & Prasad (1995), using both the *rate of change* and exchange rates *news,*[23] finds no difference in the exposure coefficient results. Gao (2000) also finds that the firms' exposure coefficients are still generally insignificant, even when exchange rate *news* is used.[24]

The Market Portfolio

Empirical studies suggest that the type of market portfolio (equally-weighted or value-weighted) included in equation (1.1) has implications for the significance of the exchange rate exposure coefficient. Bodnar & Wong (2000) concludes from a sample of large US firms that value-weighted and equally-weighted have economically different conditions with the exchange rates. They explain that value-weighted portfolios are dominated by large firms (multinationals and exporting firms) likely to experience more negative cashflow reactions to dollar appreciations than other US firms, such that their use as market returns removes the macroeconomic effects and bias tests toward finding no exposure. As a result, the failure to control for size in the regressions causes omitted variable problem especially in cross sectional studies, which will misstate the significance of other variables in the model. Jorion (1990), Bodnar & Gentry (1993), Bartov & Bodnar (1994), Khoo (1994), He & Ng (1998), DiIorio & Faff (2000), Gao (2000) all use value-weighted indices. Bodnar & Wong (2000) and Dominguez & Tesar (2001) use equally weighted to capture market returns.

Effects of Hedging.

The use of derivative instruments by firms to hedge exchange rates risks is well established in corporate financial management. Therefore, the greater the extent to which companies hedge, the lower their exchange rates exposure. He & Ng (1998) finds evidence that about forty one percent of 493 Japanese corporations use derivatives like currency swaps and options, futures, combinations of these, and other

[23] They define exchange rates news as the difference between the actual and expected exchange rates. Expected exchange rates are proxied by the forward rate (even though an increasing number of empirical literature show that the forward rates is a biased predictor of future spot rates, see e.g. Bilson, 1981) and lagged spot rates.

[24] Gao (2000) defines exchange rate news as the residuals from (a) a *random walk* process, and (b) the regression of exchange rates on macroeconomic variables like interest rates, money supply, industrial output, trade balance and the inflation rate. These differences did not have any significant impact on results.

derivatives to hedge their foreign exchange exposures. Geczy et al (1997) also shows that approximately forty one percent of 352 firms in the US *Fortune 500* use derivatives to hedge currency risks. They also find that the likelihood of using currency derivatives is positively related to foreign pre-tax income and sales and foreign-denominated debt, consistent with theory that the benefits of hedging are greatest and costs lowest for firms with extensive foreign exchange exposure.[25]

From a sample of 1110 Japanese firms listed on the Tokyo Stock Exchange, Chow & Chen (1998) suggest that large firms have economies of scale in hedging exchange rates risks and are therefore better able to hedge economic exposure[26]. Chow et al (1997) suggests that the widespread practice of hedging short-term currency exposure can sever the link between the short-term effects of exchange rate changes and short-horizon stock returns, resulting in the insignificance of the exposure coefficients.[27] Consequently, it may not be surprising that most exposure coefficients in some studies[28] based on large internationally-involved firms and/or short-horizon data are statistically insignificant especially in light of the findings by Bodnar et al (1996) and Allayanis & Ofek (2001) that MNCs tend to use foreign currency hedging instruments more than their domestic-oriented counterparts. Moreover, it is difficult to test the impact of hedging on exposures because of lack of data on firm's or industry hedging activities. Nydahl (1999), Gao (2000) and Dominguez & Tesar (2001) suggest that insignificant exposure coefficients should therefore be taken as 'after-hedge' measures.

Other issues.

Economic theory suggests that the susceptibility of the value of firms to exchange rates fluctuations is even greater in (small) *open* economies.[29] Ma & Kao (1990) note that the effect of exchange rate changes on stock market indices might be insignificant if the economy is less dependent on foreign trade. Friberg & Nydahl (1999) suggest

[25] See Nance et al (1993) and Chow et al (1997) for more support on theory that large firms hedge more than small firms in practice.
[26] They define economic exposure as the effect of exchange rates changes on a firm's long-term cash flow.
[27] The fact that Chow et al (1997) find evidence of insignificant (significant) exposure coefficients at short (long) return horizon gives weight to this argument.
[28] See for instance Jorion (1990), Bartov & Bodnar (1994), Khoo (1994), Choi & Prasad (1995), and Gao (2001)
[29] See Bodnar & Gentry (1993) and Friberg & Nydyal (1999).

that a possible reason for poor exposure coefficients is that the US economy, on which Jorion (1990), Bartov & Bodnar (1994), Choi & Prasad (1995), Bodnar & Wong (2000), Gao (2000) amongst others, are based is relatively closed as compared to the economies of other industrialised countries like Japan, Germany, and the UK.[30] The fact that Choi & Prasad (1995) find that only two of twenty US industry portfolios have significant exposure, as compared to Dominguez & Tesar (2001) that 65 percent, 61 percent, and 46 percent of German, Japanese, and UK industries, respectively, have significant exposure coefficients may suggest some implications of economic openness. It may be worthwhile to extend research to a variety of markets. Bodnar & Gentry (1993) also suggest that the more industrially diverse a country is, the more likely it is to get insignificant exposures across different firms. The large extent of the industrial diversity of the US economy as compared to other countries is documented in Griffin & Karolyi (1998), and may also have implications on US results.

Gao (2000) remarks that non-consideration of the potential effects of *time-variation* of exchange rates exposure may yield insignificant coefficients. The behaviour of exchange rates under various *regimes* is a major driving force behind this time-variation. For example, the domestic currency depreciation makes exporters more price competitive, while currency appreciation favours importers. The empirical evidence on time variation is mixed. Jorion (1990), Chow et al (1997), He & Ng (1998), and Bodnar & Wong (2000) find evidence that the significance of exposure coefficients changes from period to period, with different signs. Choi & Prasad (1995) finds evidence that exchange rates effects on stock prices varies under a 'strong' dollar (1978 – 1985) and 'weak' dollar (1985 – 1989) regimes, even though direction of exposure (positive or negative) does not change significantly. Doukas et al (2003) finds that the exchange rate exposure of Japanese firms varies across time i.e. in the pre-Plaza Accord[31] era (January 1975 to September 1985), Japanese firms generally had a negative exposure, whereas they had a positive exposure in the latter period (October 1985 to December 1995).[32] Also Dominguez & Tesar (2001) finds evidence of time-variation in exposure over the period 1980 – 1999 even though the overall

[30] In fact, Nydahl (1999) notes that the US economy is the least open economy of the OECD countries.
[31] The Plaza Accord of September 1985 is the agreement between the Group of Ten industrialised countries to cooperate to bring down the real value of the US dollar against major currencies.
[32] A centre-point of the Doukas et al (2003) study is that firms exposure varies over, thus employing a GMM method to estimate their exposure model.

extent of exposure is not sample dependent i.e. subperiod variations do not drive overall results. On the other hand, Bartov & Bodnar (1994) reports that the coefficients of the structural breaks dummies, over two equal subperiods associated with dollar appreciation and depreciation respectively, is insignificant. Bodnar & Gentry (1993), Khoo (1994), and DiIorio & Faff (2000) do not consider time variations in their exposure coefficient.[33]

The possibility that stock prices respond to exchange rates with a time lag as opposed to instantaneously (contemporaneous) is investigated in some studies. Bartov & Bodnar (1994) notes that such lagged relationships arise as a result of mispricing or systematic errors made in investors' estimation of the relationship. They find no evidence of contemporaneous relationship, but that stock prices respond to lagged exchange rates (at 1% significance level) showing evidence of mispricing. DiIorio & Faff (2000) find that two (eight) of twenty four industry portfolios have significant contemporaneous (lagged) relationships with exchange rate changes. On the other hand, He & Ng (1998) find strong contemporaneous relationships (25% of firms) as opposed to weak (10% of firms) lagged relationship, even when up to 26 exchange rate lags are included. Nydahl (1999) and Doukas et al (2003) do not find evidence of mispricing. Thus, testing the potential effects of mispricing may be effective in analysing the relationship between exchange rates and stock prices.

Globalisation, cross-border mergers and acquisitions, and international equity cross-listings and other global factors contribute to the integration of international equity markets,[34] such that stock price movements may be influenced by *external factors*. Dominguez & Tesar (2001) suggest that in a perfectly integrated world, market returns are best proxied by 'global returns' – a point not considered in most studies discussed so far. Multinational corporations, the favourite samples for studies on exchange rates exposure of stock prices, are more susceptible to international factors than domestic market-oriented firms (see Errunza & Senbet, 2001). Therefore, it may be worthwhile to control external market movements, even though Nydahl (1999)

[33] Since Khoo (1994) covers the sample period 1980 – 1987, the effects of non-consideration of time-varying exposure coefficients may be costly, since the Australian dollar was only floated in December 1983. Bartov et al (1995) find evidence of increased variability in stock returns corresponding to the floating of the US dollar following the collapse of the Bretton Woods system in 1973.
[34] See Shawky et al (1997) and references therein for evidence on stock market integrations.

finds that using the world market index does not affect the exposure coefficients significantly, neither does it alter the number of firms with significant exposure.

The discussions so far show the complexities in the empirical testing of the exchange rates exposure of equity returns, albeit at the micro-level. On a macro-level, Ma & Kao (1990) suggest that the cash flow of a typical economy is affected by exchange rate changes either through price competition in the world-wide product market or through the cost impact of imported goods, such that the net impact of exchange rates change is determined by the relative importance of importing firms versus exporting firm within a given economy. Using monthly data for the UK, France, Canada, West Germany, Japan, and Italy, Ma & Kao (1990) find that domestic currency appreciation negatively affects the domestic stock price movement for an export-dominant economy and positively affects and import-dominant economy.

Another asset model – the portfolio balance models of Kouri (1976) and Branson et al (1977) suggest 'stock-oriented' exchange rates movement i.e. stock prices lead exchange rates with a negative correlation. The dynamics of the model are as follows. Suppose a negative shock causes stock prices to decrease unexpectedly, leading to a reduction in the wealth of domestic investors, demand for money falls, and along with it, interest rates decline. Domestic investors therefore try to switch their lower return domestic assets for higher yield foreign asset, encouraging capital outflow. However, in the short run, the current account is sluggish and the investors cannot increase their net foreign asset positions. As a result, the exchange rate will have to jump up sufficiently (depreciation) so that the purchase of foreign assets is made unattractively expensive. Though empirical tests of the portfolio balance model abound,[35] few studies have investigated this *stock-oriented* exchange rates directly. Lewis (1988) finds some support for the portfolio balance model although her results indicate that the influence of asset stocks, which represent the cornerstone of the theory, is not strong. Using the portfolio balance model to derive an estimable exchange rates equation which depends on the value of equities, Smith (1992) verifies the importance of stock market variables in the determination of the sterling-dollar exchange rate

[35] Earlier tests of the portfolio balance model in general found evidence in its favour in the short run (DeGrauwe 1996), although the model, along with other asset models, is generally deemed unsuccessful empirically (see Frankel & Rose, 1994).

using quarterly data from 1974 to 1988, finding that UK equity returns are a significant determinant of the pound-dollar exchange rate especially from 1979 to 1988 perhaps as a result of the reduction in capital flow barriers.

Research on a potential *bidirectional* relationship between stock prices and exchange rates, as suggested by theory, has been very limited. As can be expected, the possibility of stock price changes affecting exchange rates may only be viable at the macro-level, unless of course a single firm dominates the entire national equity market.

Cointegration tests and Granger-Causality models of Granger (1969) are often applied in studies investigating any lead-lag relationship between exchange rates and stock market indices. Abdalla & Murinde (1997) applies unit root tests, the Engle & Granger (1987) cointegration procedure, and Granger-Causality models, to monthly exchange rates and stock market indices data in India, Korea, Pakistan, and the Philippines over the period January 1985 to July 1994. They reject the null hypothesis of no cointegration between the stock price index and the effective exchange rate of India and the Philippines, suggesting the existence of a long-term relationship between the variables in these two countries, although no such relationship is found in the data of Korea and Pakistan where the null hypothesis of no cointegration is not rejected. Results of the causality tests suggests that there is a feedback relationship between exchange rates and stock prices in Korea, although exchange rates are found to exert some influence over the stock market when lags are included in the causal model as opposed to present values. In India, Pakistan, and Philippines, exchange rates led stock prices, thus suggesting that exchange rate risks are reflected in the stock markets considered.

Granger et al (2000) starts by testing for unit roots in daily (5 days a week) data for exchange rates and stock indices in Japan, Philippines, Malaysia, Taiwan, Thailand, Singapore, Hong Kong, Indonesia, and South Korea from January 3 1986 to June 16, 1998, using the Zivot & Andrew (1992) test. Whilst the null hypothesis of unit roots cannot be rejected in the stock market data, it is rejected in the exchange rates data (vis-à-vis US dollar) for Hong Kong, Indonesia, Korea, Malaysia, Philippines, and Thailand, since they were pegged to the dollar prior to the Asian financial crises of

1997/98. Using the Gregory & Hansen (1996) cointegration test, the null hypothesis of cointegration between stock prices and the exchange rate is rejected in all markets, contradicting the result of Abdalla and Murinde (1997) for the Philippines.

Applying the causality test (over three sub periods), Granger et al (2000) show that during period 1 (January 3, 1986 to November 30, 1987), there existed little interaction between currency and stock markets except for Singapore, where exchange rates led stock prices. In period 2 (December 1987 to May 1987), there is no definitive pattern of interaction between the two variables except that exchange rates led stock prices in Singapore again, but stock prices led exchange rates in Taiwan and Hong-Kong. In period 3 (June 1997 to June 1998) seven of the nine countries suggest significant relations between the two variables. Exchange rates led in South Korea, while stock prices led in Hong Kong, and the Philippines (again contradicting Abdalla & Murinde, 1997). Malaysia, Singapore, Thailand, and Taiwan had feedback interactions in which exchange rates granger-cause stock prices, and vice versa. No relation between the stock and exchange rate markets in Japan and Indonesia is found. Thus Granger et al (2000) suggests that there is a bidirectional relationship between exchange rates and equity prices, and this relationship may be more significant during periods of crises than in periods of relative financial stability.

Hatemi & Irandoust (2002) also contribute to the literature by testing Granger Causality between the stock market index and nominal effective exchange rates in Sweden, using monthly data over the period 1993 – 1998. Using Perron (1989) and Kwaitkoski et al (1992) unit root tests, they find that each series is integrated of order I (1). Results of their Granger Causality tests (including changes in the CPI to control the effects of domestic prices) show that stock prices granger-cause effective exchange rates, such that increases in stock prices leads to an appreciation of the Swedish Krona (i.e. a negative correlation), in line with the predictions of the portfolio balance model. Kim (2003) applies Johanssen (1988) cointegration techniques to assess both short-run and long-run equilibrium relations between the US S&P 500 index and some macroeconomic variables such as industrial production, corporate bond yield, inflation and real dollar exchange rates, using monthly data from January 1974 to December 1998, finding evidence of long-run equilibrium relationships between the stock index and the real dollar exchange rates, and indeed all other US macroeconomic variables considered. Murinde & Shakwale (2004) models causal linkages between the stock market and exchange rates market of some European emerging financial markets: Hungary, Czech Republic, and Poland, before and after the adoption of the EMU i.e. during the period January 1995 to December 1998 (pre-Euro), and January 1999 to December 2003 (Euro period). Using daily stock price indices and the effective exchange rates, they failed to reject the null hypothesis of no cointegration for all countries. During the pre-Euro period, Murinde & Shakwale (2004) find a feedback causal link in the Czech Republic and Poland and no interactions in Hungary, while exchange rates granger-cause the stock market in all three countries during the Euro period.

It is clear from discussions thus far that there is no empirical consensus on the relationship between exchange rates and stock prices, perhaps reiterating the point made in Morley (2002) that there are differences in how exchange rates react to movements in the stock market across different financial systems or the need for further analysis on the issue.

Section 1.2: Is Exchange Rate Risk Priced In Equity Markets?

Advances in modern portfolio theory over the last four decades introduced the pricing of risky assets through the development of asset pricing models. Such models assume that the rate of return on any security (equity inclusive) is a linear function of one or more factors. However, asset-pricing models do not always say what these factors should be. Again, portfolio theory suggests that only un-diversifiable risk of an asset should carry a premium in the pricing of the asset (see for instance Bartov et al 1995). Thus, per the asset pricing models, a factor would have an influence on the price of an asset if it carries a risk premium. A different perspective to assessing exchange rate – stock prices relations is testing if exchange rate risk carries a premium in the pricing of stocks, using the asset pricing models.

Modified versions of the capital asset pricing model (hereafter CAPM) of Sharpe (1964) and Lintner (1965) are widely used to assess the significance of exchange rate risks in stock markets. In its original form, the CAPM is a model of market equilibrium that suggests that security returns are linearly related to fluctuations in a market wide index, with a known degree of sensitivity, and that security-specific returns are generated with a known mean and variance. Majority of studies testing the original CAPM per Sharpe (1964) and Lintner (1965) have found evidence against its empirical validity (See for instance Black et al 1972, Roll 1977, Fama & Macbeth 1973, Shanken 1987, Kandel & Stambaugh 1987, and Korajczyck & Viallet 1989 for further details). Other versions like the Intertemporal CAPM of Merton (1973) and the Consumption CAPM of Breeden (1979) did not have much empirical success either.

In testing the price of exchange rate risks, majority of studies use the CAPM in an international context i.e. testing the *world* price of exchange rates risk using the aggregate national stock market level rather than firms in individual countries. The International CAPM models (hereafter ICAPM) of Solnik (1974), Stulz (1981), and Adler & Dumas (1983) suggest that the investors are sensitive to currency risk and expect to be compensated for such currency risks, using stock index data from Germany, Japan, the UK and the USA. Dumas & Solnik (1993) discriminate empirically between an ICAPM which contains additional terms to reward exchange rate risk, and a classic CAPM which does not contain this additional term, to test the null hypothesis that exchange rate risks receives zero price against the international alternative that tests whether the exchange rate risk is priced in world equity markets. Because they recognise the lack of specification of instrumental variables as the failure of the CAPM, the ICAPM is conditioned by restricting the market prices of risk to be linear functions of six instrumental variables: the exchange rate, the excess rate of return, the world index lagged one month, a January dummy, the US bond yield, the dividend yield on the US index, and the one-month rate of interest on a Eurodollar deposit. The Classic CAPM is also conditioned, on similar information set. Monthly data on excess returns on equity and currency holdings (measured in the US Dollar) for the period January 1970 to December 1991 from four countries: Germany, the UK, Japan and the US are used in estimating the conditional ICAPM with the generalised method of moments (GMM). Although the conditional classic CAPM applied to the data is rejected, Dumas & Solnik (1993) find that the ICAPM is not rejected by the data. Therefore, the hypothesis of a zero price on exchange rate risk on the Conditional ICAPM is rejected – exchange rate is significantly priced in equity markets. The null hypothesis that prices of foreign exchange risks are time invariant in the ICAPM is also rejected. Since the empirical failure of the CAPM is attributed to the difficulty in identifying a true market portfolio,[36] Dumas & Solnik (1993) test whether the significance of the foreign exchange risk premium in the ICAPM is perhaps linked to the large outstanding amount of government bonds in investors' portfolios which should have been included in the market portfolio, for robustness. They show that the identified foreign exchange risk premise cannot be interpreted as proxies for missing bonds in the market portfolios. On the contrary, testing the ICAPM and the classic CAPM in their unconditional form, on the same data, presents contradictory results. The estimation of the unconditioned model reveals that the hypothesis that the exchange rate risk is not priced in the unconditional, static ICAPM is not rejected. Thus, conditioning of information plays a crucial role in the results of Dumas & Solnik (1993). However, the economic magnitude of their exchange rate risk premiums relative to market premiums cannot be evaluated because they do not specify the dynamics on the conditional second moments. Dumas & Solnik (1993) also note the possibility of spurious results is noted due to the violation of some assumption of the GMM method e.g. the finite size of sample while χ^2 tests are asymptotic, non-stationarity of rates of return and instrumental variables, and serial dependence on the sample moments.

De Santis & Gerrard (1998) resolves some of these issues and extends the work of Dumas & Solnik (1993), by testing directly a conditional version of the ICAPM, using multivariate GARCH processes to test whether exchange rate risk premium significantly affects international equity returns. In addition to the assumption of time-variation in prices of currency risks, DeSantis & Gerrard (1998) also assume that the conditional second moments follow a diagonal GARCH process, thus enabling an assessment of the relative magnitude and dynamics of both currency and market risk premia. Their data includes monthly returns on stock indexes for UK, Japan, Germany, and the US, plus a value-weighted world index, and Eurocurrency rates offered in interbank markets for one-month deposits in US dollars, Deutsche Mark, Yen, and Pound Sterling, during the period June 1973 to December 1994.[37] De Santis

[36] Roll (1977) suggests that the true market portfolio is not a single equity market index, but an index of all wealth – bonds, property, foreign assets, human capital, and anything else.
[37] The instrumental variables are similar to those employed in Dumas & Solnik (1993).

& Gerrard (1998) find that market and currency risks are only relevant when their prices are allowed to change over time, such that failure to allow time-variation in the prices of risk would lead to the conclusion that investors are not rewarded for their exposure to any source of risk in international financial markets. They also find that the currency premium is an economically significant (but small) fraction of the total premium, except in the US market. Allowing time-variation, German, Japanese, and UK currency risks are significant individually, even with robust Wald tests.

In addition to testing the pricing of exchange rate and foreign inflation risk in international equities, Vassalou (2000) tests whether exchange rate and foreign inflation risk factors can explain part of the variation in domestic equity returns, using unconditional tests of ICAPM, highlighting that the assumption of constant first and second moments of security returns makes conditional and unconditional moments identical. The model is estimated by SUR, allowing for contemporaneous correlations in error terms. Vassalou (2000) combines information from a cross section of exchange rates into two indexes. The first, a common component index, combines information common to all exchange rates. Whereas, the second, a residual exchange rate index, captures fluctuations that are specific to individual exchange rates, thereby including more information about changes in exchange rates rather than the single index approach adopted in previous studies. Inflation series are filtered by an ARIMA (0,1,1) model and the innovations, representing unexpected inflation, is used in the test. Monthly equity returns is collected for ten developed markets (Australia, Canada, France, Italy, Switzerland, the Netherlands, Japan, Germany, UK, and the USA), with the number of firms in each country varying from 32 to 600. Exchange rates are vis-à-vis the US dollar, and the sample runs from January 1973 to December 1990. Vassalou (2000) finds that at least one of the exchange rate indexes is priced in six out of the 10 countries. The common component is priced in Germany, Japan, Switzerland, and the Netherlands. The residual is significantly priced in Canada, Germany, Japan, the Netherlands, and the US. Unanticipated US inflation is priced significantly in all countries.

One important insight from Merton's intertemporal CAPM is that multiple factors are needed to explain asset prices. The Arbitrage Pricing Theory (hereafter APT) of Ross (1976), developed as an alternative to the CAPM, is also used in testing the significance of exchange rate risk premiums. Unlike the CAPM, the APT is an arbitrage relation rather than an equilibrium condition. The multiple factor APT allows asset returns to be determined by fundamental risks in the economy. Since any market equilibrium must be consistent with no arbitrage profits, every equilibrium will be characterised by a linear relationship between each asset's expected returns and its return's response loadings on the common (systematic or pervasive) factors. Roll & Ross (1980), Chen (1983), and Mei (1993) find some empirical evidence in favour of the APT, using factor analysis.[38] Others like Chen et al (1986), Burmeister & McElroy (1988), Clare & Thomas (1994), Priestley (1996), and Antoniou et al (1998a and 1998b) that use observed macroeconomic variables also find some evidence in favour of the APT. However, the APT as an empirical model of asset returns is not without controversy. Firstly, the APT does not pre-specify the set of macroeconomic or financial variables that should enter into the model, such that any set of variables can be included. Secondly, Shanken (1982) shows that the strict factor structure of the APT,[39] as tested in Roll & Ross (1980) and Chen (1983), for instance, is a strong restriction. Chamberlain & Rothschild (1983) proves that the APT holds more generally if returns conform to an approximate factor structure. However, Reisman (1992) shows that for approximate factor structures of returns, as tested in Burmeister & McElroy (1987 and 1988), Connor & Korajczyk (1993), Priestley (1996) and Antoniou et al (1998a and 1998b), almost any set of variables correlated with the *true* factors can serve as the benchmarks, just as with the single-index CAPM. Therefore, there would be no basis for the traditional view that the APT is a viable alternative to the CAPM. Clare & Thomas (1994) and Antoniou et al (1998b) find evidence that the requirement that the return generating process must be unique (in that the same factors are priced and carry the same prices of risks across subsets of assets) is violated.

Jorion (1991) examines the pricing of currency risks in the US stock market, based on a two-factor model in which exchange rates and market index are the factors[40] and a

[38] Factor analysis is a technique that allows an inference of the factors from the data on security returns thereby allowing the factors to be determined from data. However, the drawback is that the factors usually have no economic interpretation.
[39] As presented in Ross (1976), the strict factor structure of the APT is that asset returns have an exact linear relationship with the systematic factors such that idiosyncratic returns of the individual equities are not correlated and idiosyncratic risk does not affect the expected returns.
[40] The two-factor model tests CAPM against the alternative that exchange rates risk is undiversifiable.

multi-factor model[41] of the APT, using monthly excess returns data on 20 value-weighted industry portfolios and data on industrial production growth rate, change in expected inflation, unexpected inflation, unanticipated risk premium, the unanticipated term structure, excess returns on a value-weighted stock market, and changes in trade-weighted dollar over the period January 1971 to December 1987. Jorion (1991) adopts a maximum likelihood procedure that allows the joint estimation of the factor sensitivities and the risk prices, thereby allowing for contemporaneous correlations across the industry portfolios. The results for the two-factor model suggest that the constant risk premium coefficient representing the pricing of exchange rates exposure is small, unstable, and never significant even though the chi-square statistics for the cross-sectional restrictions suggests that the model fits the data rather well. The results for the multi-factor model also shows that US investors do not price foreign exchange risks, in line with the two-factor model, even though the joint hypothesis that the prices of the seven factors are zero is rejected.

Clare & Thomas (1994) use eighteen macroeconomic variables (including US dollar / UK sterling exchange rates) to test the APT in the UK stock market from January 1978 to December 1990. Noting that the 'rate of change' method of deriving factor innovations causes systematic omissions or mispricing, and are usually serially correlated, they apply autoregressive models of up to lag 12 to generate unanticipated macroeconomic factor components. Stock excess returns of 840 UK firms are grouped into 56 equally-weighted portfolios (each containing 15 randomly selected stocks) to reduce the impact of the error-in-variables (EIV) problem.[42] A second set of portfolios, 56 size-based equally-weighted portfolios, to investigate the implications of portfolio formations method on results. From the first set of portfolios, Clare & Thomas (1994) find that seven factors – default risk, inflation, debenture & loan redemption yield, current account balance, oil price, private sector bank lending, and a 'comfort' index (measured by the rates of the consol to equity market dividend yields) that captures the relative 'expensiveness' of the gilt and equity markets; have significant (at 10% level) risk premia in the APT model over the sample period. Apart

[41] The multifactor model includes the six factors in the APT model of Chen at al (1986) and exchange rate innovations. Note that Chen et al (1986) did not test whether exchange rates risk is priced.
[42] As per Blume & Friend (1973), the error-in-variable problem arises from the need to estimate the equity return sensitivities to macroeconomic variables and the associated prices of risk in two separate steps as suggested by Fama & Macbeth (1973). Clare & Thomas suggest that the betas of the portfolios will be more precise estimation of the true beta than those of individual stocks.

from the fact that the price of exchange rate risks is insignificant, the price of excess returns on the FT-All Share index is also insignificant suggesting that the model is not incorrectly specified. However, Clare & Thomas (1994) find that only three factors – inflation, the comfort index, and market returns are priced in the size based portfolios, thus suggesting that priced factors may not be invariant to the method used to order the portfolios.

Priestley (1996) finds evidence that the methodology of extracting innovations in observed macroeconomic variables has a large influence on the significance of factor premiums in an approximate factor structure APT model, using non-linear three staged least square (NL3SLS) regression that permits the joint estimation of both risk premiums and the factor sensitivities, and allows an endogenous market return.[43] He justifies the choice of factors that might influence systematic risk by reference to the present value model of share prices.[44] Priestley (1996) shows that the 'rate of change' methodology as applied in Chen et al (1986) and Jorion (1991) do not always meet the criteria for *white-noise* innovations, and autoregressive models applied in Clare & Thomas (1994) do not produce stable innovations. Exchange rate risk is not priced in the monthly excess stock returns of sixty-nine UK firms over the period January 1980 to August 1993, using innovations derived from these two methods. On the other, using Kalman-filtered innovations, which are shown to be both serially uncorrelated and stable, exchange rate risk, is significantly priced alongside default risks, money supply, unexpected inflation, and market portfolio. Furthermore, mispricing using Kalman-filtered innovations is nearly half that of 'rate of change' innovations and 29% lower than that of the autoregressive innovations.

Antoniou et al (1998a) investigates the claim held by the European Commission and the Bank of England that a volatile exchange rate contributes to the systematic risk of the economy (i.e. foreign exchange risk is priced) so that by fixing the exchange rates as under the European Monetary System Exchange Rate Mechanism (hereafter EMS/ERM) the associated systematic risk is removed and thus exchange rates and

[43] See Burmeister & McElroy (1988) and Chapter 3 of this thesis for further details on the NL3SLS methodology.
[44] The factors used in the APT estimation are unanticipated shocks to the following variables: default risk, real industrial production, exchange rate, real retail sales, money supply, term structure of interest rates, and commodity prices. Other variables are unexpected inflation, change in expected inflation, and returns on the market portfolio.

equity markets risk premia reduce. Using Kalman-filtered innovations, the NL3SLS method of estimation, an APT model similar to Priestley et al (1996) in terms of return generating structure, and monthly excess returns on 70 UK firms (including the market portfolio) over the period January 1980 to December 1993, Antoniou et al (1998a) finds that exchange rate risk is priced alongside unexpected inflation, changes in expected inflation, unanticipated changes in money supply, default risk, and returns on the market portfolio. Moreover, tests of the APT cross-sectional restrictions that the prices of factor risk risks are not rejected thus giving validity to their APT model. Antoniou et al (1998a) recursively re-estimates the APT model with these six factors over the period January 1989 to August 1993. Their result suggests that the behaviour of the UK equity market risk premium was to a large extent influenced by the changes in the UK exchange rate risk premium. The unabated downward trend in both equity market and foreign exchange risk premium prior to the end of 1991 was due to the credibility of the UK's commitment to the EMS/ERM as perceived by financial markets. However, the conflict between UK domestic monetary policy and ERM requirement at the beginning of 1992 signalled a lack of policy credibility to market participants, and increased both exchange rate and equity market premiums significantly until the UK's exit from the EMS in September 1992.

Doukas et al (1999) assesses the pricing of currency risk in the Japanese equity market based on a multi-factor intertemporal asset pricing testing procedure that allows risk premia to change through time in response to changes in macroeconomic conditions and investors' perception of risk, using the Iterated Nonlinear Seemingly Unrelated Regression Equation (INSURE) procedure of McElroy and Burmeister (1988). Unlike previous studies, excess returns are regressed on four risk factors: a residual market factor, a currency risk factor, a factor representing the difference between the return on a portfolio of Japanese value (high-book-to-market) stocks and the return on a portfolio of Japanese growth (low-book-to-market) stocks, and another factor representing the difference between the return on a Japanese portfolio of small capitalisation stocks and the return on a Japanese portfolio of large capitalisation stocks. Their data includes monthly excess stock returns of 1079 Japanese firms (from 25 different two-digit standard industrial classification (SIC) industries) traded on the Tokyo Stock Exchange over the period from January 1975 to December 1995. Sixty-two of these firms are classified as MNCs, a second sample of 260 firms with foreign sales to total sales ratio exceeding 20%, a third sample of 281 firms with a ratio exceeding 0% but less than 20%, and a last sample of 476 firms with no reported foreign sales to total sales (pure domestic firms). This classification is thought necessary to determine whether the level of exchange rate exposure is significant to results in present and previous studies. End-of-month exchange rate for the Japanese Yen against the US dollar (both bilateral, and multilateral), published by the Bank of England are used. Data on macroeconomic variables – industrial production growth, unexpected inflation, term structure series, money supply, the US-Japan interest rate spread, the trade balance, and the market rate of return (the value weighted index of all firms included in the Nikkei 225 index) are used as instrumental variables.

Doukas et al (1999 and 2003) finds evidence of significant time-varying risk premiums for exchange rate risk, market risk, and other risk factors, in line with Dumas & Solnik (1993) and DeSantis & Gerrard (1998). The coefficient of the currency-risk factor is positive and significant at the 5% level thus implying that investors require a higher rate of return for bearing currency-risk. Evidence suggests that MNCs and high-exporting firms' currency exposure commands a higher risk premium in the Japanese stock market than low-exporting and domestic firms, whose currency risk premium coefficient is found to be small and insignificant at conventional levels. This is in line with evidence from He & Ng (1998) that the higher the degree of foreign involvement of Japanese firms, the more significant the exchange rates exposure coefficient.

Like the ICAPM, an 'international' APT (hereafter IAPT) has also been applied to test if priced factors are identical across markets, which should be the case if the IAPT is valid and capital markets are integrated. Ferson & Harvey (1994) examine the extent to which returns on a world equity portfolio, exchange rates, interest rates spread, global inflation, real interest rates, and industrial production growth can explain monthly returns on MSCI indices of eighteen national equity markets[45] over the period January 1970 to December 1989, by implementing restricted seemingly unrelated regression models via GMM. They find that exchange rate (vis-à-vis US dollar) risk premium is significantly priced in world equity markets, and that global

[45] The markets are the sixteen OECD countries and Singapore/Malaysia, and Hong Kong.

risk factors can explain between 15% and 86% of the variance of monthly returns (depending on country) over the sample period. Moreover, Wald tests of the hypothesis that a given factor has betas which are equal to a common value in all of the countries cannot be rejected for four factors[46] i.e. consistent with a four factor model.

Section 1.3: Currency Risks and International Portfolio Diversification.

Within an economy, a strong tendency exists for economic phenomena to move more or less in unison giving rise to periods of relatively high or low general economic activity. As a result domestic securities tend to be strongly positively correlated. However, the existence of foreign capital markets provides the opportunity to diversify or reduce the domestic systematic risks just as domestic diversification reduces risk to the average covariance without sacrificing expected return.

The potential gains from international diversification of investment portfolios have been widely investigated in empirical finance. Grubel (1968) concludes that the potential gains from diversifying internationally are substantial. Using weekly stock returns data from seven European countries and the USA over the period 1966 – 1971, Solnik (1974) finds that the market risk (calculated using the Markowitz efficient frontier) is higher for a US portfolio than for an internationally diversified portfolio. Levy & Sarnat (1970) shows that the diversification benefits from investing in developed equity markets are limited given the high level of correlation among them and recommend investing in developing stock markets. Odier & Solnik (1993) find that the average correlation among equity returns of the world's 15 largest stock markets over the period 1980 – 1990 is approximately 0.5, so that substantial diversification gains can still be derived from investments across these markets. Odier et al (1995) suggest that emerging markets might provide some good diversification benefits (given their low correlation with world markets) to a portfolio that is invested solely in developed markets.

[46] These factors are unexpected component of the global inflation measure (G-7 inflation rate), change in interest rate spread between the 90-day Eurodollar deposit rate and the 90-day US treasury bill yield, changes in the weighted average of industrial production growth rate of G-7 countries, and the weighted average of short-term real interest rates in the G-7 countries.

Any investment in a foreign asset is a combination of an investment in the performance of the foreign asset and an investment in the performance of the domestic currency relative to the foreign currency. Exchange rate risk is therefore a crucial factor for cross-country investors. Pioneering studies on benefits of international portfolio diversification (for instance Solnik 1974) may have overstated its potential gains by applying modern portfolio theory to Bretton Woods-era data, implying that exchange rate risks may not be factored into the returns of international portfolios since exchange rates do not vary much under fixed exchange regimes. Izan et al (1991) and Ziobrowski & Ziobrowski (1995) show that a flexible exchange regime contributes to the risk of foreign investment not only through its own variance but also through its positive covariance with the local stock market returns. Eun & Resnick (1988) shows that between 1980 and 1985, exchange rate volatility accounted for about fifty percent of the volatility of the dollar returns from investments in the stock markets of Germany, Japan, and the UK. Jorion (1985), Eun & Resnick (1988, 1994) and Levy & Lim (1994) note that if investors would not control the uncertainty parameter of foreign currency exposure, the potential gains from international portfolio diversification may not be enough to justify the expense of international investment. However, the high correlation among exchange rate changes, especially those of developed countries[47] suggests that much of exchange rate risk will remain non-diversifiable in a multi-currency portfolio. Note also that findings of the ICAPM models of Solnik (1974), Stulz (1981), Adler & Dumas (1983) Dumas & Solnik (1993), and De Santis & Gerrard (1997) discussed earlier suggest that exchange rates contributes to the systematic risk in world equity portfolios.

The use of hedging instruments to mitigate the adverse effects of exchange rate fluctuations is well-advocated in finance literature. Currency risks are hedged primarily through currency swaps, multi-currency diversification, options, and forward and futures contracts. Eun & Resnick (1988) and Glen & Jorion (1993) find that the US investor can eliminate a large proportion of currency risks and hence

[47] Using various cointegration tests, Ballie & Bollerslev (1989a) find evidence of long-run relationship between daily exchange rates of G-7 countries and Switzerland over the period 1980 to 1985. Using GARCH methods to model exchange rates, Ballie & Bollerslev (1989b) finds that the parameter estimates and characterisation of each model is found to be very similar for six major currencies regardless of data horizon.

reduce international portfolio risk (as measured by the Sharpe ratio) through the use of forward exchange contracts, since the forward exchange premium is known to be a '*nearly unbiased*' predictor of future changes of exchange rates. Izan et al (1991) finds that the Australian investor, who uses forward contracts to hedge currency risks in a portfolio diversified across eight developed equity markets, benefits over one who does not hedge. Using a continuously adjusted currency hedging strategy over the period 1978 – 1987, Kaplanis & Schaefer (1991) finds that portfolios (diversified across developed markets) that do not hedge currency risks may even be riskier than similar US domestic portfolios. Although there exist many empirical studies on forward contracts to hedge the currency risk, the evidence for other types of derivatives like options are not much. Hsin et al (1994) and Conover & Dubofsky (1995) worked on the use of American options where they found that protective puts dominate fiduciary calls.

In practice, hedging currency risk is not without complications. Eun & Resnick (1988) note that the effectiveness of a hedge will depend upon the investor's ability to estimate accurately the expected foreign currency returns of an international portfolio. However, Erb et al (1994), Longin & Solnik (1995), and Shawky et al (1997) find evidence of unstable correlation structures among international equity markets. An unstable correlation structure would suggest that the efficient frontier of an internationally diversified portfolio is continuously changing, thus it would be difficult for an investor to select an optimal investment strategy ex-ante.[48] Jorion (1985) argues that '*estimation risk*' due to such uncertainties has a considerable impact on optimal portfolio selection, and may ultimately affect the effectiveness of currency risk hedges. Kaplanis & Schaefer (1991) reports that optimal currency hedging ratios are highly unstable such that substantial risk reduction can only be achieved with perfect foresight of hedge ratios. Glen & Jorion (1993) also shows that even if currency hedging reduces the volatility of portfolio returns, hedging will be beneficial only if the risk reduction is not accompanied by an offsetting decrease in returns. Furthermore, some empirical studies (see for instance Frankel & Froot, 1989) find that forward rates are biased predictors of future spot rates. In examining the performance of hedged (using interbank forward contracts) and unhedged

[48] This also implies that the potential benefits of international investment may be large when ex-post data is considered, but such benefits may not be attainable in reality.

international portfolios[49] over two periods, Levy & Lim (1994) show that the direction of bias in forward rates affects hedged portfolio expected returns and hence the relative performance of hedged and unhedged strategies. They find that hedged portfolios outperformed their unhedged counterparts from 1981 to 1988, whereas unhedged strategies outperformed the hedged strategies over 1985 to 1988.

A striking feature of the literature on currency risk hedging is the focus on portfolios diversified across developed equity markets. Whether this arises from the fact that the ability to hedge against currency risk is considerably lower for emerging economies as a group than for industrial countries given that currency derivatives are more readily available in developed markets as also suggested in Solnik (2000), is not certain. Yet, many studies (see for instance Shawky et al, 1997) suggest that investments in emerging equity markets are the *main* source of international diversification benefits, given the high level of co movement among developed equity markets. Therefore, given the relative difficulty in hedging currency risks, a portfolio, consisting of emerging market equities which are also known to be relatively more volatile,[50] may be quite a risky cocktail of international equity assets.

In addition to exchange rate risks, a number of other factors mitigate the realization of benefits of an internationally diversified portfolio. Firstly, diversifying internationally involves higher transaction costs. Rowland (1999) finds evidence that the rate of portfolio diversification decreases as the magnitude of transaction costs increases. Secondly, despite emerging equity market liberalization policies especially in the 1990s,[51] a number of restrictions to foreign equity ownership are still in place, making it difficult for international investors to take full advantage of potential diversification benefits. Eun & Janakiramanan (1986) and De Roon et al (2001) find evidence that when such investment constraints are taken into account, the marginal diversification benefits are statistically and economically insignificant. Bekaert (1995) and Bekaert et al (1997) report the negative impact of liquidity risks and political

[49] The international portfolios are constructed ex ante, based on the returns on equity market indices (MSCI) of the USA, Japan, West Germany, France, Switzerland, Canada, and the UK.
[50] See Bekaert & Harvey (1997) for more on emerging equity markets volatility.
[51] For instance, See Henry (2000) and references therein for information on equity market liberalization.

risks, respectively, on investments in emerging equity markets.[52] Thirdly, empirical evidence[53] shows that investors are *home biased* i.e. they appear to only invest in their home country equity market, virtually ignoring foreign opportunities despite evidence of international portfolio benefits. Some studies (see for instance Salehizadeh, 2003) suggest that political and exchange rate risks, high transaction costs, restrictions of foreign equity ownership, and information asymmetries are the possible causes of this home bias phenomenon. However, Coval & Moskowitz (1999) shows that even if all these factors are removed, investors still have a preference for geographically proximate investments, such that on an international scale, investment proximity still accounts for a large portion of the observed abstinence on holdings of foreign securities. Fourthly and finally, empirical analyses have pointed to rising levels of economic and financial interdependence worldwide and have shown various industries and sectors becoming increasingly global leading to highly synchronised share-price movements.[54] As such, the benefits from international portfolio diversification may have actually reduced.

In light of these issues, and the increasing availability of foreign-based equity assets traded on US markets (for example, Country Funds and American Depository Receipts (ADRs)), Errunza et al (1999) examines whether it is possible to gain some benefits of international diversification by investing in equity assets traded on the US equity market. They define a (mimicking) portfolio of domestically traded securities as one that is most highly correlated with a target foreign market index i.e. the fitted values obtained from a regression of each of sixteen foreign equity indices[55] on twelve US industry stocks, stocks of thirty large US multinational corporations, country

[52] These studies find that liquidity problems and political factors are priced factors in emerging equity markets.
[53] See for instance, French & Porteba (1991), Coval & Moskowitz (1999), and Salehizadeh (2003) for evidence on investor's home-bias.
[54] Shawky et al (1997) shows the correlation among weekly rates of return on the US and six European indices from 1990 to 1995 (as compared to those reported in Bertoneche (1979) for the period 1969 to 1976) have increased substantially in recent times. For example, the correlation coefficient between the Belgian and UK equity markets reported in Shawky et al (1997) is 0.51 whereas for Bertoneche (1979) it is only 0.12. See also Kaplanis (1988) and Longin & Solnik (1995) for more evidence of increasing equity market correlations. Brooks & Catao (2000) finds that the fraction of return variation explained by global industry effects is on average 23 percent from mid-1997, far above the 4 percent reported in Griffin and Karolyi (1998).
[55] These sixteen foreign equity market indices include Morgan Stanley Capital International (MSCI) market indices of seven developed markets (Australia, Canada, France, Germany, Italy, Japan, and the UK), and International Finance Corporation (IFC) market indices of nine emerging markets (Argentina, Brazil, Chile, Greece, India, Korea, Mexico, Thailand, and Zimbabwe), all value-weighted.

funds (where available) underlying the particular foreign index, and American Depository Receipts (ADRs) of firm(s) based in that foreign country. Using monthly returns data from January 1976 to December 1993, Errunza et al (1999) finds that the unconditional correlation between the foreign market indices and their underlying mimicking portfolios of domestically traded assets are much higher (especially for emerging markets) than the correlation between the S&P 500 index and the foreign indices, thus suggesting that index-level correlations tend to overstate the benefits of international portfolio diversification in line with Agmon (1972).

In addition, Errunza et al (1999) investigates whether it is possible to exhaust the benefits from international diversification by investing in these US traded assets, in the context of mean-variance spanning tests of Huberman & Kandel (1987) and Bekaert & Urias (1996). Their results under the Huberman & Kandel (1987) OLS test show that the null hypothesis of spanning cannot be rejected (at the five percent critical level) for most foreign indices except for five emerging market indices (i.e. Chile, Greece, India, Thailand, and Zimbabwe), suggesting that significant diversification gains may still be obtained by investing in these markets. However, the GMM-based spanning tests per Bekaert & Urias (1996) suggest that the null of spanning can only be rejected (at five percent level) for India and Zimbabwe. Errunza et al (1999) also assess the economic significance of these diversification benefits using the change in Sharpe ratios, finding that only the indices of Chile and Thailand provide economically meaningful diversification benefits. Finally, using the Generalised Dynamic Covariance (GDC) multivariate GARCH model of Kroner & Ng (1998), Errunza et al (1999) show that there is substantial time-variation in conditional correlations between foreign indices and home-made diversification portfolios, and that the time variation is consistent with changes in investment barriers, changes in rules governing foreign portfolio investments, and political, national and economic events.

Section 1.4: Summary

This chapter updates findings on the interrelationship between exchange rates and stock prices from various perspectives.

In Section 1.1, there is evidence that there are a number of issues that may potentially undermine the significance of the exchange rate exposure coefficient as examined under the traditional approach, given that most studies report that the majority of firms and/or industries are not exposed to exchange rate changes contrary to the monetary models of exchange rate determination and the present value model of share prices. Due to the specification of the empirical model, an insignificant exposure coefficient does not necessarily mean that firms are not affected by exchange rates, but may suggest an exposure coefficient similar to that of the market index. Moreover, the nature of the relationship may not be captured by contemporaneous regressions or even short horizon data. The involvement of firms and industries in both importing and exporting activities may lead to offsetting exchange rate exposure, which ultimately results in insignificant exposure coefficients. While use of 'rate of change' in exchange rates may not be appropriate for deriving exchange rate innovations, trade-weighted indices or even the use of a single bilateral exchange rate may bias t-statistics downwards, as would a value-weighted market portfolio. Some studies suggest that insignificant exposure coefficients should be taken as after-hedge measures, since many firms utilise currency swaps, futures and forward contracts to hedge exposure. In addition, it is suggested that the more *open* the economy, the more susceptible firms are to exchange rate risks, such that the relative *closeness* of the US economy may have contributed to the insignificance of firms exposure coefficients. Evidence from more open economies like the UK, Germany, and Japan suggest that a larger proportion of firms and industries are significantly exposed to exchange rate shocks. Apart from the fact that exchange rate exposure coefficient may vary with different signs resulting in weak overall results; external factors may also have an impact on results due to globalisation and international market interactions. Unlike the traditional approach, portfolio balance models also suggest that movements in stock prices can cause changes in exchange rates. As a result, recent studies (however few) have focused on investigating two-way causality between both variables. Although no long term relationships are found as shown in cointegration tests, the evidence is mixed, suggesting that stock prices lead exchange rates and vice-versa.

Section 1.2 reviews the literature on the pricing of exchange rate risks in the equity market. Empirical tests of the international asset pricing models (ICAPM and IAPT) suggest that exchange rates are significantly priced in world equity markets i.e. exchange rates contribute to the systematic movements in international stock markets, especially when the exchange rate premium is not allowed to be time-invariant. Studies estimating a domestic APT provide mixed evidence on the significance of the exchange rate premium. While it appears that the null hypothesis of a zero exchange rate premium cannot be rejected in the US equity market, the same cannot be said about the UK equity market. Although the ICAPM of Vassalou (2000) shows that exchange rate changes contribute to the systematic risks within other developed markets like Germany, Japan, and the Netherlands, it would be interesting to see if the exchange rate premium remains significant when other macroeconomic factors are accounted for as in an APT model.

The discussions in Section 1.3 show that exchange rate risks contribute to the total risk of any portfolio containing equity assets from different countries, such that if currency risks are not managed it may wipe out the entire benefit of diversifying a portfolio internationally. Evidence on the effectiveness of currency hedges is also mixed. It is not clear whether a currency risk-hedged portfolio will consistently outperform an unhedged portfolio. The exposure of international portfolios to exchange rate risks, together with high transaction costs, liquidity and political risks, barriers to foreign equity ownership, the home bias phenomenon, and the "increasing" integration among world equity markets appears to undermine the viability of international investments as effective means of reducing portfolio risks. Evidence from the US suggests that it is possible to mimic foreign equity market indices, and exhaust any diversification benefits from them by investing in Industry portfolios, stocks of MNCs, country funds, and ADRs. Since the US equity market accounts for nearly half of the world's total market capitalisation and is perhaps the world's most developed equity market, it will be interesting to see whether equity assets traded domestically in non-US market can substitute international portfolio diversification.

Chapter 2

Causal links between Stock Prices and Exchange Rates - evidence from six developed markets.

Section 2.1: Introduction.

No doubt there is an unprecedented level of academic, practitioner, and policy-maker interests in identifying and understanding the link between exchange rates and stock prices especially in the face of global trends in world financial markets.

The nature of the relationship between these two variables crucial to the development of any country's economy is underpinned by economic theory. Models of exchange rates determination[56] identify the links. Monetary models suggest that when monetary shocks occurs within the economy, the price of the foreign currency must increase (or decrease) for asset markets to remain in equilibrium and this has implications on the value of firms, as per the present value model of share prices. This is the hypothesis that exchange rates movements could cause changes in stock prices (either negatively or positively), hence the term *exchange rate exposure* of stock prices as described in Adler & Dumas (1984). Empirical studies, which have mainly been US-market oriented, provide weak evidence on the exchange rate exposure of firms.[57] The hypothesis that exchange rates lead stock prices is henceforth termed the *traditional approach.*

On the other hand, the portfolio balance models of exchange rates determination in Kouri (1976) and Branson et al (1977) suggest that negative shocks to the stock market leads to capital outflows, which in turn cause domestic currency depreciation. This is the *portfolio approach* i.e. the notion that stock prices lead exchange rates with a negative sign. However, empirical evidence on the portfolio approach is not only very limited, but also suggests a weak relationship.

The possibility that both financial variables affect each other is also put forward by Adler & Dumas (1984), noting that both exchange rates and stock prices are

[56] See Chapter One for further details on Asset models.
[57] See previous chapter for a survey of the literature.

determined jointly, in which case, a '*feedback*' relationship is said to occur. Both exchange rates and stock prices may be influenced by the same but unknown underlying independent stochastic process or by other economic variables, as noted in Aggarwal (1981), facilitating such a feedback relationship. Sadeghi (1992), Kwon & Shin (1999), and Nasseh & Straus (2000) find evidence that macroeconomic factors affect stock prices. Messe & Rogoff (1983) and Wolff (1988) also find evidence that macroeconomic factors influence exchange rates.

Until recently, the bulk of empirical research on the dynamics between exchange rates and stock prices has focused on testing the traditional hypothesis. Given the mixed results from these studies and economic theory suggesting that stock price fluctuations may also have an impact on exchange rates variability, research is increasingly focusing on investigating dynamics between the two variables from a bi-directional perspective. As discussed in the previous chapter, a number of empirical studies have focused on analysing cointegration and bivariate granger-causality links between exchange rates and stock prices. Such analysis may also be seen as surrogate measures to test market efficiency. No causality suggests that past information does not have a significant information content to be used as a predictor of stock prices and/or exchange rates. On the other hand, suppose it is established that exchange rates in an economy granger-cause the stock prices, policy-makers may fortify the economy's stock market by enhancing the country's exchange rate market conditions either by reducing excessive fluctuations of exchange rates or regulating favourable exchange rate conditions. Alternatively, if stock prices granger-cause exchange rates, then exchange rate conditions may be strengthened via improving stock market fundamentals. Moreover, the identification of a statistical lead/lag relationship may encourage academics in their hitherto unsuccessful attempts at modelling movements in both exchange rates and stock markets.[58] Empirical results so far have been very mixed, to say the least, even though a causal link is established in many cases.

[58] For instance, Solnik (1987) finds that poor quality of macroeconomic variables (as a result of erroneous measurement and/or impossible direct measurement) may be responsible for the limited success of exchange rate models. Since stock prices and exchange rates may be affected by the same underlying systematic factors, perhaps the inclusion of stock indices in exchange rate models may reduce the importance of accurate measurement of other macroeconomic variables.

This chapter extends the bivariate causality research to data from six developed markets. Although it contributes to the empirical literature on the links between exchange rates and stock market indices, the need for this current study evolves from a number of important considerations neglected in previous studies.

Firstly, results from previous studies may be undermined by the effects of aggregating stock prices into a single market index – a concern also expressed but not accounted for in Granger et al (2000). Firms and industries vary widely in terms of the nature of importing and exporting activities, the terms of competition, and the sensitivity of input and output to exchange rates. Numerous studies suggest that industry-related factors which reflect technological and product market characteristics also explain movements in national equity markets.[59] Testing the traditional hypothesis, Bodnar & Gentry (1993) find that industries are exposed to exchange rates in different ways and suggests that exposure should depend on industry characteristics. Therefore disaggregating the market index into industry portfolios for causality testing within each market should convey better information on any lead/lag structure.[60] In addition to testing the hypothesis of causality between exchange rates and stock indices, the hypothesis that the direction of causality (i.e. from exchange rates to stock prices or vice-versa) within each national market is robust to industrial characteristics (i.e. market-specific) is being tested here, especially as the models of exchange rates determination which underpin exchange rates/stock prices causal links ignore these industrial differences.

Secondly, the use of a single bilateral exchange rate or trade-weighted rates as in many studies may affect causality results – a point discussed in Chapter One. Empirical evidence (see for instance, Khoo, 1994) suggests that stock prices respond differently to movements in various bilateral rates, whilst using a trade-weighted index assumes that all firms have similar exposures to a set of currencies (see Vassalou, 2000). This prompts the question: is the causality relationship between exchange rates and stock markets invariant to exchange rates information? Thirdly,

[59] See Roll (1992), Heston & Rouwenhorst (1994), and Griffin & Karolyi (1998) for further discussion of industrial factors in national equity markets.
[60] Note however that since it is unlikely that a few firms' stock prices would wield a significant influence on a macroeconomic variable as the exchange rate, one should not investigate bivariate causality with industrial portfolios classified at very fine levels.

with the exception of Granger et al (2000), previous studies do not take into account the possibility of time variation in the direction of causality (also known as causality structure) arising from changes in barriers to international capital flows, exchange rate regimes, and other macroeconomic conditions, neither do they consider the sign of the lead/lag structure; both of which are important considerations for predictability purposes as suggested under the empirical tests of the models of exchange rates determination, and even for policy-makers. Therefore, it is important to raise the question: does the direction of causality change over time? Fourthly and finally, global trends in financial markets suggest that it is important to control the effects of external variables on lead/lag structure between exchange rates and stock prices within each market. In fact, many studies (see for instance Dominguez & Tesar, 2001) argue that the world index is the appropriate proxy for market portfolio in an increasingly integrated global market.

The chapter examines causal links between exchange rates and stock prices in Australia, Germany, Hong Kong, Japan, Singapore, and the USA,[61] using daily data over the period January 1976 to December 2001 (including sub-period analyses). In addition to stock market indices, this study analyses causality using industry indices, and consider the effects of global equity movements, and that of variations to bilateral exchange rates.

To anticipate results, there is evidence of significant causal links between the two variables contrary to some studies based on the traditional approach. The direction of causality may differ within each country. Even where there are no links between the market index and exchange rates, some industry stocks granger-cause or lead exchange rate changes whereas changes in other industry equities are granger-caused by currency movements, highlighting the implications of stock data aggregation. The lead/lag structure and the sign of causality change contrary to the predictions of economic theory. The insignificance of the exchange rate exposure coefficient of US stocks as reported in many studies may be due to the fact that movements in US equity prices lead the dollar exchange rates in most periods, as suggested by the

[61] Equity markets of Japan, Hong Kong, and Singapore were included in this study to enable comparisons with the results obtained for them in Granger et al (2000) when the considerations mentioned discussed earlier are accounted for.

portfolio approach. There is also evidence of significant differences in causality or lead/lag structure arising from changes to the exchange rates base currency despite empirical evidence suggesting co-movements among major currencies. Global equity movements may also affect the causality structure within each country.

The rest of the chapter is organised as follows: Section 2.2 discusses the methodology – unit root tests, cointegration tests, Granger Causality models, and data. Section 2.3 reports and discusses empirical results, and Section 2.4 presents some issues on robustness of results. Section 2.5 summarises the chapter.

Section 2.2: Empirical Models and Data.

This section discusses the various empirical models applied in the study, together with details of data and sub-period analysis.

Testing Unit Roots and Cointegration

Since Granger (1969) causality definitions assume that only stationary series are involved, the empirical analysis is commenced by testing for unit root using the Augmented Dickey Fuller (ADF)[62] test, and the Perron (1989) test[63] denoted as:

$$\Delta y_t = \alpha + \beta t + (\rho - 1) y_{t-1} + \gamma DU_t(\lambda) + \sum_{i=1}^{k-1} \theta_i \Delta y_{t-i} + \varepsilon_t \qquad (2.1)$$

where $DU_t(\lambda) = 1$ for $t > T\lambda$, otherwise $DU_t(\lambda) = 0$; $\lambda = T_B / T$ represents the location where the structural break occurred. The estimation result hinges critically on the value of λ since Perron (1989) shows that when the residuals are identically and independently distributed, the distribution of $(\rho - 1)$ depends on the proportion of observations occurring prior to the break.

To investigate the stationarity assumption of I(1) variables, the Gregory & Hansen (1996) method, which revises the Engle & Granger (1987) model to consider the

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[62] See Dickey & Fuller (1981) for further details on the ADF test.
[63] ADF tests of the unit root hypothesis against trend stationary alternatives cannot reject the unit root hypothesis if the true data generating process is that of stationary fluctuations around a trend function that contains a one-time break. Note however, that the use of the Perron (1989) here does not preclude the existence of a single structural break in each series.

regime shift via residual based cointegration technique, is adopted. The method is a two-stage estimation process, of which the first step is to estimate:

$$y_{1t} = \alpha + \beta t + \gamma DU_t(\lambda) + \theta_1 y_{2t} + e_t \qquad (2.2)$$

where y_{1t} and y_{2t} are of I(1) and y_{2t} is a variable or a set of variables; and DU_t (λ) has the same definition as in equation (1).

The second step is to test if e_t in equation (2.2) is of I(0) or I(1) via the ADF or Phillips-Perron (1992) technique. If e_t is found to be consistent with I(0) – cointegration exists between y_{1t} and y_{2t}.

Testing Granger Causality.

As per Granger (1969), a variable Y_t is causing another variable X_t if one is better able to predict X_t using all available information than if the information apart from Y_t had been used.

If cointegration exists between variables, an error correction term is needed in testing Granger Causality between the variable because cointegrated variables have a long-term equilibrium relationship, which may influence the causal tests. The error-correction term captures the adjustment towards the long-run equilibrium. Long run relationship exists if one or both of the speed of adjustment coefficients is statistically significant, whereas the short run dynamics are captured by coefficients of the causal model.

$$\Delta y_{1t} = \alpha_0 + \delta_1 (y_{1t-1} - y_{2t-1}) + \sum_{i=1}^{k} \alpha_{1i} \Delta y_{1t-1} + \sum_{i=1}^{k} \alpha_{2i} \Delta y_{2t-1} + \varepsilon_{1t}$$

$$\Delta y_{2t} = \beta_0 + \delta_2 (y_{1t-1} - y_{2t-1}) + \sum_{i=1}^{k} \beta_{1i} \Delta y_{1t-1} + \sum_{i=1}^{k} \beta_{2i} \Delta y_{2t-1} + \varepsilon_{2t} \qquad (2.3)$$

where y_{1t} and y_{2t} represent stock prices and exchange rates respectively. δ_1 and δ_2 (the coefficients of the error correction term) denote speeds of adjustment. Per Engle & Granger (1987), the existence of the cointegration implies causality among the set of variables as manifested by $\delta_1 + \delta_2 > 0$.

Failing to reject the H_0: $\alpha_{21} = \alpha_{22} = ... = \alpha_{2k} = 0$ and $\delta_1 = 0$ implies that y_2 does not Granger-Cause y_1. Also, failing to reject the H_0: $\beta_{21} = \beta_{22} = ... = \beta_{2k} = 0$ and $\delta_2 = 0$ indicates that stock prices do not granger-cause exchange rates.

If cointegration <u>does not</u> exist, the following simple causal model is needed in testing Granger Causality:

$$\Delta y_{1t} = \alpha_0 + \sum_{i=1}^{k} \alpha_{1i} \Delta y_{1t-1} + \sum_{i=1}^{k} \alpha_{2i} \Delta y_{2t-1} + \varepsilon_{1t}$$

$$\Delta y_{2t} = \beta_0 + \sum_{i=1}^{k} \beta_{1i} \Delta y_{1t-1} + \sum_{i=1}^{k} \beta_{2i} \Delta y_{2t-1} + \varepsilon_{2t} \qquad (2.4)$$

where y_{1t} and y_{2t} represent stock prices and exchange rates.

Failing to reject the H_0: $\alpha_{21} = \alpha_{22} = ... = \alpha_{2k} = 0$ implies that y_2 does not Granger-Cause y_1. Likewise, failing to reject the H_0: $\beta_{21} = \beta_{22} = ... = \beta_{2k} = 0$ implies that stock prices do not granger-cause exchange rates.

Data

Daily exchange rates and stock market indices (closing rates) of Germany (GMY), Australia (AUS), the USA (USA), Japan (JPN), Hong Kong (HKN), and Singapore (SIN) are used in this study. Exchange rates are expressed as national currency to the UK pound Sterling.[64] Stock Price Indexes are datastream-calculated – including the most important companies with the precise number varying from market to market according to the size of the market capitalisation, and changes to reflect current market conditions.[65] For industrial analysis, data on 10 economic sectors[66] (based on

[64] Note again that data from the latter 3 countries, having been used in Granger et al (2000), were included in this study to allow some comparability, especially in light of evidence (see Khoo, 1994) that a change in exchange rates base currency may have implications on results.
[65] The numbers of companies in the stock indexes are as follows: Australia (160), Germany (200), Hong Kong (130), Japan (1000), Singapore (100), the UK (550), and the USA (1000).

Datastream level 3 classifications) are obtained over our sample period. These are Resource (mining, oil & gas), Basic industries (chemicals, construction, building materials, forestry and paper, steel and other metals), General Industries (aerospace, defence, diversified industrials, electrical equipment, commercial vehicle, engineering contractors, engineering fabricators, engineering and machinery), Cyclical consumer goods (automobiles and parts, household goods and textiles), Non-cyclical consumer goods (beverages, food producers and processors, health, personal care and household products, pharmaceuticals and biotechnology), Cyclical services (retailers, leisure, entertainment, hotels, media, photography, support services, and transport), Non-cyclical services (food & day retailers, telecom services), Utilities (electricity, gas distribution, and water), Information technology (IT hardware, software and computer services), and Financials (banks, insurance, life assurance, investment companies, real estate, speciality and other finance). Data sampling period is from Jan 2, 1976 to Dec 31, 2001: a total of 6780 observations are obtained from datastream, prior to corrections for different stock exchange holidays.[67] Data on stock indices and exchange rates (vis-à-vis UK sterling) are transformed into logarithmic scale and are shown in time series plots in Figures 2.1a and 2.1b below.

<u>Sub-Period Analysis.</u>

To allow for the possibility of time-varying interactions as found in Jorion (1990) and Bartov & Bodnar (1994), five sub-periods of various lengths are used to better dissect the relationship between exchange rates and stock prices. The segregation of data into sub periods is primarily influenced by; major economic events that may have a bearing on exchange rates and stock prices interrelationships in the countries, and also sub-periods adopted in similar studies to facilitate comparisons of causality tests results.

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[66] It is noted again that a higher level of industrial classification may yield different results, because a smaller number of firms may have too much idiosyncratic risks to measure the impact of exchange rate shocks. Regardless of this, the possibility of obtaining a small number of firms in some industries and countries is still recognised.

[67] The choice of start date is primarily influenced by data availability, although it is thought that by January 1976, the effects of the post Bretton Woods flexible exchange rates (if any) should be well reflected on stock prices. National holidays are found by taking first differences of the stock market index, and 10 industrially classified indexes (e.g. resource, basic, and general industries, etc) for each country, and then deleting zero observations common to all country-specific indexes, and the corresponding exchange rates data.

Hamilton (1996) notes the effects of the oil shock of 1973 –74 and 1979 – 80, especially on the economies of 'oil-consumers' (oil net importers) as depressing demand for key consumption and investment goods. The effects were especially large in Germany and Japan, where they involved a transfer of purchasing power of 2 to 4% of GDP to oil producing countries.[68] Mishkin & White (2002) argue that financial markets were forced to cope with rising inflation and inflation uncertainty, following the OPEC oil shock; thereby resulting in large declines in asset values. In 1986, oil prices declined sharply as OPEC oversupply deepens, such that by the end of 1986, they had dropped to almost half the level attained in 1985. Masih & Masih (2002) also notes that the decline in oil prices was an important catalyst for the stock market boom in Japan, and possibly in other countries in our study. Given these and the fact that most of the countries in this study are net importers of oil (possibly with the exclusion of Australia), the relationship between exchange rates and stock prices is analysed during the period of 'high oil prices' from January 1976 to December 1985. Moreover during this period, the US dollar appreciated significantly (by as much as forty three percent) against other major currencies, following the October 1978 change in US monetary policy until February 1985, at which time the trend reversed to a marked dollar depreciation (about sixty seven percent) until the turn of the decade. Analysis in this sub-period is comparable to the pre-Plaza Accord (1975 to 1985) sub-period in Doukas et al (2003).

The October 19, 1987 stock market crash saw the largest one-day decline in the stock market value in the US history. The Dow Jones fell 22.6 percent, and major indexes all around the world, including those of countries in this study, fell substantially as a result.[69] Stock prices continued to oscillate violently for the remainder of 1987. Roll (1988) argues that the crash can be ascribed to the normal response of each country's stock market to a worldwide market movement. Under the portfolio balance theory, this turbulence in the stock market should cause swings in exchange rates. In line with Granger et al (2000) the lead/lag structure of exchange rates and stock prices are analysed under a 'black Monday' sub-period from January 2 1986 to November 30 1987.

[68] See De Grauwe (1996).

[69] The single-day drop in the DataStream-calculated stock indexes ranged from 12% in Germany to 33% in Hong Kong. However, larger percentage points were lost by the end of the October 1987.

Data within the sub period December 1, 1987 to May 31, 1997 are analysed under a period called 'after crash' in comparison with Granger et al (2000). Although macroeconomics events such as the US stock market crash in the fall of 1990[70] and the September 16 1992 EMS currency crisis,[71] which may influence the lead/lag structure between exchange rates and stock prices, may have occurred within this period, our objective of comparability of results with previous studies is given the upper hand here.

The effect of the financial crisis (now known as the Asian flu) which began in Thailand in July 1997 was soon felt in other South East Asian countries through the depreciation of local currencies and a fall in stock indexes, and in many western countries as well. Rijckeghem & Weder (2001) noted that in Thailand alone, three to five percent of capital of banks from the US, France, Germany, and the UK, and 29% in Japan had been lost in the financial crisis. As stated by Granger et al (2000), "*the financial tsunami continued to exert its devastating force and did not slow down until the first quarter of 1998*" (p. 338). To examine exchange rates/stock prices relationships during this event, an 'Asian flu' sub period from June 1 1997 to June 18 1998 similar to Granger et al (2000) is used.

The last sub period is the 'EMU' period, from June 19 1998 to December 31, 2001. Theoretically, the commencement of the European Monetary Union (EMU) in January 1999 should stabilize the stochastic processes of certain economic fundamentals (including exchange rates) in participating European economies. Models of stock price determination suggest that such stabilization should be followed by a reduction in the variance of stock returns, not only in the member states but also among the eurozone's major trading partners, as suggested by the European Commission[72]. It should be interesting to see how exchange rates and stock prices have interacted in the aftermath of the Asian flu crises, and more importantly, following the introduction of the European single currency (Euro).

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[70] See Mishkin & White (2002).

[71] On this date, financial markets decided the £-DM central rate of 2.95 was too high, leading to a depreciation of the Sterling (our base currency). See Wadhwani (1999) for further details.

[72] Findings by Eun & Resnick (1988) suggest that over half of the total volatility of equity returns is due to the volatility of exchange rates, and as such the EMU should have significant implications for international equity market movements.

Section 2.3: Empirical results and discussions.

This section presents the results of the application of the various empirical models presented earlier, providing some discussions.

Unit Root and Cointegration results

Table 2.1 (see below) reports the results of the Perron (1989) unit root test based on equation (2.1).[73] The t-statistics are reported and the values of λ are in brackets. Table 2.1 reveals that the null hypothesis of a unit root in the logarithmic stock indexes and exchange rates cannot be rejected.

Based on results from the estimation of equation (2.1), the two-step cointegration analysis represented by equation (2.2) is estimated.[74] The cointegration results are presented in Table 2.2(a) below. As can be seen, the residuals e_t of the cointegration analyses are not consistent with I(1), thus suggesting that there is no cointegration or long term equilibrium relationship between exchange rates and stock prices.[75] This result is in line with Granger et al (2000), Hatemi & Irandoust (2002), and Kim (2003) which also find no cointegration between the two financial variables.

Granger-Causality results

Given that no cointegration exists between the logarithmic exchange rates and stock prices, the traditional Granger Causality model (as in equation (2.4)) is employed to test causality between the two variables in the various countries and markets. In line with Granger et al (2000), the relationship is investigated in terms of rates of changes in both exchange rates and stock prices (i.e. using log-differenced data) owing to the intuition in prior studies[76] that rates of changes in exchange rates reflect exchange

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[73] Although not reported, results of the ADF tests also suggest that the null of unit root cannot be rejected in all series.

[74] It is important to note that the Gregory and Hansen (1996) residual-based cointegration test "*could be used for testing models where the timing of the regime shift τ were known a priori*" - (Gregory and Hansen 1996, pg 103), so that it plausible to use this cointegration test vis-à-vis the Perron (1989) test used.

[75] The cointegration residuals tested for consistency with I(2). The results reported in Table 2(b) confirms that at the 1% significance level, the cointegration residuals are consistent with I(2).

[76] See Jorion (1990), Bartov & Bodnar (1994) etc for further details.

rates risk (exposure). Moreover, given the evidence that the logarithmic exchange rates and stock prices are I(1), use of log-differenced data, which are stationary, should minimise the risk of spurious results, given findings of He & Maekawa (2001) that the F-statistic for testing Granger-causality often leads to spurious causality where there is no causal relationship when one or both of the two processes is or are non-stationary.

The optimum lag (k) for each country and each variant of the granger-causality model in equation (2.4) is derived from a comparison of both the Schwarz Bayesian criterion (SBC), and the Akaike Information Criterion (AIC). For the first variant of equation (2.3) i.e. exchange rates granger-causing stock prices, the optimum lag (k) is one for Germany, Singapore and the USA, k = 2 for Japan, and k = 3 for Australia and Hong-Kong[77] over the whole sample period. For the second variant (i.e. stock prices granger-causing exchange rates), both the AIC and the SBC are not only in agreement in all cases, but also K = 1 for all countries over the whole sample period. However, within sub-periods the optimal lags may vary. For instance, in the 'after-crash' period in Japan, the optimal lag k = 2, by admission of both AIC and SBC. It is not clear whether this possibility is accounted for in Granger et al (2000). The causality results for the whole data set, and the five sub-periods are reported in Table 2.3 (see below).

Granger Causality models, by definition, do not provide intuitions on the sign of causal links between variables. Impulse Response (IR) functions (5 periods), based on equation (2.4), are employed to assess the signs of causal links (where found to be significant), in similar fashion as Granger et al (2000).[78]

Germany.

Shown in Table 2.3(a), DM/Sterling rates led the stock market index (at 1% significance level) over the whole sample period (Jan 1976 – Dec 2001), as predicted under the traditional approach; with a negative sign i.e. exchange rates depreciation (appreciation) results in a fall (rise) in stock prices. This mirrors findings in Vassalou

[77] K = 3 for Hong Kong is consistent with Granger et al (2000).

[78] Although Impulse Response (IR) functions can be used to further analyse short-term dynamics between the variables, the use here is restricted to identifying the nature (or sign) of the response of exchange rates to a one-unit shock in stock price, and vice-versa, in those periods where Granger Causality models suggest significant causal relations. The signs are discussed in these cases.

(2000) that exchange rate changes explain a large proportion of equity market changes in Germany. Given the horizon of our data, there appears to be a persistent causal relationship between the two financial variables. Moreover, exchange rates led stock prices in six of the ten industry portfolios, although significant feedback links are found in two of these: general and financial industries.

In period 1 (high oil price uncertainties) the stock market led exchange rates (at 10% level of significance) with a positive sign.[79] The fluctuations of stock prices of cyclical consumer good, cyclical services, and financials sectors are largely responsible for changes in the exchange rate over this period.

During the Black Monday period, exchange rates led the stock market again in Germany (5% significance level) but with a positive sign (contradicting findings for the whole sample period and the high oil price sub period) indicating that depreciation (appreciation) of the DM vis-à-vis the UK Sterling led to increases (decreases) in stock prices, as one would expect if firms were net exporters under monetary models intuitions.[80] Using trade balance data from the IMF's *International Financial Statistics* (not reported), this study finds an unprecedented rise in Germany's trade balance during this period, suggesting that German firms were indeed net exporters, thereby bringing our results in line with theory. However, this causal structure is only supported by equity data of three of the ten industries: basic, cyclical consumer goods, and non-cyclical services.

In period 3 (after-crash), there is evidence of a significant feedback interaction between exchange rates and the entire stock market (exchange rates led with a negative sign at 1% significance level, and stock prices led with a positive sign at 5% significance level). While exchange rates granger-caused stock prices in all industries (except utilities and IT sectors), only equity prices in basic, general, and financials sectors granger-caused the DM/Sterling rates, hence the sources of the feedback relationship.

[79] This is contrary to the portfolio balance theory.
[80] See Dornbusch (1976).

The entire German equity market and equities in six of ten industries granger-caused (positive sign) the DM/Sterling rate during the Asian flu period. However, the null hypothesis of no Granger Causality cannot be rejected in the EMU period.

Singapore

Over the entire sample period, SP$ / Sterling exchange rates granger-caused the Singapore stock market index (at 1% significance level) and equity in resources, basic, and non-cyclical goods sectors with a negative sign i.e. exchange rates depreciation (appreciation) results in a fall (rise) in stock prices on the Singapore market, as shown in Table 2.3(b). This mirrors our earlier findings for Germany. However, stock prices in the resource, non-cyclical goods, non-cyclical services, and financials sectors granger-caused SP$/Sterling rates thus suggesting a feedback link in the first two sectors.

Exchange rates also led the entire stock index and the cyclical services sector in sub-period 1 again with a negative sign, although a significant feedback relationship is found for financial stocks. During the Black-Monday period, Singapore dollar rates led the market index (1% significance level) and three of nine industry portfolios with a negative sign, in line with Granger et al (2000).

In period 3 (After-Crash), no relationship is found. A significant feedback interaction (with negative sign in both cases) is evident during the Asian flu period, in line with Granger et al (2000). Although the exchange rate granger-caused most of the industry portfolios, only three of the nine[81] (non-cyclical goods, non-cyclical services, and financials) can be identified as the sources of the significant feedback relationship.

Exchange rates led the overall market index, and cyclical services and IT sectors with a positive sign, whilst stocks of resource, general, and IT sectors led the Sp$/Sterling rates i.e. a feedback relationship in the EMU period.

[81] No data is available for the utilities sector in Singapore.

Japan.

Table 2.3(c) shows that there is no interaction between exchange rates and the stock market index over the entire sample period. However, Yen/Sterling rates led equity prices in the resources, utilities (both with negative sign), general, and cyclical consumer goods (both with positive sign), all at 1% significance level. Given Japan's dependence on foreign inputs of production, as also recognised in Doukas et al (1999), it is a net importer of natural resources, thus the findings that Yen appreciations leads to a rise in the values of firms in the resources sector is consistent with theory.[82] In similar spirit, Japan is a net exporter of products of firms in the general and cyclical consumer goods sectors, thus the positive sign of causality is predictable. Given that no significant causal link is found for the entire market index, the problem of aggregating stock data in tests of exchange rate exposure is again highlighted.

In Period 1 (high oil prices), exchange rates granger-caused the Japanese market index and half of the ten industry portfolios (including resource and utilities sectors) at five percent significance level with a negative sign. This result for Japan is similar to the findings of Doukas et al (2003) that about eighty-four percent of 1079 Japanese firms had a negative exposure to exchange rate changes over this period. However, stock prices of utility firms granger-cause the yen/sterling rate implying a feedback causal link – an unsurprising finding, given the prevalence of high energy prices and direct consequences for utility companies, in this period. Gjerde & Saettem (1999) also find that the Japanese stock market reacts accurately to oil price changes.

During Black Monday period, there is no interaction between exchange rate and the market index, in line with Granger et al (2000). However, exchange rates led stocks of firms in the general and cyclical consumer goods sectors with a positive sign, as over the entire period, in line with theory.

In Period 3 (after-crash), the market index granger-caused yen exchange rates (at 5% significance level) with a positive sign thereby contradicting the portfolio balance

[82] Although Japan may not necessarily import utilities, the dependence of the utilities sector on the energy (resource) sector may have influence the significant negative causality from yen rates to utilities' firms equities.

theory. This causal structure appears to result from the significant influence of equity prices in cyclical consumer goods, non-cyclical consumer goods, and IT sectors over exchange rates. Prior to the 1970s, the Japanese capital market was tightly controlled. A drastic shift in policy occurred with the implementation of the foreign exchange and foreign trade control law in December 1980, eliminating most capital controls in Japan. *"The impact of this significant change in Japanese policy began to be felt on and from about the mid-1980s"* – (Masih & Masih, 2002, p. 85), such that by the end of the 1980s, the Japanese stock market had grown fivefold. This boom may have led the yen/sterling rate as per the portfolio models, though the positive causal link may have resulted from a number of factors.[83] As before, yen/sterling rates led the stocks of resources, general, cyclical consumer goods, utilities, and IT sectors, suggesting a feedback interaction between cyclical consumer goods and IT sectors and the exchange rate. Granger et al (2000) found no interaction in the two variables in Japan during this period.

During the Asian flu period, exchange rates granger-caused the market index (negative sign), with fluctuations in the yen causing significant fluctuations in six of the ten industry portfolios. Though no significant causal link is found between the yen and the market index during the EMU period, exchange rates granger-caused equity prices in the resource, general, and cyclical consumer goods sectors, whereas movements in the equities of firms in the cyclical services sector granger-caused the yen/sterling rates.

Australia

Over the entire sample period, there is no significant causal link between AUD/Sterling rates and the market index (see Table 2.3d). However, exchange rates granger-cause stock prices in the basic, general, and IT sectors (with a positive sign) as found in Loudon (1993); whereas equity prices in resource and IT sectors granger-caused exchange rates.[84] In period 1, there are still no causal links between the market index and AUD/Sterling rates, but exchange rates granger-caused movements in the

[83] In the same spirit, Frankel & Rose (1994) stated that the portfolio balance models, which seem to be doing well in explaining a particular historical episode fails to do so when applied to other periods. It is also noted that the Japanese equity market bubble appear to burst in the early 1990s.
[84] Note that due to data availability, start date for equity data in the IT sector is April 1994.

equities of five of the 10 industries, with mixed signs. The same results are observed in periods 2 and 3. During the Asian-Flu period, exchange rates granger-caused the market index and equity in all industries (except non-cyclical services and utilities) with a positive sign, suggesting responses to a common or market-wide factor. In the EMU period, AUD/Sterling rates granger-cause only industry equities – resources, basic, general, and non-cyclical services.

Hong Kong

Table 2.3(e) shows that there is no causal links between the HK$/Sterling rates and the market index from January 1976 to December 2001. This may not be surprising since Hong Kong has been practising some form of fixed exchange rate arrangement for all but nine years (1974 to 1983) since the collapse of the Bretton Woods arrangement.[85] However, the exchange rate led stock prices in the non-cyclical services sector (at 1% significance level) with a negative sign.[86] During the high oil prices period, when Hong Kong practised a floating currency, exchange rates led the market index (at 10% significance level) and all industry portfolios (for which data is available) with a negative sign, perhaps also reflecting its 'net-importer of oil status'. In line with Granger et al (2000), no significant causal link is found between the HK$/Sterling rates and the market index during the Black Monday period, although the exchange rate led equity prices in three of the four industrial sectors for which data is available, with a negative sign. In the After-Crash period, there is no definitive causal links between the two markets, contrary to Granger et al (2000) which found that the stock index changes led the HK$/US$ rates over the same period. However, there is a significant feedback interaction between stock price changes of IT firms and the HK$/Sterling rates, and that the exchange rates led stock prices of firms in the non-cyclical consumer goods sector.

During the Asian flu period, exchange rates granger-caused changes in the market index (at 5% significance level) and equity prices in both general and non-cyclical

[85] Ever since 1983, Hong Kong adopted a Currency Board Arrangement (CBA) to fix the exchange rate at HK$7.8 per US Dollar. This implies that the exchange rate data used here should mainly reflect US Dollar/Sterling fluctuations.
[86] Note that that due to data availability start date for equity data in this sector is February 1988.

consumer goods with a positive sign. Contrary to my findings, Granger et al (2000) found that the market index led HK$/US$ rates in this period. However, it is found that changes in non-cyclical services stocks granger-caused the HK$/Sterling at 10% significance level during this period. No significant interactions are found during the EMU period except that the exchange rate led equity price changes in the cyclical consumer goods.

The USA

Table 2.3(f) does not show any evidence of significant causal links between US$/Sterling rates and the market index and industrial portfolios over the entire January 1976 to December 2001 period. However during high oil prices period, the market index led the dollar rates (at 1% significance level) with a negative sign, consistent with the portfolio theory of exchange rates determination, and supports the view in De Grauwe (1996) that US budget deficits (fiscal expansion) which increased substantially after 1980, together with a policy of monetary restrictions initiated by the Federal Reserve Board in 1978, raised US interest rates and induced massive capital movements to the US. These capital movements then explain the dollar appreciation against other major currencies from 1978 – 1985.[87] Importantly, equity prices in all ten industries granger-cause the dollar exchange rate during this period, again giving added weight to the portfolio approach.

In period 2 (black Monday), there is no significant causal link between dollar rates and US stock prices (both market index and industrial indices) in general. This in agreement with Ong & Izan (1999) which states "*it appears that while equity markets react to information conveyed by currency movements to some extent, they are also subject to other shocks, as demonstrated by the lack of corresponding volatility in exchange rates during the share market crash of 1987...*" – (p. 530).

During period 3 (after-crash), the market index led the US$/Sterling rates (at 1% significance level) but with a positive sign as in Japan, suggesting that a bullish stock market caused a dollar depreciation, contradicting the portfolio approach. This causal

[87] See De Grauwe (1996) Chapter 7 for further explanations.

structure is also reflected in the tests with most industry portfolios, except that exchange rates led equity prices of utilities, and a feedback relationship is observed in non-cyclical consumer goods industry. Movements in the market index also granger-cause US$/Sterling rates during the Asian flu period (at 1% significance level) again with a positive sign. Equity prices in seven of the ten industries also led exchange rates. Over the last period (EMU), the market index also led (at 5% significance level) still with a positive correlation. However, this causal link is only significantly reflected in three of the ten industries – non-cyclical services, utilities, and financials.

In light of the results, another plausible theoretical explanation for this *post*-1985 change in causal sign (to positive) is given by the Natural Real Exchange Rate (NATREX) model developed by Stein et al (1995). Stein & Paladino (1998) note that whilst standard asset models such as the portfolio theory describe the medium term, the NATREX model is a neoclassical growth model designed to explain the medium to longer run movements in the real exchange rate, the current account, and the net liabilities to foreigners. Under the NATREX model, the US budget deficit → interest rates rise → capital inflows → the appreciation of the dollar (1979 – 1985) analogy is a medium run phenomenon. The ensuing dynamics are that the current account deficit raises foreign debt and as a result, the interest payments on the debt rises, leading to a steady growth in foreign debt, and a depreciation of the real exchange rate.[88] Therefore, the effect of US Government budget deficits is to depreciate the real exchange rate despite capital influx in the longer run, consistent with our findings. Although the NATREX model postulates a long run convergence of the real exchange rate to equilibrium, it is not clear whether this long run, vaguely defined as a '*reasonable*' length of time in Stein & Paladino (1998), is long enough to explain the positive correlation in the stock price → exchange rate causality in periods 3, 4 and 5, especially in light of the change in US fiscal policy towards fiscal discipline in the early 1990s, resulting in the longest series of improvements in budget outcomes in the history of the United States (see Gensler, 1999). Perhaps the effects of fiscal policy have evolved. "*Experience has changed our understanding of fiscal policy……financial markets have become more forward-looking, and more sensitive to changes in the outlook for fiscal policy. As a result, a change in the outlook for the*

[88] See Stein & Paladino (1998) for a fuller explanation of dynamics.

budget is likely to provoke a more aggressive and immediate offsetting response from financial markets. This was powerfully demonstrated by the stimulative impact of deficit reduction in the 1990s, as increased investment demand resulting in a lower cost of capital more than outweighed any demand losses to the economy that resulted from lower government spending" - Summers (2000). This change in the outcome of fiscal policy, not foreseen by the theoretical models, may also have influenced the change in causal signs in the latter three sub periods.

Any cross-country similarities in lead/lag structures?

The results in table 2.3 show that from January 1976 to December 2001, exchange rates led market indices, with a negative sign in two of the six countries: Germany and Singapore. No significant relationship is recorded in other countries. During high oil prices, exchange rates led market indices of the 3 Asian countries with a negative correlation, while market indices led in Germany and the USA, although with different signs. Exchange rates granger-caused German and Singapore equity indices over the black Monday period, and again no relationship is found in the other markets. During the stock market boom years of December 1987 to May 1997, the market indices of the three largest markets (i.e. Japan, USA, and Germany) granger-cause their respective exchange rates vis-à-vis the UK sterling. Exchange rates led in all Asian countries (including Australia) while the market indices led again in the USA and Germany during the Asian Crisis. No similarity whatsoever during the EMU period except that there are no significant relationships in four markets – Germany, Japan, Australia, and Hong Kong.

There is no substantial evidence to suggest any similarity in lead/lag structure in similar industries located in the different countries. At best, the lead/lag structure are more country-specific i.e. there is a tendency for causal relations (where significant) between exchange rates and industry equity indices within a country to be similar to that between the exchange rate and market index, rather than industry-specific as shown in Table 2.3. However, with the exception of the USA, and to a lesser extent, Australia, there are substantial time and direction of causality variations within each country.[89]

Section 2.4: Robustness of Results

This section investigates the robustness of the earlier results by; looking at the implications of adding error correction terms, changes in exchange rates base currency, the inclusion of interest rate differentials in the causality model, and controlling external equity market effects.

Causality: Error-Correction Model (ECM).

As noted in Granger et al (2000), the rejection of the null hypothesis of cointegration may be due to noisy daily data. Moreover, adding an error-correction term, as stated in equation (2.3), to the causality model allows the identification of long-run equilibrium links between the exchange rates and stock prices. A long-run relationship exists if one or both of the speed of adjustment coefficients δ_1 and δ_2 are statistically significant. Estimating equation (2.3), it is found that the lead/lag structures in Table 2.3 are not changed. Moreover the coefficients of the error-correction terms (not reported) are insignificant in most cases, again suggesting no long-run relationships. However, the coefficient δ_1 and δ_2 are statistically significant (at 5% level) in Japan 'after-crash', again suggesting that the Japanese stock market behaviour had sustained effects on the Yen rates during this ten-year period.

Changes in exchange rates base currency.

Changes in the exchange rates data (i.e. the base country adopted for exchange rate specification in this case is the UK Sterling) may account for differences in our results and those of Granger et al (2000).[90] Our hypothesis is that the lead/lag structure between exchange rates and stock index (only) is not different if exchange rates are

89 Henceforth, our discussions are focused on results over the entire sample period.
90 Although it is acknowledged that the slight variation in our stock market index data (our stock data are DataStream-calculated, whilst those of Granger et al (2000) are specific indexes like the Hang Seng for Hong Kong, the Nikkei 225 for Japan, and the Singapore All Share index for Singapore) may also contribute to this differences, it is not expected that it would contribute as significantly as our results indicate, given the high level of correlation (over 98%) between the two sets of stock index data in each of these countries.

expressed vis-à-vis a different currency, given the high level of cointegration among major currencies, as reported in Baillie & Bollerslev (1989). To investigate this, granger-causality between the two variables is tested using exchange rates data vis-à-vis the US dollar over the period January 2, 1986 to December 31, 2001.[91] The results obtained for each sub period in Japan, Singapore, and Hong Kong is highly similar to the findings in Granger et al (2000). As a result, the thesis tests the implications of the variation in exchange rates data in the other countries. The results are interpreted and compared with the earlier findings when exchange rates were expressed vis-à-vis the UK Pound Sterling in Table 2.4 (see below).

From Table 2.4, there is evidence to suggest that exchange rates/stock index causal relationships are significantly affected by the exchange rate base currency. This is perhaps surprising in light of empirical evidence that exchange rates (especially of major currencies) tend to move together (see Ballie & Bollerslev, 1989). It is observed that with the exceptions of two sub periods (Japan (period 3) and Hong Kong (period 5)), exchange rates vis-à-vis the Pound Sterling increases (reduces) the statistical significance of exchange rates (stock prices) in the causality model, while the reverse is true for exchange rates vis-à-vis the US Dollar. Perhaps evidence in numerous studies[92] suggesting that the US equity market is the global market leader, together with earlier results that the US stock market Granger-causes US Dollar rates may help explain this observation. This suggests that the US market is an important conduit of causal flows from stock prices to exchange rates.

Interest rate differentials.

Lutkepohl (1982) finds that just as Granger Causality in a bivariate system may be due to an omitted variable, non-causality in such a bivariate system may theoretically result from omitted variables. The asset models of exchange rate determination recognise the close link between exchange rates, stock prices, and interest rates. Interest rate differentials give details of capital flows between two countries. Moreover, fundamental shocks within an economy are reflected in interest rates. In

[91] Due to data unavailability, the sample period could not be extended prior to 1986. However, the period chosen will allow direct comparisons with Granger et al (2000).
[92] See for instance Agmon (1972) and Yang et al (2003).

line with Granger et al (2000), changes in interest rates and the differentials are incorporated into the causality models for robustness. Note that Hatemi & Irandoust (2002) also include an exogenous variable (CPI) in their causality model. Interest rate differentials are calculated as foreign risk-free rates minus UK risk-free rate. The results[93] show no change in the lead/lag structure between exchange rates and stock prices as in Granger et al (2000). This finding is in line with Choi & Prasad (1995) and Cavaglia & Wolff (1996), which find that interest rate news are relatively unimportant to unexpected movements in exchange rates, suggesting that exchange rates and stock prices are more linked directly.

External influences.

As with exchange rates, the stock market is not excluded from external influences. Agmon (1972) shows evidence that share price behaviour especially in the US, UK, Germany, and Japan, is consistent with the one-market hypothesis that these four countries comprise a single multinational equity market, i.e. share prices in these countries move together. Agmon (1972) also shows that equity prices in non-US countries respond immediately to changes in US prices. Granger et al (2000) includes stock price changes of the US in the Granger-causality model, as a control variable. Although Granger et al (2000) notes that the lead/lag structure remains unchanged with a few exceptions,[94] it is worthwhile to control for external stock market influences in our study for robustness. Changes in the datastream-calculated global market index (to capture global fluctuations in light of the arguments by Roll (1988) that each country's stock market responds to a worldwide market movement), are included in the causality model in equation (2.4) over the whole period and during sub-periods. By so doing, one hopes that a 'more' idiosyncratic causal structure will be identified in each market. The results of the causality tests controlling for external factors with global equity changes are presented in Table 2.5 (see below).

The results shown in Table 2.5 are generally similar to the results in Table 2.3 except for a few differences. For the whole sample period, there is a suggestion of feedback causality in Germany (exchange rates leading with a negative sign, stock prices

[93] See Appendix A1

[94] Note that Granger et al (2000) only controls for external influences in stock index during the Asian flu period. Moreover, the fact that the lead/lag structure does not change may be due to the use of exchange rates vis-à-vis the US dollar throughout the study.

leading with a positive sign) contrary to earlier findings of unidirectional causality i.e. that exchange rates led stock prices, although still with a negative correlation. This finding must be interpreted carefully since *"it has been shown that a simple causal mechanism can appear to be a feedback mechanism if the sampling period for the data is so long that details of causality cannot be picked out"* - Granger (1969, p. 427). During the high oil prices, no significant relationship is reported in Singapore, Hong Kong and Germany, suggesting that the links reported in Table 2.3 were influenced by the global equity market. Unlike in Table 2.3, exchange rates led stock prices in Australia (negative sign), Hong Kong (positive sign), and Singapore (negative sign) during Black Monday, in line with Granger et al (2000), demonstrating the impact of global equity markets.[95] Exchange rates also led stock prices in Australia After-Crash (with a negative sign). In Hong Kong, Germany, and Japan, no significant relationship is found during the Asian flu period contradicting earlier findings.[96] Post Asian flu, stock prices in Singapore led exchange rates (at 10% significance level, and negative sign).

Section 2.5: Summary.

The objective is to empirically investigate a causal link between exchange rates and stock prices in six developed countries, given poor and mixed evidence from previous research focused mainly on testing the implications of exchange rate movements on stock prices, and other considerations that have potential implications on causality structure within each market.

As suggested by results of cointegration tests, there does not appear to be a long-run relationship between both variables in all six countries, from January 1976 to December 2001. One cannot reject the null hypothesis of Granger Causality between exchange rates and stock prices either over the entire period, or at least, in one sub-period in all countries. The structure of causality (i.e. exchange rates leading stock

[95] The lack of causal relationship in the Hong Kong market during black Monday as in Granger et al (2000) may therefore be the result the use of exchange rates vis-à-vis the US dollar, which 'biases' results in favour of stock prices movements causing changes in exchange rates.
[96] However, the result of no causal link in Japan during the Asian flu period is similar to the findings of Granger et al (2000).

prices and/or vice-versa) is not only country-specific but also changes over time except in the USA, where movements in stock prices granger-caused changes in the dollar/sterling rates in all subperiods except during the period covering the stock market crash of 1987. Therefore, the insignificance of the exchange rate exposure coefficients of US stocks as found in previous studies (traditional approach) may be due to the fact that stock prices lead exchange rates.

The findings highlight the potential adverse effects of aggregating stock price data on the results of causality tests between exchange rates and stock prices. Where there is no significant causal link at the stock index level, the same cannot be said with respect to industrial stock data. In fact, there is evidence suggesting that industrial stocks may cause changes in the exchange rates when the stock market index indicates a susceptibility to exchange rates fluctuations. However, the evidence suggests that the direction of causality is more country-specific, rather than industry-specific. Thus, country characteristics still dominate in the industrial stocks/exchange rates causal links, in line with the theoretical models.

Unsurprisingly, the nature of response (positive or negative) of exchange rates to stock market shocks often contradicts the predictions of the theoretical models. Where exchange rates granger-cause stock prices, the nature of response is as suggested by the monetary models. The influence of the US stock market on the US dollar has serious implications for the causality structure in the other countries. When exchange rates are specified vis-à-vis the dollar, there is a tendency for stock prices to lead currency rates; this evidence is again suggestive of a significant influence of US equity price movements on individual stock markets across the globe. The US dollar is indeed an important vehicle for transmitting this influence. Consequently, it is found that causal structures are slightly altered in these other countries when exogenous shocks are controlled.

The results suggest that the causal link between exchange rates and stock prices may not be spurned by links to other important macroeconomic variables like interest rates and inflation, in line with previous studies.

List of Tables and Figures.

Table 2.1: Unit root test results.

	GMY	JPN	SIN	AUS	HKN	USA
Exchange Rate	-1.26 (0.64)	-1.59 (0.64)	-1.59 (0.35)	-3.41 (0.04)	-3.68 (0.64)	-2.18 (0.35)
Stock Index	-2.69 (0.45)	0.626 (0.45)	-2.12 (0.45)	-2.82 (0.45)	-2.55 (0.45)	-2.94 (0.45)

The estimation result is based on equation (2.1). λ denotes the location of the structural break. Critical values for null of unit roots at various λs (shown in parentheses) are from Table IV(b) provided by Perron (1989). For λ = 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, the 5% critical values are –3.68, -3.77, -3.76, -3.72, -3.76, -3.76, -3.80, -3.75, -3.69, respectively.

Table 2.2(a): Cointegration analysis: t-statistic of ADF test on e_t = I(1)

	GMY	JPN	AUS	SIN	HKN	USA
Y_1 on Y_2	-2.32	-1.91	-3.38	-2.56	-2.85	-2.82
Y_2 on Y_1	-1.36	-3.65	-3.48	-2.02	-4.18	-2.18

Y_1 represents stock prices, and Y_2 represents exchange rates. The corresponding critical values taken from Table 1 in Gregory & Hansen (1996) for the 1%, 5%, and 10% levels of significance are 5.45, 5.21, and 4.99 respectively

Table 2.2(b): Cointegration analysis: t-statistic of ADF test on e_t = I(2)

	GMY	JPN	AUS	SIN	HKN	USA
Y_1 on Y_2	-30.15*	-30.51*	-28.77*	-29.45*	-28.72*	-32.85*
Y_2 on Y_1	-78.25*	-31.97*	-30.38*	-31.14*	-30.38*	-30.55*

Y_1 represents stock prices, and Y_2 represents exchange rates. The critical values are taken from Table 1 in Gregory & Hansen (1996). * indicates significance at the 1%-level

Table 2.3a: Bivariate causality test between exchange rates and stock prices in Germany.

H_0: exch-/→stock	**Whole sample period**		**High Oil Prices (1)**		**Black Monday (2)**		**After-Crash (3)**		**Asian Flu (4)**		**EMU (5)**	
	Causal Sign	P-value	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value	Causal sign	p-value	Causal sign	p-value
H_0: Exchange rate -/→ Stock prices												
Market Index	_	0.009^{***}	n/a	0.89	+	0.05^{**}	_	0.004^{***}	n/a	0.75	n/a	0.95
Resources	n/a	0.97	n/a	----	n/a	----	n/a	0.57	n/a	0.24	n/a	0.27
Basic Industry	_	0.00^{***}	n/a	0.28	+	0.07^{*}	_	0.000^{***}	n/a	0.82	n/a	0.11
General Industry	_	0.01^{***}	n/a	0.73	+	0.08*	_	0.000^{***}	n/a	0.80	n/a	0.58
Cyc. Cons goods	_	0.004^{***}	n/a	0.34	+	0.006^{***}	_	0.01^{***}	n/a	0.56	n/a	0.16
Non-cyc cons gds	_	0.009^{***}	n/a	0.34	n/a	0.11	_	0.000^{***}	n/	0.84	n/a	0.29
Cyc. Services	_	0.07^{*}	n/a	0.55	n/a	0.30	_	0.003^{***}	n/a	0.33	n/a	0.72
Non-Cyc Services	n/a	0.22	n/a	0.44	+	0.03^{**}	_	0.008^{***}	n/a	0.96	n/a	0.12
Utilities	n/a	0.70	n/a	0.58	n/a	0.52	n/a	0.79	n/a	0.64	n/a	0.48
Info Technology	n/a	0.78	n/a	------	n/a	-------	n/a	0.79	n/a	0.62	n/a	0.68
Financials	_	0.08^{*}	n/a	0.21	n/a	0.13	_	0.002^{***}	n/a	0.77	n/a	0.93

Note: -/→ implies does not Granger-cause. *** = 1% significance level, ** = 5% significance level, * = 10% significance level. The p-values reported are those derived from testing the linear restrictions (null hypotheses) derived in equation (2.4). Where the p-values are significant, the signs of causality (+/-) are reported. Due to data unavailability, the sample period for resource and information technology industrial indexes in Germany is January 1989 – Dec 2001. Thus, comparisons may not plausible for these two industries over the whole sample period.

H_0: stock-/→exch	Whole sample period		High Oil Prices (1)		Black Monday (2)		After-Crash (3)		Asian Flu (4)		EMU (5)	
	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value
H_0: Stock prices -/→ Exchange rates												
Market Index	n/a	0.21	+	0.09*	n/a	0.92	+	0.05**	+	0.07*	n/a	0.46
Resources	n/a	0.22	n/a	----	n/a	----	n/a	0.17	n/a	0.78	n/a	0.81
Basic Industry	n/a	0.27	n/a	0.26	n/a	0.56	+	0.03**	n/a	0.41	n/a	0.71
General Industry	+	0.05**	n/a	0.30	n/a	0.96	+	0.06*	+	0.05**	n/a	0.14
Cyc. Cons goods	n/a	0.31	+	0.03**	n/a	0.91	n/a	0.28	+	0.01***	n/a	0.19
Non-cyc cons gds	n/a	0.20	n/a	0.25	n/a	0.85	n/a	0.14	+	0.02**	n/a	0.43
Cyc. Services	n/a	0.54	+	0.07*	n/a	0.84	n/a	0.11	n/a	0.30	n/a	0.32
Non-Cyc Services	n/a	0.41	n/a	0.53	n/a	0.45	n/a	0.16	n/a	0.44	n/a	0.99
Utilities	n/a	0.66	n/a	0.32	n/a	0.27	n/a	0.80	+	0.04**	n/a	0.99
Info Technology	n/a	0.58	n/a	----	n/a	----	n/a	0.32	n/a	0.83	n/a	0.88
Financials	+	0.10*	+	0.06*	n/a	0.96	+	0.01***	+	0.04**	n/a	0.32

Note: -/→ implies does not Granger-cause. *** = 1% significance level, ** = 5% significance level, * = 10% significance level. The p-values reported are those derived from testing the linear restrictions (null hypotheses) in equation (2.4). Where the p-values are significant, the signs of causality (+/-) are reported. Due to data unavailability, the sample period for resource and information technology industrial indexes in Germany is January 1989 – Dec 2001. Thus, comparisons may not plausible for these two industries over the whole sample period.

Table 2.3b: Bivariate causality test between exchange rates and stock prices in Singapore.

H_0: exch-/→stock	Whole sample period		High Oil Prices (1)		Black Monday (2)		After-Crash (3)		Asian Flu (4)		EMU (5)	
	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value
H_0: Exchange rates -/→ Stock prices												
Market index	_	0.01^{***}	_	0.08^{*}	_	0.004^{***}	n/a	0.57	_	0.006^{***}	+	0.09^{*}
Resources	_	0.06^{*}	n/a	----	n/a	----	n/a	0.28	_	0.002^{***}	n/a	0.92
Basic Industry	_	0.01^{***}	n/a	0.67	n/a	0.53	n/a	0.37	_	0.006^{***}	n/a	0.32
General Industry	n/a	0.26	n/a	0.15	_	0.05^{**}	n/a	0.58	_	0.004^{***}	n/a	0.39
Cyc. Cons goods	n/a	0.18	n/a	0.74	n/a	0.98	n/a	0.15	_	0.008^{***}	n/a	0.15
Non-cyc cons gds	_	0.02^{**}	n/a	0.40	n/a	0.12	n/a	0.25	_	0.001^{***}	n/a	0.90
Cyc. Services	n/a	0.23	_	0.03^{**}	_	0.05^{**}	n/a	0.46	_	0.09^{*}	+	0.01^{***}
Non-Cyc Services	n/a	0.90	n/a	0.15	n/a	0.89	n/a	0.13	n/a	0.16	n/a	0.96
Utilities	n/a	--------	n/a	----	n/a	----	n/a	----	n/a	----	n/a	----
Info Technology	n/a	0.37	n/a	----	n/a	----	n/a	0.38	n/a	0.47	+	0.08^{*}
Financials	n/a	0.17	_	0.04^{**}	_	0.06^{*}	n/a	0.56	_	0.06^{*}	n/a	0.34

Note: -/→ implies does not Granger-cause. *** =1% significance level, ** = 5% significance level, * = 10% significance level. The p-values reported are those derived from testing the linear restrictions (null hypotheses) in equation (2.4). Where the p-values are significant, the signs of causality (+/-) are reported. Due to data unavailability, the sample start period for Resources, cyclical consumer goods, non-cyclical services, and information technology industrial indexes in Singapore are January 1983, January 1983, December 1979, and August 1991. Thus, comparisons may not plausible for these industries over the whole sample period. No data is available for the utilities sector.

H_0: stock-/→exch	**Whole sample period**		**High Oil Prices (1)**		**Black Monday (2)**		**After-Crash (3)**		**Asian Flu (4)**		**EMU (5)**	
	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value	Casual Sign	p-value	Causal Sign	p-value
H_0: Stock Prices-/→ Exchange rates												
Market Index	n/a	0.16	n/a	0.19	n/a	0.75	n/a	0.18	_	0.05^{**}	n/a	0.36
Resources	+	0.02^{**}	n/a	----	n/a	----	n/a	0.76	n/a	0.15	+	0.07^{***}
Basic Industry	n/a	0.92	n/a	0.58	n/a	0.49	n/a	0.36	n/a	0.36	n/a	0.25
General Industry	n/a	0.64	n/a	0.40	n/a	0.64	n/a	0.99	n/a	0.22	_	0.05^{*}
Cyc. Cons goods	n/a	0.50	n/a	0.67	n/a	0.54	n/a	0.56	n/a	0.78	n/a	0.70
Non-cyc cons gds	_	0.01^{*}	n/a	0.15	n/a	0.12	n/a	0.94	_	0.009^{***}	n/a	0.26
Cyc. Services	n/a	0.38	n/a	0.62	n/a	0.59	n/a	0.18	n/a	0.35	n/a	0.21
Non-Cyc Services	_	0.02^{**}	n/a	0.70	n/a	0.27	n/a	0.17	_	0.07^{***}	n/a	0.14
Utilities	n/a	0.78	n/a	----	n/a	----	n/a	----	n/a	----	n/a	----
Info Technology	n/a	0.15	n/a	----	n/a	----	n/a	0.84	n/a	0.74	+	0.05^{**}
Financials	_	0.05^{**}	_	0.05^{**}	n/a	0.82	n/a	0.29	_	0.04^{**}	n/a	0.42

Note: -/→ implies does not Granger-cause. *** = 1% significance level, ** = 5% significance level, * = 10% significance level. The p-values reported are those derived from testing the linear restrictions (null hypotheses) in equation (2.4). Where the p-values are significant, the signs of causality (+/-) are reported. Due to data unavailability, the sample start period for Resources, cyclical consumer goods, non-cyclical services, and information technology industrial indexes in Singapore are January 1983, January 1983, December 1979, and August 1991. Thus, comparisons may not plausible for these industries over the whole sample period. No data available for the utilities sector

Table 2.3c: Bivariate causality test between exchange rates and stock prices in Japan.

H_0: exch-/→stock	Whole sample period		High Oil Prices (1)		Black Monday (2)		After-Crash (3)		Asian Flu (4)		EMU (5)	
	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value	Casual Sign	p-value	Causal Sign	p-value
Exchange rates -/→ Stock prices												
Market Index	n/a	0.64	_	0.02^{**}	n/a	0.33	n/a	0.47	_	0.02^{**}	n/a	0.71
Resources	_	0.000^{***}	_	0.04^{**}	n/a	0.53	_	0.08^{*}	_	0.04^{**}	_	0.02^{**}
Basic Industry	n/a	0.37	n/a	0.19	n/a	0.78	n/a	0.51	n/a	0.29	n/a	0.82
General Industry	+	0.003^{***}	n/a	0.51	+	0.10^{*}	+	0.002^{***}	n/a	0.23	+	0.03^{**}
Cyc. Cons goods	+	0.002^{***}	n/a	0.41	+	0.03^{**}	+	0.004^{***}	n/a	0.14	+	0.001^{***}
Non-cyc cons gds	n/a	0.94	_	0.04^{**}	n/a	0.62	n/a	0.89	_	0.06^{*}	n/a	0.17
Cyc. Services	n/a	0.46	_	0.03^{**}	n/a	0.50	n/a	0.79	_	0.01^{***}	n/a	0.48
Non-Cyc Services	n/a	0.19	n/a	0.52	n/a	0.87	n/a	0.40	_	0.03^{**}	n/a	0.40
Utilities	_	0.001^{***}	_	0.005^{***}	n/a	0.30	_	0.01^{***}	_	0.06^{*}	n/a	0.35
Info Technology	n/a	0.24	_	0.04^{**}	n/a	0.11	_	0.001^{***}	n/a	0.15	n/a	0.56
Financials	n/a	0.12	n/a	0.14	n/a	0.39	n/a	0.94	_	0.003^{***}	n/a	0.48

Note: -/→ implies does not Granger-cause. *** = 1% significance level, ** = 5% significance level, * = 10% significance level. The p-values reported are those derived from testing the linear restrictions (null hypotheses) in equation (2.4). Where the p-values are significant, the signs of causality (+/-) are reported.

H_0: stock-/→exch	Whole sample period		High Oil Prices (1)		Black Monday (2)		After-Crash (3)		Asian Flu (4)		EMU (5)	
	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value	Causal sign	p-value	Causal sign	p-value
Stock prices -/→ Exchange rates												
Market Index	n/a	0.2	n/a	0.71	n/a	0.62	+	0.02**	n/a	0.34	n/a	0.61
Resources	n/a	0.20	n/a	0.67	n/a	0.48	n/a	0.94	n/a	0.67	n/a	0.14
Basic Industry	n/a	0.79	n/a	0.48	n/a	0.25	n/a	0.87	n/a	0.81	n/a	0.71
General Industry	n/a	0.65	n/a	0.73	n/a	0.84	n/a	0.82	n/a	0.71	n/a	0.37
Cyc. Cons goods	n/a	0.40	n/a	0.66	n/a	0.68	+	0.03**	n/a	0.79	n/a	0.17
Non-cyc cons gds	n/a	0.57	n/a	0.83	n/a	0.34	+	0.07***	n/a	0.19	n/a	0.46
Cyc. Services	n/a	0.60	n/a	0.58	n/a	0.38	n/a	0.14	n/a	0.26	+	0.08***
Non-Cyc Services	n/a	0.49	n/a	0.36	n/a	0.53	n/a	0.36	n/a	0.68	n/a	0.41
Utilities	n/a	0.18	+	0.04**	n/a	0.16	n/a	0.18	n/a	0.75	n/a	0.69
Info Technology	n/a	0.69	n/a	0.93	n/a	0.55	–	0.06***	n/a	0.72	n/a	0.47
Financials	n/a	0.76	n/a	0.15	n/a	0.22	n/a	0.21	n/a	0.15	n/a	0.56

Note: -/→ implies does not Granger-cause. *** = 1% significance level, ** = 5% significance level, * = 10% significance level. The p-values reported are those derived from testing the linear restrictions (null hypotheses) in equation (2.4). Where the p-values are significant, the signs of causality (+/-) are reported.

Table 2.3d: Bivariate causality test between exchange rates and stock prices in Australia

H_0: exch-/→stock	**Whole sample period**		**High Oil Prices (1)**		**Black Monday (2)**		**After-Crash (3)**		**Asian Flu (4)**		**Post-EMU (5)**	
	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value
Exchange rates -/→ Stock prices												
Market Index	n/a	0.445	n/a	0.20	n/a	0.185	n/a	0.298	+	0.003^{***}	n/a	0.23
Resources	n/a	0.84	_	0.09^{*}	n/a	0.72	n/a	0.45	+	0.000^{***}	+	0.000^{***}
Basic Industry	+	0.000^{***}	n/a	0.34	+	0.004^{***}	n/a	0.75	+	0.01^{***}	+	0.005^{***}
General Industry	+	0.000^{***}	n/a	0.37	+	0.04^{**}	n/a	0.55	+	0.04^{**}	+	0.05^{**}
Cyc. Cons goods	n/a	0.16	+	0.02^{**}	n/a	0.20	+	0.07^{*}	+	0.04^{**}	n/a	0.12
Non-Cyc cons gds	n/a	0.38	+	0.03^{**}	+	0.04^{**}	+	0.04^{**}	+	0.000^{***}	n/a	0.89
Cyc. Services	n/a	0.24	+	0.003^{***}	+	0.01^{***}	+	0.03^{**}	+	0.007^{***}	n/a	0.75
Non-Cyc Services	n/a	0.40	n/a	----	n/a	----	n/a	0.11	n/a	0.43	_	0.07^{*}
Utilities	n/a	0.55	_	0.09^{*}	n/a	0.32	n/a	0.92	n/a	0.55	n/a	0.87
Info Technology	+	0.03^{**}	n/a	----	n/a	----	n/a	0.55	+	0.05^{**}	n/a	0.30
Financials	n/a	0.26	n/a	0.34	_	0.09^{*}	_	0.09^{*}	+	0.02^{**}	n/a	0.50

Note: -/→ implies does not Granger-cause. *** = 1% significance level, ** = 5% significance level, * = 10% significance level. The p-values reported are those derived from testing the linear restrictions (null hypotheses) in equation (2.4). Where the p-values are significant, the signs of causality (+/-) are reported. Due to data unavailability, the sample start period for non-cyclical services and information technology industrial indexes in Australia is June 1993 & April 1994. Thus, comparisons may not plausible for these two industries over the whole sample period.

H_0: stock-/→exch	Whole sample period		High Oil Prices (1)		Black Monday (2)		After-Crash (3)		Asian Flu (4)		Post-EMU (5)	
H_0: exch-/→stock	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value
Stock prices -/→ Exchange rates												
Market Index	n/a	0.39	n/a	0.69	n/a	0.40	n/a	0.379	n/a	0.664	n/a	0.50
Resources	–	0.08***	n/a	0.36	n/a	0.41	n/a	0.18	n/a	0.55	n/a	0.56
Basic Industry	n/a	0.57	n/a	0.91	n/a	0.45	n/a	0.95	n/a	0.38	n/a	0.33
General Industry	n/a	0.75	n/a	0.50	n/a	0.96	n/a	0.21	n/a	0.25	n/a	0.39
Cyc. Cons goods	n/a	0.68	n/a	0.44	n/a	0.23	n/a	0.44	n/a	0.50	n/a	0.36
Non-cyc cons gds	n/a	0.79	n/a	0.88	n/a	0.73	n/a	0.62	n/a	0.88	n/a	0.91
Cyc. Services	n/a	0.62	n/a	0.94	n/a	0.45	n/a	0.30	n/a	0.12	n/a	0.85
Non-Cyc Services	n/a	0.82	n/a	----	n/a	----	n/a	0.50	n/a	0.86	n/a	0.74
Utilities	n/a	0.18	n/a	0.23	n/a	0.65	n/a	0.85	n/a	0.26	n/a	0.59
Info Technology	–	0.07**	n/a	----	n/a	----	n/a	0.39	n/a	0.15	n/a	0.16
Financials	n/a	0.51	n/a	0.14	n/a	0.18	n/a	0.78	n/a	0.33	n/a	0.52

Note: -/→ implies does not Granger-cause. *** = 1% significance level, ** = 5% significance level, * = 10% significance level. The p-values reported are those derived from testing the linear restrictions (null hypotheses) in equation (2.4). Where the p-values are significant, the signs of causality (+/-) are reported. Due to data unavailability, the sample start period for-cyclical services and information technology industrial indexes in Australia are June 1993 & April 1994 respectively. Thus, comparisons may not plausible for these two industries over the whole sample period.

Table 2.3e: Bivariate causality test between exchange rates and stock prices in Hong Kong

H_0: exch-/→stock	Whole sample period		High Oil Prices (1)		Black Monday (2)		After-Crash (3)		Asian Flu (4)		Post-EMU (5)	
	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value
Exchange rates -/→ Stock Prices												
Market Index	n/a	0.80	_	0.09^{*}	n/a	0.11	n/a	0.86	+	0.05^{**}	n/a	0.21
Resources	n/a	0.75	n/a	----	n/a	----	n/a	0.65	n/a	0.46	n/a	0.55
Basic Industry	n/a	0.57	n/a	----	n/a	----	n/a	0.67	n/a	0.16	n/a	0.93
General Industry	n/a	0.56	_	0.02^{**}	_	0.06^{*}	n/a	0.96	+	0.02^{**}	n/a	0.30
Cyc. Cons goods	n/a	0.44	n/a	----	n/a	----	n/a	0.76	n/a	0.23	+	0.003^{*}
Non-cyc cons gds	_	0.005^{***}	n/a	----	n/a	----	_	0.07^{*}	+	0.03^{**}	n/a	0.34
Cyc. Services	n/a	0.95	_	0.10*	n/a	0.20	n/a	0.93	n/a	0.51	n/a	0.64
Non-Cyc Services	n/a	0.19	n/a	----	n/a	----	n/a	0.87	n/a	0.64	n/a	0.11
Utilities	n/a	0.75	_	0.10*	_	0.05^{**}	n/a	0.74	n/a	0.28	n/a	0.95
Info Technology	n/a	0.26	n/a	----	n/a	----	_	0.01^{***}	n/a	0.75	n/a	0.99
Financials	n/a	0.92	_	0.06^{*}	_	0.05^{**}	n/a	0.40	n/a	0.51	n/a	0.19

Note: -/→ implies does not Granger-cause. *** = 1% significance level, ** = 5% significance level, * = 10% significance level. The p-values reported are those derived from testing the linear restrictions (null hypotheses) in equation (2.4). Where the p-values are significant, the signs of causality (+/-) are reported Due to data unavailability, the sample start period for resource, basic, cyclical consumer goods, non-cyclical consumer goods, non-cyclical services, and information technology industrial indexes in Hong Kong are May 1988, May 1987, July 1991, October 1993, February 1988, and May 1988. Thus, comparisons may not plausible for these two industries over the whole sample period.

H_0: stock-/→exch	**Whole sample period**		**High Oil Prices (1)**		**Black Monday (2)**		**After-Crash (3)**		**Asian Flu (4)**		**Post-EMU (5)**	
	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value
Stock Prices -/→ Exchange rates												
Market Index	n/a	0.64	n/a	0.69	n/a	0.67	n/a	0.75	n/a	0.60	n/a	0.25
Resources	n/a	0.17	n/a	----	n/a	----	n/a	0.22	n/a	0.83	n/a	0.58
Basic Industry	n/a	0.95	n/a	----	n/a	----	n/a	0.52	n/a	0.86	n/a	0.70
General Industry	n/a	0.68	n/a	0.33	n/a	0.63	n/a	0.50	n/a	0.51	n/a	0.41
Cyc. Cons goods	n/a	0.73	n/a	----	n/a	----	n/a	0.39	n/a	0.11	n/a	0.19
Non-cyc cons gds	n/a	0.64	n/a	----	n/a	----	n/a	0.73	n/a	0.61	n/a	0.95
Cyc. Services	n/a	0.88	n/a	0.72	n/a	0.52	n/a	0.79	n/a	0.65	n/a	0.92
Non-Cyc Services	n/a	0.32	n/a	----	n/a	----	n/a	0.81	+	0.07*	n/a	0.27
Utilities	n/a	0.60	n/a	0.79	n/a	0.71	n/a	0.48	n/a	0.76	n/a	0.51
Info Technology	n/a	0.17	n/a	----	n/a	----	+	0.07*	n/a	0.82	n/a	0.73
Financials	n/a	0.57	n/a	0.81	n/a	0.75	n/a	0.84	n/a	0.70	n/a	0.36

Note: -/→ implies does not Granger-cause. *** = 1% significance level, ** = 5% significance level, * = 10% significance level. The p-values reported are those derived from testing the linear restrictions (null hypotheses) in equation (2.4). Where the p-values are significant, the signs of causality (+/-) are reported. Due to data unavailability, the sample start period for resource, basic, cyclical consumer goods, non-cyclical consumer goods, non-cyclical services, and information technology industrial indexes in Hong Kong are May 1988, May 1987, July 1991, October 1993, February 1988, and May 1988. Thus, comparisons may not plausible for these two industries over the whole sample period.

Table 2.3f: Bivariate causality test between exchange rates and stock prices in the USA.

H_0: exch-/→stock	**Whole sample period**		**High Oil Prices (1)**		**Black Monday (2)**		**After-Crash (3)**		**Asian Flu (4)**		**Post-EMU (5)**	
	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value
Exchange rate -/→ Stock Prices												
Market Index	n/a	0.15	n/a	0.50	n/a	0.62	n/a	0.23	n/a	0.51	n/a	0.86
Resources	n/a	0.81	n/a	0.76	n/a	0.65	n/a	0.74	n/a	0.65	n/a	0.87
Basic Industry	n/a	0.38	n/a	0.85	n/a	0.84	n/a	0.77	n/a	0.95	n/a	0.25
General Industry	n/a	0.87	n/a	0.39	n/a	0.94	n/a	0.29	n/a	0.84	n/a	0.93
Cyc. Cons goods	n/a	0.49	n/a	0.96	n/a	0.94	n/a	0.25	n/a	0.88	n/a	0.75
Non-cyc cons gds	n/a	0.17	n/a	0.98	n/a	0.67	_	0.01***	n/a	0.86	n/a	0.84
Cyc. Services	n/a	0.91	n/a	0.80	n/a	0.68	n/a	0.64	n/a	0.65	n/a	0.98
Non-Cyc Services	n/a	0.26	n/a	0.86	n/a	0.69	n/a	0.32	n/a	0.86	n/a	0.85
Utilities	n/a	0.18	n/a	0.99	n/a	0.63	_	0.09*	n/a	0.77	n/a	0.91
Info Technology	n/a	0.96	n/a	0.92	n/a	0.73	n/a	0.64	n/a	0.44	n/a	0.84
Financials	n/a	0.84	n/a	0.96	n/a	0.75	n/a	0.77	n/a	0.64	n/a	0.92

Note: -/→ implies does not Granger-cause. *** = 1% significance level, ** = 5% significance level, * = 10% significance level. The p-values reported are those derived from testing the linear restrictions (null hypotheses) in equation (2.4). Where the p-values are significant, the signs of causality (+/-) are reported

H_0: stock-/→exch	Whole sample period		High Oil Prices (1)		Black Monday (2)		After-Crash (3)		Asian Flu (4)		Post-EMU (5)	
	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value
Stock Prices -/→ Exchange rate												
Market Index	n/a	0.40	_	0.001^{***}	n/a	0.64	+	0.003^{***}	+	0.01^{*}	+	0.02^{**}
Resources	n/a	0.65	_	0.004^{***}	n/a	0.26	+	0.004^{***}	+	0.001^{*}	n/a	0.78
Basic Industry	n/a	0.64	_	0.07^{*}	n/a	0.70	+	0.04^{**}	+	0.03^{**}	n/a	0.46
General Industry	n/a	0.26	_	0.08^{*}	n/a	0.59	+	0.001^{***}	+	0.02^{**}	n/a	0.34
Cyc. Cons goods	n/a	0.79	_	0.01^{***}	n/a	0.88	+	0.01^{***}	+	0.10^{***}	n/a	0.47
Non-cyc cons gds	n/a	0.62	_	0.003^{***}	n/a	0.89	+	0.04^{**}	+	0.05^{**}	n/a	0.23
Cyc. Services	n/a	0.34	_	0.01^{***}	n/a	0.73	+	0.001^{***}	+	0.001^{*}	n/a	0.14
Non-Cyc Services	n/a	0.50	_	0.009^{***}	n/a	0.71	+	0.02^{**}	n/a	0.33	+	0.08^{*}
Utilities	n/a	0.91	_	0.001^{***}	n/a	0.75	n/a	0.14	n/a	0.18	n/a	0.36
Info Technology	n/a	0.25	_	0.01^{***}	n/a	0.52	+	0.006^{***}	+	0.01^{*}	+	0.10^{*}
Financials	n/a	0.23	_	0.000^{***}	n/a	0.96	+	0.02^{**}	n/a	0.16	+	0.01^{***}

Note: -/→ implies does not Granger-cause. *** = 1% significance level, ** = 5% significance level, * = 10% significance level. The p-values reported are those derived from testing the linear restrictions (null hypotheses) in equation (2.4). Where the p-values are significant, the signs of causality (+/-) are reported

Table 2.4: Implications of the variations in exchange rates data (i.e. home currency vis-à-vis US Dollar, and UK Sterling) in testing Granger-causality between Stock prices and Exchange rates. Stock index data is the same in both cases.

	Exchange rates vis-à-vis US Dollar	**Exchange rates vis-à-vis UK Sterling**
Period 2: Black Monday		
Germany	Stock prices lead exchange rates (1% significance level)	Exchange rates lead stock prices (5% significance level)
Japan	No statistically significant relationship	No statistically significant relationship
Australia	Stock prices lead exchange rates (1% significance level)	No statistically significant relationship
Hong Kong	No statistically significant relationship	No statistically significant relationship
Singapore	Exchange rates lead stock prices (5% significance level)	Exchange rates lead stock prices (1% significance level)
United States	-----------	No statistically significant relationship
Period 3: After Crash		
Germany	Stock prices lead exchange rates (5% significance level)	Feedback interaction at 5% significance level.
Japan	No statistically significant relationship	Stock prices lead exchange rates (5% significance level)
Australia	Stock prices lead exchange rates (5% significance level)	No statistically significant relationship
Hong Kong	Stock prices lead exchange rates (5% significance level)	No statistically significant relationship
Singapore	No statistically significant relationship	No statistically significant relationship

United States	-----------	Stock prices lead exchange rates (1% significance level)
	Exchange rates vis-à-vis US Dollar	**Exchange rates vis-à-vis UK Sterling**
Period 4: Asian Flu		
Germany	Stock prices lead exchange rates (1% significance level)	Stock prices lead exchange rates (10% significance level)
Japan	No statistically significant relationship	Exchange rates lead stock prices (5% significance level)
Australia	No statistically significant relationship	Exchange rates lead stock prices (1% significance level)
Hong Kong	Feedback interaction at 1% significance level.	Exchange rates lead stock prices (5% significance level)
Singapore	Feedback interaction at 1% significance level.	Feedback interaction at 5% significance level.
United States	-----------	Stock prices lead exchange rates (1% significance level)
	Exchange rates vis-à-vis US Dollar	**Exchange rates vis-à-vis UK Sterling**
Period 5: Post-EMU		
Germany	Stock prices lead exchange rates (1% significance level)	No statistically significant relationship
Japan	Exchange rates lead stock prices (10% significance level)	No statistically significant relationship
Australia	Feedback interaction at 5% significance level.	No statistically significant relationship
Hong Kong	Exchange rates lead stock prices (1% significance level)	No statistically significant relationship
Singapore	Exchange rates lead stock prices (10% significance level)	Exchange rates lead stock prices (10% significance level)
United States	-----------	Stock prices lead exchange rates (5% significance level)

Table 2.5: The causality test between exchange rates & stock prices, correcting for external influences with Global Stock Index

H_0: stock-/→exch	**Whole sample period**		**High Oil Prices (1)**		**Black Monday (2)**		**After-Crash (3)**		**Asian Flu (4)**		**Post-EMU (5)**	
	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value
GMY -/→ SGMY	_	0.02^{**}	n/a	0.95	_	0.08^{*}	_	0.002^{***}	n/a	0.36	n/a	0.94
SGMY -/→ GMY	+	0.04^{**}	n/a	0.19	+	0.96	+	0.01^{***}	n/a	0.29	n/a	0.15
JPN -/→ SJPN	n/a	0.63	_	0.02^{**}	n/a	0.39	n/a	0.38	n/a	0.30	n/a	0.78
SJPN -/→ JPN	n/a	0.62	n/a	0.92	n/a	0.33	+	0.05^{**}	n/a	0.46	n/a	0.47
AUS -/→ SAUS	n/a	0.51	n/a	0.20	n/a	0.03^{**}	_	0.01^{**}	_	0.02^{**}	n/a	0.75
SAUS -/→ AUS	n/a	0.64	n/a	0.60	n/a	0.59	n/a	0.72	n/a	0.17	n/a	0.33
USA-/→SUSA	n/a	0.14	n/a	0.50	n/a	0.56	n/a	0.39	n/a	0.30	n/a	0.84
SUSA -/→ USA	n/a	0.27	_	0.002^{***}	n/a	0.91	+	0.002^{***}	+	0.01^{***}	+	0.02^{**}
HKN -/→ SHKN	n/a	0.37	n/a	0.23	n/a	0.07^{*}	n/a	0.59	n/a	0.13	n/a	0.23
SHKN -/→ HKN	n/a	0.81	n/a	0.56	n/a	0.71	n/a	0.92	n/a	0.32	n/a	0.29
SIN -/→ SSIN	+	0.07^{***}	n/a	0.38	+	0.006^{***}	n/a	0.56	_	0.01^{*}	n/a	0.68
SSIN -/→ SIN	n/a	0.11	n/a	0.15	n/a	0.41	n/a	0.33	+	0.06^{***}	_	0.08^{*}

Note: -/→ implies does not Granger-cause. *** = 1% significance level, ** = 5% significance level, * = 10% significance level. The p-values reported are those derived from testing the linear restrictions (null hypotheses) in equation (2.4). Where the p-values are significant, the signs of causality (+/-) are reported

Figure 2.1(a): Time Series of Stock Indices (in Logs)

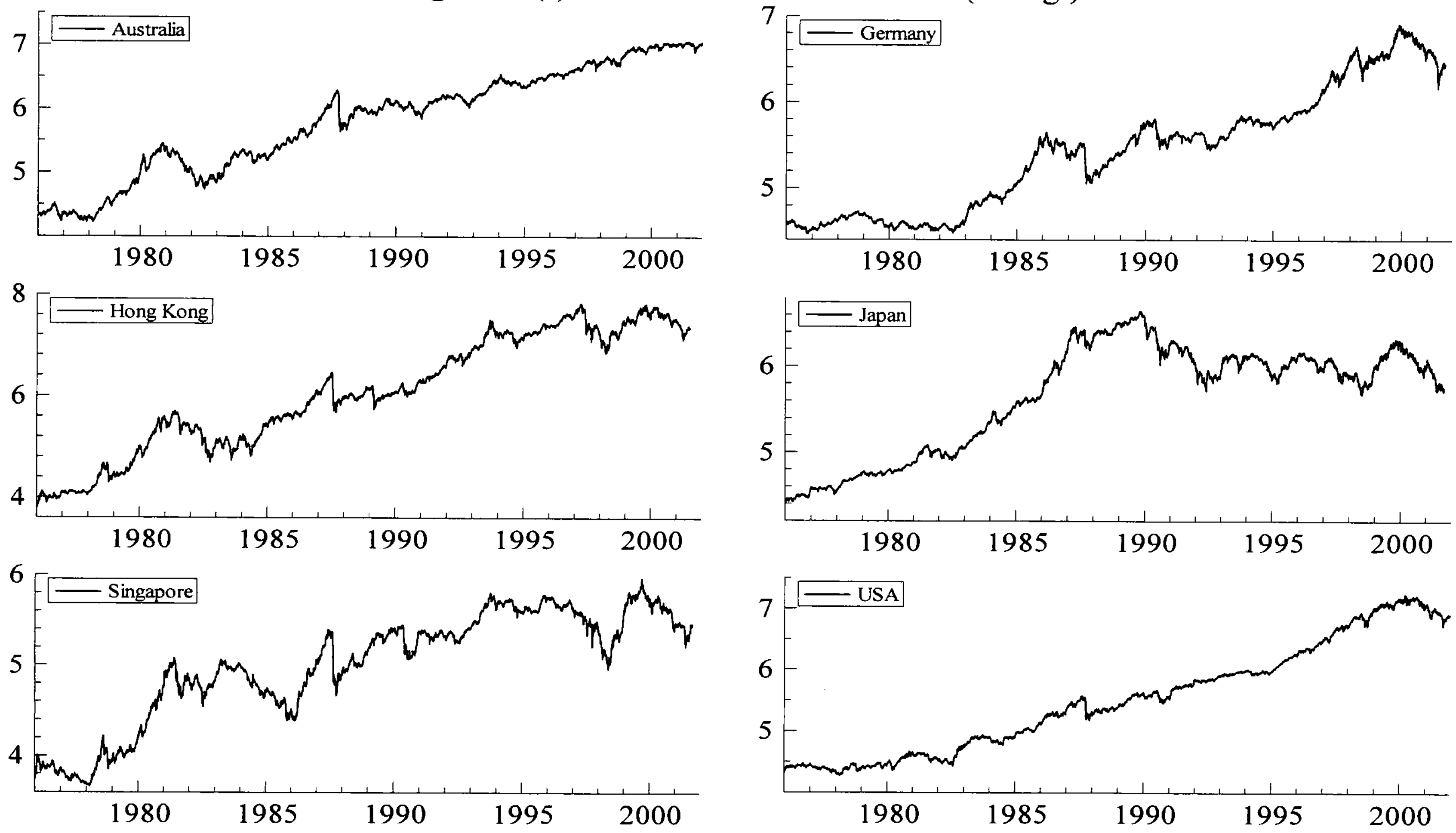
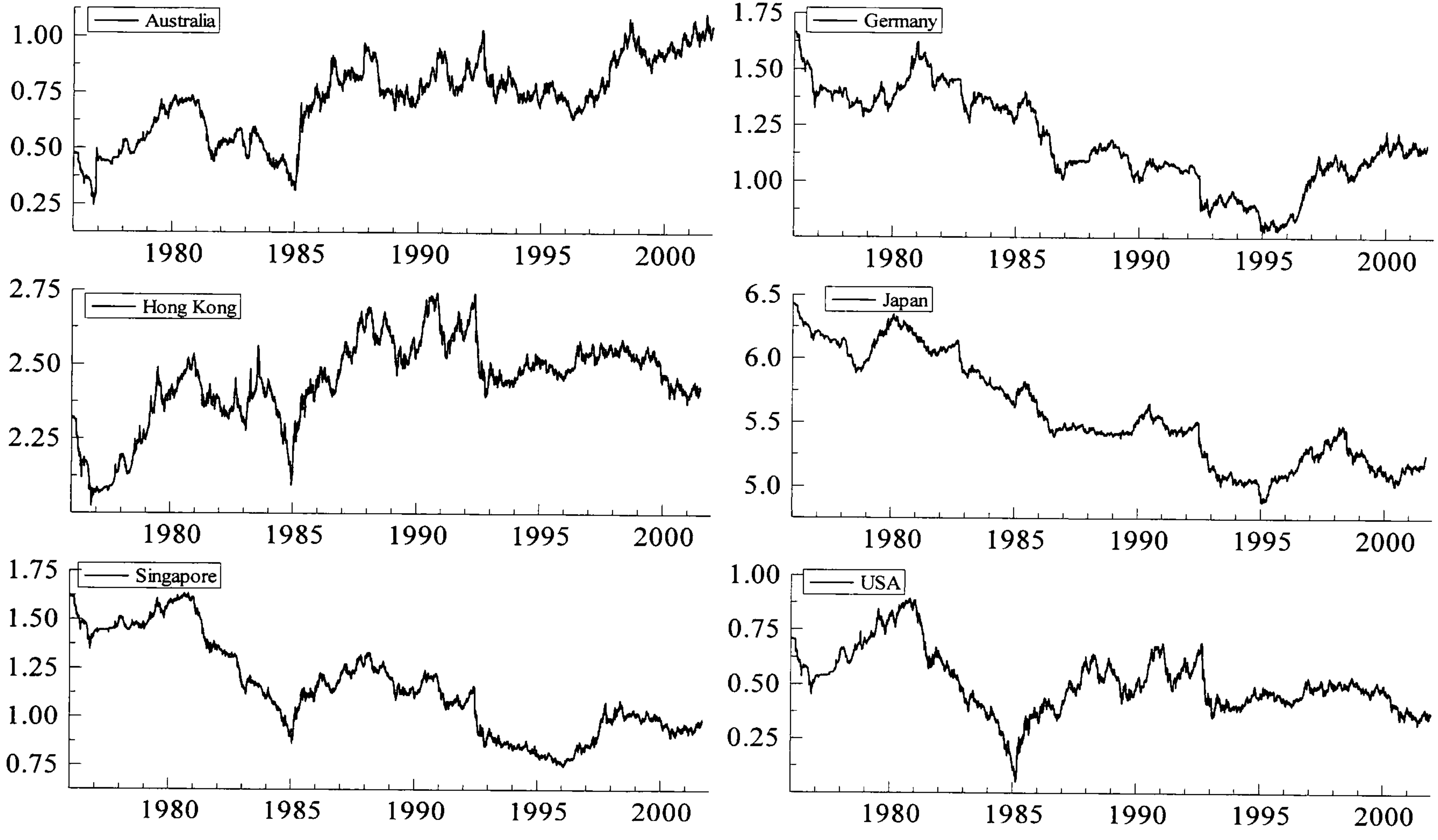


Figure 2.1(b): Time Series of Sterling Exchange Rates (in logs)



Chapter 3.

Does the Exchange Rates Regime alter both Currency and total Equity Market Risks Premia? Evidence from the EMU.

Section 3.1: Introduction.

The much-anticipated European Economic and Monetary Union (hereafter EMU) is now a reality at long last. According to the European Commission (hereafter, EC), the EMU should bring much-needed stability given some member states' experiences that high levels of inflation, the accumulation of public deficits and high long-term interest rates distort business decisions and expectations, shift the burden of a short-lived recovery onto future generations and deter investment, slow down growth and hold back job creation. A key feature of the EMU is the *euro* – the single European currency, which the EC believes would be beneficial to participating members by eliminating exchange rate uncertainty, and controlling and reducing inflation. Therefore, the EMU should lead to a reduction in the market risk premium.

The objective of this study is to investigate the extent to which EMU member states have enjoyed these perceived benefits since the euro launch in January 1999. In particular, given that the EMU and its single currency is now in place, has both currency and total equity market risk premia (or the cost of equity capital which firms apply to their investment projects) in Eurozone countries reduced, as suggested by the EC? How have both premia responded to the different exchange rate regimes or phases of the EMU? Analysis of the post-EMU behaviour of the equity market risk premium will enhance literature and shed more light on the effects of monetary union on member states equity markets and enable prospective participants to make informed decisions on whether or not to join the euro bandwagon.

First, interests centre on whether or not exchange rate is a priced factor in the equity market. As in Antoniou et al (1998a), the Arbitrage Pricing Theory (hereafter APT), based on macroeconomic and financial variables as opposed to derived factor analysis,[97] is used to model the equity market risk premium. This permits empirical testing on whether the exchange rate, alongside other factors, is viewed as a potential source of systematic risk by equity market participants, and if it is, to analyse its behaviour before and after the introduction of the euro. If there is any validity to the EC claim that the single currency will eliminate exchange rate uncertainty, then there should be a reduction in the exchange rate risk premium, and therefore in the total market premium. It should be noted that any reduction in the equity market risk premium may also result from the reduction in other potential factor risk premia, such as inflation, given the price stability objective of the EMU, as also expressed in the European Union's Stability and Growth Pact.

Given the mixed evidence on the pricing of exchange rate risks as discussed in Chapter One, this study contributes to the literature by testing the significance of the exchange rate premium in six developed equity markets, using the APT. It focuses on the equity markets of Italy, the Netherlands, Germany, and France – the largest and most developed stock markets in the EMU, representing about 80% of the total EMU market capitalisation. The study also includes two non-euro markets: the UK, and the USA, given their strong linkage to the EMU markets,[98] and to facilitate some comparisons. The pursuit of this objective also permits contribution to literature on another topical issue – the current state of the equity risk premium (hereafter ERP). Using the APT as the asset pricing model, one is able to evaluate the ERP for the countries over the last two decades. Applying the dynamic conditional correlation (hereafter DCC) of Engle (2002), the correlations between the equity market premiums of the countries are analysed in an attempt to assess the implications of the EMU (thus far) on participating markets integration – another important mission of the monetary union. This provides inferences on the convergence of the equity market premium in the eurozone, in comparison to other markets.

[97] In derived factor analysis (DFA), as applied in early empirical tests of the APT (See Roll and Ross, 1980), factors are unidentified since they are simply derived from data and therefore lack any economic meaning, whereas analysis based on macroeconomic and financial variables (MFV) provides a more direct link between corporate strategic policies and changing economic events. Moreover, Chen and Jordan (1993) find that there is little difference between the forecasting ability of the DFA and the MFV methods.

[98] See Yang et al (2003) for further details on linkages between these equity markets.

As established, testing APT that uses observed variables is based on the notion that stock prices react to *news* regarding macroeconomic and financial variables. Since news is akin to *unanticipated or unexpected information*, investors form expectations of the factors that command a risk premium in asset markets. Therefore, the method used in deriving agents' expectations formation processes will influence the factor return generating structure. The traditional condition for unanticipated components of factor changes is that they are *white-noise*, i.e. mean-zero, serially uncorrelated processes. However, following Priestley (1996), another important criterion is stability. To meet these two objectives and for robustness purposes, the Kalman Filter and an ARIMA methodology described in Juntilla (2001) are both employed to model expectations. The efficiency of both methods with respect to APT innovations is therefore evaluated in this study.

To anticipate some of the results, there is evidence of different priced factors in the various countries from January 1980 to June 2002. More importantly, the exchange rate risk premium is significantly priced in four of the six equity markets. There is some similarity between the return generating factor structure under Kalman-filtered and ARIMA innovations unlike previous studies, and mixed evidence regarding their APT efficiency. Recursively estimating the model from January 1989 to June 2002, this study finds that movements in the resultant premiums generally reflect economic events. There is an increase in the exchange rate risk premium in the larger eurozone markets of France and Germany after an initial 'europhoria' in the early months of 1999, with increased volatility in the latter country. However, unlike Germany, there is a reduction in the French equity market premium. The Italian exchange rate and equity market risk premiums appear to have stabilized considerably post-euro launch. The Dutch exchange rate premium has reduced considerably, though the equity market premium appears to rise towards the end of the analysis period. Results for the UK show a decline in both exchange rate and equity market risk premiums, whilst the US exchange rate risk premium rises post-1999, though the equity market premium is more or less stable. The study reports an average annual ex ante ERP figures ranging from 2.75 percent in Germany to 6.6 percent in Italy. Although there is increased correlation among the eurozone equity market premiums, the increase cannot be attributed strictly to EMU factors.

The rest of the chapter is organised as follows: Section 3.2 discusses the common European currency and its rationale, Section 3.3 discusses the Arbitrage Pricing Theory (APT) and estimation issues; Section 3.4 outlines the macroeconomic and financial variables used in the study, and the data; Section 3.5 illustrates the methods for generating innovations; Section 3.6 provides and discusses the empirical results; and Section 3.7 analyses the dynamic conditional correlation between the equity and exchange rate markets premia. Section 3.8 summarises the chapter.

Section 3.2: The Euro and its Rationale.

This section discusses briefly, the history of European economic and monetary union, recognising the various policies initiated over time to achieve this goal, and the rational for the monetary unification with respect to the countries in this study. Some alternative views to the notion held by the EU that a single currency leads to exchange rates stability are also discussed.

Towards a Common European Currency.

The introduction of euro notes and coins on January 1, 2002 signalled the end of the long and hard journey towards a European single currency. The evolution of this currency can be traced back to mid-20th century. With the belief that a common European market could increase economic prosperity and help towards promoting closer ties among the people of Europe, the 1957 Treaty of Rome – signed by Italy, Belgium, France, the Netherlands, West Germany, and Luxembourg – established the European Economic Community (EEC). Subsequently, the European Summit at The Hague in December 1969 made single currency an official objective, appointing then Prime Minister of Luxembourg, Pierre Werner to report on exchange rate volatility reduction. The Werner Report, published in October 1970, proposed a three-stage process for achieving complete monetary union by 1980, and called for the centralisation of member states macroeconomic policies entailing the total and irrevocable fixing of parity rates and the complete liberation on movements of capital.

Following the demise of the Bretton Woods dollar-peg in March 1973, a "currency snake" involving the tying together of the currencies of Germany, Denmark, and the

Benelux countries was achieved. By March 1979, European Monetary System (EMS) began with the Exchange Rate Mechanism (ERM), defining rates in relation to the European Currency Unit (ECU) – a quasi-currency representing an average of participating countries, and allowing a fluctuation band of ± 2.25% (± 6% for Italy). With pervasive capital controls and wide inflation differentials, there were eleven realignments from March 1979 to January 1987. In 1986, the Single European Act, which modified the Treaty of Rome, was signed, setting up a framework for the single European market. Subsequently, the European Council met in June 1988 in Hanover and empowered the Delors Committee to set plans for a common currency. After consideration of the Delors Report in 1989, the European Council agreed that the first of three stages of the Economic and Monetary Union (EMU) will begin in July 1990. Two countries were admitted to the ERM - Spain (in 1989) and the UK (in 1990).

Stage one of EMU began in 1990 with the narrowing of the ERM bands and closer cooperation between economic policy and between national banks. At the Maastricht Treaty in December 1991, plans for a single currency by the year 2000 were made. Strict rules were agreed for those joining including targets for inflation, interest rates, and budget deficits. However, Denmark and UK exercised their "opt-out" options from stage three of the EMU. Shortly after Portugal joined in 1992, the ERM was in crisis. German interest rate rose, prompted by fears of overheating economy and inflationary pressures following fiscal expansion after Unification in June 1990. Following September 1992 speculative attacks, Finnish Markka depreciated, Swedish interest rate was raised, the UK and Italy drop out of the ERM, the peseta devalues and Spain reintroduced capital controls. Later, Portuguese escudo and the Irish Punt devalued, and the Swedish krona and Norwegian Krone floated. In August 1993, following concerns of French Franc fluctuations, the ERM was suspended and a new system was introduced with fluctuation bands widened to ± 15% in wake of speculative attacks.

Stage two of the EMU began in 1994, starting with the establishment of the European Monetary Institute (EMI), the forerunner of the European Central Bank (ECB), and in January 1995, Austria, Finland, and Sweden joined the European Union. The name "Euro" was chosen for the new currency at the European Council in Madrid in

December 1995, and the single currency was to be introduced in three new phases: (a) preparation period (from 1/1/98 to 31/12/98) when EU leaders' selected countries that would qualify for the EMU, (b) transitional period (from 1/1/99 to 31/12/01) when national currencies and the euro coexist such that the euro, though mainly an accounting currency i.e. electronic euro, is irrevocably fixed to the national currencies, and (c) Changeover period (from 1/1/02 to 30/6/02) when all national currencies will be withdrawn making the euro the only legal currency within the EMU. Italy rejoined the EMS with target bands, at devalued rate in November 1996.

In 1998, the European Council agreed that 11 member states – Belgium, Germany, Spain, France, Italy, Ireland, Luxembourg, the Netherlands, Austria, Portugal and Finland – were ready to adopt the euro on January 1, 1999. The European Central Bank (ECB) was established in Frankfurt to maintain price stability and set interest rates in the eurozone. Stage three of the EMU began on January 1, 1999 with the launch of the euro as an electronic currency used by banks, foreign exchange dealers, big firms, and stock markets. After meeting the criteria, Greece joined the euro bandwagon in January 2001.

Why the EMU?

The rationale for the single European currency is one of the most rigorously debated issues in European history. The question remains: is the EMU a political project – in which case the euro currency is a means to attaining an end of political integration, or is it an economic project? The Rome Treaty of 1957 called for the ever-closer union of the people of Europe. On the continent, the EMU project is seen as a tool for political integration i.e. towards a 'United States of Europe'. German Chancellor Helmut Kohl, arguably the leading architect of the EMU, noted in a speech to the council of Europe in September 1995 that "*we want the political unification of Europe. If there is no monetary union, there cannot be a political union and vice versa*" (Notts Commission Report, chapter 5). Wim Duisenberg, pioneer President of the ECB also noted that "*the process of monetary union goes hand in hand, must go hand in hand, with political integration and ultimately political union. EMU is, and always was meant to be, a stepping stone on the way to a united Europe*" (Notts

Commission Report, chapter 5). Economists have tried to justify the single currency by using the theory of Optimum Currency Area (OCA), which postulates that subject to certain economic criteria,[99] a currency union would be beneficial to participating member nations. Thus, the fact that politics may be the ultimate objective of the monetary union does not mean that economics is not important.[100]

According to the European Commission (EC),[101] given that fluctuation of exchange rates causes uncertainty among companies, the EC believes that suppression of exchange rate variability will brighten business climate considerably leading to about 5% rise in the community income due to impetus in investment brought about by eliminating exchange rate risk. A single currency also eliminates transaction costs associated with converting one EC currency to another, such that cost savings may vary from 0.1 to 0.2 % of GDP in large countries, and 1% of GDP for small open and less developed states. Moreover, a single currency may reduce inflation given price stability and stable interest rates brought about by common monetary policy. If goods and services are priced in one currency, the competitive effect of the single currency will be strengthened since prices of goods, services, and resources in different countries are easily compared thus encouraging trade. The EC also believes that the single currency allows genuine merger of constituent national financial markets,[102] yielding benefits in terms of market depth and efficiency.

As may be expected, a monetary union is not without its costs. There is a loss of national control over economy arising from the loss of control of three key macroeconomic tools, namely: interest rates, exchange rates, and fiscal policy, thus resulting in limited tools for absorbing country-specific macroeconomic disturbances.

[99] Some of these are the criteria proposed in the original optimum currency area literature, such as labour and capital mobility (Mundell, 1961), openness (McKinnon, 1963), and product diversification (Kennen, 1969). Others, more recently emphasized, have to do with the relative magnitude and synchronization of country-specific business cycle shocks (Eichengreen, 1992).

[100] The Nott Commission Report (1999) suggests the dominance of politics over economics, noting that the political imperative was responsible for the relaxation of the Maastricht convergence criteria (especially in the case of the Belgian and Italian debt/GDP ratios) to allow the eleven countries to join the Euro in the first wave.

[101] See Commission of European Communities (1992).

[102] The EC believes that creating a single market for equities is essential to compete with the USA, where the size and strength of the equity market has been a key factor in America's robust economic performance over the last decade.

As a result, the effects of domestic shocks on other member states may be more prominent under the EMU than under a floating exchange rate regime.

It is also important, perhaps, to discuss the EMU rationale with respect to the various interests of the *eurozone* countries in this study. One of the biggest challenges that confronted Italian monetary authorities in the 20th century was how to tackle the spiralling inflation that characterised the economy, badly affecting the value of the Italian Lira such that by the end of the 1970s, Italians had become used to counting their money in thousands and millions. Various measures, beginning with Mussolini's "Battle of the Lira" which fixed the Lira to the British Pound in the 1920s, restrictive monetary policy and price controls of the 1960s, and membership of the EMS in the late 1970s, all failed to bring inflation under control. Moreover, Italy's political instability (often resulting in a lack of coherent economic policies), corruption, and mismanagement of public funds[103] did not help the situation. With such a rocky monetary history, it is perhaps unsurprising that Italians were far and away the most enthusiastic of the eurozone populations for the single currency with 83 percent in favour.

Klaster and Knot (2002) describes the Netherlands economy as "*a small open economy that attaches great value to stable exchange rates*" – (p. 509). As the 6th largest exporter in the world,[104] the Dutch economy is vulnerable to international economic shocks due to a relatively small manufacturing sector dependent on imported materials and an economy based on foreign trade. In line with the quest for exchange rate stability, the Netherlands – home to the world's oldest regular stock market, the Amsterdam Stock Exchange, very closely linked the Dutch Guilder to the low-inflation Deutsche Mark – the currency of its largest trading partner,[105] throughout the stage two of the EMU.[106] In fact, Berk (2002) notes that since 1983, the Netherlands has formed a de facto monetary union with Germany.

[103] See Miccio (1998).
[104] See OECD country report 1999.
[105] According to the Netherlands Foreign Investment Agency (NFIA) in 1999, Germany accounted for 25.5% of exports and 19.2% of imports.
[106] In fact, the Dutch Guilder was the only currency which maintained its fluctuation bands with the DM when all other EMS currencies widened the band to +/- 15% in August 1993.

Eichengreen (1994) observed that since Germany is the largest economy in Europe, and the least susceptible to inflationary pressures, Germany of all EC states had the least reason to be attracted to the EMU. "*However, its support for the Maastricht Treaty, according to popular view, is that it offered to trade monetary union, for which it had little intrinsic desire, for an expanded foreign policy role within the context of an EC defence policy*" – (Eichengreen 1994, p.2). France, the second largest economy in the EMU, combines modern capitalist methods with extensive, but declining government control and interaction in key sectors of the economy. Though France had experiences of high inflation and unemployment rates over the last two decades, politics may have significantly influenced membership of the EMU. Eichengreen (1994) reiterates that the memory of two devastating wars between Germany and France plays a non-negligible role in the desire for EMU between the two countries. What is clear is how adjustment to the euro plays itself out will vary from country to country, since it appears that each country will face its own unique challenges.

At this point in time, the UK's potential membership of the EMU is hotly debated in all straddles of the British economy. Being a member of the EU, is the UK missing out on the supposed benefits of the euro single currency? Should the UK ditch the pound sterling? Bessler and Young (2003) find that the USA market is the only market that has a consistently strong impact on price movements in other major markets in the long run. Thus, including the UK and USA in this study should facilitate a deeper understanding of the EMU impact by examining how the equity markets risks changed (if at all) following the introduction of the euro. Note that the EC also expects the eurozone's major trading partners to benefit, though to a lesser extent, from the EMU.

The EMU and Exchange Rates Stability: An Alternative Opinion.

Empirical analyses do not always subscribe to the EC's perception that the single European currency will eliminate exchange rate variability.[107] The 'benign neglect effect' of Benassy-Quere et al (1997) postulates that the creation of the euro will eliminate the European Union's interests in international cooperation in exchange

[107] In this sense, exchange rates variability denotes the variability of the euro against external currencies, compared with the variability of a basket of the pre-EMU currencies of EMU participants.

rates management and lead the EMU countries to attach less weight to exchange rates stability as a policy objective, showing further that a change from the pre-EMU exchange rate regime to the euro single currency increases exchange rate variability in response to all types of shocks except symmetric European supply shocks. Cohen (1997) suggests that the EMU will increase exchange rate variability in response to price shocks and reduce it for demand shocks, concluding that "*there is no apriori reason to believe that the euro will be a more stable currency than its predecessor.... unless we believe we are entering a world in which price shocks will become less prevalent relative to demand shocks*" – p. 409. Using a three-country, three-good, factor-specific model of trade with wage rigidities to investigate how the EMU is likely to affect exchange rate variability, Ricci & Isard (2002) find that variability is likely to be lower under the EMU than under the pre-EMU when there are shocks to industries in which large economies countries are specialised whereas variability is likely to be higher under EMU when there are shocks to the industries in which the small euro-area countries are specialised. In light of these findings, one may not necessarily observe a decline in the currency risk premium, following the commencement of the EMU.

On a general note, regardless of whether the EMU reduces the variability of exchange rates or not, empirical evidence suggests that the EMU has reduced the volatility of some euro-area equity markets. Using a Markov-switching three-regime model to analyse the effects of the EMU on the volatility of daily stock market returns in Germany, Italy, Spain, and France from January 1988 to December 2000, Morana & Beltrati (2002) find that there is a significant reduction in the volatility of equity markets of historically unstable economies like Italy and Spain, due to a reduction of volatility of macroeconomic fundamentals. In addition, they suggest that the reason for reduction in volatility of the Italian stock market is the stabilisation of economic fundamentals and not the elimination of exchange rate risk. Morana & Beltrati (2002) also find that the volatility of the French equity market has reduced relative to the volatility of German, UK, and US equity markets.

Section 3.3: Estimating the Arbitrage Pricing Theory (APT).

In this section, issues concerning the estimation of the APT as an empirical model of asset prices are discussed.

The APT Re-visited.

Although a CAPM model can be used to assess the pricing of exchange rate risks within each national stock markets as in Vassalou (2000), this study opts for the APT as its empirical model given evidence from several studies that the APT outperforms the CAPM (whatever the version).[108] Moreover, the APT allows the inclusion of other key macroeconomic variables such as inflation, interest rates, and money supply that would be directly affected by the EMU, within the equity pricing model, following the suggestions of Morana & Beltrati (2002) that strict fiscal discipline associated with the Maastricht Treaty and the Stability and Growth Pact may be responsible for the reduction in the volatility of euro area stock markets, rather than the elimination of exchange rate risks. Therefore, the APT model will enable the 'culprits' of any change in the equity market risk premium to be more easily identified.

The APT was introduced in Ross (1976) as an alternative to the Capital Asset Pricing Model (CAPM) of Sharpe (1964) and Lintner (1965). The fundamental differences between the APT and the CAPM, as identified in Roll and Ross (1980) are that the APT allows more than one returns generating factor (i.e. there are multiple factors that represent the fundamental or systematic risks in the economy), and the APT demonstrates that since any market equilibrium must be consistent with no arbitrage profit, every equilibrium will be characterised by a linear relationship between each asset's expected return and its returns response loadings on the common factor. Thus, per the APT, the return on the i^{th} asset at time t (r_{it}) can be written as:

$$r_{it} = E_{it} + b_{i1}\delta_{1t} + \dots\dots\dots\dots + b_{ik}\delta_{kt} + \varepsilon_{it} \qquad (3.1)$$

where E_{it} is the expected return; δ_{jt}, $j = 1, \dots, k$, are the mean zero factors common to all assets, b_{ij} is the sensitivity of the return on asset i to changes in factor j, and ε_{it} is the non-systematic risk component idiosyncratic to the i^{th} asset with $cov(\delta_j, \varepsilon_i) = 0$ for all j.

[108] See Roll & Ross (1980), Chen (1983), Burmeister & McElroy (1988), Jorion (1991), Mei (1993), and Fletcher (2001) for more evidence on the advantages of the APT over the CAPM.

Ross (1976) shows that the covariance matrix of asset returns, Σ, can be written as:

$$\Sigma = BB' + \Gamma, \tag{3.2}$$

where BB' is the matrix of factor risk and $\Gamma = E(\varepsilon\varepsilon')$ is the matrix of idiosyncratic risk assumed to be diagonal i.e. asset returns have a strict factor structure as idiosyncratic risks are assumed to be diversified away and in the limit are equal to zero.

As such, the only source of risk is systematic in nature and the equilibrium expected excess return on the i^{th} asset (defined as $E_i - \lambda_0$ where λ_0 is the risk free rate) is given by the approximate linear relationship:

$$E_{it} - \lambda_0 \approx \lambda_1 b_{i1} + \lambda_2 b_{i2} + \ldots\ldots\ldots\ldots + \lambda_k b_{ik} \tag{3.3}$$

where $\lambda_j, j = 1, \ldots, k$, are the risk premiums corresponding to the risk factors δ_j, $j = 1, \ldots, k$, and b_{ij} is the sensitivity of the return on asset i to changes in factor j.

Chamberlain and Rothschild (1983) and Connor and Korajczyk (1993) find that the diagonality restriction on the covariance matrix of idiosyncratic returns in the Ross (1976) APT version is not only an unnecessary condition for the APT to hold, but is also too restrictive in the sense that it does not account for cross-correlation in idiosyncratic returns.[109] They then suggest a weakening of the diagonality restriction to allow cross-correlation in idiosyncratic returns, in which case asset returns are said to follow an approximate factor structure.

In estimating an APT model that enables non-diagonal idiosyncratic return covariance matrix, McElroy et al (1985) introduce a multivariate regression methodology which treats the APT as a system of non-linear Seemingly Unrelated Regressions (NLSUR) which imposes the crucial cross-equation pricing restriction that the prices of risk are the same for all assets. Assuming that Eq. (3.3) is an equality, solving for E_{it} and substituting into Eq. (3.1) gives:

[109] See Connor and Korajczyk (1993) for more details.

$$\rho_{it} = \sum b_{ij}\lambda_j + \sum b_{ij}\delta_{jt} + \mu_{it} \qquad (3.4)$$

where ρ_{it} is the excess return on asset i at time t defined as $r_{it} - \lambda_0$, and μ_{it} is the idiosyncratic return of asset i at time t.

As implied in Eq. (3.4), the NLSUR technique allows the joint estimation of the risk premium and the factor sensitivities thereby eradicating the errors-in-variables (EIV) problems which plague the Fama and Macbeth (1973) two-step methodology of APT tests in which asset sensitivities to the factors in one period are first estimated, followed by the cross-sectional estimation of the prices of risk.[110] To see how the NLSUR technique allows the testing of the crucial cross-equation pricing restriction that the prices of risk are the same for all assets, consider the unrestricted version of Eq. (3.4):

$$\rho_{it} = \alpha_i + \sum b_{ij}\delta_{jt} + \mu_{it} \qquad (3.5)$$

where α_i is a constant. Comparing Equations (3.4) and (3.5) shows that the cross-equation pricing restriction that the prices of risk is equal for all assets i is $\alpha_i = \sum b_{ij}\lambda_j$. This restriction has been tested in Priestley (1996), Antoniou et al (1998a, 1998b) using a likelihood ratio test.

Since it has been suggested that portfolio formation may *possibly* mitigate the EIV problem[111] in the Fama and MacBeth (1973) two-step method, another advantage of the NLSUR methodology, as noted in Antoniou et al (1998a), is that individual asset returns (rather than portfolios) can be used to estimate the APT thus enabling the cost of equity capital for individual securities to be estimated and evaluated. Given interests in the behaviour of the equity market risk premium (which according to Burmeister and McElroy (1988) may be treated as endogenous i.e. on the left-hand side, enabling a generalisation of the APT to allow for unobserved factors which are proxied by individual securities not included in the sample) an equation for the excess return on the market portfolio of the nature:

[110] See Shanken (1992) for further information on the EIV problem.
[111] See Blume and Friend (1973) for further details.

$$\rho_{mt} \quad = \quad \sum b_{m\,k-1}\lambda_{k-1} \quad + \quad \sum b_{m\,k-1}\,\delta_{k-1,\,t} \quad + \quad \mu_t \qquad (3.6)$$

where ρ_{mt} is the excess return on the market portfolio, $b_{m\,k-1}$ is the is sensitivities of the return on market portfolio to factors $K - 1$, λ_{k-1} are the prices of risk, and δ_{k-1} are the observations on the factors $K - 1$ at time t. μ_t is the error term.

needs to be included with the system of equations of individual security returns to be estimated. However, since the study is also interested in the effects of the market portfolio return on the return of individual securities (in which case the return on market portfolio is exogenous and appears on the right hand side), a non-linear three stage least square (NL3SLS) technique is used to estimate our APT model, in light of Burmeister and McElroy (1988), rather than NLSUR.

Three-stage least squares requires three steps: first-stage regressions to get predicted values for the endogenous regressors (instrumental variables, which are uncorrelated with the error term, are used as regressors to model the predicted values); a two-stage least-squares step to obtain parameter estimates (using the predicted values of the regressors) and to get residuals to estimate the cross-equation correlation matrix; and the final estimation step, which accounts for cross-equation correlation of the errors. In essence, NL3SLS combines the N2SLS and NLSUR methods to take into account both simultaneous equation bias and cross-equation correlation of the errors.[112]

Following Amemiya (1977), current and squared values of the exogenous variables are specified as instrumental variables, and the market return is instrumented using the fitted and square fitted values from a regression of excess returns on the market portfolio on the other factors, in line with Antoniou (1998a) thus enhancing comparability of results of the two studies.

[112] See Gallant (1987) for more details on NL3SLS.

Section 3.4: Macroeconomic and Financial Variables, and Data.

This section discusses the potential candidature of some macroeconomic and financial variables for the return-generating model of the Arbitrage Pricing Theory (APT), and then, describes the data set employed in the estimation.

Macroeconomic and Financial Variables.

Since the APT model does not prespecify the macroeconomic and financial factors that may carry risk premia, there is a possibility of including a wide variety of factors in estimating an APT model, possibly resulting in datamining. However, Chen et al (1986), Jorion (1991), and Antoniou et al (1998a) based their choice of factors on the present value model of share prices which states that any factors that affect future dividends, which ultimately depend on future cashflows, and the discount rate will affect stock prices, and thus returns, and will therefore carry a risk premium. To show this, let stock prices (P) be written as expected discounted dividends:

$$P = E(c) / k, \qquad (3.7)$$

where E is the expectations operator, c is the dividend stream and k is the discount rate.

Therefore, any factors that change the discount rate and the dividend stream will carry a risk premium. In addition to the factors used in Priestley (1996) and Antoniou et al (1998a and 1998b), this current study includes three factors – imports, exports, and tax revenue, given our interests in currency risks. Evidence from Patro et el (2002) suggests that these factors contribute significantly to and may be useful predictors of currency risks, although other studies find that the factors may directly affect the value of firms. Therefore, inclusion of the three factors may allow 'spurious' priced currency risks to be avoided. All the factors used in this study and their possible links to stock returns are discussed below.

Term Structure and Default risk

Given that the discount rate, being an average of rates over time, is affected by the level of rates, the term-structure spreads across different maturities, and risk premium (default risk), unexpected changes in both the risk free rate of interest and the risk premium will affect pricing, the time value of future cash flows, therefore equity returns. Chen et al (1986) notes that both term structure and default risk are a direct measure of risk aversion implicit in pricing with the former being a proxy for the business cycle, and the latter the overall business risk. The effect of these two factors on equity returns is also documented in Fama and French (1993) and Campbell (1987).

Inflation.

The relationship between inflation and stock returns is well grounded in economic theory. The *Fisher Hypothesis* states that nominal asset returns move one-for-one with expected inflation, such that expected real returns are independent of expected inflation. The Fisher Hypothesis is written as:

$$E_t R^i_{N,t+N} = r^i + E_t \pi_{N,t+N} \qquad (3.8)$$

where $R^i_{N,t+N}$ is the continuously compounded nominal return on asset i over the period t to $t+N$, $\pi_{N,t+N}$ is the continuously compounded rate of inflation over the period t to $t+N$, r^i is the ex ante real return on asset i (assumed constant), and E_t denotes expectations as of time t.

Although empirical studies[113] suggest that stock returns are negatively correlated with inflation rejecting the Fisher Hypothesis, Boudoukh and Richardson (1993) and Engsted and Taggaard (2002) find evidence that the hypothesis holds in the long run. Using principal-agent analysis, Jovanovic and Ueda (1998) finds that unexpected inflation shifts real income from firms (the principals) to workers (the agents), and thereby lowers stock returns because a positive price-level shock makes sellers think they are producing better goods than they really are, splitting this apparent windfall with workers who get a higher real wage.

Exchange rates

As mentioned in earlier chapters, the exposure of stock returns to unanticipated movements in exchange rates derives from translation exposure (the sensitivity of

[113] For instance, see Fama and Schwert (1977), and Barnes et al (1999).

home currency book values and accounting earnings to changes in exchange rates, arising from foreign currency investing and financing activities), transaction exposure (the sensitivity of the home currency future settlement value of the firm's existing contracts denominated in foreign currency to exchange rates changes) and lastly operating exposure (the sensitivity of the home currency economic value of the firm to changes in exchange rates), reflecting the responsiveness of the price and cost competitiveness of firms to fluctuations in currency values.

Commodity Prices.

In economic theory, commodity prices have been closely linked to standard models of exchange rate determination such that its relationship to equity returns may result from this.[114] Chen and Rogoff (2003) finds that commodity prices have a strong and stable influence on floating real exchange rates with the magnitude of the effects consistent with predictions of standard theoretical models. However the relationship may not only exist because of links to exchange rates. Bailey et al (2003) found that commodity prices explain a greater fraction of stock return behaviour than currency related factors. Using volatility as a measure of risk, Kia (2003) finds that the volatility of the growth of commodity prices is a factor in equity return volatility in the US and Canadian markets.

Retail Sales.

Retail sales are a major indicator of consumer spending trends because they account for nearly one-half of total consumers spending and approximately one-third of aggregate economic activity in the US.[115] Rapach (2001) shows that aggregate consumer spending has an important effect on real stock prices in conformity to the present value equity valuation model. Strong retail sales are favourable for the stock market, particularly retail stocks but sluggish retail sales could lead to a bearish stock market. Using economic tracking portfolios (tracking expectations about future economic variables), Lamont (2001) shows that stock returns can be useful in forecasting consumer spending.

[114] See Messe and Rogoff (1983).
[115] See US census bureau, Economic Census, 1997.

Industrial Production.

The discounted cash flow valuation model states that stock prices reflect investors' expectations about future real economic variables, such as corporate earnings, or its aggregate proxy – industrial production.[116] Fama (1990) and Schwert (1990) suggest that real stock returns should provide information about the future evolution of industrial production. Using Granger Causality, Malliaris and Uruutia (1991) find that the US S&P 500 index leads industrial production. Choi et al (1999) shows that log-levels of industrial production and real stock prices are cointegrated in G-7 countries, and that the domestic stock markets in US, Canada, Japan, and the UK do incorporate information about future industrial production growth.

Money Supply.

It is noted in Rapach (2001) that money supply shocks explain about a third of the variability in real stock prices at shorter horizons. Per Conover et al (1999), conventional view suggest that a restrictive monetary environment serves as bad news as it is generally associated with higher future interest rates and decreases in the level of economic activity. They also find that stock returns in 16 OECD countries are generally higher in expansive monetary environments than they are in restrictive environments. Malliaris and Uruutia (1991) find that money supply and the US S&P 500 index exhibit contemporaneous causality.

Import, Exports, and the Trade Balance.

Theory and empirical evidence suggests a link between the trade balance (exports minus imports) and stock returns, especially through exchange rates. Aktiala and Orgler (1995) notes that an exporting firm takes into consideration the perceived impact of the different prices on sales and the risks and cost of foreign exchange exposure, to maximise the present value of net revenues in its currency. Likewise, the behaviour of importers who optimise their payment and currency-choice decisions is determined by their foreign exchange exposure and preferences. Puffer (1995) suggests from theory that if productivity and the foreign propensity to save are unchanged, a surprisingly large US trade balance deficit implies a dollar appreciation, an increase in US interest rates and negative US aggregate stock returns. The study

[116] See Choi et al (1999).

also finds that trade balance 'news' accounts for about two percent of the variation in the stock indexes on the announcement days.[117] Large trade deficit announcement yields expectations of larger trade deficits in future months and thus financial markets respond significantly to trade announcements since they affect expectations of future current account deficits through the higher future interest payments on foreign debt. Patro et al (2002) find evidence that imports and exports significantly affect currency risks (which are themselves significant) in equity index returns of 16 OECD countries.

Government Tax Revenue.

The effect of various types of taxation on equity returns is a highly discussed issue in finance. On the micro-level, corporate taxes affect cashflows and the profits of firms. On the macro-level, there is evidence of an increase (decrease) in stock market volatility following an increase (decrease) in capital gains tax (see Norongha and Ferris, 1992). Geske & Roll (1983) notes that Government principal revenues are personal and corporate taxes, such that when stock prices increase or decrease in response to anticipated changes in economic conditions, personal and corporate income moves in the same direction, inducing a similar change in government revenues. Thus fluctuations in Government revenues are closely related to stock price movements. Porteba and Summers (1983) notes evidence that dividend taxes discourage corporate investment and may have a potent effect on the cost of capital and investment strongly confirms the importance of the tax levied at both corporate and personal levels in assessing the tax system's impact on capital formation. Gultekin and Gultekin (1983) also show that strong seasonalities in the stock market returns distribution in most of the capital markets such as large January returns, in most countries, and April returns in the UK, seem to coincide with the turn of the tax year. Lang and Shackleford (2000) note that there is an increase in market value when there is a reduction in the expected capital gains if returns are expected to be taxed as capital gains. Asea and Turknovsky (1998) find that higher taxes make it less likely that households will hold risky assets like equity. Patro et al (2002) shows also that tax revenue has a positive impact on currency risks in 16 OECD countries, such that the higher the tax, the higher the currency risk.

[117] Puffer (1995) notes that this is separate from the variations caused by currency movements.

Return on Market Index.

As known, the market index is some aggregation of individual stocks that according to the present value model should reflect future economic activity. There are a good number of indicators (both domestic and international) of economic activity, which may directly or indirectly affect stock prices, but are not included among the factors discussed above due to, the difficulty in their measurement or lack of data, and for reasons of parsimony and practicality of our APT model (see also Chen et al (1986)). As noted in Antoniou et al (1998a) if there are any factors omitted from those pre-specified as above, but are priced then its effect should feed through the market portfolio as proxied by the market index.[118] For instance, Geske and Roll (1983) note that the stock market forecast changes in economic activities like corporate earnings and unemployment rates. Moreover, the role of the stock market index as a leading economic indicator is discussed in the literature (See Fama (1991)).

Data.

To estimate the APT model in Italy, France, Germany, the Netherlands, the United Kingdom, and the United States, this study uses country-specific monthly data on the macroeconomic and financial variables described above from January 1980 to June 2002. Unexpected Inflation (UNEXINF) is $\pi_t - E_{t-1}(\pi_t)$, where π is the change in the log of the CPI. Expected Inflation (EXINF) is $E_t(\pi_{t+1}) - E_{t-1}(\pi_t)$, where π is as defined above.[119] As in Chen and Jordan (1993), the Term Structure (TS) of interest rates is defined as the difference between the yield on Long-term Government Bonds (10-year maturity) and the Treasury Bill rate. Default Risk (DR) is the difference between the yield on corporate bonds and the yield on long-term (10-years maturity) government bonds.[120] Commodity Prices (CP) is the log of IMF All-Commodity Price Index. Exchange Rate (ER) is the log of the nominal trade-weighted index for each country. Real Industrial Production (RIP) is the log of the industrial production deflated by the Producer Price Index (PPI). Real Retail Sales (RRS) is the log of retail sales deflated by the Retail Price Index (RPI). Real Money Supply (RMS) is the log

[118] The findings of King et al (1994) that national stock markets are driven by unobserved rather than observed international factors adds weight to the inclusion of the market portfolio as a factor.
[119] Note that the change in expected inflation is used as the factor in our analysis.
[120] Data on default risk was collected from the Economist.

of currency-in-circulation[121] deflated by the Consumer Price Index (CPI) (All Items). Real Imports (RIMP) and Real Exports (REXP) are the logs of Imports and Exports (both denominated in domestic currency) respectively, deflated by the CPI. Real Tax Revenue (RTAX) data is based on total tax (personal, income, capital gains, etc) collected by the central government in each country,[122] deflated by the CPI. Unless otherwise indicated, all macroeconomic data were collected from Datastream.

The return on the Datastream total market index for each of the six countries is used as return on market portfolio. This choice of market return is primarily to allow some uniformity, given that other country-specific indices (e.g. FTSE all-share, Dow Jones, etc) may be calculated differently i.e. equally-weighted, or value-weighted, and this may have implications on the results.[123] Furthermore, Datastream market return may give a better reflection due to their in-depth coverage of national markets. In selecting firm-specific returns data, two important factors were considered. Firstly, returns data of financial companies (i.e. retail banks, insurance, life assurance, merchant banks, miscellaneous financial investment companies, fund managers, stock brokers, investment trusts, and real estate) are excluded. Secondly, firms that have returns data from January 1980 to June 2002[124] are selected. Returns data on securities for each country were obtained as follows: France (individual returns of 55 companies listed on the SBF-250 index), Germany (individual returns of 104 companies listed on the CDAXGEN index), the Netherlands (individual returns of 54 companies listed on the

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[121] Note that from Jan 1999, currency-in-circulation in Germany, France, Italy, and the Netherlands become currency-in-circulation (EA-wide residency).

[122] For instance, tax revenue data in the UK is the Central Govt consolidated fund: Inland Revenue receipts. Due to data unavailability, tax revenues are excluded from the APT model for the Netherlands and France. Even data for a proxy, such as Government revenue, was unavailable for these two countries for most of the time period.

[123] Note that the Datastream market index is based on market capitalisation, i.e. value-weighted. As expressed in Chapter One, Bodnar & Wong (2000) finds that the type of portfolio (value-weighted or equally weighted) may affect the significance of exchange rate risks. However, in analysing the effects of a change in monetary policy on firms in Germany, France, Italy, and Spain, Mogon et al (2002) suggest that there is little evidence that the effects of monetary policy on small firms are different from effects on large firms, so therefore, use of a value-weighted index, as in this case, may not have significant implications on results.

[124] This raises the issue of survivorship bias, the effect of which per Antoniou et al (1998b) may be conservative prices of risk. However, the solution of forming and rebalancing portfolios is criticised by Clare and Thomas (1994), who finds that the method of constructing portfolios may affect the number and type of priced factors found significant. Moreover, Davis (1996) and Elfakhani and Wei (2003) suggests that the differences in the explanatory power of certain financial variables with respect to realised stock returns for survivor stocks and the overall group is weak, at best. Also, Antoniou et al (1998b) finds evidence of common priced factors (some with similar sign and magnitude) in two equal sub sample of 138 UK equity returns, thus giving some support to the APT requirement that prices of risk be the same across the subsets of assets.

Amsterdam All-Share Index), the US (individual returns of 120 companies listed on the S&P 500 index), the UK (individual returns of 141 companies listed on the FTSE All-Share Index), and Italy[125] (individual returns of 76 companies listed on the Milan Stock Exchange). The Treasury Bill rate (1-month)[126] is transformed and used to calculate the monthly risk-free rate used in excess returns computations.

Section 3.5: Generating Unanticipated Factor Components (Innovations)

This section discusses the empirical methods employed in deriving innovations or news components from the macroeconomic and financial variables discussed in the previous section, as required by the APT model.

On the derivation of factor 'news'.

The APT does not include a model for agents' expectation formation processes. As a result, a variety of approaches have been used to model expectations formation processes. Chen et al (1986) derive their unanticipated components by taking the 'rate of change' in factors i.e. a simple first-differencing of the macroeconomic factors that enter the APT model. Chen et al (1986) therefore assume that factors follow a random walk process such that the current value is thus the expectation. Clare and Thomas (1994) derived unanticipated factor components using autoregressive models. Priesley (1996) shows that these methods are fraught with problems. The 'rate of change' methodology does not meet the white noise requirements of serially uncorrelated component in most of the macroeconomic time series data. Even with this condition satisfied in autoregressive models, Priestley (1996) shows they do not meet the requirement of parameter stability if they are to be employed as expectations generation models. In other words, autoregressive models do not rule out agents making systematic forecast errors. Given this, Priestley (1996) and Antoniou et al (1998a & 1998b) employ the Kalman Filter, generalised by Cuthbertson (1988), to generate unanticipated factor components for the APT model.

[125] Due to the very small number of Italian firms that had useable data for this period, the APT analysis for Italy is started in 1986, such that the 76 companies selected in Italy are those that had data from January 1986.

[126] The Netherland Interbank Rate is used to compute the country's risk-free rate, due to unavailability of data on Treasury bill rates.

In this study, for comparative and robustness purposes, two innovations generating models are adopted to decompose the unanticipated factor components crucial to the APT estimation: (a) an ARIMA-based methodology applied in Junttila (2001), and (b) the Kalman Filter state-space model. Stock & Watson (1996) found that these two moderate and high adaptivity time varying parameter (TVP) models perform better than fixed coefficient models of expectations generations.

(A) Non-linear least square Recursive ARIMA models.

This methodology involves an estimation of a univariate time series model on the observed factors using nonlinear least square regressions of an ARIMA model and outlier analysis, thereby taking into account the fact that agents consider possible regime changes in their adaptive expectations i.e. a learning procedure. As expressed in numerous studies, instability in autoregressive model parameters could result from structural breaks. Tsay (1988) notes that the presence of extraordinary events in an economy could easily mislead the conventional econometric analysis of time series resulting in erroneous conclusions. Clements and Hendry (1998) analysed the role of parameter stability and structural breaks in affecting the forecast performance of autoregressive models, advocating that a theory of economic forecasting which allows for model mis-specification and structural breaks is feasible and may provide a basis for interpreting and circumventing systematic forecast failure in macroeconomics. Juntilla (2001) notes that the use of an ARIMA model for forecasting purposes, without attempting to detect the timing, size, and nature of structural changes during the time period, might not be appropriate. The autoregressive models analysed in Priestley (1996) did not consider structural breaks in the time series – a possible reason for the parameter instability.

Therefore, an attempt is made to capture the effects of large exogenous shocks, using outliers, level and variance changes in time series, introduced in Tsay (1988) and applied in Balke (1993) and Chen and Liu (1993), thus accounting for possible greater variability of model coefficients induced by such shocks and improving the possibly poor longer-run forecasts. Strength of the Tsay (1988) procedure rests on the fact that the structural breaks are identified endogenously, rather than apriori, thus allowing pre-testing to be avoided. Tsay (1988) identifies three types of structural breaks in time series: Additive Outliers (AOs) which affect only one observation in the time series; Level Shifts (LSs) which increase or decrease all observations from a certain time point onwards by some constant amount; and Temporary Changes (TCs) which allow for an abrupt increase or decrease in the level of the series that returns to its previous level exponentially rapidly.[127]

In Webb (1995), stability analysis of an econometric model consists of re-estimating the model on a single or perhaps two or three sub samples. In light of Priestley (1996) and Juntilla (2001), the ARIMA model is recursively estimated to test the parameter stability.[128]

Application.

Since the identification of the order of time series integration is crucial to Box and Jenkins (1976) ARIMA modelling, this study starts by examining the stationarity and non-stationarity of the monthly macroeconomic and financial time series for the six countries, using both the Augmented Dickey Fuller (ADF) test and the Perron (PP) (1989) tests. For those time series data where both the ADF test and the PP test reject the null hypotheses of stationarity,[129] the time series are differenced once, to obtain difference-stationary series in all cases.

To aid identification of the ARIMA models, the sample correlograms (showing both autocorrelation (ACF) and partial autocorrelation (PACF) functions) of each series are constructed as in Juntilla (2001). Given that the significance of ACF-PACF coefficients at various lags may suggest the possibility of seasonality,[130] various tests (both parametric and non-parametric) are employed to formally identify stable seasonality in the various time series, namely: an F-Test between monthly data, the Kruskal-Wallis (1952) Test, the Moving Seasonality (MS) Test, and a combined test

[127] See Tsay (1988) for further details.

[128] Given that Juntilla (2001) finds that recursive (with fixed starting dates) ARIMA models perform better than rolling regression (with a five-year moving window) models, the study adopts the previous method.

[129] Where there is a difference between the results of the ADF and the PP, the latter is used.

[130] Note however that as pointed out by Rozeff and Kinney (1976), a detected significant autocorrelation for one or some of the lags does not automatically imply seasonality in the usual sense.

for identifiable seasonality based on the other three tests.[131] The inclusion of a seasonal component in the ARIMA models may therefore be required where necessary.[132] A seasonal ARIMA model includes a multiplicative term of the form:

ARIMA (p, d, q) **X** (P, D, Q),

> where P is the number of seasonal autoregressive (SAR) terms, D is the number of seasonal differences, and Q is the number of seasonal moving average (SMA) terms.[133]

Using nonlinear least squares estimation, an appropriate ARIMA model is fitted to the stationary and differenced-stationary time series. For time series with identifiable seasonality, a multiplicative seasonal ARIMA model is used. The model chosen for each variable is influenced by: the minimum values for both the Akaike Information Criterion (AIC) and the Schwartz Bayesian Information Criterion (SBC), the recursive significance of the estimated autoregressive and/or moving average parameters, the portmanteau statistic,[134] an ARCH (1) test statistic,[135] the Jarque-Bera test statistic for normality, and an examination of the ACF-PACF functions of the residuals of the fitted model. Next, to guard against possible parameter instability, the study estimates the chosen model structure using recursive regression with only a moving sample end point over the whole sample period,[136] taking into account structural breaks along the

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[131] Tests are reported in X-12 ARIMA program developed by the US Census Bureau.

[132] The final decision on seasonality rests on the results of the combined tests and the significance of the seasonal AR, MA components for each series. The use of seasonally adjusted time series was considered, but as noted in Koopman et al (1999a) techniques of seasonal adjustment may not always remove seasonality in time series.

[133] As usual, if the autocorrelation at the seasonal period is positive, an SAR term is added to the model, and if negative, an SMA term is added to the model.

[134] This is corresponds to Box and Pierce (1970), but with a degrees of freedom correction as suggested by Ljung and Box (1978). It is designed as a goodness-of-fit test in stationary, autoregressive moving-average models. Under the assumptions of the test, LB(s) is asymptotically distributed as $c^2(s-n)$ after fitting an AR(n) model. A value such that LB(s) ³2s is taken as indicative of mis-specification for large s. However, small values of such a statistic should be treated with caution since residual autocorrelations are biased towards zero (like *DW*) when lagged dependent variables are included in econometric equations.

[135] This is the Autoregressive Conditional Heteroscedasticity (see Engle, 1982) which in the present form tests the joint significance of lagged squared residuals in the regression of squared residuals on constant and lagged squared residuals. The F-statistic are shown.

[136] The first two years of the sample period (i.e. Jan 1980 – Dec 1982) are taken as fixed during the recursive estimations to allow for degrees of freedoms of the chosen models.

way as described in Tsay (1988). The chosen models for generating the innovations are reported in Appendix B1.

(B) The Kalman Filter.

The Kalman filter, introduced in Kalman (1960) is a set of mathematical equations that provide an efficient computational (recursive) solution of the least squares method, supporting estimations of the past, present, and future states even if the precise nature of the modelled system is unknown. It is designed to calculate forecasts and forecast variances for time series models, and per Harvey (1987) can be applied to any time series model that can be written in state-space form. Given that the Kalman filter is applied recursively through time to construct forecasts and forecast variances, each step of the process allows the next observation to be forecast based on the previous observation and the forecast of the previous observation, i.e. each consecutive forecast is found by updating the previous forecast.

The Kalman filter is widely used in engineering and the natural sciences, and to a lesser extent in economics and finance, although its use in the latter discipline has increased over the years. As suggested by Slade (1989), "the fact that kalman filtering techniques provide an ideal framework for estimating equations with latent (or unobserved) variables has been increasingly recognised by economists" (p. 364). Burmeister and Wall (1982 & 1987) finds that the use of kalman filtering is well suited to investigating the assumption that rational expectations always lie on a convergent path, since it can be effected in the absence of stationarity and stability unlike alternative expectation modelling techniques which are suspect without additional verification of the underlying stability hypothesis. In decomposing interest rates into expected real returns and expected inflation rates, Fama and Gibbons (1982) employ signal extraction (kalman filtering) technique since it allows modelling time series with wavering intercept. Hamilton (1985) used kalman filter to arrive at econometric estimates of agent's expectation of inflation, finding that the estimated series of expected inflation is consistent with the assertion that financial market expectations of inflation have historically been unbiased and rational and make efficient use of information available to agents. Slade (1989) finds that an application of Kalman Filter to the task of estimating the rate and direction of change in the technology of production uncovers significant cost changes that fail to be detected when more traditional methods of differentiation (or rate of change) are employed.

In generating unanticipated factor components required for APT estimation, Priestley (1996) finds that unobserved components / time varying parameter autoregressive models estimated by Kalman Filter do not only produce innovations, but also have stable coefficients.

Application.

As a starting point, the expectation generation process of the various time series are initially specified as unobserved component models – the state-space model which underlies the Kalman Filter. Using notation employed in Priestley (1996), the model is specified as:

$$X_t = X_t^* + U_t, \tag{3.9}$$

$$X_t^* = X^*_{t-1} + \gamma_{t-1} + \zeta_t, \qquad \gamma_t = \gamma_{t-1} + \omega_t, \tag{3.10}$$

Where X_t is the observation on the system (i.e. the variable of interest) and X_t^* is the state vector (or expectation of X_t). U_t, ζ_t, and ω_t are white-noise processes, suggesting that shocks to X_t and X_t^* are statistically independent. γ_{t-1} is a random-walk time-varying parameter that changes the state vector. Eq. (3.9) is known as the observation or measurement equation and Eq. (3.10) is the transition equation which determines the evolution of the expectation X_t^*.

Harvey (1987) and Priestley (1996) demonstrate the state-space Kalman Filter algorithm for one-step ahead of prediction is given (in matrices and vector notations) as follows: Let

$$z' = [1,0], \quad \alpha_t = [X_t^*, \gamma_t]', \quad \Theta = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}, \quad \nu = [\zeta_t, \omega_t]'.$$

Equations (3.9) and (3.10) can be re-written as:

$$X_t = z'\alpha_t + U_t, \qquad \alpha_t = \Theta\alpha_t + \nu_t, \tag{3.11}$$

where U_t has a variance $\sigma^2 h_t$ and ν_t has a variance $\sigma^2 Q_t$. Given that $\hat{\alpha}_{t-1}$ is the best estimator of α_{t-1} and P_{t-1} as the covariance matrix of $\hat{\alpha}_{t-1}$, the prediction equations become:

$$\hat{\alpha}_{t|t-1} = \Theta\hat{\alpha}_{t-1}, \tag{3.12}$$

$$P_{t|t-1} = \Theta P_{t-1}\Theta' + Q_t. \tag{3.13}$$

The updating equations[137] which update the estimate of X_t^* as observations of the factor X_t^* become available are given by:

$$\hat{\alpha}_t = \hat{\alpha}_{t|t-1} + P_{t|t-1}z_t\left(X_t - z_t'\hat{\alpha}_{t|t-1}\right)/z_t'P_{t|t-1}z_t + h_t, \tag{3.14}$$

$$P_t = P_{t|t-1} - P_{t|t-1}z_t z_t' P_{t|t-1}/z_t'P_{t|t-1}z_t + h_t. \tag{3.15}$$

If the residuals from these models are serially uncorrelated, they enter into the APT model as unanticipated factor components. In the event that the residuals are serially correlated, an autoregressive model with time-varying parameters is employed, as in Antoniou et al (1998a) and Priestley (1996). The measurement and transition models take the form:

$$X_t = \delta_{it} X_{t-i} + \varepsilon_t, \tag{3.16}$$

$$\delta_{it} = \delta_{it-1} + \omega_{it} \tag{3.17}$$

where δ_{it} is a $T-p$ X K matrix of observations on the lagged-dependent variable and ε_t is the factor of interest. Equation (3.10) is the measurement equation and equation (3.11) is the transition equation that models the time-varying parameter as a random walk.

[137] Both prediction and updating equations define the kalman filter.

Using maximum likelihood estimation, the Ljung and Box (1978) Q-statistic is used to test residual serial correlation in order to decide between an unobserved components model, and the autoregressive models. The model coefficient of determination (R^2) is reported. To guard against a spuriously good fit, twelve observations are withheld at the end of each series to test the predictive or forecasting ability of the chosen model in line with Koopman et al (1999a) which states that "*predictions near the end of the series give a good idea of the properties of the model and how well it fits*" – p.43. The predictive 'failure' test (hereafter *pft*) statistic[138] introduced in Koopman et al (1999a) is reported. The *pft* statistic is insignificant in all cases, suggesting that the chosen models have some predictive power. The results are presented in the Appendix (see Appendix B2).

Although two different methods of generating unanticipated factor components, as described above, are used, the correlations between the innovations of the ARIMA procedure and those of the Kalman Filter process are very high,[139] such that the results of the APT estimation, as regards priced factors, may be expected to be similar. The unconditional correlations among the Kalman-filtered innovations over the entire sample period are insignificant in most cases for the six countries.[140] It is therefore expected that the potential effects of multicollinearity on our results will be minimal.[141]

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[138] The post-sample predictive 'failure' test (*pft*) statistic in Koopman et al (1999a) is denoted as:

$pft = \Sigma\, v^2_{T+j}$, where L is the number of observations 'outside the sample' i.e. y_t, $t = T + 1,\ldots,T + L$, T is the number of observations in the state sample such that the final date of T is less than the final date of data sample L, v_T is the standardised residuals for , $t = T + 1,\ldots,L$. *pft* is approximately distributed as χ^2_L (chi-square). The null hypothesis is H_0: predictive 'success', such that if the statistic is significant, one can reject the null.

[139] The least unconditional correlation statistic between the ARIMA innovation and Kalman Filtered innovation of a particular macroeconomic variable in any of the countries is 0.87, with most being in the 0.95 region. Further details are not reported in the thesis.

[140] See Appendix B3. Interestingly, the exchange rate innovations are not significantly correlated with any of the factors in the six countries, except in the USA, where it is significantly correlated to innovations in industrial production index. Results of correlation among ARIMA-generated components are similar.

[141] Note also that Jorion (1991) and Clare & Thomas (1994) report significant correlation among their macroeconomic innovations.

Section 3.6: Empirical Results.

This section presents the empirical findings in line with the objectives. Issues concerning robustness of both the return generating model and the APT as a model of equity prices are discussed. Priced factors, together with the significance of the exchange rates premiums are discussed, and, finally the behaviour of both exchange rate and equity market premia over the period January 1989 to June 2002.

On Robustness.

Before discussing results, it is worthy to note that the sample size of returns (N) and the number of observations (T) satisfies the condition for the NL3SLS estimators to exist, namely that NT > K(N+1), where K is the number of factors, in each of the six markets. The sample size of returns should also be large enough for approximately valid asymptotic results.[142]

For each of the two techniques used to generate the unexpected components, the APT model is estimated and the results of the priced factors and tests of the APT cross-equation restrictions are presented in Table 3.1 (see below). Unlike Antoniou et al (1998a) insignificant factors are not sequentially deleted, to arrive at the "correct" model thereby avoiding possible pre-test bias. Since Gallant (1987) shows that the necessary correction to standard errors in a nonlinear system is upwards in nature, one can expect the priced factors under a 'sequential deletion of insignificant factors' process to be a subset of the priced factors found in this study, so that there should be no omitted variable bias.[143] For robustness, the test for the number of priced factors in approximate factor models developed in Connor and Korajczyk (1993) for robustness[144] is applied. Using p-values (at 10 percent significance level) based on the robust covariance estimator of Newey and West (1987) which is consistent with time series correlation and heteroscedasticity, one finds that the number of priced factors

[142] Priestley (1996) and Antoniou et al (1998a & 1998b) state that sample size of 70 returns should be large enough, one must note the smaller sample sizes for France and the Netherlands, although the N3SLS criteria is satisfied.

[143] In fact, sequentially deleting insignificant factors as in Antoniou et al (1998b) may have resulted in omitted variable bias since the number of priced factors (six) is lower than that (seven or possibly eight factors) suggested by the application of the Connor and Korajczyk (1993) test for the number of priced factors in approximate factor models in the study.

[144] This test is based on a simple statistic with results implying that if k is the correct number of pervasive factors, then there should be no significant decrease (adjusting for degrees of freedom) in the cross sectional mean square of idiosyncratic returns in moving from k to $k+1$ factors.

found in each market appears to be reasonable, though in the US the test suggests seven pervasive factors (as opposed to the eight found) with the p-value for the addition of an eight factor being 0.13.

Antoniou et al (1998b) notes that tests of the APT pricing restrictions give a good idea of whether the APT is likely to be valid as a reduction of a more general linear factor model. Reported in Table 3.1, the APT pricing restrictions are easily accepted in all six markets, suggesting that the APT seems to provide an adequate description of the behaviour of the excess returns of the assets used in the analysis.

As expected, it is clear from Table 3.1 that the two innovations techniques produce very similar return generation processes, though results are not identical (as far as size of the price of risk is concerned) in most cases. Unlike the findings of Priestley (1996) that only two of six priced factors were similar under both autoregressive models and kalman filter generated components, the priced factors using ARIMA generated residuals and kalman filtered residuals were the exact same in Germany and France. Both methods of generating innovations produced the same number and largely similar priced factors in all other countries. To formally analyse the performance of the two methods with respect to the APT in terms of explaining asset returns, in-sample performance of the model is assessed, following Mei (1993) and Priestley (1996) and the measure of mispricing in the APT models are calculated. The measure of general mispricing is given as the intercept in the following cross-sectional regressions of average actual excess returns on predicted excess returns:

$$R_i = \alpha_0 + \sum b_{ij}\lambda_j + \varepsilon_i \qquad (3.18)$$

where R_i is the average excess return on individual stocks, b_{ij} is the estimate of the sensitivity of asset i to the jth factor and λ_j is the estimated price of risk for factor j, α_0 is the measure of mispricing, and ε_i is an error term.

As in Mei (1993), this study reports the annualised measure of mispricing in Table 3.1. The adjusted-R^2 is also reported to assess the ability of priced factors to explain the return generating process, under both methods of innovations generation. Given the subjectivity of individual shares to noise, the APT model appears to perform well, explaining more than half of the excess returns-generating process in all markets.

Results from Table 3.1 appear to be mixed. The measure of mispricing is insignificant (even at 10%) under both methods. In line with Priestley (1996), the kalman filtered innovations appear to outperform the ARIMA innovations (i.e. lower mispricing and higher adj-R^2) in the UK, USA, Italy, and The Netherlands markets. However, evidence from Germany and France suggests that the ARIMA innovations outperform kalman-filtered innovations.

On 'priced' factors.

Over the entire sample period, the return generating process appears to vary from market to market, although the similarities between the priced factors in the UK and Germany are noted. Evidence from Clyman (1997) suggests that differences must exist between the factor risk premia of different countries, even if the cost of equity capital is not different. Inflation appears to be the only priced factor common to all markets, in line with Adler and Dumas (1983) which suggests the presence of inflation risk premiums in equities of all countries. The return on market portfolio is priced in all markets except Italy and the Netherlands – the two smallest markets in our analysis. The high adjusted R^2 statistic from the cross sectional regression (80% and 68% respectively) suggests that no significant national and, even more importantly, international factors are omitted thus providing evidence that accounting for macroeconomic factors reduces the impact of the overall stock market index on individual shares as noted in Chen et al (1986).

To answer the research questions, Table 3.1 shows that exchange rate is a priced factor in Germany, Italy, the UK, and also the USA contrary to Jorion (1991) and Bartov & Bodnar (1994). The result for the UK is comparable to Antoniou et al (1998a & 1998b) where exchange rate risk price is negative. In France, the price of exchange rates risk appears to be insignificant, in line with the findings of Vassalou (2000) which uses three International CAPM models to test exchange rate risks. The Kalman-filtered innovations also suggest that exchange rate is not a priced factor in the Netherlands.[145] This is particularly surprising in light of the openness of the Dutch economy and the findings of Vassalou (2000) that exchange rate risks are significantly priced. However, the fact that imports and exports (both sources of currency risks) are priced factors may have contributed to this. Moreover, the introduction of the Euro in January 1999 may have achieved the desired effects of currency risk elimination in these two countries, in which case recent events dominate historic occurrences resulting in the insignificant risk price.[146] Evidence from Mei (1993), Doukas et al (1999), and Dumas and Solnik (1999) that the exchange rate risk premium (and perhaps any factor risk premium) is not time- invariant reiterates this point.

It is therefore essential to analyse the behaviour of the exchange rate risk premium for each equity market before and after the introduction of the euro. To do this, the study estimates a model with all kalman-filtered significantly priced factors recursively from January 1989 to June 2002.[147] For France and the Netherlands, exchange rates are included in the model. The recursive estimation therefore permits an analysis of the total equity market risk premia (hence the cost of equity capital) over the period. The study calculates, for the market portfolio, the risk premium for each individual factor ($b_{mkt} \lambda_{kt}$) and the equity market premium as a whole ($\sum b_{mkt} \lambda_{kt}$).

The behaviours of the exchange rates risk premiums and the equity market premiums are charted in Figure 3.1 (see below). Note that the estimated equity market premiums are presented as annualised percentages to aid analysis and comparisons. Before results are discussed, the change (first differences) in the equity market risk premium is regressed on a constant and the change in exchange rate risk premium so as to

[145] Although the ARIMA innovations find exchange rate is a priced risk, results suggests the kalman filter innovations perform better in the Netherlands, so results are interpreted based on the latter set of innovations.

[146] To investigate this possibility, the APT model is estimated over two periods for France and the Netherlands: pre-1999, and post-1999. The result confirms that exchange rate was indeed a priced factor in the Dutch equity market prior to the launch of the electronic euro, and insignificant post-1999. Ironically, exchange rate was not a priced factor pre-1999 in the French equity market, but becomes significant post-1999.

[147] The choice of starting date allows direct comparison with Antoniou et al (1998a). It also follows the recursive procedure employed in Antoniou et al (1998a). Using data from 1980 to January 1989, the model is estimated to obtain the first estimates of the parameters. Then one observation (February 1989) is added, obtaining another set of parameter estimates, repeating this procedure to the end of the sample (June 2002)

determine whether the behaviour of the exchange rates premium had any effects on the equity market premium before and after the introduction of the euro. This is particularly important because other priced factors, especially those that may be directly affected by membership of the EMU,[148] may exert significantly different effect on the equity market risk premium. The regressions are carried out over three sub periods: the EMS/ERM (1989 – 1993), Pre-Euro (1994 – 1998), and Euro era (1999 – 2002). The results are presented in Table 3.2 (see below). In France and Germany, the susceptibility of equity market risk premium to changes in exchange rate premium appears to have largely increased since the introduction of the euro, whereas in the Netherlands and Italy, the impact of the exchange rate premium on the behaviour of equity market risk premium has significantly reduced – almost negligible in the latter country. The exchange rate premium exerts a significant influence on the UK equity premium, especially during the EMS, in line with the findings in Antoniou et al (1998a). Given the low impact of currency risks on the US equity market, the result mirrors De Santis & Gerard (1998).

France and Germany: the pre-EMU years.

Figure 3.1 confirms that the exchange rate risk premium in France was very low and relatively insignificant before the EMU. Apart from: (a) the sharp rise in November 1989 reflecting concerns over the collapse of the Berlin Wall, in the third quarter of 1990 reflecting market tensions following Iraq's invasion of Kuwait and German reunification, and in May 1998 probably highlighting market concerns following the EU special council decision on May 3 1998 that eleven member states (including France) satisfy the conditions for the adoption of the single currency on January 1 1999; and (b) the sharp decline in December 1990 following announcements of US recession, and in June 1998 until it reached an all time low with the launch of the electronic euro in January 1999 following some restoration of market confidence with the announcement of the creation of the ECB on May 26 1998 and continued belief that the single currency would eliminate exchange rates risks; the exchange rate risk premium was more or less stable prior to the latter months of 1999. The equity market

[148] The ECB sets euro zone interest rates, manages the euro currency, and provides a definition for price stability (defined as a year-on-year increase in the Harmonised Index of Consumer Prices (HICP) for the euro area of below 2%), thus market expectations on exchange rates, interest rates, money supply, and inflation within the eurozone should be directly affected.

premium appears to mirror the behaviour of the exchange rate premium around these dates, despite evidence from Table 3.2. The general downward trend in the equity market risk premium is also very noticeable, and may have resulted from a decline in the expected inflation risk premium – another source of risk the EC believes would be eliminated by the EMU. During the EMS, the equity market behaved erratically. The decline in the premium in the second quarter of 1989 coincides with the adoption of the Delors Plan for the EMU. The French market premium also fell sharply in December 1991 and November 1992 following the Maastricht Treaty agreement and the withdrawal of the Irish Punt, the Portuguese Escudo, and the Spanish Peseta from the ERM. The hike in the market premium in the third quarter of 1993 perhaps reflects market concerns over French franc fluctuations which led to substantial losses in French foreign exchange reserves and the widening of the ERM band to ±15%. The increased market confidence following the commencement of both the independence of the Banque de France (the French central bank) and stage two of the EMU (which involved the establishment of the EMI and the enforcement of the European Economic Agreement (EEA) under the Maastricht Treaty) in January 1994 is reflected by the sharp drop in the equity market premium. Moreover, market anxiety towards the euro and uncertainty about the ECB's monetary policy prior to the electronic euro launch may have resulted in the upward movement of the market risk premium.

The behaviour of the German exchange rate risk premium over the pre-euro period is highly similar to that observed in France: relatively low and steady prior to the introduction of the euro (especially after the ERM bands widened in August 1993) possibly reflecting the strength of the German Mark over this period and upward volatile movements after the euro launch. Exchange rate risk has a significant impact on the equity market premium during managed currency systems but lesser impact on the equity cost of capital in the pre-euro era, as Table 3.2 shows. Since Germany had the strongest economy in Europe, it had the least reasons for a monetary union. As stated in the *Wall Street Journal,*[149] German citizens were uneasy about giving up their known, low inflation currency for an unknown and untested single currency such that good news on the single currency implied bad news for the German Mark. The rise in the exchange rate and equity market premiums in August 1989 and November

[149] See Bond and Najand (2002).

1993 coincides with the removal of EEC trade barriers and the commencement of the enforcement of the Maastricht Treaty respectively, possibly reflecting these concerns. However, from then onwards, a downward shift in the exchange rate premium (reaching an all time low following the euro launch in January 1999) is noticeable except for the slight rise in the exchange rates premium in January 1995 and the last quarter of the same year reflecting, market fears of currency crisis that saw the removal of the Spanish peseta from the ERM, and concerns following weaknesses in the US Dollar, Yen, and the Sterling. The German equity market premium also exhibited a downward trend until the sharp rise in January 1997 and the first half of the year following warnings of "*irrational exuberance in equity markets*" by Alan Greenspan (Chairman of US FRB) in December 1996, signals of Asian corporate failures due to announcements of defaults by leading South Korean steel maker, and the sharp strengthening of the dollar due to US interest rates hikes.

France and Germany: post-EMU.

After the introduction of the euro, Table 3.2 shows that over half of the changes in the German equity premium were due to the behaviour of the euro premium. Confidence in German equity markets in November and December 1999 rose given the sharp falls in the equity market premiums, following the 'new economy' driven surge in equity prices in the fourth quarter of 1999 and the announcements of German government plans to cut corporate taxes and abolish taxes on asset sales respectively.

The announcements of continuing strong growth in the USA and optimistic earnings growth forecasts for US businesses in the third quarter of 1999 resulted in increased markets interests towards the US. Despite a bright economic outlook for the euro area economies announced by the ECB at about the same time, and apparent imbalances in the US economy, markets focused on the US causing a decline in the euro. The unabated rise in the French and German exchange rate risk premiums from September 1999 to the first quarter of 2000 suggests the 'europhoria' that prevailed since the introduction of the euro was over. The ECB President's criticism of German economic policy[150] on December 3, 1999 is widely believed to be partly responsible for the fall of the euro below the dollar parity for the first time and announcements of weaker-than-expected growth rate in Germany by the Bundesbank in January 2000 accelerated euro weaknesses as the premiums reflect. The uncertainty with the euro also caused negative financial flows that affected the whole euro area. Apart from the rise in the exchange rate premium, fears of the millennium bug (Y2K) may have also contributed to the steady rise in the equity market premium towards the end of 1999.

Concerns on the US current account deficit and investors fears of interest rate hike following announcement of stronger-than-expected economic data by the US Government at the end of January 2000, continued weaknesses of the euro, and even higher oil prices exacerbated the continuous rise in the German exchange rate and equity market premiums in February 2000. Announcements of interest rate rises by both the ECB and the US Federal Board of Reserve (FBR) in early February 2000 tilted interest rate differentials in favour of the US, coinciding with the depreciation of the euro in March 2000. Brent oil prices also reached a 9-year high in the same month. Whilst the euro remained at the mercy of US economic news for most the coming months, announcements of 'the best inflation figures for France since the independence of the French central bank' for the first quarter of 2000 in February may have reinforced strong economic outlook and growth potentials, resulting in the decline in both exchange rates and equity market premiums (except in March perhaps reflecting high oil prices) until the US Government signalled a downturn in the economy in June 2000. This, and the September 22 intervention of G-7 central banks in support of the ailing euro anchored market expectations of a stronger euro, but the exchange rate premium rose slightly in October 2000, owing to fresh tensions in the Middle East and ensuing oil price rises, as reflected in the equity market premium. The Danish vote against the adoption of the euro did not help matters. The unilateral interventions of the 'eurosystem' on November 3, 6, and 9, through reminding the markets of the euro area's sound economic fundamentals may have convinced the market as demonstrated by the continuous downward movement in the French exchange rate premium until the end of the first quarter in 2001. This intervention did

[150] Wim Duisberg criticised the German government for trying to rescue the construction group Phillip Holzman saying such actions are not in line with the EMU objective of an increasing market driven economy.

not affect the German exchange rate premium which continued to rise reflecting the weak state of the economy. Equity markets followed the same direction, the rise in the market premium in March, contrary to the euro premium, suggests the economic uncertainty in the US which prevailed following the announcements of disappointing earnings of 'new economy' companies and the slowdown in European economic growth signalled by the ECB in the same month may have been anticipated. The ECB decision on March 30 to leave interest rates unchanged, contrary to the widely anticipated reduction, and the safe-haven purchase of US bonds which sent the dollar to a 15-year high prompted fresh weakness in the euro as shown by the sharp rise in the exchange rate and equity risk premiums in April. Fears of a global recession in the second half of 2001, reinforced by fears of further assaults and dangers of war following terrorist attacks in the US is evident in the rise in the both premiums for the rest of the year, except in the French equity market premium in October and November, reflecting not only expectations of declining inflationary pressures following the sudden reduction in oil prices, but also renewed market confidence following the cooperation of the FRB and the ECB in cutting interest rates. Sharp premium rises in December 2001 and January 2002 coincided with market concerns about inflation and chaos during the introduction of the euro notes and coins, announcements of German GDP figures suggesting recession, and the wave of concerns about accounting regularities following the collapse of Enron. The exchange rates and equity premiums in France and Germany reduced significantly in February 2002, following the successful introduction of euro notes and coins. Fresh concerns and economic uncertainty due to the prospects of war in the Middle East is reflected in the rise in both premiums the following month. Announcements of US and Japanese economic recoveries in March improved economic outlook in April as shown, except in Germany due to the recession, and the announcement of disappointing US corporate earnings.

It is noteworthy to mention the difference between the behaviour of the equity market premiums of France and Germany after the euro launch. Whilst the French premium continues on a general downward trend (except in the last quarter of 1999 and early 2000), the German premium shows an upward, more-volatile trend. The greater effect of exchange rate premium on the equity market in Germany than in France and the equity premium upward trend may be due to the uncertainty and economic growth crisis as reflected by weak corporate propensity to invest[151] in Germany over the period, which contributed to the weakness of the euro in the first place. Moreover, Germany had a strong trade relationship with Asia and Russia such that it faced a relatively large decline in its external demand, following the economic crises in these countries. In sharp contrast, the economic outlook and investment appeal of France, due to low inflationary pressure and high growth figures, since the euro launch has never been better since the independence of the Banque de France.[152] This is in line with Morana & Beltrati (2002) which shows that the volatility of the French equity market reduced significantly relative to that of the German market.

Italy

The behaviour of the exchange rate premium in Italy over the estimation period[153] highlights the effects of managed exchanged rate regimes on the Italian Lira (see Figure 3.1 below). Apart from the sharp rise around the German reunification period, the stability of the exchange rate premium and even the equity market premium is noticeable during the ERM. After the EMS crisis of September 1992 which saw the exit of the Lira from the ERM, both premiums rise and become more volatile. As in Bond and Najand (2002), it appears that good news on the single currency causes an appreciation of the Lira. For instance, the fall in the exchange rate premium in January 1994 again reflects expectations when the Maastricht Treaty came into force and the sharp rise in the both exchange rate and equity premiums in February 1995 owing to anxieties following the currency crisis that saw the exit of the Spanish peseta from the ERM. The sharp rise in May 1995 also coincides with G-7 warnings of currency misalignments, and the setting of a new timetable for the introduction of the single currency following the decision by EU finance ministers that the 1997 start date was not feasible. Given the importance of the EMU to Italy, the sharp rise in the exchange rate premium in the first quarter of 1997 coincides with the EC's report suggesting that Italy may not be ready for the first stage of the EMU due to its failure to meet the debt ratio criteria,[154] coupled with sharp dollar appreciations following US interest rate hikes, prompting G7 intervention. It also appears that confidence in the Lira rose around the period of Asian financial crisis mid-1997. The sharp rise in the

[151] See Deutsche Bundesbank Annual Report 1999 – 2002.
[152] See Banque de France Annual Report 1999 – 2002.
[153] The recursive estimation for Italy is started from January 1990, to allow degrees of freedom.
[154] See Hooper (1997).

exchange rate premium in March 1998 probably reflects market concerns arising from French and German opposition to Italy's membership of the single currency, ahead of the convergence report. The EC's recommendation of Italy for EMU membership may have restored confidence as shown by the sharp drop in the exchange rate premium in April 1998. Since the May 1998 announcement that Italy met the Maastricht criteria for EMU membership, the exchange rate premium appears to be stable. Although an upward trend is noticeable, reflecting continued concerns over the euro and even poor economic growth, the characteristic volatility appears to have disappeared. In fact, its impact on the equity market risk premium (which itself has been moving downwards since the euro launch reflecting anti-inflation confidence except for rises due to euro concerns and announcements of weaker-than-expected growth results by the Bank of Italy in December 1999[155]) becomes more or less negligible, as Table 3.2 shows. Although Italy's economy did not perform strongly, inflation improved considerably from pre-euro levels.[156] Our results therefore mirror the findings in Morana & Beltrati (2002) that the volatility of the Italian stock market reduced following the introduction of the euro, and that the reason for this reduction is the stabilization of macroeconomic fundamentals and not the elimination of exchange rate risks.

The Netherlands

Figure 3.1 shows a declining Dutch exchange rate and equity market premiums during the EMS/ERM until mid-1992, with the exchange rate premium having a significant effect on the equity market premium (see Table 3.2). Unlike Germany, France, and Italy, there appears to be a downward level shift in the exchange rate premium after January 1999 suggesting a significant reduction in exchange rate risks after the introduction of the euro, as Table 3.2 also confirms. Given Dutch interests in stabilizing exchange rates, good news (bad news) on the European single currency coincides with a reduction (increase) in the exchange rate premium. For instance, the reduction in the exchange rate premium in May and October 1995 coincides with the EC's underscoring of its commitment to achieving the EMU by adopting a new timetable for the single currency in May, and the announcement of the three-step

[155] See Bank of Italy Annual Report 1999 – 2002.
[156] See De Nederlandsche Bank Annual Report 2000

process to implementing the single currency in October, respectively. The sharp rises in both exchange rates and equity premiums in the fourth quarter of 1996 reflects general market concerns over the period due to the admission and re-admission of the Finnish Markka and the *volatile* Italian Lira into the EMS in October and November respectively. The slight drop in the equity market premium in December 1996 suggests that the EU agreement on the Stability and Growth Pact restored some market confidence at least until January 1997 when both premiums rose sharply following the interest rates hikes leading to dollar appreciation until the Berlin G7 meeting announcement of objectives to curb the value of the dollar at the end of February coincides with a sharp drop in the premium in March 1997. Perhaps a more important contributor to this sharp decline (also in the equity market premium) is the announcement of the EC report that the Netherlands is one of five countries that satisfied all the convergence criteria.[157] The sharp rises in the exchange rates and equity premiums in July 1997 also reflect market worries over the Asian currency meltdown. Figure 3.1 shows that the introduction of the Euro in January 1999 led to a substantial reduction in both exchange rate and equity risk premiums. For the rest of the analysis period, the Dutch exchange rate premium appears to be below its pre-euro (post-EMS) level, whereas the cost of equity capital rises at the beginning of 2001. This reflects market concerns due to the fact that from 2001, Dutch inflation rate was the highest within the eurozone,[158] poor economic outlook due to lower-than-expected domestic demand, the economic situation of Germany (its largest trading partner) which exacerbated declining exports, and substantial US interest rates cuts.

Why, therefore, does the Netherlands unlike Germany, France, and to a much lesser extent Italy, provide some evidence to support the EU's theory that the single currency would eliminate (or at least reduce) exchange rates risks, regardless of the fact that the Netherlands has perhaps the most open economy[159] of the four euro countries thus suggesting higher susceptible to euro uncertainty? One possible explanation is that the direction of Dutch international trade is primarily euro-area oriented. In addition to being a net exporter (i.e. Netherlands recording a yearly trade surplus from 1999 – 2002), about 80% of Dutch exports are oriented at the other

[157] See Hooper (1997).
[158] See De Nederlandsche Bank Annual Report 2001.
[159] See De Nederlandsche Bank Annual Report 1999.

countries of the eurozone, compared to Germany (56%), France (60%), and Italy (55%)[160] although its proportion of eurozone arrival of goods and services to total imports (57%) is comparable to that of Germany (58%), France (60%), and Italy (55%). The importance of euro trade to Dutch trade surplus is such that the Netherlands is the only country of the four that has an *extra-eurozone* trade deficit (i.e. difference between exports and imports outside the euroarea). Therefore, the direct exposure of the Dutch market to exchange rate risk appears to have been limited by adopting a common currency with major trading partners.

The USA

How did the premiums in non-euro countries behave? The US exchange rate premium behaviour is quite similar to that of Germany: slightly U-shaped over the recursive estimation period, with sharp fluctuations after the introduction of the euro. A downward trend is noticeable in the exchange rate premium during the EMS/ERM period, when the US monetary authorities set target bands for the dollar and intervened in the currency market on several occasions. However, the end to the Cold War, Communism in Europe, and the dissolution of the Warsaw Pact may have played a prominent role in the decline of both exchange rate and equity market premiums,[161] especially as the latter starts to fall immediately after the collapse of the Berlin Wall. The sharp fall in the premium in February 1994 and the April/May 1994 rises, reflects both market expectations of a strengthening dollar due to interest rate hikes and the concerns owing to the 1994/95 dollar selling chaos which prompted Federal Reserve Bank (FRB hereafter) intervention (by buying $6.1 billion) from April 24. However, the equity market premium moved in the opposite direction in both months. The hike in the exchange rate premium in December 1994 coincides with the commencement of the Mexican Crisis. The concerted intervention in support of the dollar by the FRB and G-3 central banks from March 1995 seemed to calm market nerves judging by the decline in the exchange rate premium until the end of

[160] To calculate these figures, the study divides intra-eurozone dispatches of goods and services for each country from 1999 to 2002 by its total exports of goods and services (all in euros). The average over the three years is found, and express results in percentage. Data is from Datastream International.
[161] The breakdown of communism was expected to bring about as much as $116 billion in 'peace dividend'.

1995,[162] but the equity market premium again moves the opposite direction, falling sharply in September 1995 following financial turmoil in Japan that sees the Official Discount Rate (ODR) in the world's second largest economy cut to just 0.5%. Perhaps the rise in the equity market premium from the last quarter of 1995 reflects the general unease in the economy owing to the budget crisis[163] between President Clinton and the Republican Congress, and market concerns of a slowdown in economic expansion and deceleration of consumer spending, anchored by FRB interest rate cuts in December 1995 and January 1996. The equity market premium also rises during the last quarter of 1997 coinciding with Greenspan's warnings of unrealistic equity market gains and inflation risks. The sharp rise in the exchange rate premium in October and in both premiums in December 1998 may reflect market nervousness over rumoured hedge funds liquidation which sees bonds tumble and the December 1998 US House of Representatives impeachment of President Clinton, respectively. Since 1999, the exchange rate premium has not only been higher but also more volatile. The surge in the equity market premium in the second and third quarters of 1999 probably reflects concerns on high oil prices following OPEC's production cuts, monetary policy tightening in June and August, and "*worries about Y2K.....and expectations of an acceleration of borrowing ahead of the fourth quarter prompted a resurgence in liquidity and credit* premiums" (p. 19 US FRB Annual Report 1999). Confidence in the US dollar reached high levels in September 2000 following euro uncertainty which worsened with the Danish 'no' vote, Japanese crisis which led to Moody's cut of Japan's domestic ratings, and the announcement by US authorities of the largest release of strategic oil reserves since January 1991 Gulf War. The exchange rate and total equity market premiums rose sharply in the last quarter of 2000 reflecting the fact that "*from early September through the end of the year, stock prices fell considerably in response to the downshift in economic growth, a reassessment of the prospects for some high tech industries, and disappointments in corporate* earning" (p. 23 US FRB Annual Report 2000). It may also have reflected rise in oil prices to 10-year highs and a chaotic US Presidential Election. An upward trend appears in the post-EMU US equity market premium until after the presidential

[162] This decline may also have resulted from bad news from abroad, such as the Japanese Crisis which sees the Official Discount Rate (ODR) cut to just 0.5% in September 1995 given that the US cost of equity capital fell sharply in the same month, and the weakening of the UK Sterling in November.
[163] See O'Connor et al (1998) for further details of the gridlock and power struggle between the president and the congress over the 1996 budget.

elections turmoil in December 2000. Although the US economy turned in its weakest performance in a decade in 2001,[164] a downward trend in the equity market premium is noticeable following the decline in inflation due to sharp drop in energy prices, sharp cuts in the federal funds rates which bolstered investor confidence, and the fact that investors' had largely discounted the bleak profit news of US firms. The premium rises after September 2001, reflecting gloomy market climate following terrorist attacks in Washington and New York, announcements of 'US-in recession' by the US National Bureau of Economic Research (NBER), collapse of US energy giant Enron, prompting concerns about accounting irregularities, and Argentina's financial crisis, which sees a break in the dollar-peso link.

The UK

The movement in the UK equity and exchange rate risk premiums in Figure 3.1 are similar to that observed in Antoniou et al (1998a): sharp rises following the announcement of UK ERM membership from October 1990, and the subsequent decline until December 1991. It also appears that the crisis which saw the exit of the Sterling from the ERM was anticipated in the markets. Table 3.2 also suggests that the UK exchange rate premium behaviour had a significant impact on the declining market premium during the EMS and after 1999. The speculation of a rift between the UK treasury and the BOE over interest rate in May 1995 coincides with a sharp rise in the equity market premium. Fall in the both exchange rates and equity premium reflecting expectations of the sterling due to the unexpected rise in interest rates in August 1997 and August 1998. From August 1998, the focus of UK financial markets shifted from domestic to international development.[165] Market concerns over the turmoil in emerging markets such as the devaluation of the Russian rouble and the moratorium on Russian debt repayment and also events in Asia in August 1998 are reflected in the rise in the exchange rates premium. Market anxiety exacerbated by the belief that the US hedge fund long term-capital management had large short fall positions in a number of assets that subsequently came into demand resulting in sharp falls in bond yields of major industrialised economies in October 1998. Interest rate

[164]US FRB Annual Report 2001.
[165] See the Bank of England Quarterly Bulletin November 1998.

cuts in November 1998 helped bolster investor confidence temporarily, until the sharp sterling depreciation in December partly caused by anticipation of strong euro raised market concerns. The January 1999 speech by the Governor of the Bank of England[166] that strength of the sterling following the EMU highlights prospective weakness of the euro, coupled with interest rate hikes that helped strengthen the euro bolstered market confidence as reflected by the large decline in the exchange rate premium in January 1999. Markets were gradually attracted to UK equities after increased UK growth trend relative to the euro area[167] and increased inward takeover of UK companies furthered strengthened the pound sterling lowering the premium in March. Sharp rises in both exchange rates and equity premiums in April 1999 reflects concerns over oil prices after OPEC agreed to cut production to stem falling prices at the end of March. The strengthening of the dollar, oil price rises, and UK interest rate hikes by 50 basis points reinforced expectations of a Sterling depreciation from November 1999 to March 2000, as reflected both exchange rates and equity premiums (in addition to Y2K fears) show. However, from April 2000, the sterling continued to appreciate owing to better-than-expected UK domestic results and increased capital flight from euro area economies, as the decline in exchange rate premium and the market cost of equity capital (except in January 2001 perhaps owing to concerns over the outbreak of foot and mouth disease) shows.

It appears that the exchange rate premium in larger equity markets of the euro area (France and Germany) has not only increased (after the brief europhoria in the early months) but has become more volatile since the commencement of the EMU in 1999. Evidence also suggests the increased effects of the exchange rates premium on the cost of equity capital in these two countries although it is more pronounced in Germany where the rise in equity market premium also reflects the post-euro stagnation of the economy. Unlike Germany, the French equity market premium appears to have fallen lower than in pre-EMU era despite euro concerns in the last quarter of 1999 and may be due to the strong performance of the post-euro French economy. The smaller Italian and Dutch equity markets appear to have benefited from membership of the euro bandwagon, as far as exchange rate risks are concerned. Though a slight upward trend is noticeable in the Italian exchange rate premium, the

[166] Speech given by Sir Eddie George at the Institute of Manufacturing on Tuesday 12 January 1999.
[167] See Bank of England Annual Report 1999.

stabilising effects of the euro is apparent. This stability is also reflected in the country's equity premium which on the other hand appears to have declined like in France. Moreover, Table 3.2 suggests that the importance of exchange rate risks has diminished considerably in the Italian equity Markets. In the Netherlands, the exchange rate premium has reduced significantly as expected. However, the equity cost of capital appears to have increased towards the latter end due to inflationary pressures and economic recession in its largest trading partner. The UK, arguably the second largest economy in the EU, appears to have gained substantially by not joining the monetary union. Generally, the evidence suggests that the US market has been largely unaffected by the introduction of the EMU, signalling that the effect of the euro on stock markets is not due to modification of the currency risk premium but mainly to the stabilization of fundamentals, in line with Morana & Beltrati (2002).

Section 3.7: The Equity Risk Premium (ERP) in the Eurozone.

This section briefly discusses the equity risk premium figures in recent literature, and presents the estimates for each country. Then, the dynamic correlation of the changes in equity market risk premium among the six countries is analysed to provide an intuition on Eurozone equity market integration.

The ERP.

As per Welch (2000), the ERP is the "*single most important number in financial economics*" (p. 501). Investors need to assess what additional returns are available for taking on greater risks associated with equity investment and whether these additional returns, or premia, are sufficient. Corporate managers need to appraise the potential return and risks of specific capital projects against the cost of capital.

A wide range of ERP figures have been reported in the literature, with most pointing to a significantly different historical (ex-post) and forward-looking (ex-ante) ERP. Several considerations[168] suggest that the ERP may have shifted downwards over the past few decades due to low inflation, lower trading costs in equities, improved

[168] See Blanchard et al (1993) for instance.

regulatory and legal infrastructure to protect investors, and increased feeling of global political security. Recent studies like Ibbotson and Chen (2001) report a forward-looking long-term ERP of about 6% per annum (arithmetic mean) over the period 1926 – 2000 in the USA. Based on the earnings growth model, Fama and French (2002) estimate the ex-ante real ERP from 1951 – 2000 to be 4.32% per year. Lamdin (2002) reports average ex-ante ERP of 2.7% – 3.3% per annum in the US economy over the period 1991 – 2000. Using surveys of consensus economist forecasts from March 1979 to March 1999, Best and Byrne (2000) report ex ante ERP of about 2% for the USA and the UK. Clause & Thomas (2001) obtained a Residual Income Model (RIM)-based ERP of between 2.5% and 4.0% for the USA over the period 1985 to 1998, with a mean of 3.4%. They also provide estimates for Canada, France, Germany, Japan and the UK, with equity premiums that lie between 2% and 3% for most markets.

Table 3.3 below presents the average ex ante ERP in each equity market over the period 1989 – 2002.[169]

On Equity Risk Premium convergence within the Eurozone

One of the major objectives of the EMU is to facilitate equity market integration, owing to the belief that the cost of equity capital decreases as markets become more integrated. A number of studies have analysed the degree of European equity market integration from different empirical perspectives.[170] Baele et al (2004) notes that equity markets in the euro area are more and more determined by common news factors, such that following the launch of the EMU, over 40% of local equity return variance is explained by aggregate European and US shocks. If the importance of individual country specific risk factors is declining in the euro area equity markets, then the correlation between the changes in the various eurozone ERPs should be increasing. This study employs the Dynamic Conditional Correlation (DCC) developed in Engle (2002) and applied in Engle & Sheppard (2001), to investigate the time-varying correlation between changes in the equity risk premia of the six countries in this study from January 1989 to June 2002, as plotted in Figure 3.1.

[169] For Italy, the period is 1990 – 2002.

[170] See Baele et al (2004) and references therein.

The Dynamic Conditional Correlation (DCC)

As noted in Engle (2002), the DCC method can best be described as a generalisation of Bollerslev (1990) Constant Conditional Correlation (CCC) analysis, in which the correlation matrix containing the conditional correlations is allowed to be time-varying. The computational advantage of the DCC over previous correlation estimation methods such as Kroner & Ng (1998) as noted in Engle (2002) is that the DCC is designed to support the estimation of very large covariance matrices. The DCC procedure is to first estimate univariate GARCH processes for each series, standardising the residuals, and then estimating the correlation of the standardised residuals.

The conditional correlation between two random variables r_1 and r_2 that each have mean zero is defined to be:

$$\rho_{12,t} = \frac{E_{t-1}(r_{1,t}\, r_{2,t})}{\sqrt{E_{t-1}(r_{1,t}^2)\; E_{t-1}(r_{2,t}^2)}}, \qquad (3.19)$$

Let the conditional variance $h_{i,t} = E_{t-1}(r_{i,t}^2)$, and then $r_{i,t} = \sqrt{h_{i,t}}\, \varepsilon_{i,t}$, (3.20)

where $i = 1, 2$; ε is a standardised disturbance that has mean zero and variance one for each series.

Engle (2002) shows that the conditional correlation is also the conditional covariance between the standardised disturbances i.e.:

$$\rho_{12,t} = E_{t-1}(\varepsilon_{1,t}\, \varepsilon_{2,t}), \qquad (3.21)$$

Engle (2002) suggest estimating the following GARCH (1,1) model:

$$q_{ij,t} = \bar{\rho}_{ij} + \alpha\,(\varepsilon_{i,t-1}\, \varepsilon_{j,t-1} - \bar{\rho}_{ij}) + \beta\,(q_{ij,t-1} - \bar{\rho}_{ij}) \qquad (3.22)$$

and

$$\rho_{ij,t} = \frac{q_{ij,t}}{\sqrt{q_{ii,t}\ q_{jj,t}}}, \tag{3.23}$$

where $\bar{\rho}_{ij}$ is the unconditional correlation between $\varepsilon_{i,t}$ and $\varepsilon_{j,t}$, α and β are the GARCH (1,1) parameters. ρ_{ij} is the correlation estimator.

From the above, the average of $q_{ij,t}$ will be $\bar{\rho}_{ij}$, and the average variance will be 1. The resulting covariance matrix is obtained as:

$$\Sigma_t = D_t R_t D_t \tag{3.24}$$

where D_t is the k x k diagonal matrix of time varying standard deviations from the univariate GARCH models with $\sqrt{h_{it}}$ on the ith diagonal, and R_t is the time-varying correlation matrix. Refer to Engle (2002) for more details.

Engle & Sheppard (2001) suggests that one of the ways to test the null of constant correlation against an alternative of dynamic conditional correlation is to test the null against an alternative with a specific coefficient for beta β, using standard likelihood ratio test. Lanza et al (2004) suggests that in essence, the significance of the DCC parameters (α and β) is suggestive of a rejection of the null hypotheses of constant conditional correlation.

The results of the DCC analysis are presented in Figure 3.2. First, the null hypothesis of constant conditional correlation is rejected, as shown by the significance of the DCC parameters (α and β) that capture time variations.[171] There appears to be an increase in the correlation between the ERP movements in the euro zone equity markets especially from 1997, in line with the findings of Hardouvelis et al (2002a, 2002b) that the relative importance of Europe-wide factors over local country factors with respect to European stock returns increased with the probability of joining the EMU. Using cointegration analysis to examine European equity market integration

[171] Details are available from the authors.

over 1985 – 2002, Aggarwal et al (2004) also report increased degree of integration during the 1997 – 98 period. However, with the exception of the correlation between the Netherlands and the USA, ERP movements appear to be increasingly correlated between all markets, in line with Ayuso & Blanco (1999) who, using a general arbitrage approach, find that the degree of integration in the largest stock markets has increased over the 1990s. Moreover, Karolyi & Stulz (2003) provide evidence that national equity market risk premiums are determined internationally i.e. the importance of global factors. Therefore, it may be difficult to demonstrate that the increasing convergence of the various euro area national ERPs is mainly due to the EMU, especially in light of empirical evidence suggesting increasing global factors in equity market returns.[172] This is left to future research.

Section 3.8: Summary.

The APT model appears to be an empirically plausible model of explaining equity market returns in all six markets. As far as priced factors are concerned, it is found that the results are more or less robust to the method utilised in generating innovations in the macroeconomic factors i.e. priced factors obtained using ARIMA innovations are largely similar to those obtained using Kalman-filtered innovations. However, the mispricings under kalman-filtered innovations are lower than those of ARIMA components in four of six cases – except Germany and France where the latter sets of innovations appear to be more efficient.

The null hypothesis that exchange rates are significantly priced in Germany, Italy, the Netherlands, the UK, and the USA cannot be rejected using data from 1980 – 2002. The idea that a single European currency will ensure exchange rates stability may not necessarily hold, as suggested by the European Union. Although insignificant overall, the study finds that the exchange rate premium in France rose sharply in the third quarter of 1999 and stayed higher than pre-EMU levels. This sharp rise may not be unconnected to economic policy disputes between the German government and the European Central Bank which sent negative signals to an already agitated financial market, as well as improvements to the poor US economic climate (existing at the

[172] See for instance Brooks & Catao (2000) and Diermeier & Solnik (2001).

time of the euro launch), which may have also contributed significantly to any initial europhoria. However, the equity market premium has declined considerably as a result of the strong performance of the French economy in recent years. The loss of investor confidence in the euro had a much severe impact on the German equity market even though the gloomy economy as a result of demand shocks exacerbated the situation further. The sharp rise in the German currency risk premium with increased volatility accounted for over half of the volatility in the German equity market premium, suggesting therefore that the German public had a genuine reason to be concerned about the loss of their beloved Deutsche Mark. Overall, evidence suggests that the exchange rate risk premium in the larger EMU countries (France and Germany) which appear to have 'more political than economic reasons' for forming a the monetary union has increased.

On the other hand, the Italian public appears to have made the right decision (so far) by voting to join the EMU. In spite of the recent rising trend in the currency risk premium, its stability, following the mid-1998 announcement of Italy's membership of the EMU is very apparent. Moreover, the equity market premium is not only decreasing but has also become more stable. However, this stability is due largely to the effects of the EMU on Italy's long-term *economic nemesis*: inflation, and not on the elimination of exchange rate risks, in line with previous evidence. In contradiction to findings for other EMU countries, both currency and equity market risks premia for the Netherlands have declined, at least below pre-EMU levels. Since trade within the euro area is the core of Dutch foreign trade unlike France, Germany, and Italy, this reduction in the currency risk premium may not be surprising.

Evidence from the UK shows a significant decline in the equity market premium, and to a lesser extent, the exchange rate risk premium. In light of this recent performance and the EMU experiences of large countries like Germany and France (so far), an equity market participant may not advocate the UK's membership of the EMU. The US currency risk has also increased since the beginning of 1999. From the behaviour of the US equity market premium, it appears that movements in both premia are mainly driven by US specific factors, although the findings of an increasing correlation among the equity market premiums of the six countries suggests increasing global factors in international equity market movements.

Table 3.1: Estimated prices of risk and tests of APT pricing restriction from 1980 - 2002.

Germany.

Kalman-Filtered Components		ARIMA Components	
Factors	**Price of Risk**	**Factors**	**Price of Risk**
Exchange Rates	-0.0073301*** (-2.82)	Exchange Rates	-0.00682*** (-2.91)
Term Structure	0.005814*** (4.20)	Term Structure	0.01164*** (3.86)
Default Risk	0.00240401* (1.91)	Default Risk	0.003725** (2.37)
Money Supply	-0.0037082*** (-2.71)	Money Supply	-0.00327** (-1.91)
Imports	-0.003354** (-2.58)	Imports	-0.002502*** (-2.86)
Tax Revenue	0.002134** (2.19)	Tax Revenue	0.001803* (1.72)
Expected Inflation	-0.00377*** (3.95)	Expected Inflation	-0.00386*** (3.91)
Market Portfolio	0.00235** (2.55)	Market Portfolio	0.002762*** (3.02)
APT Pricing Restrictions:		**APT Pricing Restrictions:**	
$H_0: \alpha_i = \sum b_{ij} \lambda_j$	$\chi^2(96) = 59.34$	$H_0: \alpha_i = \sum b_{ij} \lambda_j$	$\chi^2(96) = 72.49$
Mispricing (% per annum):	1.61%	**Mispricing (% per annum):**	1.23%
Adjusted R^2	69%	**Adjusted R^2**	73%

Notes: Figures in parentheses are t-statistics. *, **, and *** denote significance at 10%, 5%, and 1% respectively.
Approximate 5% critical value for the likelihood ratio test is $\chi^2(96) = 120$.

United Kingdom.

Kalman-Filtered Components		ARIMA Components	
Factors	**Price of Risk**	**Factors**	**Price of Risk**
Exchange Rates	-0.003819*** (-3.02)	Exchange Rates	-0.00337*** (-2.63)
Term Structure	-0.009724*** (-4.12)	Term Structure	-0.008936** (-1.98)
Default Risk	-0.0028841** (-2.51)	Default Risk	-0.005288** (-2.11)
Industrial Production	0.0027735** (-2.32)	Industrial Production	0.00187* (-1.89)
Imports	-0.0058416*** (-3.51)	Imports	-0.01621*** (-3.78)
Tax Revenue	-0.0030668** (-2.50)	Money Supply	-0.01081*** (-3.09)
Expected Inflation	-0.00187*** (-5.25)	Expected Inflation	-0.00262*** (5.58)
Market Portfolio	0.002368*** (3.15)	Market Portfolio	0.002935*** (4.71)
APT Pricing Restrictions: H_0: $\alpha_i = \sum b_{ij} \lambda_j$	$\chi^2(133) = 114.30$	**APT Pricing Restrictions:** H_0: $\alpha_i = \sum b_{ij} \lambda_j$	$\chi^2(133) = 101.29$
Mispricing (% per annum):	1.41%	**Mispricing (% per annum):**	2.96%
Adjusted R^2	70%	**Adjusted R^2**	54%

Notes: Figures in parentheses are t-statistics. *, **, and *** denote significance at 10%, 5%, and 1% respectively.
Approximate 5% critical value for the likelihood ratio test is $\chi^2(133) = 160$.

Italy.

Kalman-Filtered Components		ARIMA Components	
Factors	**Price of Risk**	**Factors**	**Price of Risk**
Exchange Rates	0.00485517** (2.19)	Exchange Rates	0.00263* (1.92)
Term Structure	0.003654** (1.70)	Term Structure	0.01818** (2.15)
Industrial Production	0.0027844* (1.69)	Industrial Production	0.008294*** (3.12)
Retail Sales	-0.0083064*** (-3.62)	Retail Sales	-0.01185** (-2.11)
Exports	-0.003362*** (-2.89)	Exports	-0.003153*** (-2.91)
Expected Inflation	-0.0002** (-2.36)	Expected Inflation	-0.00012* (-1.76)
Unexpected Inflation	-0.0053599*** (-2.84)	Commodity Prices	0.002009** (2.49)
APT Pricing Restrictions: H_0: $\alpha_i = \sum b_{ij} \lambda_j$	$\chi^2(69) = 30.96$	**APT Pricing Restrictions:** H_0: $\alpha_i = \sum b_{ij} \lambda_j$	$\chi^2(69) = 38.99$
Mispricing (% per annum):	0.94%	**Mispricing (% per annum):**	1.92%
Adjusted R^2	80%	**Adjusted R^2**	68%

Notes: Figures in parentheses are t-statistics. *, **, and *** denote significance at 10%, 5%, and 1% respectively.
Approximate 5% critical value for the likelihood ratio test is $\chi^2(69) = 90$.

USA.

Kalman-Filtered Components		ARIMA Components	
Factors	**Price of Risk**	**Factors**	**Price of Risk**
Exchange Rates	0.00561105*** (4.28)	Exchange Rates	0.004802*** (2.96)
Unexpected Inflation	-0.00214** (-2.13)	Term Structure	-0.01325*** (-4.62)
Default Risk	-0.0047396*** (-5.40)	Default Risk	-0.004502*** (-3.72)
Industrial Production	-0.0025387** (-2.48)	Industrial Production	-0.00213*** (-3.47)
Money Supply	-0.0016986* (-1.87)	Money Supply	-0.0018*** (-2.80)
Exports	-0.010807*** (-5.68)	Exports	-0.00771** (-2.56)
Retail Sales	0.002527*** (3.07)	Commodity Prices	-0.00065** (-2.12)
Market Portfolio	0.002514*** (2.90)	Market Portfolio	0.002148*** (3.53)
APT Pricing Restrictions: H_0: $\alpha_i = \sum b_{ij}\lambda_j$	$\chi^2(112) = 96.47$	**APT Pricing Restrictions:** H_0: $\alpha_i = \sum b_{ij}\lambda_j$	$\chi^2(112) = 101.29$
Mispricing (% per annum):	1.94%	**Mispricing (% per annum):**	3.48%
Adjusted R^2	57%	**Adjusted R^2**	51%

Notes: Figures in parentheses are t-statistics. *, **, and *** denote significance at 10%, 5%, and 1% respectively.
Approximate 5% critical value for the likelihood ratio test is $\chi^2(112) = 138$.

France

Kalman-Filtered Components		ARIMA Components	
Factors	**Price of Risk**	**Factors**	**Price of Risk**
Expected Inflation	0.0006012** (2.45)	Expected Inflation	0.00058** (2.00)
Exports	0.007862*** (2.70)	Exports	0.01626*** (2.99)
Money Supply	0.007725** (2.29)	Money Supply	0.0065118*** (2.62)
Market Portfolio	0.005204*** (3.34)	Market Portfolio	0.005503** (2.21)
Retail Sales	-0.0005746*** (2.93)	Retail Sales	-0.0006046*** (2.84)
APT Pricing Restrictions:		**APT Pricing Restrictions:**	
H_0: $\alpha_i = \sum b_{ij}\lambda_j$	$\chi^2(50) = 26.21$	H_0: $\alpha_i = \sum b_{ij}\lambda_j$	$\chi^2(50) = 28.99$
Mispricing (% per annum):	-1.72%	**Mispricing (% per annum):**	-1.38%
Adjusted R^2	58%	**Adjusted R^2**	60%

Notes: Figures in parentheses are t-statistics. *, **, and *** denote significance at 10%, 5%, and 1% respectively.
Approximate 5% critical value for the likelihood ratio test is $\chi^2(50) = 67$.

The Netherlands.

Kalman-Filtered Components		ARIMA Components	
Factors	**Price of Risk**	**Factors**	**Price of Risk**
Unexpected Inflation	-0.0010621** (-2.51)	Unexpected Inflation	-0.00185** (-2.23)
Industrial Production	0.0078291* (1.88)	Industrial Production	0.014385* (1.87)
Money Supply	0.009065** (2.49)	Money Supply	0.014658** (2.46)
Imports	0.003721** (2.18)	Exchange rates	-0.00268** (-2.29)
Exports	0.007755** (2.12)	Exports	0.002005** (1.98)
APT Pricing Restrictions:		**APT Pricing Restrictions:**	
$H_0: \alpha_i = \sum b_{ij} \lambda_j$	$\chi^2(48) = 30.96$	$H_0: \alpha_i = \sum b_{ij} \lambda_j$	$\chi^2(48) = 32.22$
Mispricing (% per annum):	-1.11%	**Mispricing (% per annum):**	-2.42%
Adjusted R^2	68%	**Adjusted R^2**	59%

Notes: Figures in parentheses are t-statistics. *, **, and *** denote significance at 10%, 5%, and 1% respectively.
Approximate 5% critical value for the likelihood ratio test is $\chi^2(49) = 66$.

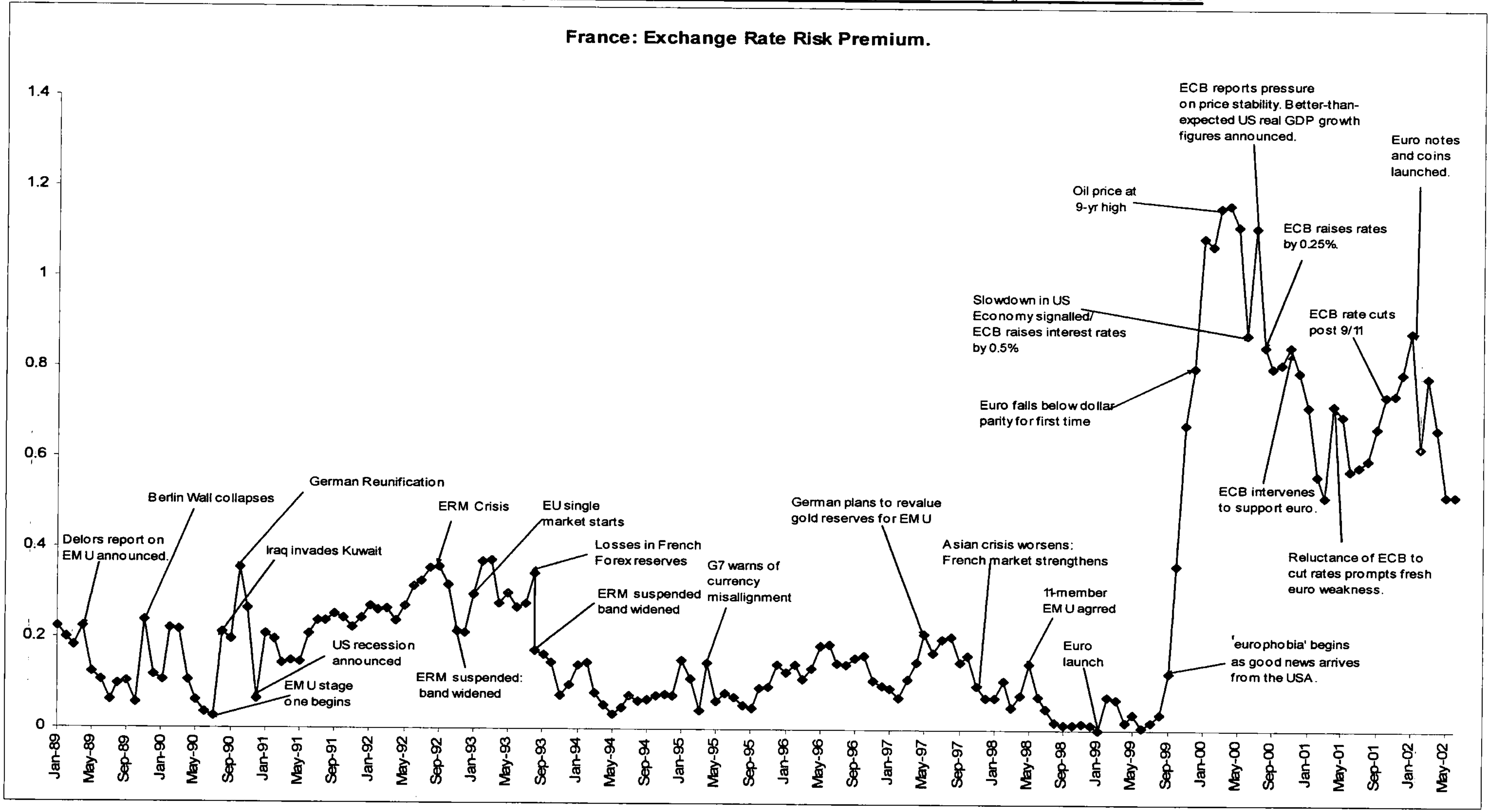
Table 3.2: Adjusted R^2 from the regression of equity market risk premium on constant and the exchange rate risk premium.

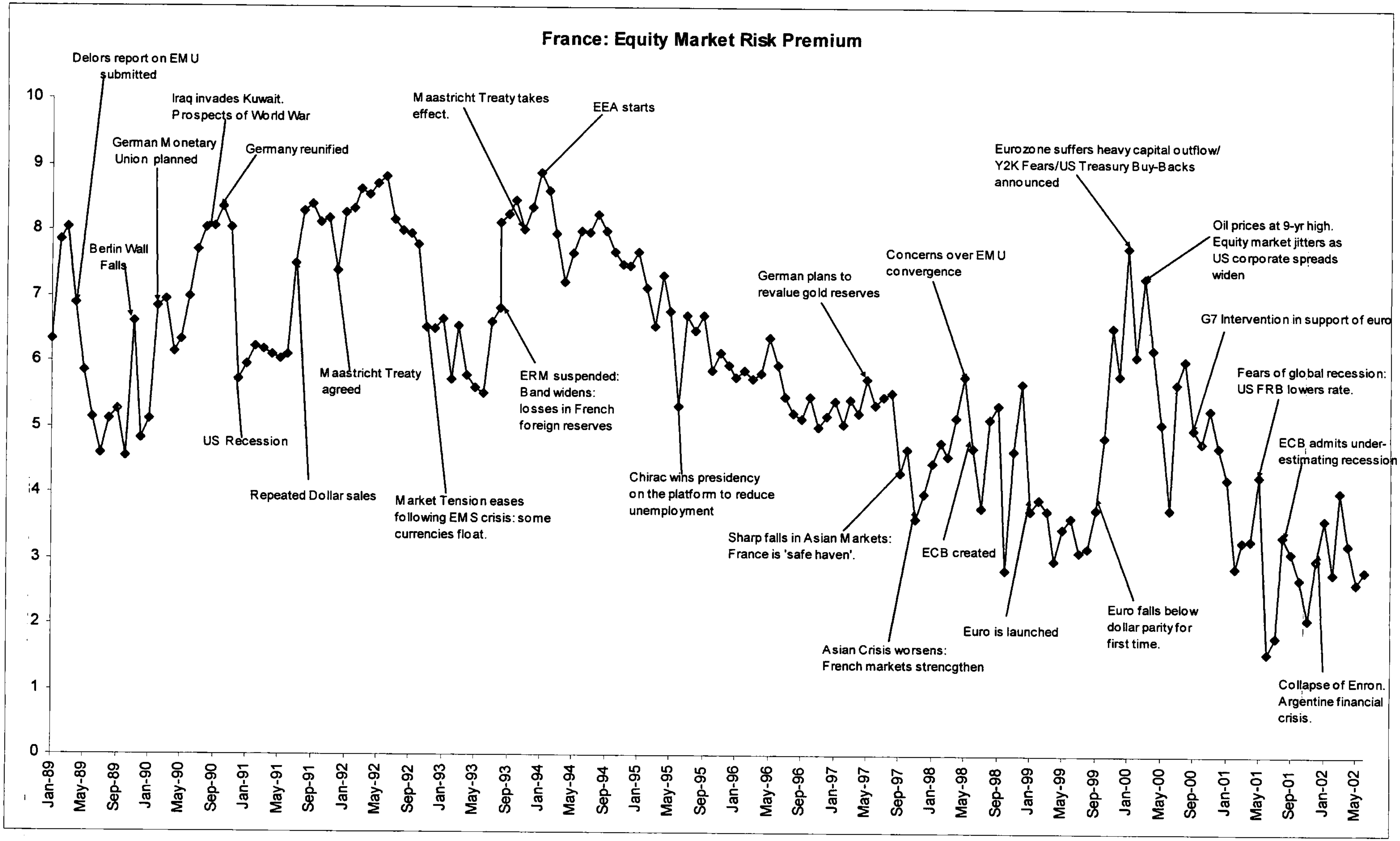
Country	EMS/ERM	Pre-Euro	Post-Euro
The Netherlands	60%	76%	17%
France	8%	3%	39%
Germany	48%	8%	75%
Italy	4%	14%	2%
UK	65%	13%	38%
USA	10%	13%	12%

Table 3.3: Average Equity Market Risk Premium.

Country	**ERP (% p.a)**
The Netherlands	5.33
France	5.86
Germany	2.75
Italy	6.63
USA	3.27
UK	4.83

Figure 3.1: Behaviour of exchange rates and equity markets premiums from January 1989 to June 2002.




France: Equity Market Risk Premium
Delors report on EMU submitted
Berlin Wall Falls
German Monetary Union planned
Iraq invades Kuwait. Prospects of World War
Germany reunified
US Recession
Repeated Dollar sales
Maastricht Treaty agreed
Market Tension eases following EMS crisis: some currencies float.
Maastricht Treaty takes effect.
ERM suspended: Band widens: losses in French foreign reserves
EEA starts
Chirac wins presidency on the platform to reduce unemployment
German plans to revalue gold reserves
Sharp falls in Asian Markets: France is 'safe haven'.
Asian Crisis worsens: French markets strencgthen
Concerns over EMU convergence
ECB created
Euro is launched
Euro falls below dollar parity for first time.
Eurozone suffers heavy capital outflow/ Y2K Fears/US Treasury Buy-Backs announced
Oil prices at 9-yr high. Equity market jitters as US corporate spreads widen
G7 Intervention in support of euro
Fears of global recession: US FRB lowers rate.
ECB admits under-estimating recession
Collapse of Enron. Argentine financial crisis.
10
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Jan-89
May-89
Sep-89
Jan-90
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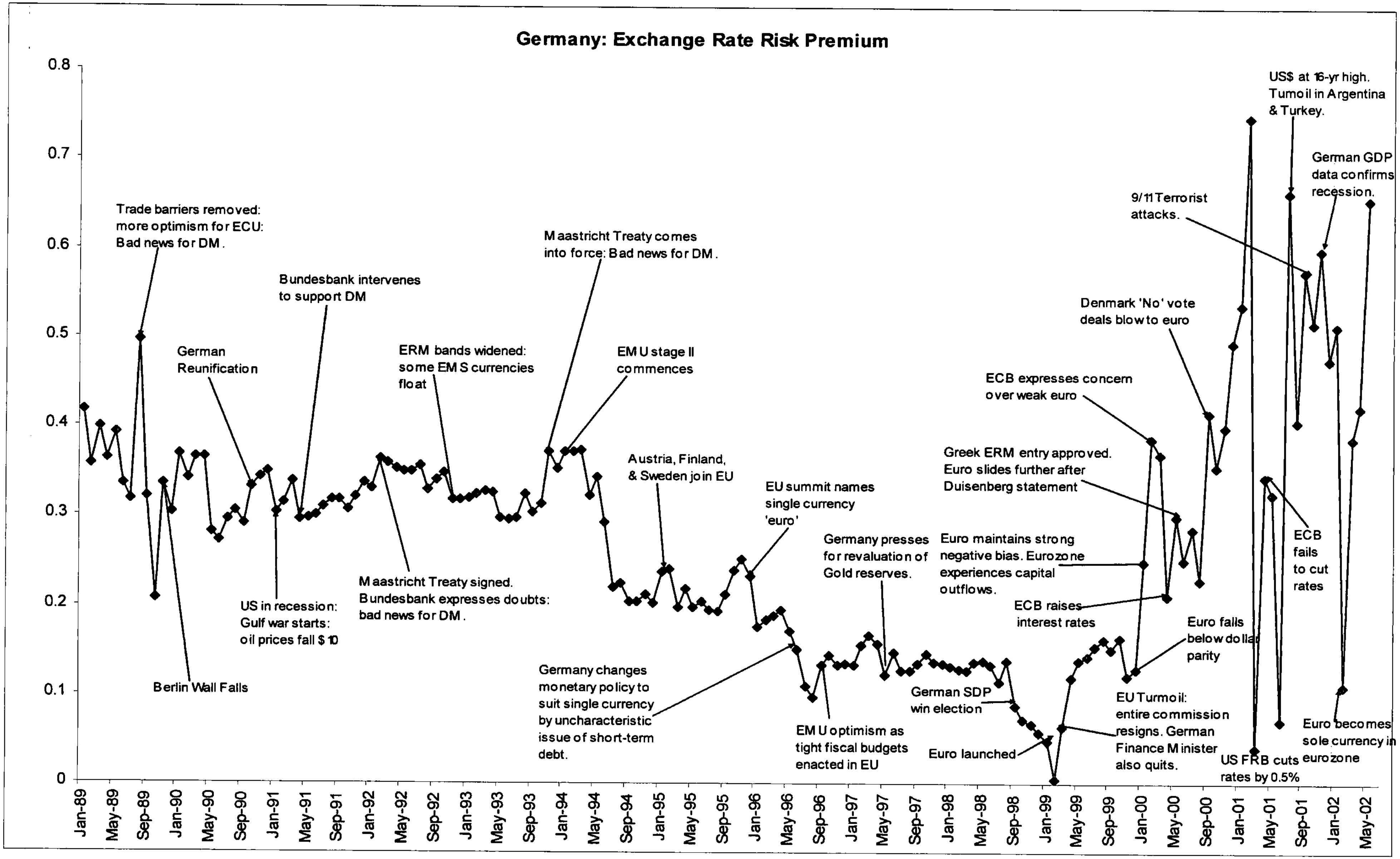
May-02


Germany: Exchange Rate Risk Premium
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Jan-89
May-89
Sep-89
Jan-90
May-90
Sep-90
Jan-91
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Jan-92
May-92
Sep-92
Jan-93
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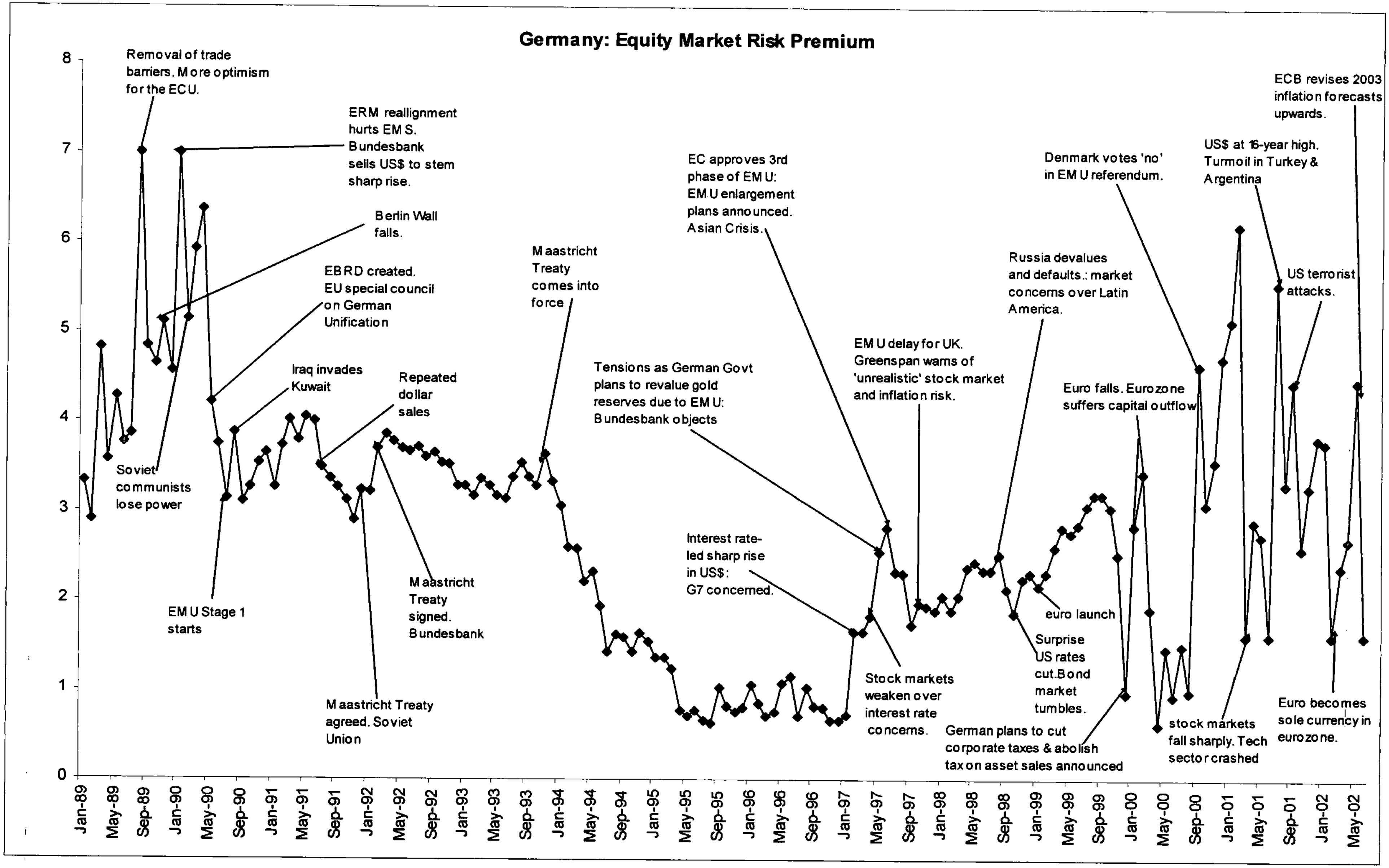
May-02
Trade barriers removed: more optimism for ECU: Bad news for DM.
Berlin Wall Falls
German Reunification
US in recession: Gulf war starts: oil prices fall $10
Bundesbank intervenes to support DM
ERM bands widened: some EMS currencies float
Maastricht Treaty signed. Bundesbank expresses doubts: bad news for DM.
Maastricht Treaty comes into force: Bad news for DM.
EMU stage II commences
Austria, Finland, & Sweden join EU
Germany changes monetary policy to suit single currency by uncharacteristic issue of short-term debt.
EU summit names single currency 'euro'
EMU optimism as tight fiscal budgets enacted in EU
Germany presses for revaluation of Gold reserves.
German SDP win election
Euro launched
Euro maintains strong negative bias. Eurozone experiences capital outflows.
ECB raises interest rates
Greek ERM entry approved. Euro slides further after Duisenberg statement
ECB expresses concern over weak euro
EU Turmoil: entire commission resigns. German Finance Minister also quits.
Euro falls below dollar parity
Denmark 'No' vote deals blow to euro
9/11 Terrorist attacks.
US$ at 16-yr high. Tumoil in Argentina & Turkey.
ECB fails to cut rates
US FRB cuts rates by 0.5%
German GDP data confirms recession.
Euro becomes sole currency in eurozone


Germany: Equity Market Risk Premium
Removal of trade barriers. More optimism for the ECU.
ERM reallignment hurts EMS. Bundesbank sells US$ to stem sharp rise.
Berlin Wall falls.
EBRD created. EU special council on German Unification
Soviet communists lose power
EMU Stage 1 starts
Iraq invades Kuwait
Repeated dollar sales
Maastricht Treaty agreed. Soviet Union
Maastricht Treaty signed. Bundesbank
Maastricht Treaty comes into force
Tensions as German Govt plans to revalue gold reserves due to EMU: Bundesbank objects
Interest rate-led sharp rise in US$: G7 concerned.
EC approves 3rd phase of EMU: EMU enlargement plans announced. Asian Crisis.
EMU delay for UK. Greenspan warns of 'unrealistic' stock market and inflation risk.
Stock markets weaken over interest rate concerns.
Russia devalues and defaults.: market concerns over Latin America.
euro launch
Surprise US rates cut.Bond market tumbles.
German plans to cut corporate taxes & abolish tax on asset sales announced
Euro falls. Eurozone suffers capital outflow
Denmark votes 'no' in EMU referendum.
stock markets fall sharply. Tech sector crashed
US$ at 16-year high. Turmoil in Turkey & Argentina
US terrorist attacks.
ECB revises 2003 inflation forecasts upwards.
Euro becomes sole currency in eurozone.
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May-89
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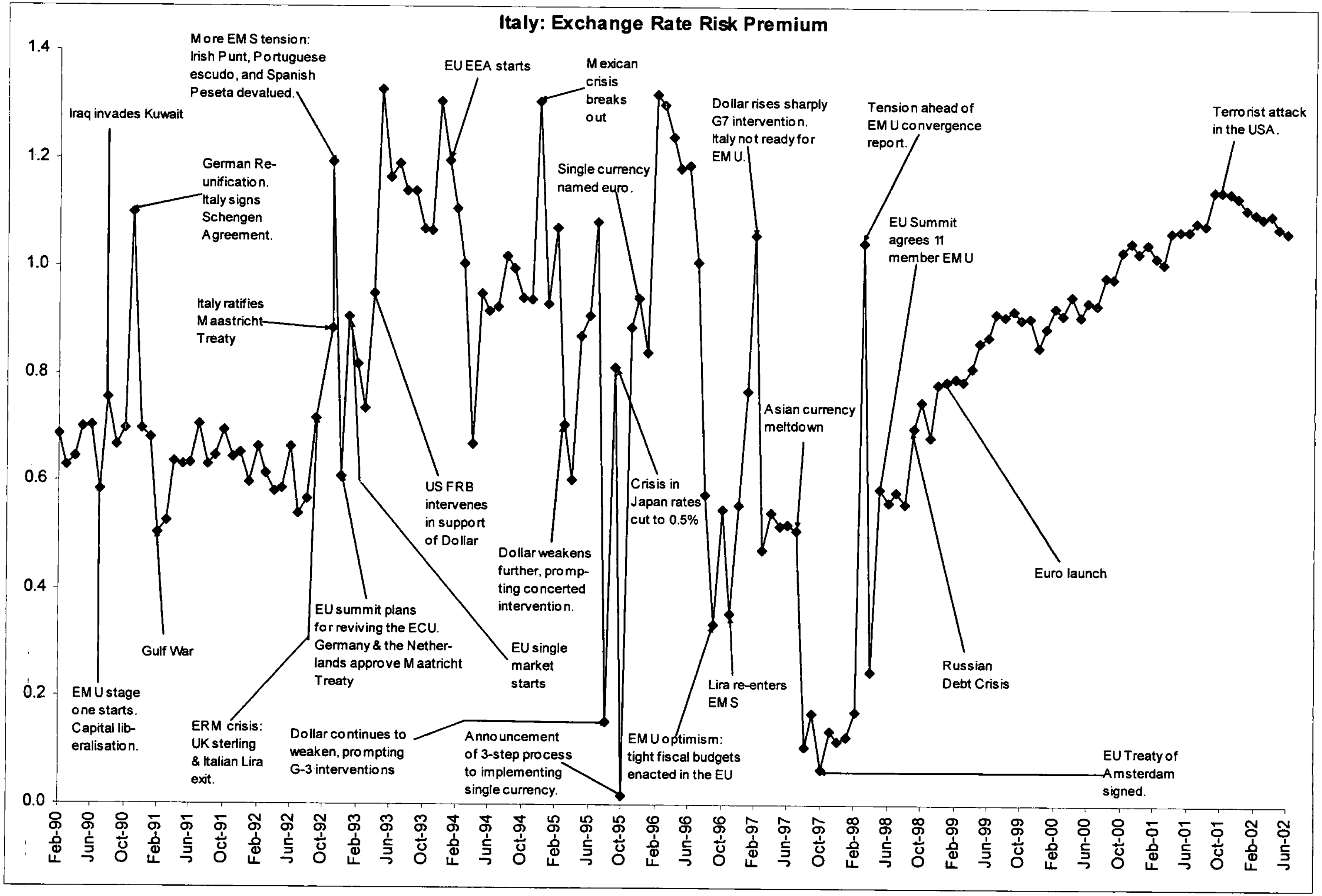
Jan-02
May-02



Italy: Exchange Rate Risk Premium
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Feb-90
Jun-90
Oct-90
Feb-91
Jun-91
Oct-91
Feb-92
Jun-92
Oct-92
Feb-93
Jun-93
Oct-93
Feb-94
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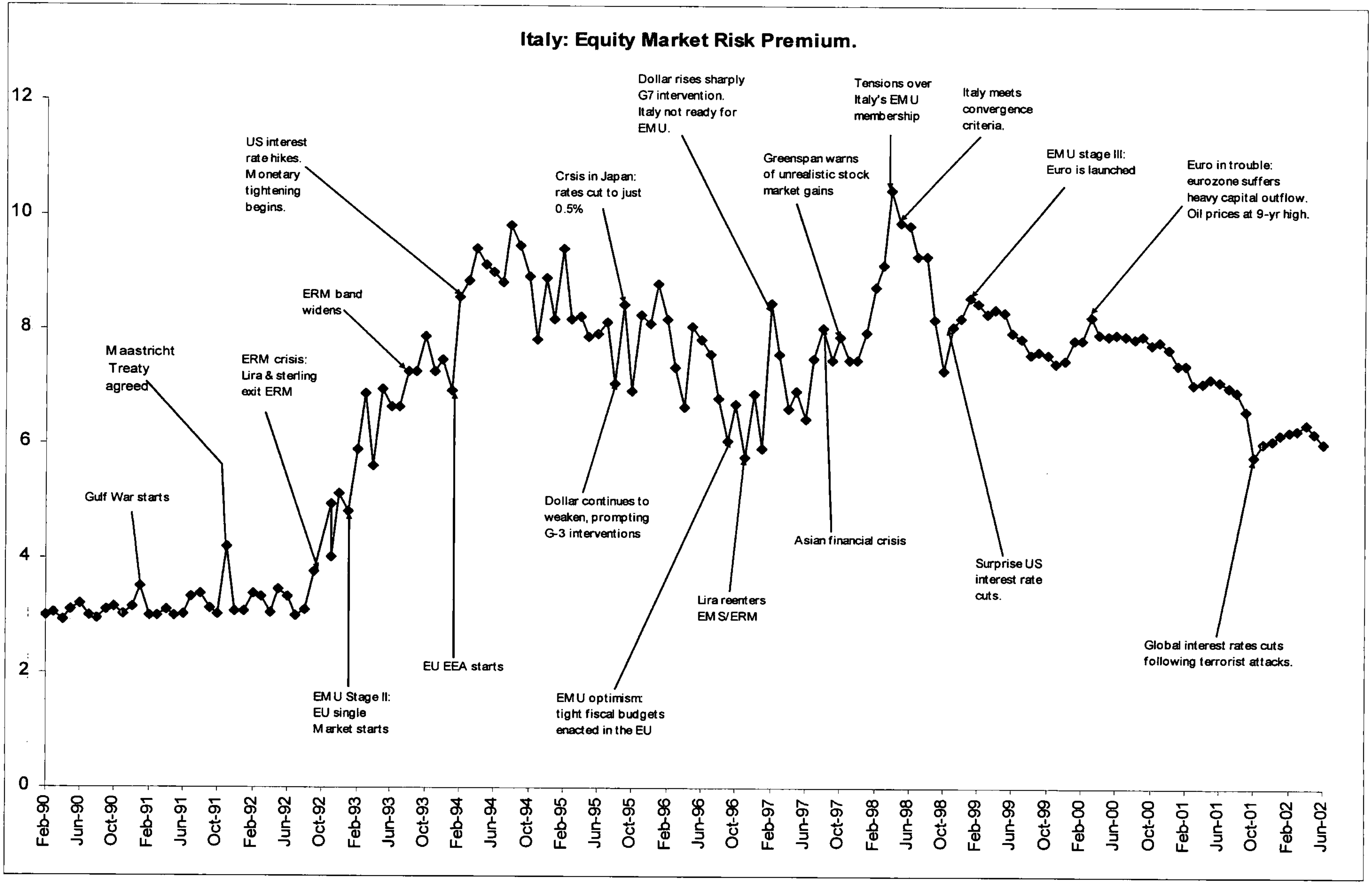
Feb-00
Jun-00
Oct-00
Feb-01
Jun-01
Oct-01
Feb-02
Jun-02
Iraq invades Kuwait
More EMS tension: Irish Punt, Portuguese escudo, and Spanish Peseta devalued.
German Re-unification. Italy signs Schengen Agreement.
Italy ratifies Maastricht Treaty
EU EEA starts
Mexican crisis breaks out
Single currency named euro.
Dollar rises sharply G7 intervention. Italy not ready for EMU.
Tension ahead of EMU convergence report.
EU Summit agrees 11 member EMU
Terrorist attack in the USA.
Asian currency meltdown
US FRB intervenes in support of Dollar
Crisis in Japan rates cut to 0.5%
Dollar weakens further, prompting concerted intervention.
Euro launch
EU summit plans for reviving the ECU. Germany & the Netherlands approve Maatricht Treaty
Gulf War
EU single market starts
Russian Debt Crisis
EMU stage one starts. Capital liberalisation.
ERM crisis: UK sterling & Italian Lira exit.
Dollar continues to weaken, prompting G-3 interventions
Announcement of 3-step process to implementing single currency.
EMU optimism: tight fiscal budgets enacted in the EU
Lira re-enters EMS
EU Treaty of Amsterdam signed.


Italy: Equity Market Risk Premium.
12
10
8
6
4
2
0
Feb-90
Jun-90
Oct-90
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Jun-91
Oct-91
Feb-92
Jun-92
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Jun-93
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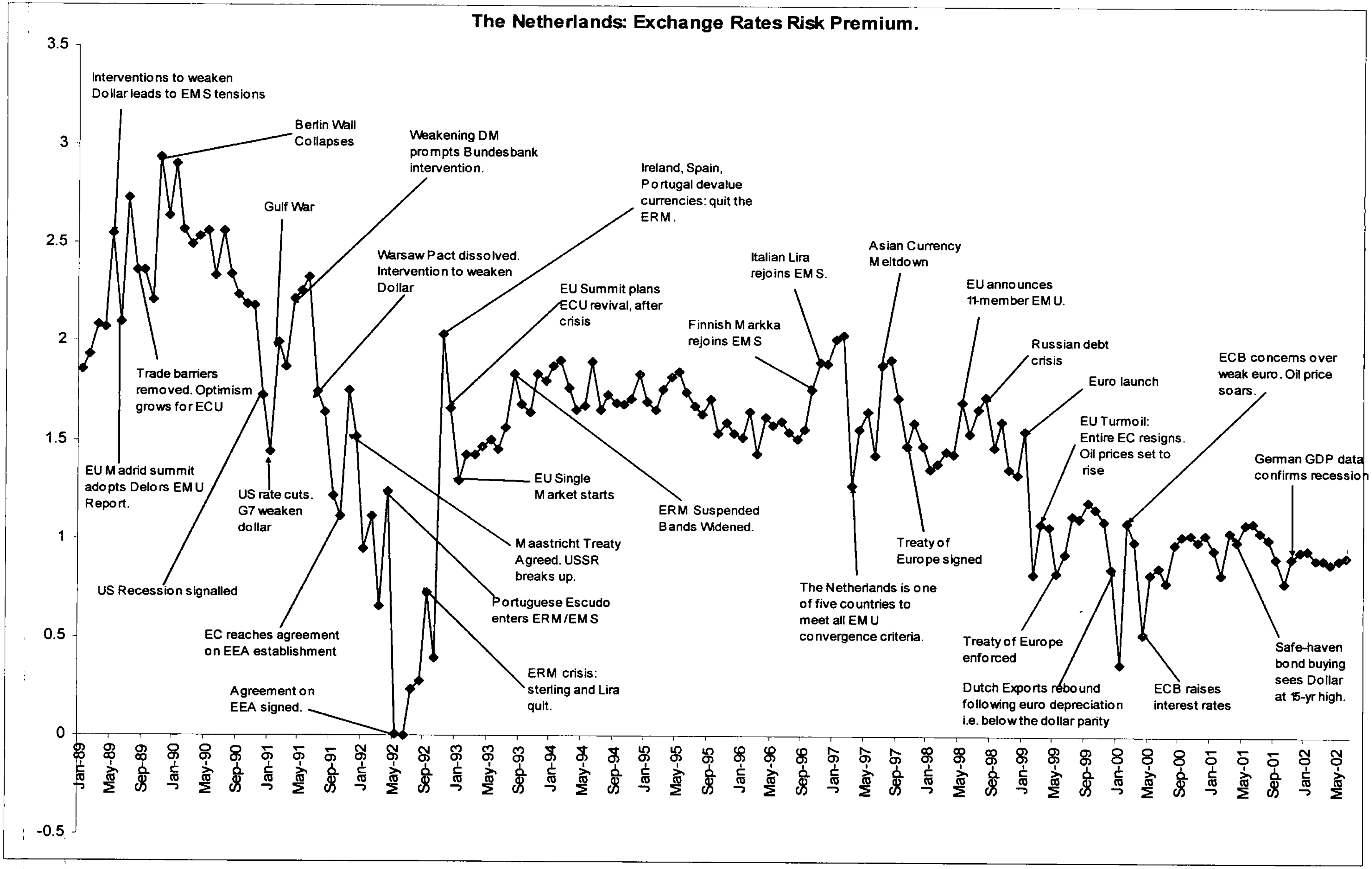
Oct-98
Feb-99
Jun-99
Oct-99
Feb-00
Jun-00
Oct-00
Feb-01
Jun-01
Oct-01
Feb-02
Jun-02
Gulf War starts
Maastricht Treaty agreed
ERM crisis: Lira & sterling exit ERM
US interest rate hikes. Monetary tightening begins.
ERM band widens
EMU Stage II: EU single Market starts
EU EEA starts
Crsis in Japan: rates cut to just 0.5%
Dollar continues to weaken, prompting G-3 interventions
EMU optimism: tight fiscal budgets enacted in the EU
Dollar rises sharply G7 intervention. Italy not ready for EMU.
Lira reenters EMS/ERM
Greenspan warns of unrealistic stock market gains
Asian financial crisis
Tensions over Italy's EMU membership
Italy meets convergence criteria.
Surprise US interest rate cuts.
EMU stage III: Euro is launched
Euro in trouble: eurozone suffers heavy capital outflow. Oil prices at 9-yr high.
Global interest rates cuts following terrorist attacks.


The Netherlands: Exchange Rates Risk Premium.
Interventions to weaken Dollar leads to EMS tensions
Berlin Wall Collapses
Weakening DM prompts Bundesbank intervention.
Gulf War
Warsaw Pact dissolved. Intervention to weaken Dollar
Ireland, Spain, Portugal devalue currencies: quit the ERM.
EU Summit plans ECU revival, after crisis
Finnish Markka rejoins EMS
Italian Lira rejoins EMS.
Asian Currency Meltdown
EU announces 11-member EMU.
Russian debt crisis
Euro launch
ECB concerns over weak euro. Oil price soars.
EU Turmoil: Entire EC resigns. Oil prices set to rise
German GDP data confirms recession
Trade barriers removed. Optimism grows for ECU
EU Madrid summit adopts Delors EMU Report.
US rate cuts. G7 weaken dollar
US Recession signalled
EC reaches agreement on EEA establishment
Agreement on EEA signed.
EU Single Market starts
ERM Suspended Bands Widened.
Maastricht Treaty Agreed. USSR breaks up.
Portuguese Escudo enters ERM/EMS
ERM crisis: sterling and Lira quit.
The Netherlands is one of five countries to meet all EMU convergence criteria.
Treaty of Europe signed
Treaty of Europe enforced
Dutch Exports rebound following euro depreciation i.e. below the dollar parity
ECB raises interest rates
Safe-haven bond buying sees Dollar at 15-yr high.
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
Jan-89
May-89
Sep-89
Jan-90
May-90
Sep-90
Jan-91
May-91
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Jan-92
May-92
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Jan-93
May-93
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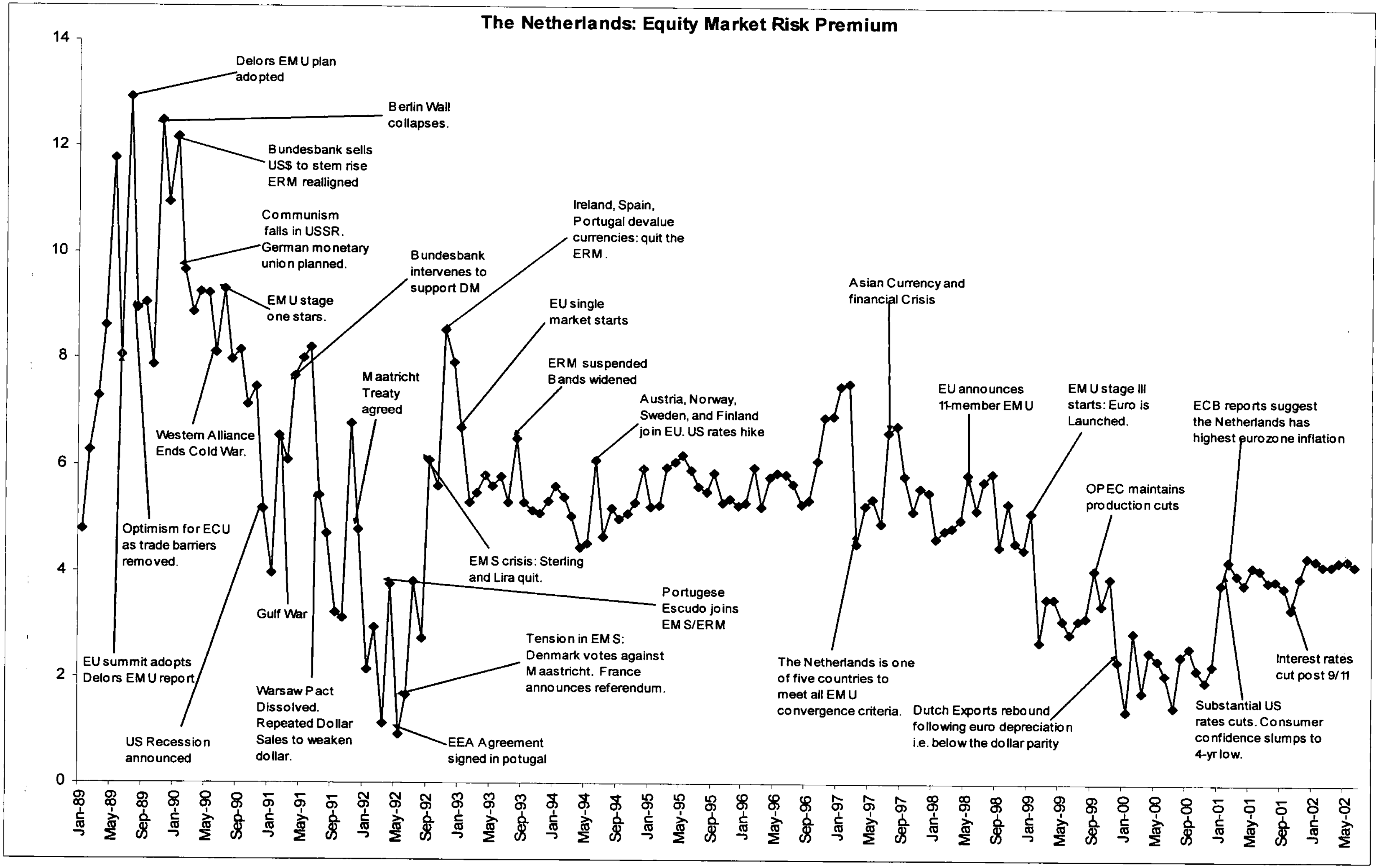
Sep-01
Jan-02
May-02


The Netherlands: Equity Market Risk Premium
14
12
10
8
6
4
2
0
Delors EMU plan adopted
Berlin Wall collapses.
Bundesbank sells US$ to stem rise ERM realligned
Communism falls in USSR. German monetary union planned.
EMU stage one stars.
Bundesbank intervenes to support DM
Ireland, Spain, Portugal devalue currencies: quit the ERM.
EU single market starts
ERM suspended Bands widened
Austria, Norway, Sweden, and Finland join EU. US rates hike
Asian Currency and financial Crisis
EU announces 11-member EMU
EMU stage III starts: Euro is Launched.
ECB reports suggest the Netherlands has highest eurozone inflation
Maatricht Treaty agreed
Western Alliance Ends Cold War.
Optimism for ECU as trade barriers removed.
EMS crisis: Sterling and Lira quit.
Portugese Escudo joins EMS/ERM
Tension in EMS: Denmark votes against Maastricht. France announces referendum.
OPEC maintains production cuts
Gulf War
EU summit adopts Delors EMU report
Warsaw Pact Dissolved. Repeated Dollar Sales to weaken dollar.
US Recession announced
EEA Agreement signed in potugal
The Netherlands is one of five countries to meet all EMU convergence criteria.
Dutch Exports rebound following euro depreciation i.e. below the dollar parity
Interest rates cut post 9/11
Substantial US rates cuts. Consumer confidence slumps to 4-yr low.
Jan-89
May-89
Sep-89
Jan-90
May-90
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May-91
Sep-91
Jan-92
May-92
Sep-92
Jan-93
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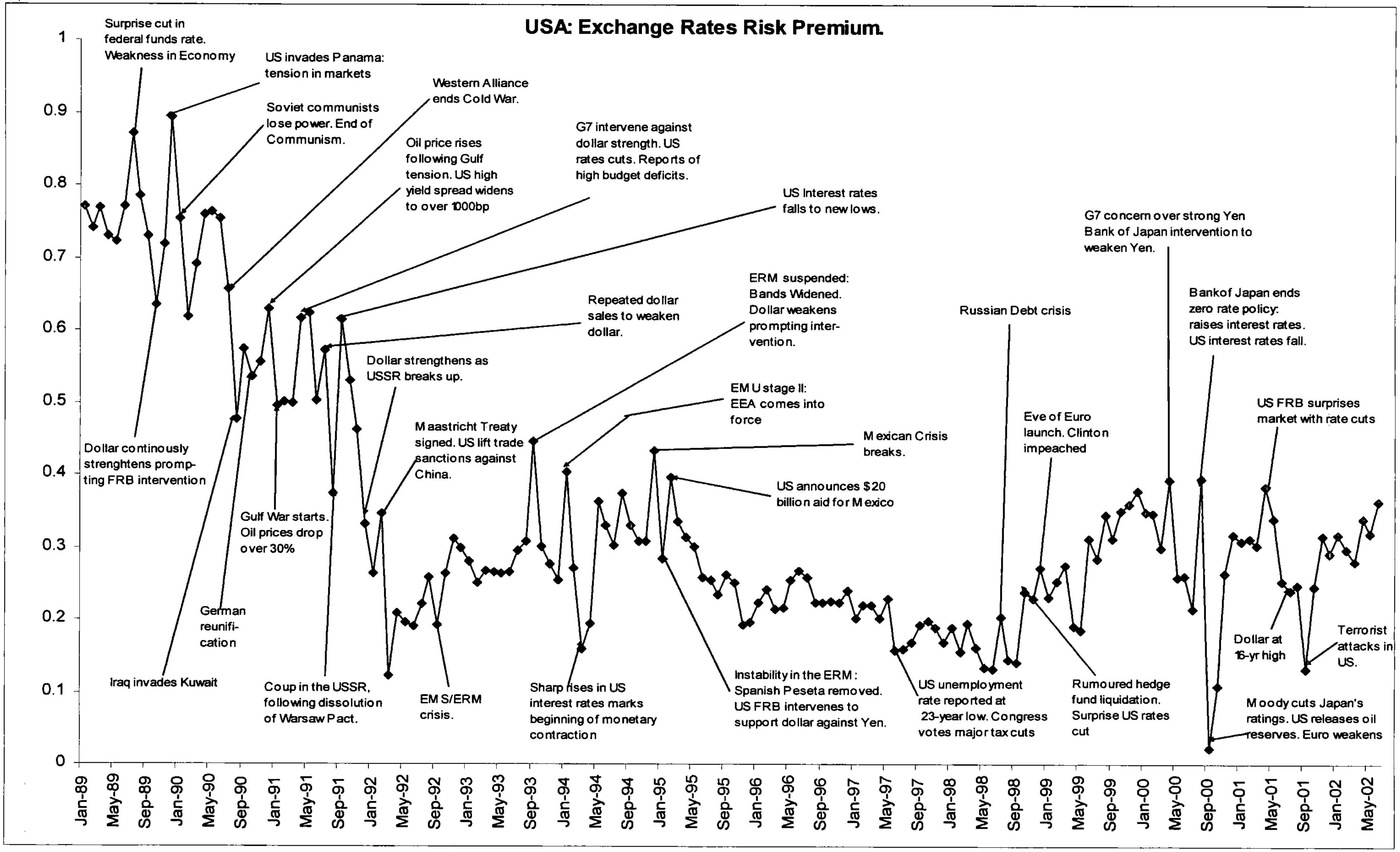
May-02


USA: Exchange Rates Risk Premium.
Surprise cut in federal funds rate. Weakness in Economy
US invades Panama: tension in markets
Western Alliance ends Cold War.
Soviet communists lose power. End of Communism.
Oil price rises following Gulf tension. US high yield spread widens to over 1000bp
G7 intervene against dollar strength. US rates cuts. Reports of high budget deficits.
US Interest rates falls to new lows.
G7 concern over strong Yen Bank of Japan intervention to weaken Yen.
ERM suspended: Bands Widened. Dollar weakens prompting inter-vention.
Repeated dollar sales to weaken dollar.
Russian Debt crisis
Bank of Japan ends zero rate policy: raises interest rates. US interest rates fall.
Dollar strengthens as USSR breaks up.
EMU stage II: EEA comes into force
US FRB surprises market with rate cuts
Maastricht Treaty signed. US lift trade sanctions against China.
Mexican Crisis breaks.
Eve of Euro launch. Clinton impeached
Dollar continously strenghtens promp-ting FRB intervention
US announces $20 billion aid for Mexico
Gulf War starts. Oil prices drop over 30%
German reunifi-cation
Dollar at 16-yr high
Terrorist attacks in US.
Iraq invades Kuwait
Coup in the USSR, following dissolution of Warsaw Pact.
EMS/ERM crisis.
Sharp rises in US interest rates marks beginning of monetary contraction
Instability in the ERM: Spanish Peseta removed. US FRB intervenes to support dollar against Yen.
US unemployment rate reported at 23-year low. Congress votes major tax cuts
Rumoured hedge fund liquidation. Surprise US rates cut
Moody cuts Japan's ratings. US releases oil reserves. Euro weakens
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Jan-89
May-89
Sep-89
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Sep-90
Jan-91
May-91
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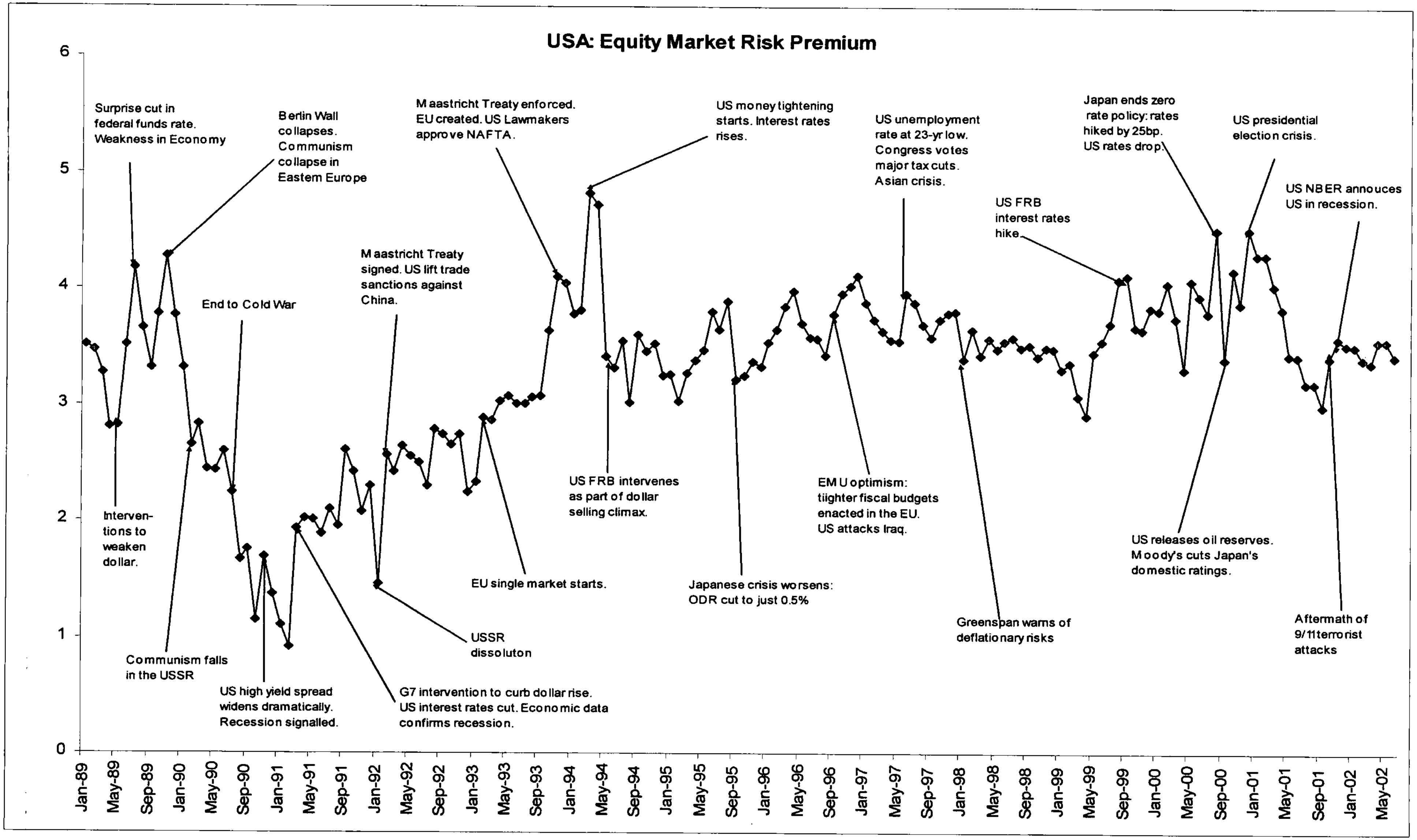
USA: Equity Market Risk Premium
Surprise cut in federal funds rate. Weakness in Economy
Berlin Wall collapses. Communism collapse in Eastern Europe
Maastricht Treaty enforced. EU created. US Lawmakers approve NAFTA.
US money tightening starts. Interest rates rises.
US unemployment rate at 23-yr low. Congress votes major tax cuts. Asian crisis.
Japan ends zero rate policy: rates hiked by 25bp. US rates drop.
US presidential election crisis.
US NBER annouces US in recession.
US FRB interest rates hike
Maastricht Treaty signed. US lift trade sanctions against China.
End to Cold War
Interven-tions to weaken dollar.
US FRB intervenes as part of dollar selling climax.
EMU optimism: tiighter fiscal budgets enacted in the EU. US attacks Iraq.
US releases oil reserves. Moody's cuts Japan's domestic ratings.
EU single market starts.
Japanese crisis worsens: ODR cut to just 0.5%
Greenspan warns of deflationary risks
Aftermath of 9/11terrorist attacks
USSR dissoluton
Communism falls in the USSR
US high yield spread widens dramatically. Recession signalled.
G7 intervention to curb dollar rise. US interest rates cut. Economic data confirms recession.
0
1
2
3
4
5
6
Jan-89
May-89
Sep-89
Jan-90
May-90
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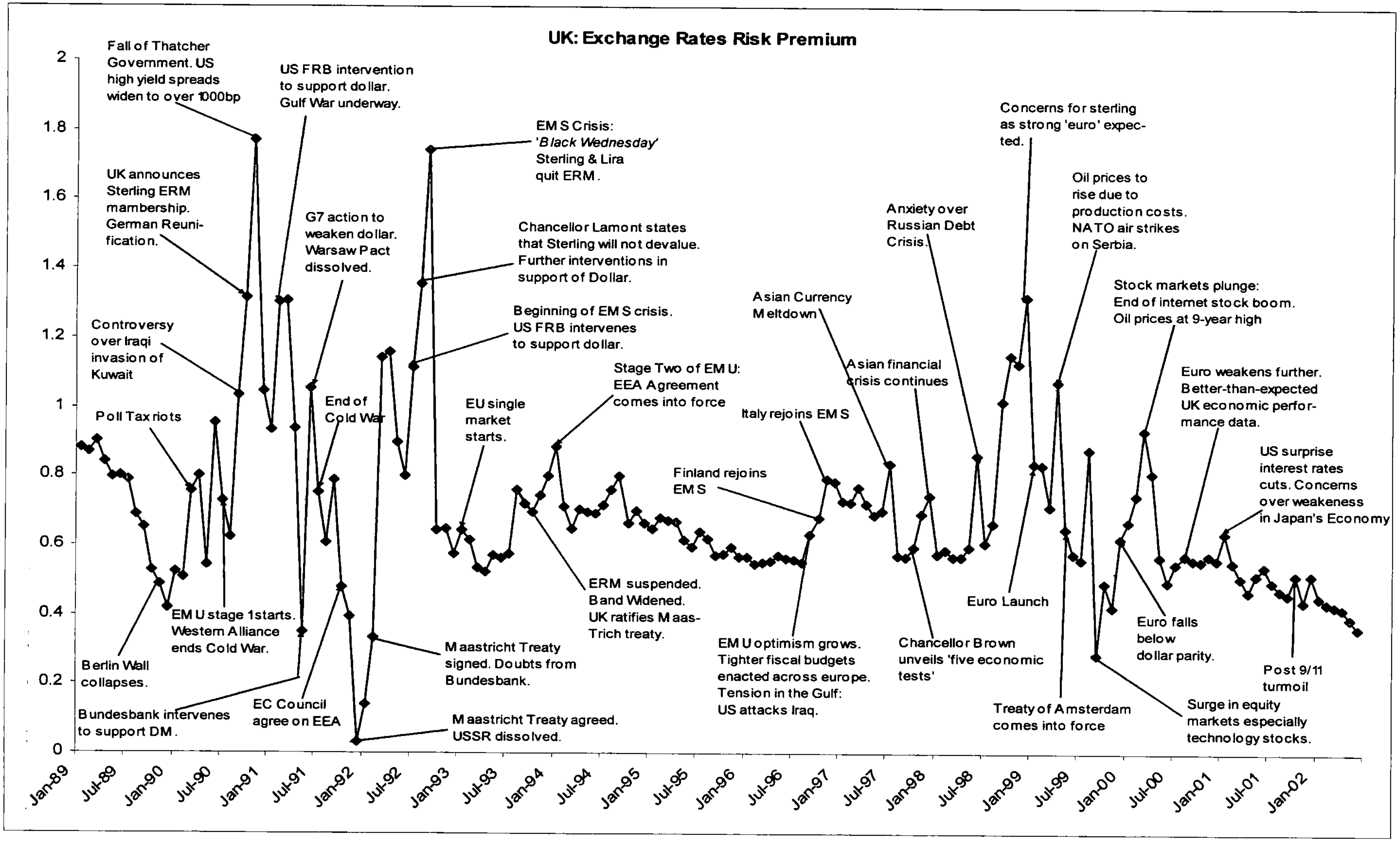
UK: Exchange Rates Risk Premium
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Jan-89
Jul-89
Jan-90
Jul-90
Jan-91
Jul-91
Jan-92
Jul-92
Jan-93
Jul-93
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Jul-96
Jan-97
Jul-97
Jan-98
Jul-98
Jan-99
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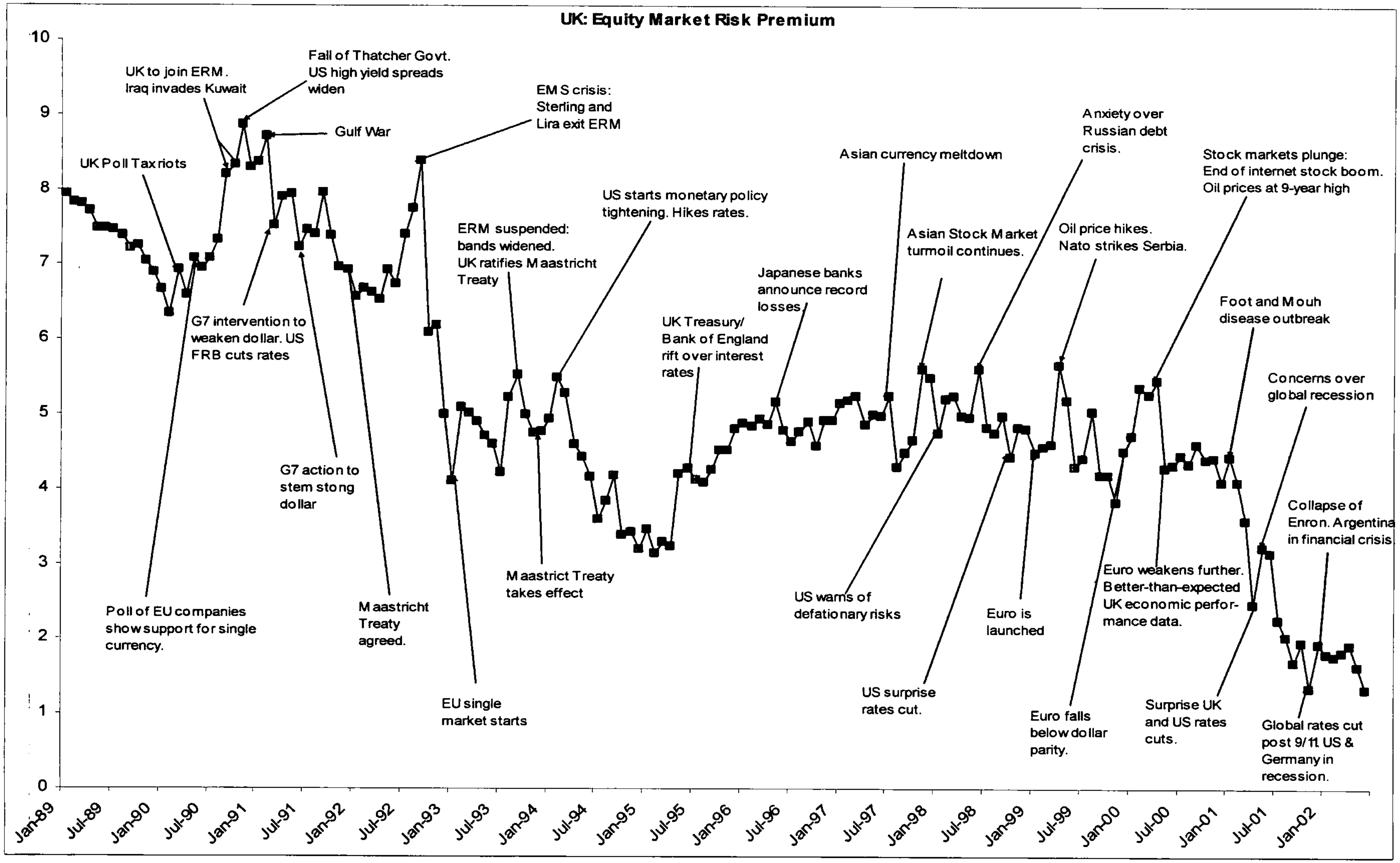
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Fall of Thatcher Government. US high yield spreads widen to over 1000bp
US FRB intervention to support dollar. Gulf War underway.
UK announces Sterling ERM mambership. German Reunification.
Controversy over Iraqi invasion of Kuwait
Poll Tax riots
G7 action to weaken dollar. Warsaw Pact dissolved.
End of Cold War
EMU stage 1starts. Western Alliance ends Cold War.
Berlin Wall collapses.
Bundesbank intervenes to support DM.
EC Council agree on EEA
EMS Crisis: 'Black Wednesday' Sterling & Lira quit ERM.
Chancellor Lamont states that Sterling will not devalue. Further interventions in support of Dollar.
Beginning of EMS crisis. US FRB intervenes to support dollar.
EU single market starts.
Maastricht Treaty signed. Doubts from Bundesbank.
Maastricht Treaty agreed. USSR dissolved.
Stage Two of EMU: EEA Agreement comes into force
ERM suspended. Band Widened. UK ratifies Maas-Trich treaty.
Finland rejoins EMS
Italy rejoins EMS
EMU optimism grows. Tighter fiscal budgets enacted across europe. Tension in the Gulf: US attacks Iraq.
Asian Currency Meltdown
Asian financial crisis continues
Anxiety over Russian Debt Crisis.
Chancellor Brown unveils 'five economic tests'
Concerns for sterling as strong 'euro' expected.
Euro Launch
Oil prices to rise due to production costs. NATO air strikes on Serbia.
Treaty of Amsterdam comes into force
Stock markets plunge: End of internet stock boom. Oil prices at 9-year high
Euro falls below dollar parity.
Surge in equity markets especially technology stocks.
Euro weakens further. Better-than-expected UK economic performance data.
US surprise interest rates cuts. Concerns over weakeness in Japan's Economy
Post 9/11 turmoil


UK: Equity Market Risk Premium
UK Poll Tax riots
UK to join ERM. Iraq invades Kuwait
Fall of Thatcher Govt. US high yield spreads widen
Gulf War
EMS crisis: Sterling and Lira exit ERM
G7 intervention to weaken dollar. US FRB cuts rates
G7 action to stem stong dollar
Poll of EU companies show support for single currency.
Maastricht Treaty agreed.
EU single market starts
ERM suspended: bands widened. UK ratifies Maastricht Treaty
Maastrict Treaty takes effect
US starts monetary policy tightening. Hikes rates.
UK Treasury/ Bank of England rift over interest rates
Japanese banks announce record losses
Asian currency meltdown
Asian Stock Market turmoil continues.
US warns of defationary risks
US surprise rates cut.
Anxiety over Russian debt crisis.
Oil price hikes. Nato strikes Serbia.
Euro is launched
Euro falls below dollar parity.
Stock markets plunge: End of internet stock boom. Oil prices at 9-year high
Euro weakens further. Better-than-expected UK economic perfor- mance data.
Foot and Mouh disease outbreak
Concerns over global recession
Surprise UK and US rates cuts.
Collapse of Enron. Argentina in financial crisis
Global rates cut post 9/11. US & Germany in recession.
10
9
8
7
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5
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Jan-89
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Jan-93
Jul-93
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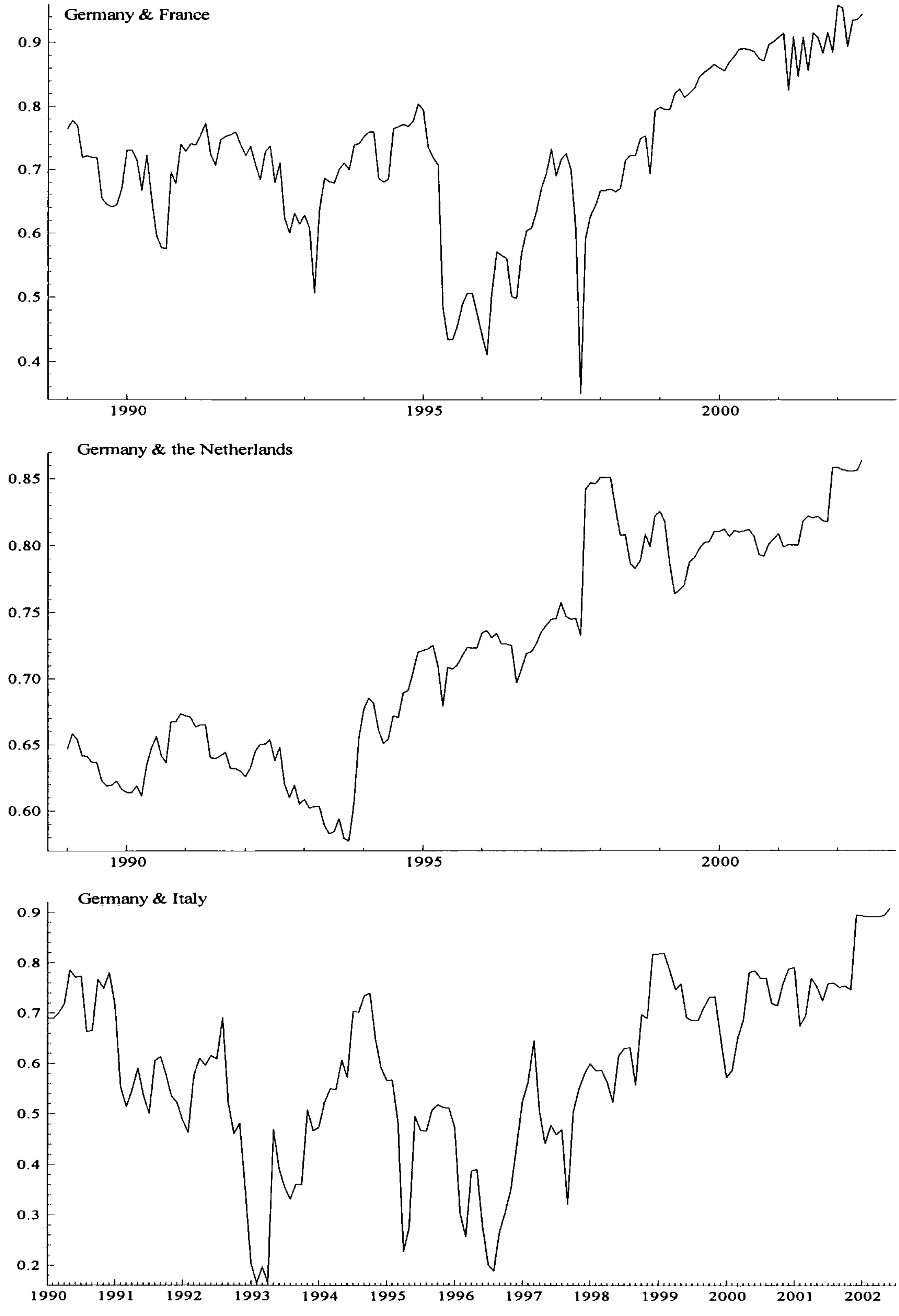
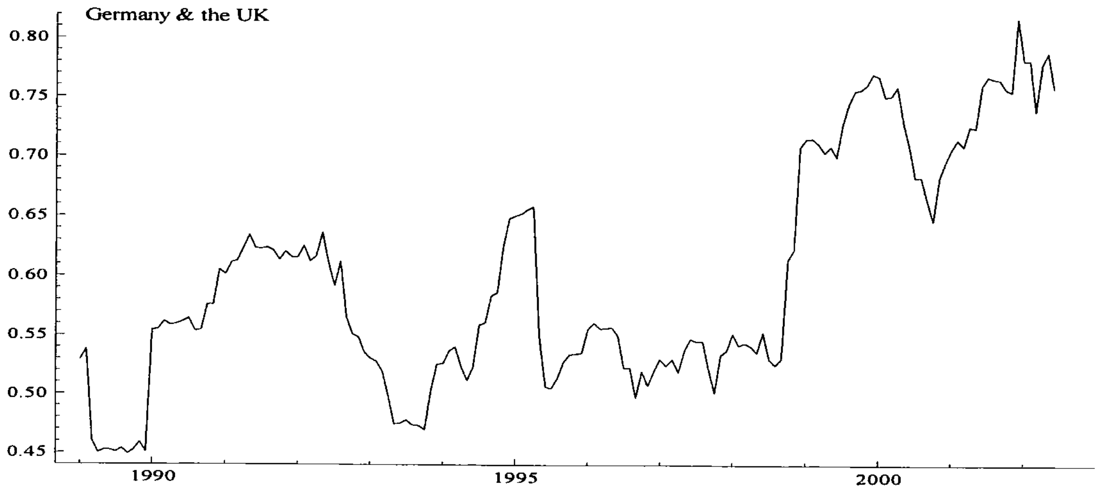
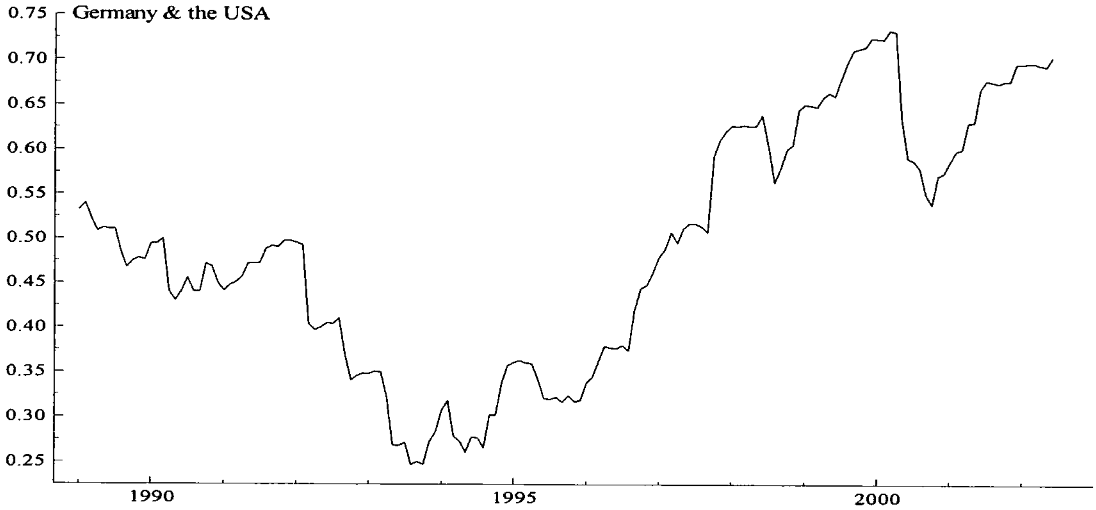
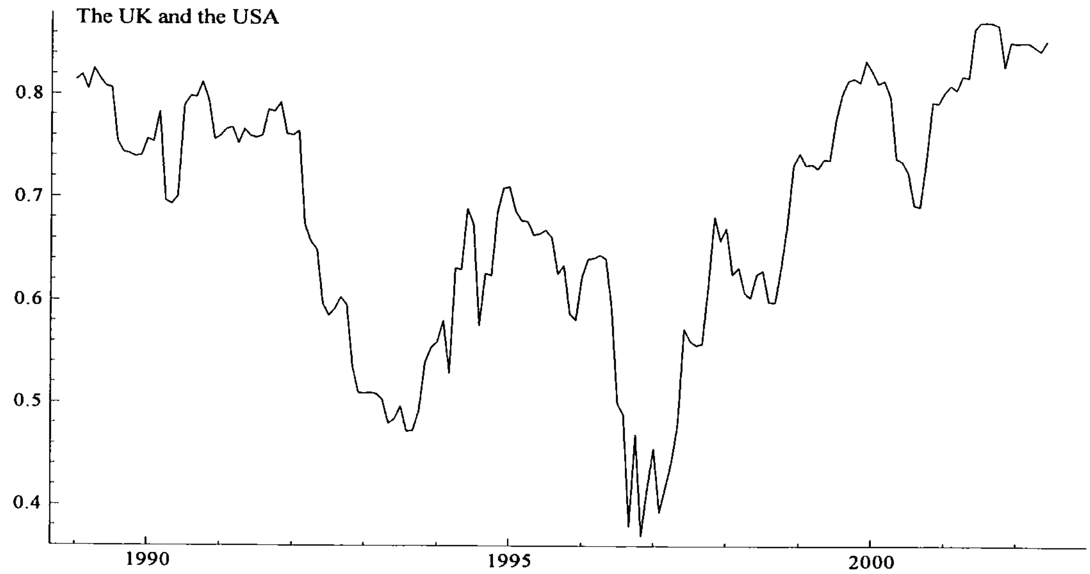
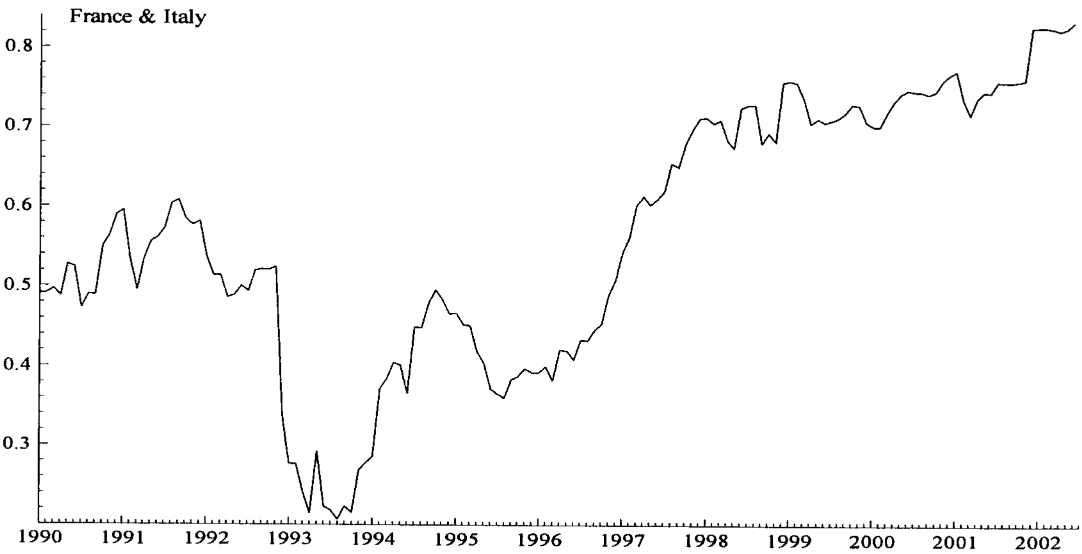
Figure 3.2: Dynamic Correlation between changes in Equity Market Premiums.

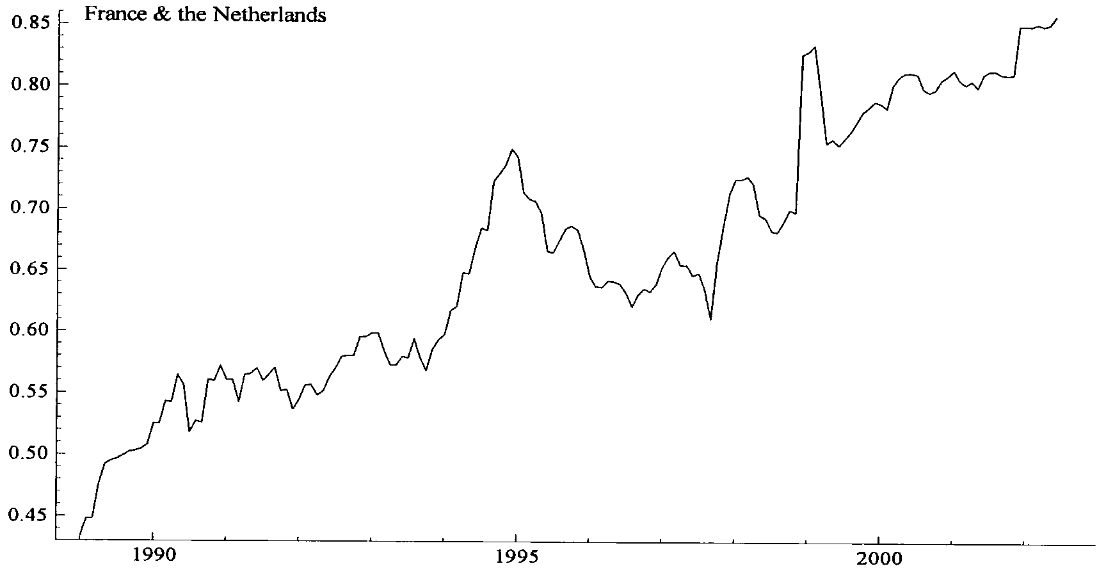


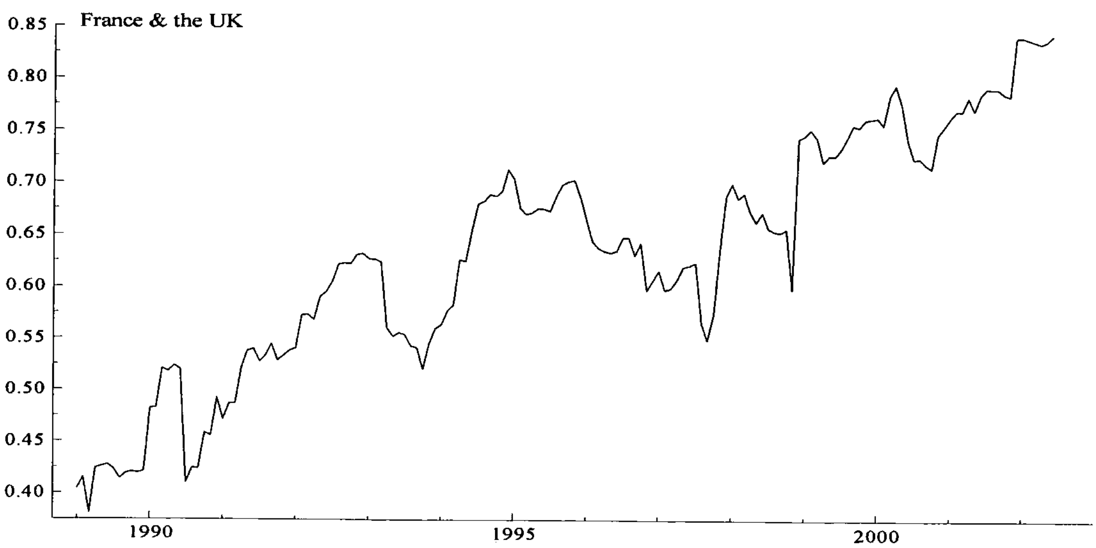

Germany & the UK
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0.45
1990
1995
2000

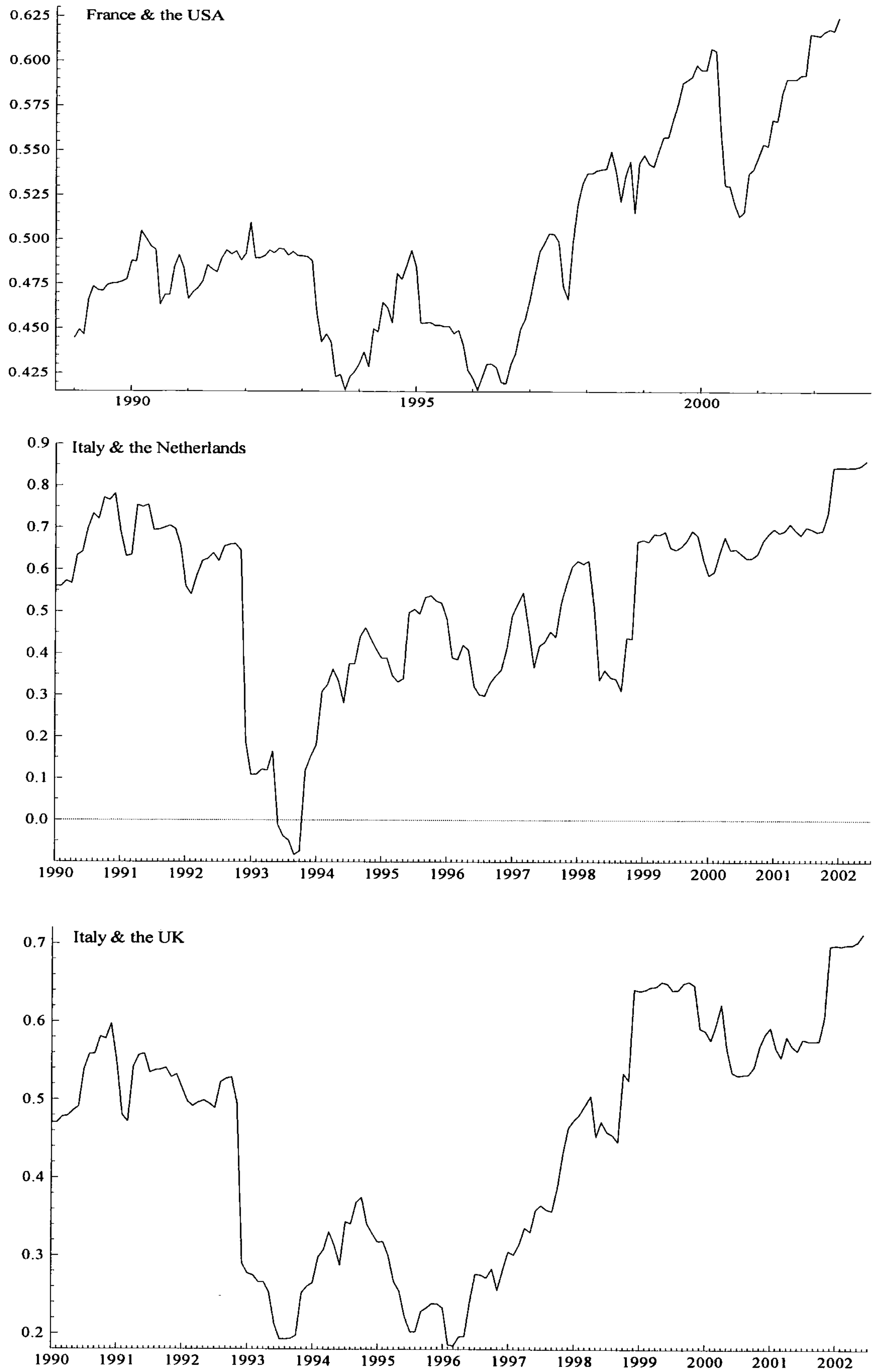

Germany & the USA
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
1990
1995
2000


The UK and the USA
0.8
0.7
0.6
0.5
0.4
1990
1995
2000


France & Italy
0.8
0.7
0.6
0.5
0.4
0.3
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002


France & the Netherlands
0.85
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0.45
1990
1995
2000


France & the UK
0.85
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
1990
1995
2000


France & the USA
0.625
0.600
0.575
0.550
0.525
0.500
0.475
0.450
0.425
1990
1995
2000
Italy & the Netherlands
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Italy & the UK
0.7
0.6
0.5
0.4
0.3
0.2
1990
1991
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1994
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1999
2000
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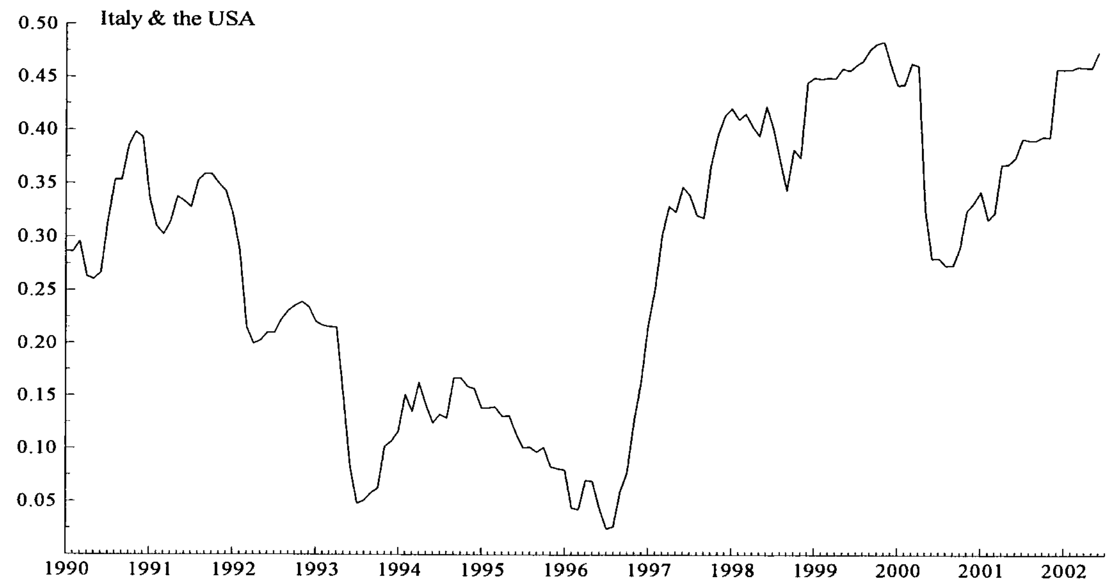
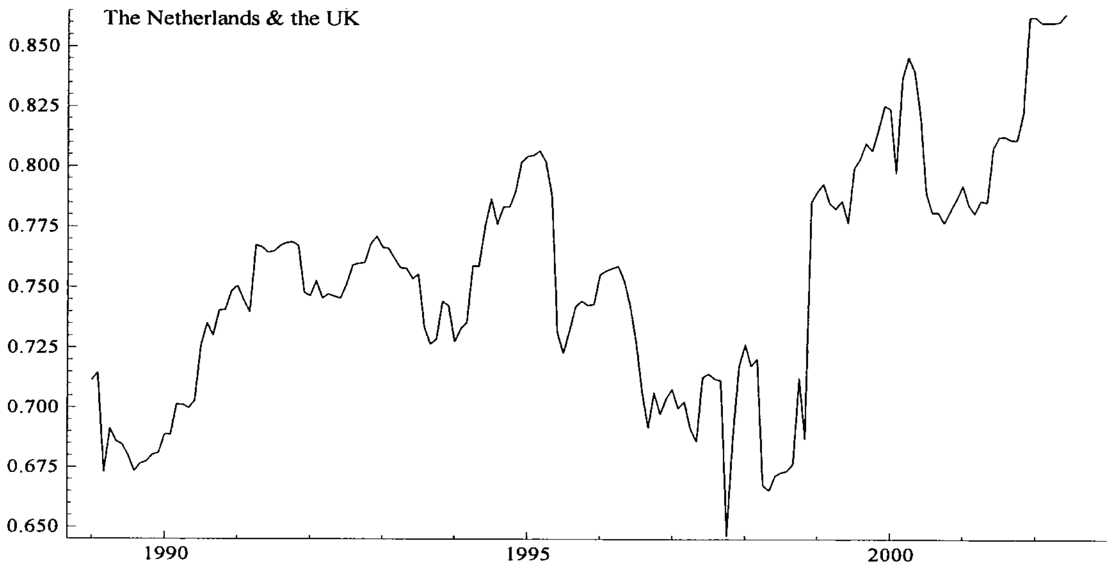
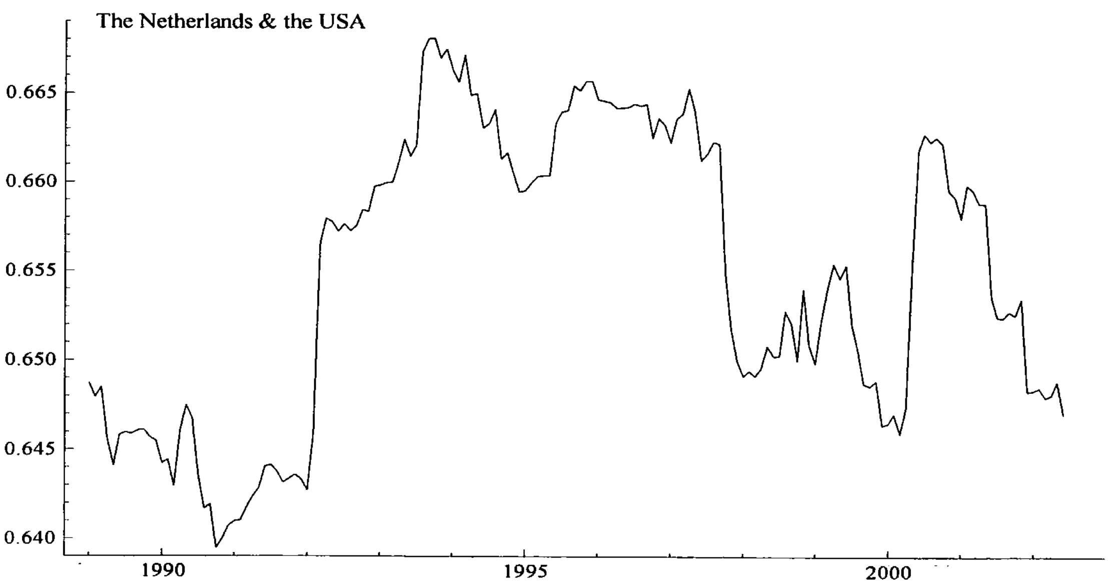
2002



Italy & the USA
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002



The Netherlands & the UK
0.850
0.825
0.800
0.775
0.750
0.725
0.700
0.675
0.650
1990
1995
2000



The Netherlands & the USA
0.665
0.660
0.655
0.650
0.645
0.640
1990
1995
2000

Chapter 4.

Why diversify internationally when domestic diversification provides similar benefits? – Evidence from Europe.

Section 4.1: Introduction.

In spite of its attractiveness, international portfolio diversification,[173] which involves cross-border equity acquisitions, has not been as widely embraced as expected – the actual portfolios that investors hold are quite different from those predicted by the theory. This phenomenon termed 'home bias' in empirical literature reflects investors' preference for local equity and reluctance to diversifying internationally due to perceived additional 'hazards' in the form of political and exchange rate risks, higher taxes and transaction costs, restrictions on foreign and domestic capital flows, investment barriers, information asymmetries, and even psychological factors.[174] Moreover in practice, empirical literature suggests that the unstable structural relationship among national markets may make it unlikely for investors to take full advantage of the entire scope of possible international indices i.e. it is difficult for the investor to select an optimal investment strategy ex-ante.[175]

The need to obtain international diversification benefits despite these issues perhaps led to the introduction of country/regional funds (i.e. funds invested exclusively or predominantly in securities of particular countries or regional equity markets) in the USA in the 1970s and more recently in Europe.[176] Moreover, the increasing number of foreign companies' listings on stock exchanges in developed markets, together with stocks of Multinational Corporations (hereafter MNCs) may be useful in obtaining some international diversification benefits especially in light of home bias in portfolio holdings.

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[173] Early studies on International Portfolio Diversification (IPD) include Grubel (1968), Levy & Sarnat (1970), and Solnik (1974). See also Shawky et al (1997) for update on IPD.

[174] See Kaplanis & Schaefer (1991), Cooper & Kaplanis (1994), Kang & Stultz (1997), Coval & Moskowitz (1999), and French & Porteba (1991) for further discussions of home bias.

[175] See Shawky et al (1997).

[176] In the UK, closed-end (open-end) country/regional funds are more commonly known as investment (unit) trusts.

The objective of this chapter is to investigate whether investors in developed European markets can obtain the benefits of international portfolio diversification (hereafter IPD) by forming portfolios of domestically-traded securities such that cross border diversifications may no longer be necessary. Errunza et al (1999) finds evidence in support of this hypothesis from USA monthly data over the period 1976 to 1993.

The importance of this current study arises for four main reasons. Firstly, there is a need to explore home-made diversification with respect to non-USA markets given that empirical literature suggests that the USA has perhaps the most diversified economy[177] in the world and as such the benefits from US home-made diversification (hereafter HMD) may make it unnecessary to diversify internationally.[178] Moreover, the significant influence exerted by the large US stock market on other international markets, as documented in the numerous studies,[179] may have implications for the US/foreign markets correlation structure. Secondly, the scope for IPD was severely limited in Errunza et al (1999) which focused on the ability to mimic only 16 foreign market indices (7 developed and 9 emerging markets). Recent financial liberalisation, deregulation, and relaxation of restrictions of foreign ownership of domestic equity in many countries (especially emerging markets) have increased the number of investable equity markets worldwide and thus the scope for IPD. This should not be ignored when comparing HMD possibilities with IPD benefits. Thirdly, evidence suggests that the main sources of IPD benefits i.e. emerging markets equities,[180] became increasingly integrated with the world market following liberalisation[181] in the early 1990s and a sharp rise in equity cross listings on developed stock markets,[182] suggesting a possible reduction in the potential benefits from investing in emerging markets. Therefore, since the analysis period in Errunza et al (1999) ends in 1993, an up-to-date assessment of the potential of HMD vis-à-vis that of IPD is necessary.

[177] See Griffin & Karolyi (1998).
[178] In fact Hannah et al (1999) finds that a portfolio consisting solely of the S&P 500 index dominates any portfolio that can be constructed from the S&P 500 and the major market indices of G-7 countries.
[179] See for instance Hassan & Naka (1996) and Bessler & Young (2003).
[180] See Odier et al (1995), and Shawky et al (1997) for more evidence on changing equity market correlations.
[181] Bekaert & Harvey (1997) finds evidence that 17 emerging markets became more integrated with the world markets following liberalisation, showing a small but statistically significant average conditional correlation increase of 0.08 in the 17 markets.
[182] See Karolyi (1998) for more details on the impact of equity cross-listing on the international markets.

Fourthly, De Roon et al (2001) suggests that market frictions (short sales constraints and transaction costs) and other investibility restrictions mainly in emerging markets may significantly reduce IPD benefits[183] – a point not often considered in empirical studies on the potentials of international diversification. Therefore, not considering these market frictions may bias results in favour of IPD. Fifthly and finally, the introduction of the European Monetary Union (EMU) in January 1999, which aimed at removing investment barriers among member states thus creating a 'super home market', may have created important diversification opportunities and/or benefits for the usually 'home-biased' investors within each eurozone state, such that the supposed importance of '*international*' (outside eurozone) portfolio diversification may have diminished.

To meet these objectives, a range of questions similar to those posed in Errunza et al (1999) are addressed, with some differences. Firstly, is it possible to mimic foreign market indices with domestically traded securities? This study focuses on the abilities of three European investors i.e. the UK, French, and German investors, to mimic 37 foreign equity markets (19 developed, 6 advanced emerging, and 12 emerging) representing over 90% of total world market capitalisation, using weekly returns from January 1994 to March 2004. It also analyses the ability to mimic a world portfolio. This allows a more direct comparison between HMD and IPD benefits given that the World index is perhaps the most internationally diversified portfolio. For each country, diversification portfolios are constructed using local market indices, industrial portfolios, stock returns of MNCs headquartered in the investor's country, and where available, Country/regional Funds (hereafter, CFs), and cross-listed securities. Unlike Errunza et al (1999), this study tests explicitly the marginal benefits of diversification obtained through MNCs, by excluding multinationals from the benchmark portfolio.

Secondly, has it become possible to exhaust the benefits of international diversification by investing in domestic traded assets? As suggested in Errunza et al

[183] Bekaert (1995) acknowledges that in addition to foreign ownership restrictions and taxes on foreign investments (most of which were abolished in the early 1990s), two other cross-border investment barriers, namely indirect barriers (differences in available information, accounting standards, and investor protection), and emerging-market specific risks (liquidity risks, political risks, and economic policy risks) lead to de facto segmentation.

(1999), theory is that as the mimicking portfolio is sequentially augmented with MNCs, CFs, and cross-listed equities, it should become increasingly correlated with the foreign market portfolio. At the limit, the benefits of investing in foreign indices would evaporate, regardless of the low correlation between the domestic index and the foreign index. Errunza et al (1999) studies this issue using mean-variance spanning tests of Huberman & Kandel (1987), Bekaert & Urias (1996), and the change in Sharpe Ratio. In addition to these tests, this study applies the step-down procedure of Kan and Zhou (2001) given certain added benefits as will be discussed later, the spanning tests in case of market frictions developed in De Roon et al (2001), and the Jensen 'alpha' measure of portfolio performance.

Thirdly, has the ability to mimic foreign indices changed over time, given the considerable time variation in return correlation, as reported in several studies?[184] Errunza et al employ the Generalised Dynamic Covariance (GDC) Multivariate GARCH model of Kroner & Ng (1998) to estimate the conditional correlation between foreign market indices and their respective mimicking indices. The Dynamic Conditional Correlation (hereafter, DCC) Multivariate GARCH model of Engle (2002) is used to estimate these correlations, testing null of constant correlation versus dynamic correlation.

Fourthly, given the Economic and Monetary Union within the eurozone, are German, French, and other eurozone nationals' abilities to mimic foreign market indices enhanced by euro-area diversification? Or to put it differently, does the European Monetary Union (hereafter, EMU) enhance home-diversification benefits? To investigate, this study distinguishes between two types of investors: a 'europhoric' investor, whose 'home frontier' shifts following the EMU, diversifying across eurozone sectors and industries from January 1999, and the 'eurosceptic' German and French investors, who only diversify within their home countries. Using unconditional correlation analyses and mean-variance spanning tests, if a particular foreign market index mimicking portfolio of the two types of investors are (not) different statistically, or preferably economically, then one might suggest that euro-area diversification does (not) enhance home diversification benefits, with respect to the eurozone investor.

[184] See for instance Longin & Solnik (1995), and Shawky et al (1997) for empirical evidence and explanation on time variations in return correlation.

Finally, is this extra diversification benefit (if any) obtainable from eurozone diversification reducing over time as economic convergence supposedly increases among eurozone countries? If this is the case, employing DCC analyses, the correlation between the portfolios of the europhoric and eurosceptic investors with respect to an underlying foreign market index (especially the EMU states) should be converging.

To summarise results, it is found that the European investors can effectively mimic foreign market indices with industrial stocks, MNCs, CFs, and cross-listed equities over the sample period. The unconditional correlations between the foreign indices and their mimicking portfolios are generally higher than the correlations with the market indices of the three domestic countries. The spanning tests suggest that it is possible to exhaust the diversification benefits of most foreign markets, especially with UK-traded assets. The potential of UK industrial diversification is also demonstrated. When market frictions are considered, assets traded on the German and French equity markets also span most foreign indices. Thus any marginal gains from diversifying internationally over home diversification may be trivial both statistically and economically. The time variation in index level conditional correlations and mimicking portfolios/foreign market correlations is significant, even though there is not always a trend. Sectoral diversification across the entire eurozone dominates that of Germany and France. Any gains of IPD over those of eurozone diversification appear to be statistically and economically insignificant, unlike German and French domestic diversification. More importantly, at this point in time, it does not appear that this extra eurozone diversification benefits would fizzle out.

The rest of the chapter is organised as follows: Section 4.2 discusses the various tools and methodology for constructing the mimicking portfolios, and the data set; Section 4.3 focuses on measuring the potential of HMD benefits using correlation analysis and mean-variance spanning tests; Section 4.4 presents and discusses some empirical results; and Section 4.5 investigates whether the ability to mimic foreign indices has changed over time on the basis of dynamic conditional correlation; Section 4.6 discusses the potential of eurozone diversification and empirical findings; and Section 4.7 summarises the chapter.

Section 4.2: Construction of Diversification Portfolios and Data.

This section discusses the various 'tools' for home-made diversification i.e. industrial indices, stocks of multinational companies, country and/or regional funds, and international cross-listings; the methodologies for constructing the portfolios, and the data set.

Constructing home-made diversification portfolios.

As mentioned earlier, this study investigates the potential of HMD in three different countries – the UK, Germany, and France. A diversification portfolio is defined as the portfolio of domestically traded securities that is most highly correlated with a target foreign market index.

The sources of gains from IPD have been subject to academic debate over the last few years. Some studies (for example Solnik,1974, and Heston & Rouwenhorst,1994) suggest that the low correlation between national markets is due mainly to cross-country variations in the economic, political, institutional, and even psychological factors affecting security returns (country factors), while others like Roll (1992) propose that diversity of industrial structures across countries largely accounts for IPD benefits[185] (industry factors). More recent studies like Cavaglia et al (2000) and Diermeier & Solnik (2001) show that industry effects have been growing in importance, and may now dominate country factors. Using data from 21 developed and 19 emerging markets, Brooks & Catao (2000) finds that the fraction of return variation explained by global industry effects is on average 23 percent from mid-1997, far above the 4 percent reported in Griffin and Karolyi (1998). Errunza et al (1999) finds some evidence from USA data that diversification benefits over and above that provided by an industrially diversified portfolio may be statistically and economically insignificant. Therefore, industrial stocks should be useful tools of HMD.

The industrially diversified portfolios (D1) for each of the three domestic investors are the fitted values of the regression of a foreign market index on the domestic

[185] Roll (1992) and Heston & Rouwenhorst (1994) grouped their securities into just seven industry sectors. However, using 66 industrial portfolios, Griffin & Karolyi (1998) find mixed evidence on the issue.

industrial indices, in similar spirit as Errunza et al (1999),[186] as set out in equation (4.1) below.[187] Following the caution of Griffin & Karolyi (1998) that broad industrial classification may not provide enough cross-sectional variation in returns across industries, Datastream Level 4 (industrial sectors) classifications are used.

$$R_{I,t} \quad = \quad \beta_1 R_{j1,t} + \ldots\ldots\ldots\ldots + \beta_n R_{jN,t} + \varepsilon_{I,t}, \qquad (4.1)$$

where $R_{I,t}$ is the return on the *I*th foreign market index during period t, and R_{j1}........,R_{jN} are the returns on the *N* industrial indices. β_1.....β_n are the sensitivities of the foreign index to the *N* industrial indices. $\varepsilon_{I,t}$ is an error term.

Errunza & Senbet (1981) suggests that MNCs enjoy more stable earnings than purely domestic firms because of diversification of real asset portfolio, and they (MNCs) also enable indirect merger of national capital markets. Kogut (1983) also notes that the primary advantage of an MNC as differentiated from a domestic corporation lies in the flexibility to transfer resources across borders through a globally maximising network. Fatemi (1984) and Bartov et al (1995) suggest that the higher the degree of international involvement, the lower the beta relative to the domestic market portfolio and as such MNC stocks may provide some diversification benefits. In addition, unlike cross-border diversification (IPD) which is susceptible to exchange rate risks, Hung (1997) finds that the net volume effect of exchange rate changes on MNCs overseas' profits is trivial. Gao (2000) also finds that stock returns of US MNCs are not significantly exposed to unanticipated changes in exchange rates because exchange rates affects MNCs' profitability through many different channels (including foreign sales and foreign production) which may be offsetting to one another. Note, however, that Jacquillat and Solnik (1978), Eun & Resnick (2001), and Salehizadeh (2003) suggest that US investors can benefit from IPD over and above diversification benefits of MNCs; hence MNCs may not be regarded as substitutes to IPD. Thus, apart from their inclusion in our HMD portfolios, this study tests exclusively the marginal diversification benefits obtained from the European MNCs.

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[186] See also Breeden et al (1989).

[187] For example, from the perspective of the UK investor, the portfolio D1 for Brazil are the fitted values obtained from the regression of the Brazilian market index on the UK's industry portfolios. Mimicking portfolios D1 for Brazil are obtained for the German and French investors in similar fashion.

To isolate the marginal diversification benefits of MNCs, portfolios (Dm) are constructed using fitted values from stepwise regressions[188] of a foreign market index on two domestic market indices (an index of listed companies that transact the majority of their business within their domestic countries, and a small cap index to capture any size effects following empirical evidence that stock returns of firms of a similar size are more correlated with each other than stock returns of firms of different sizes[189]) and a variety of MNCs. A portfolio (D2) is also constructed, using stepwise regressions of the foreign market indices on the two market indices, the industrial indices, and the MNCs. The returns on the portfolio (D2) are therefore the most diversified portfolios using purely domestic assets i.e. without reference to claims on foreign assets, even though they trade within the domestic markets.

The impact of Country and/or Regional Funds (CFs), which are generally regarded as international assets that trade on a local stock exchange, on portfolio diversification efforts has been investigated in several studies, especially those traded on stock exchanges in the USA and the UK. Bekaert & Urias (1996) examines the diversification benefits of emerging markets country funds traded on both the USA and the UK stock markets as compared to IPD using the emerging market indices, finding significant diversification benefits for UK-traded country funds, but not for those traded in the USA. Errunza et al (1998) also suggests that the ability of US-traded CFs to substitute for foreign market index returns is restricted, though they may provide some diversification benefits. Errunza et al (1999) notes that CFs are actively managed and trade at prices that differ from the market value of the underlying securities on the local markets, and thus may undermine their ability to mimic the respective local markets. They also find evidence that US-traded developed and emerging market CFs provide some diversification benefits.

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188 In similar spirit as Errunza et al (1999), the stepwise procedure is based on a forward and backward p-value threshold of 0.20.

189 See Huberman et al (1987) and Fama & French (1992) for more on size effects.

The impact of CFs (where available) on our HMD effort is isolated in the regression:

$$R_{I,t} = \varphi_1 R_{D2,t} + \varphi_2 R_{CF,t} + \varepsilon_{I,t}, \quad (4.2)$$

where $R_{I,t}$ is the return on the *I*th foreign market index during period t, $R_{D2,t}$ is the return on portfolio (D2), and $R_{CF,t}$ is the return on the relevant country or regional fund. $\varepsilon_{I,t}$ is an error term.

Given that regressions are based on the full sample of available weekly data on market returns, for those CFs that were launched after the start date of our analysis, $R_{CF,t}$ is set to zero in the weeks prior to the launch, as in Errunza et al (1999). In the absence of country-specific CFs, an appropriate regional fund is used. The fitted values from equation (4.2) above are the returns associated with portfolio (AD1).Φ_1 and Φ_2 are interpreted as weights of portfolio D2 and the CFs in the portfolio AD1. The significance of these components in the portfolio AD1 can be easily evaluated by their respective t-statistics.

The advent of globalization over the last decade enabled an increasing number of companies to raise capital through equity issues beyond the borders of their home market. Karolyi (1998) lists the potential advantages of cross-border listings, including an enlarged investor base, enhanced local market trading for shares, and the opportunity to raise new capital. Another key attraction for cross-border listing is the possibility of a reduction in the company's cost of raising capital by diversifying its exposures to different market risks through reduction of share trading illiquidity and an elimination of investment barriers. Recent research such as Miller (1999), Foerster & Karolyi (1999), and Errunza & Miller (2000) have also documented that firms that list abroad can achieve substantial gains from higher integration in world capital markets. Moreover it appears that that the gains from cross-border listings are not restricted to the listing firm but spillover to other stocks in the country. Fernandes (2003) shows from a large sample of emerging markets that when a domestic firm cross-lists, it also increases the integration of other firms in the local market. Thus, cross-border listings appear to be a catalyst for the integration of the local market to world markets. A large number of cross-border listings on the international markets take the form of Depository Receipts (DRs),[190] especially in the USA, as compared to full share listings which are subject to more stringent requirements. Following empirical evidence that adding DRs to domestic portfolios has substantial risk reduction benefits[191] although they may not replicate the well-diversified foreign market index, this study includes international dually-listed stocks in our HMD mimicking portfolios. It is noted that dividends on the foreign stocks listed on the European markets are paid in the respective European currency.

The portfolio AD2 is constructed by adding cross-listed stocks to portfolio AD1 i.e. the fitted values from the regression:

$$R_{I,t} = \Phi_1 R_{D2,t} + \Phi_2 R_{CF,t} + \Phi_3 R_{CLST,t} + \varepsilon_{I,t}. \qquad (4.3)$$

where $R_{I,t}$ are *I*th market returns, $R_{D2,t}$ are D2 returns, $R_{CF,t}$ are country fund returns, and $R_{CLST,t}$ is return on the selected cross-listed equity.

In the case of multiple cross-listed equities, the one with the longest history is selected from a subset of those that most enhance HMD in a statistically significant way, using stepwise regressions.[192] The coefficient Φ_3 captures the portfolio weight and significance of the selected cross-listed equity. Again if the selected cross-listing was launched after the start date of our analysis, $R_{CLST,t}$ is set to zero in the weeks prior to the launch.

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[190] DRs are negotiable certificates that indirectly represent ownership of shares in the corporation for domestic investors. These certificates denote depository shares which represent a specific number of underlying shares remaining on deposit in the issuer's home market. See Karolyi (1998) for literature on DRs and cross-listed equities.

[191] See Eun & Resnick (2001), Errunza et al (1999), and Karolyi (1998).

[192] Note that the selection of one cross-listed security (in the case of multiple listings) is also consistent with evidence from Ziobrowsky & Ziobrowsky (1995) that the marginal diversification gains associated with multiple equity acquisitions in a single foreign country versus the gains available from the acquisition of only one equity asset is relatively small.

Data.

Weekly equity returns from January 1994 to March 2004 (535 observations) are used to construct diversification portfolios.[193] Empirical studies suggest that stock market liberalisation[194] especially in emerging markets have significant implications on the degree of integration with developed markets.[195] Since the literature suggests that most emerging stock market liberalisation policies had been executed by the early 1990s,[196] this study focuses on diversification benefits for post-liberalization periods only, thereby avoiding any potential bias due to liberalisation.

The FTSE All-World indices for international equity markets is used as a measure of overall equity returns in each of the 37 foreign markets[197] (19 developed (DMs), 6 advanced emerging (AEMs), and 12 emerging markets (EMs)), and a world Portfolio.[198] These dividend-adjusted indices are constructed using over 90% of the market capitalisation in each country and are available in four different currencies (including the pound sterling and the euro) and are therefore suitable for this study since focus is on the perspectives of investors in the UK, Germany, and France.

The domestic market portfolios are the FTSE Local Indices for the UK, France, and Germany. The Local indices, which include only domestically-listed companies who transact the majority of their business within their domestic markets, is therefore exempt of MNCs stocks. This allows the testing of the marginal diversification benefits of using MNCs stocks.[199] The second domestic market benchmark used is the Cazenove & Rosenberg Smaller Companies Indices (CRI) (defined as an index of

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[193] Due to data constraints, the analysis period differs for 3 countries: Brazil (11/94), Thailand (11/94), and Russia (07/97).

[194] Stock market liberalization is the decision by a country's government to allow foreigners to purchase shares in that country's stock market.

[195] Bekaert (1995), and Bekaert et al (1998) provide evidence that stock market liberalization increases the correlation of the liberalizing market with world markets. The Errunza et al (1999) study used data from 1976 – 1993, and thus their results may require updating.

[196] See Henry (2000) for a review of literature on emerging stock market liberalisation dates. The latest liberalisation date recorded in the study was November 1992 for India.

[197] See Appendix C1 for full list of foreign markets. Note that the market indices of the three domestic investors (UK, Germany, and France) are also *foreign* indices to one another. For example, the UK and French market indices are also foreign indices to the German investor.

[198] The world portfolio is value-weighted and constructed from the market return indices of 49 countries.

[199] Errunza et al (1999) uses the S&P 500 index as its domestic benchmark portfolio. However, the S&P 500 is found to contain 276 MNCs (see Crabb (2002)) so their study may not give a true picture of the extra diversification benefits using MNCs.

small companies that international investors do not follow but are liquid enough to trade) to control for possible size effects for each of the UK, France and Germany.[200]

Industrial indices for the UK, France, and Germany are also derived from the FTSE-All-World series, based on level four industrial classifications (industrial sectors). There is a variation in the number of industrial indices (in brackets) used for each domestic market i.e. UK (31), France (26), and Germany (21), either because of lack of representation in specific industries as suggested in Griffin & Karolyi (1998) or simply because of data unavailability.[201]

The MNCs (those with headquarters in UK, France, and Germany) used in the study are selected from the 1994 List of Companies in the FTSE Multinationals Index.[202] The FTSE defines an MNC as a company that derives 30% or more of its revenue outside the region in which it is incorporated. However, as suggested by Errunza & Senbet (1984), measuring the degree of international involvement (hereafter DOI) this way has apparent limitations. It will be difficult to distinguish between exporting firms and 'true' MNCs using this criterion, and thus results on the marginal diversification benefits of MNCs may be biased, especially in light of Errunza & Senbet (1981).[203] As a result, this study considers another proxy of DOI – geographical distribution of the firm's operations i.e. the number of foreign subsidiaries, as applied in Errunza & Senbet (1984). Therefore, from the FTSE list, one selects those that had (as of 1994) and still have a number of foreign subsidiaries. Some companies are also selected from the S&P Global 100 (an index of companies whose businesses are global in nature), if they meet the criteria.

All data, including those on Country Funds and Cross-listed equities traded on the domestic equity markets, are obtained from Datastream. Unlike the other two

[200] This index is made up of companies with between £10m and £500m (for the UK), and between £10million and £800million (for the other European countries).
[201] For robustness purposes, it is found throughout the study that the use of the broader level 3 industrial classification (10 economic sectors) does not enhance HMD efforts (with respect to correlations and spanning) in each of the domestic countries as efficiently as the level 4 industries used.
[202] Since 1994 is the start date of our analysis period, it is deemed appropriate to use the 1994 list of MNCs.
[203] Errunza & Senbet (1981) shows that while exporting reduces the variability of only consolidated sales revenue, international corporate diversification can provide more stability to both consolidated sales and costs of production.

countries, country funds are largely unavailable in France (as at the time of our data collection). A list of eligible securities, containing details of all our tools of HMD are presented in Appendix C2. It is noted that the set of country funds and cross-listings used in this study is only a subset of those listed on various national stock exchanges (especially the UK and Germany) given the need to exclude a number of the country funds and cross-listings that are illiquid and/or very recently introduced (i.e. few data points), and in the case of multiple CFs, those with the longest history are selected, in line with Errunza et al (1999). The risk-free rates used are derived from the following 7-day rates: Euro-Sterling (UK), Euro-Mark (Germany), Euro-Franc (France), and EURIBOR (Eurozone) rates.

Summary statistics for the foreign market indices in both UK sterling and the Euro are reported in Tables 4.1(a) and 4.1(b) below, respectively.[204] The behaviour of returns in the developed, advanced emerging, and emerging markets over the sample period appears to differ from that reported in previous studies. Although, it appears that market volatility is still negatively correlated with the level of market development on average, as shown in the literature,[205] the same cannot be said about market returns. Developed Markets (DMs) returns are on average higher than those of Advanced Emerging Markets (AEMs) and Emerging Markets (EMs) over the sample period studies.[206] This is not particularly surprising since theory suggests that market liberalisation (integrations) should decrease expected returns.[207] However, it is important to note that when the returns are denominated in the local currencies (see Appendix C3), evidence still suggests that EMs returns are higher and more volatile on average, than DMs returns. Thus, given these currency induced differences in mean-variance characteristics, a caveat must be issued at this stage. Expressing emerging market indices in European currencies (as done in this study) may further synchronise their returns with those of equities in the domestic investors' markets, and may potentially direct results in favour of home diversification.

[204] Summary statistics for the foreign indices, based on US Dollars are similar to those reported in Tables 2a and 2b so discussions vis-à-vis previous studies should be facilitated.
[205] See Errunza et al (1999) and De Roon et al (2001), and Li et al (2003).
[206] Traditionally, emerging market stock returns are usually higher (on average) than those of developed markets.
[207] See Bekaert & Harvey (2002) for theory and further empirical evidence on the impact of integration on expected returns and market volatility. When recent data is analysed as in our case, there is mixed evidence on the characteristics of equity return in developed and emerging markets – see also Li et al (2003).

Section 4.3: Measuring the potential of HMD Benefits.

This section discusses the methodologies for measuring the potential of home-made diversification benefits: Unconditional Correlation Analysis and various Mean-Variance Spanning tests.

Unconditional Correlation Analysis

Numerous studies[208] show that high return correlation suggests a high degree of similarity in the 'undiversifiable' systematic risks among the markets and thus the higher the return correlation among markets, the lower the potential benefits of IPD. On the other hand, lower return correlations among markets signify higher potential benefits for IPD. The importance of correlation analysis in measuring diversification benefits can be seen in the suggestions in many studies that investors in developed markets will derive better IPD benefits by investing in emerging markets due to differences in risk-return characteristics (low correlation) rather than diversifying within highly correlated developed markets only.[209] Therefore the return correlation between our constructed HMD portfolios and a target foreign market index is a measure of HMD benefits. The higher the correlation, the greater the opportunity to obtain international diversification benefits through domestically traded assets. In other words, unconditional correlation analysis is an important tool for measuring the ability of HMD portfolios to mimic foreign indices.

Mean-Variance Spanning Tests

The possibility of exhausting the benefits of international portfolio diversification through mean-variance spanning tests is investigated. The concept of mean-variance spanning, first developed in Huberman and Kandel (1987), is based on the idea that for any partition of assets into a set of test assets, N, and benchmark assets, K, the inclusion of additional test assets into the set of benchmark assets shifts the efficient frontier to the left if and only if the test assets are not mean-variance spanned by the benchmark assets. In other words, a set of K risky assets spans a larger set of $N+K$ risky assets if the minimum-variance frontier of the K-assets is identical to the minimum-variance frontier of the K assets plus additional N assets. Huberman and

[208] See Shawky et al (1997) and the references therein.
[209] See Odier et al (1995).

Kandel (1987) propose and apply a likelihood-ratio type test to the joint restrictions in the linear model:

$$R_{i,t} = \alpha_i + B\,R_{K,t} + e_t, \qquad (4.4)$$

where $R_{i,t}$ is the return on the *I*th foreign market, α, is a constant, $R_{K,t}$ is the return on the domestic benchmark assets (*B* is a *1* X *K* matrix).

The joint restrictions are:

$$\alpha = 0, \text{ and } B = 1 \qquad (4.5)$$

Huberman and Kandel (1987) (hereafter, HK) test the hypothesis that monthly returns on three size-based indices of NYSE stocks over twenty years span the minimum-variance frontier of the monthly returns on thirty-three size-sorted portfolios, finding evidence of spanning when ten or five years of data (subperiods) are used to construct the HK statistic but rejecting spanning over the entire twenty-year period owing to temporal instability of the coefficients of the underlying return-generating model. This is perhaps not surprising since two key assumptions are made in the HK test: homoscedasticity and normality in the error term.

Ferson et al (1993) developed a test of conditional mean variance spanning that accommodates non-normal and heteroscedastic errors, based on Generalised Method of Moments (GMM) estimation of equation (4.4) thus generalising the HK test. Applying the test to the spanning hypotheses and sample of Huberman and Kandel (1987), Ferson et al (1993) rejects the conditional mean variance spanning of the sample, thus suggesting that the violation of the homoscedasticity and normality assumptions may have implications on the results of spanning tests.

DeSantis (1995) and Bekaert and Urias (1996) (hereafter BU) also develop Stochastic Discount Factor (hereafter SDF) GMM-based mean-variance spanning test, forming a likelihood ratio-type test in which corrections for serial correlation are made to evaluate the diversification benefits from emerging equity market closed-end country fund traded in the UK and the USA. Their study suggests that the unconditional format of the BU test is equivalent to the HK test, showing that the conditional format evaluates restrictions on the coefficient of a system of regressions that are analogous to the HK restrictions in the unconditional case. Bekaert and Urias (1996) also shows that the power of the mean variance spanning test is extremely sensitive to the number of benchmark assets, finding significant diversification benefits for UK country funds, but not for US funds. However, they note that the power of the HK statistic is superior to all moment-based tests. In addition, the simulated BU test statistic is based on a small sample, and thus its applicability to larger samples may be flawed. De Roon et al (2001) and Kan and Zhou (2001) find that GMM spanning tests under regression approach (as in Ferson et al, 1993) are superior to the corresponding tests under the SDF approach (as in Bekaert and Urias, 1996) when returns exhibit conditional heteroscedasticity, but the two tests are not significantly different (even in small samples) when returns are non-normally distributed.

Kan and Zhou (2001) introduce a Step-Down Procedure (hereafter, SDP) that re-examines the two components of the spanning hypothesis ($\alpha_i = 0$, and $B_i = 1$) individually rather jointly since statistical significance does not always correspond to economic significance for the spanning tests (i.e. a low p-value does not always imply there is economically significant difference between the two frontiers and a high p-value does not always imply that the test assets do not add much to the benchmark assets). The SDP test helps to identify the origins of the rejection of the spanning hypothesis: if the rejection is due to the first test ($\alpha = 0$), it is because the two tangency portfolios are statistically very different, if on the other hand the rejection is due to the second test ($B = 1$), it is because the two global minimum-variance portfolios are statistically very different.[210]

De Roon et al (2001) incorporates market frictions into the regression-based tests of spanning since prior applications of mean-variance tests assume the absence of market frictions such as short-sales restrictions and transaction costs. Testing short selling constraints involves testing equations (4.4) and (4.5), although inequality constraints

[210] See Kan and Zhou (2001) for further details.

have to be tested. A simpler version of the test is made possible when excess returns are used i.e.:

$$R_{it} - R_f = \alpha_i + \sum_{k=1}^{K} \beta_{ik} (R_{kt}^B - R_f) + \varepsilon_{it} \tag{4.6}$$

$$H_0 : \alpha \leq 0 \tag{4.7}$$

where R_{it} is the return on the test asset (foreign market index);

R_f is the risk-free rate;

R_{kt}^B is the return on benchmark assets k, k = 1…4;

ε_{it} is the error term.

Notice that α above is tantamount to the Jensen alpha measure of portfolio performance. The rationale behind the test is thus: when short sales are allowed, if an asset has a positive (or negative) alpha, including the asset long (or short) would improve the efficient frontier. However, when short-selling is constrained, then only the inclusion of an asset with a positive alpha would improve the efficient frontier. De Roon et al (2001) used an asymptotic Wald test statistic to test the restrictions in equation (4.7), finding strong evidence for diversification benefits from 17 emerging equity market when market frictions are excluded, but these benefits disappear when investors face short sales constraints or small transaction costs. On the downside, the test results indicate that there is a quick loss of power in the test as the number of constraints increases (i.e. when a group of test assets is considered as opposed to individual assets), and also in small samples.

Section 4.4: Empirical Results.

This section presents and discusses the composition of the various diversification portfolios, and then discusses empirical evidence with reference to the research questions.

Composition of Home-Made Diversification Portfolios.

The compositions of the various HMD portfolios are presented in Appendix C4. The assets in each column are presented in their order of significance following the stepwise regressions.

The UK Investor.

For the UK investor, portfolio Dm contains one or both local benchmark portfolios, and between five and nine MNCs stocks. However, for Belgium, Korea, and Thailand, portfolio Dm contains only MNCs stocks. MNC stocks are also most significant in the mimicking portfolio of some other countries. For example, the HSBC stock is the most statistically significant asset in the Dm of Hong Kong, Taiwan, China, Korea, and Thailand. This is perhaps not surprising since the HSBC has significant operations in the south-east Asian sub-region. In most cases, the MNCs that enter into a particular country's Dm are those that have major operations in that country. Evidence on the importance of international corporate diversification for market integration is therefore provided here.

The industry portfolios also play an important role in the construction of portfolio D2. For Germany, Taiwan, and Pakistan, the inclusion of industry indices leads to the insignificance of the domestic market benchmarks. The dominance of the oil and gas industry in the D2 portfolio of Australia and Norway may not be surprising, given the importance of the oil industry within these two countries. Investment companies is unsurprisingly the most significant industry in the D2 portfolios of thirteen countries (mostly DMs), and the world portfolio. The parameter estimates for the portfolio AD1 illustrate the impact of country funds on HMD efforts. With the exception of Austria and Pakistan, the various portfolio weights associated with the CFs are statistically significant. In fact for Japan, USA, Argentina, Thailand, and Brazil, the CF portfolio weights exceed those of other assets combined.

An interesting feature of portfolios Dm and D2 is that it appears the UK small-cap index is (more) significant in most markets especially the smaller DMs, AEMs and EMs portfolios unlike the domestic benchmark index, which is statistically significant in large DMs portfolios.[211] Size effects in returns characteristics therefore may have important implications for diversification benefits.

Cross-listed securities undoubtedly enhance the HMD portfolios except that of Hong Kong. For Ireland, the fact that the contribution of the CF to portfolio AD2 is subsumed by cross-listings may not be surprising, given that 22 Irish cross-listings (13 of which traded throughout our analysis period) were used in the analysis, in line with evidence from Errunza et al (1999) on the impact of multiple cross-listings.

The German Investor

The tools for HMD diversification undoubtedly enhance the diversification benefits of the German Investor. The underlying portfolio Dm for two out of thirty-seven countries (Switzerland and China) is made up entirely of MNCs stocks. The number of significant MNCs stocks varies from three for Mexico to eleven for Switzerland. Again, significant MNCs in the portfolios appear to be those that have significant operations in the respective countries e.g. Siemens in Australia and New Zealand.[212] The industrial portfolios also enhance HMD benefits (as in portfolio D2) except for five countries – the Netherlands, New Zealand, Thailand, Peru, and Israel, where portfolios Dm and D2 are equivalent. All CFs included in portfolio AD1 provide statistically significant diversification benefits, with the portfolio weight associated with that of the UK being larger than that of all other assets combined. The cross-listings in portfolio AD2 are also significant. For Japan and Korea, inclusion of the cross-listings tremendously reduces the portfolio weights of the other assets combined.

The French Investor

The French investor's Dm portfolios for Brazil, Pakistan, and Thailand comprise of MNCs stocks only. Again, most of the MNCs in the portfolios have significant

[211] The same observations are noted in the German and French investors' portfolios.
[212] In fact, the Siemens stock is the most significant asset in portfolios Dm and D2 of these two countries.

operations in the respective countries.[213] Adding industrial stocks, the local benchmark indices become insignificant and are removed from D2 portfolios of Japan, Chile, China, Colombia, Turkey, and Russia. Given the unavailability of CFs in the French market, portfolio AD1 is not obtainable for the French investor. With the exception of South Africa, it is also impossible to construct portfolio AD2 for AEMs, and EMs. Cross-listed securities are significant in portfolio AD2 of the DMs. For example, the portfolio weight of the Finnish company listed on the Paris Stock Exchange subsumes that of all other assets combined.

On the ability of HMD portfolios to mimic Foreign Market Indices.

As discussed earlier, return correlation is an important measure of the ability of the constructed HMD portfolios to mimic foreign market indices in answer to the first research question. Table 4.2 below reports the unconditional correlations of the foreign market indices with the domestic benchmarks portfolios;[214] and the HMD portfolios D1, Dm, D2, AD1, and AD2.

The results in Table 4.2 provide strong evidence in support of the hypotheses that it is possible to mimic foreign market indices with domestically-traded assets. It appears that the sequential augmentation of the mimicking portfolios substantially increases the ability of the UK, German, and French investors to substitute home-made diversification for foreign asset based international diversification, in line with Errunza et al (1999). For example, the correlation between the UK all-share index and the Japan index is 0.33 (Table 4.2a), compared with 0.81 between the most augmented portfolio (AD1) and the Japan index.

Further evidence on the potential of industrial diversification can also be deduced in Table 4.2a. The correlations between the foreign market indices and their underlying UK industrially diversified portfolios (D1) are higher than their correlations with the three domestic market indices (local, small-cap, or all-share) for all DMs, AEMs, and

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[213] See for instance ST Microelectronics and Alcatel stocks in the Dm portfolios of the USA and Canada respectively.

[214] This study also tests correlations vis-à-vis domestic market indices that cover the entire local markets i.e. the FTSE All-Share (UK), the CDAX General (Germany), and the SBF-250 (France). Note that these indices represent over 95% of the total market capitalisation in each country.

EMs. For instance, the highest correlation between the Pakistan index and a domestic index is 0.10, whereas the correlation with the underlying D1 is 0.29. The same results can be observed from the perspective of the German investor (Table 4.2b) except that the underlying D1 for five countries (Denmark, France, Norway, Israel, and Mexico) and the world portfolio cannot better mimic the foreign indices than the German CDAX (i.e. same correlation). For the French investor (Table 4.2c), higher D1 correlations with the foreign indices are also evident except in one case, where the correlation between Italy's market index and the mimicking D1 is lower than the correlation between the index and the SBF-250 index.

The impact of international corporate diversification (as with MNCs) on international market integration can also be seen from Table 4.2. Comparing the unconditional correlations between the foreign indices and the 'truly' local indices (I1) with the correlations between the foreign indices and portfolio Dm, one finds that the ability to mimic foreign indices is tremendously increased by MNCs. For example, the correlation between the UK index of local companies (I1) and South Africa index (0.34) is significantly lower that the correlation between the latter index and the underlying portfolio Dm (0.73). Moreover, the fact that some Dm portfolios are made up of MNCs stocks only, and many others have MNC stocks as the most significant assets reinforces the argument for diversification using MNCs stocks.

With the exception of the Japan CF, and to a lesser extent, the New Zealand and USA CFs, the UK investor's ability to mimic DM indices with their CFs is not significantly improved as correlations results under column AD1 in Table 4.2a show.[215] However, the ability to mimic EM indices is significantly enhanced by their UK traded CFs, corroborating Bekaert & Urias (1996) on the diversification benefits of UK-traded emerging markets CFs. German-traded CFs also improve the ability to mimic their underlying markets, as reflected by the correlation between AD1 and the respective foreign market indices in Table 4.2b.

Results under column AD2 in Table 4.2a also show that international companies traded in the UK enhance the AD1 (or D2 as in the cases of Australia and Canada) of

[215] Note here that a regional fund is used to mimic the European markets as opposed to a more country-specific fund, and this may have implications for the insignificance.

DMs only slightly, whereas the improvements as shown in portfolio AD2 of AEMs and EMs are more visible. On the other hand, foreign companies listed in Germany, and to a lesser extent France, appear to enhance the ability to mimic DMs, AEMs, and EMs indices significantly. For example, in Table 4.2b the correlation between the Korea index and the underlying D2 (0.45) is much lower than that with the underlying AD2 (0.81).

In general, the correlation between the domestic market indices and the various foreign markets enables us to make a crucial point: country indices are inadequate measures of the potential benefits of IPD because single market index does not capture all possibilities for IPD within a local market, such that the fact that two indices are weakly correlated does not necessarily mean IPD dominates national diversification. Judging by the ability to mimic foreign indices (especially EMs which according to literature provide more IPD benefits than DMs), the potential diversification benefits of HMD in the three domestic countries is larger than would be inferred by looking at national index correlations. Although one may not conclude that HMD is a perfect substitute for IPD, it is also suggested that the gains from IPD must be measured over and above gains associated with HMD.

Exhausting the benefits of IPD with domestically traded assets.

The mean-variance spanning tests discussed earlier are applied to investigate the investors' ability to exhaust IPD benefits using HMD. The *K* benchmark assets are domestic assets whereas *N* test assets are the foreign market indices.

In this study, the domestic investors' sets of *K* benchmark assets are similar to those in Errunza et al (1999): Set I comprises industrial indices only, Set II consists of industrial indices and MNCs stocks, and Set III contains all available HMD tools i.e. industrial indices, MNCs stocks, CFs, and cross-listed securities. Following suggestions of Bekaert and Urias (1996) and Errunza et al (1999), this study also restricts the number of assets in each set to four, i.e. selecting the four assets that maximise the probability of not rejecting spanning, as measured by the associated p-value of the various spanning tests. When the restrictions in equations (4.5) and (4.7) hold, then for every test asset (foreign market index), one can find a portfolio of four assets (in each benchmark set) that has the same mean but a lower variance than the test asset. Therefore, one may conclude that the *N* test assets are dominated or spanned by the *K* benchmark assets.

Panel A of Table 4.3 below reports the p-values (the degree to which one can reject the null of spanning) associated with the HK mean-variance spanning test statistics, such that the higher the p-value the higher the probability that a particular foreign market is spanned and hence does not enhance diversification benefits.

The results for the UK (Table 4.3a) are astonishing. The null hypothesis of spanning cannot be rejected for all countries (EMs inclusive) and the world portfolio even at the 10% level of significance, using any of the benchmark sets. This is contrary to Errunza et al (1999) in which the null of spanning is rejected in five of nine EM indices, and may thus be further evidence of increased international markets integration in recent years. Although the p-values increase from Set I to Set III, an interesting result is that one can find four UK industrial indices (Set I) that span each of the foreign market indices, again suggesting the importance of industrial diversification.

Unlike the UK, the null hypothesis that German domestically traded assets can span the foreign market indices is rejected for twelve market indices – two DMs (Australia and Ireland), two AEMs (Brazil and Israel) and all EMs except Poland, Russia, Turkey, and Thailand, as well as the world portfolio, as shown in panel A of Table 4.3b. Moreover, it appears that the probability of spanning increases tremendously using assets in Set III. In fact in most cases where spanning cannot be rejected, German industrial returns (set I) together with stock returns of the MNCs (set II) do not span most of the foreign indices for which one cannot reject spanning. This highlights the importance of country funds and cross-listed equities in the HMD efforts of the German investor.

Spanning is rejected for four DMs (Australia, Austria, Denmark, and New Zealand), two AEMs (Brazil and Israel), most EMs (except Argentina, Poland, Russia, Thailand, and Turkey), and the world portfolio, using HMD tools traded in France (Table 4.3c). The potential of industrial diversification is again demonstrated since assets in set I benchmark are sufficient to span 17 of the 24 markets for which the hypothesis of spanning cannot be rejected.

In cases where one rejects spanning, the SDP of Kan and Zhou (2001) is used to identify the 'culprit' i.e. the origins of the rejection. The results of the SDP (not reported here) shows strong evidence that the rejection of spanning hypothesis is due to the rejection of the hypothesis that $B = 1$ only, in almost all cases. This suggests that the global minimum-variance portfolio can be improved by the foreign market indices that are not spanned, but not the tangency portfolio.

For robustness purposes, this study applies regression-based GMM spanning tests of Ferson et al (1993), adopting lagged returns and the spanning asset returns, R_t, as conditional instruments. This test is particularly important since the error term in the HK test may be non-normally distributed and/or more crucially, may exhibit conditional heteroscedasticity. Panel B of Table 4.3 reports the Wald test p-values associated with the null of spanning from the GMM tests. The results are largely similar to those reported in Panel A (HK test), but with a few differences. Using assets traded in France, the null of spanning cannot be rejected for the New Zealand index, contrary to Panel A. Also, using German HMD tools, the null of spanning cannot be rejected for Ireland and Argentina, again contradicting the HK test. This supports evidence that the HK statistic may lead to over rejection of the spanning hypothesis if the error term is heteroscedastic. In spite of these differences, the results in Panel A are generally robust to conditional heteroscedasticity.

This study applies the De Roon et al (2001) test of spanning when market frictions such as short sales constraints and transaction costs are considered,[216] as set out in equations (4.6) and (4.7). Given that such market frictions may be minimal for domestically traded assets, only cases where there are market constraints on the foreign market indices are considered. Since the diversification benefit of each market is considered individually, the test should perform well. The 535 weekly observations

[216] This test is particularly important since the foreign indices used here, especially those of emerging markets, may not be available to foreign investors due to legal restrictions and practical reasons.

should also minimise the small sample problems of the test as mentioned earlier.[217] Note again that the number of benchmark assets in the test is still restricted to the four that maximise the probability of not rejecting spanning. Panel C in Table 4.3 presents the results of the test.

When short sales are constrained, one fails to reject the null hypothesis of spanning for most markets, suggesting a reduction in the benefits of international portfolio diversification, in line with De Roon et al (2001). Using UK-traded assets, again the null of spanning cannot be rejected for all markets.[218] For the German investor, all foreign markets are spanned except Colombia and Peru, whilst it is possible to span all foreign indices (except Peru) with the assets listed on the French stock market.

As mentioned earlier, the α in equation (4.6) is tantamount to the Jensen *alpha* – a measure of portfolio performance that addresses whether investors' can improve their portfolio efficiency by investing in the new asset. However, the correct test specification here would be H_0: $\alpha = 0$, and not as specified in equation (4.7). The result of testing this hypothesis is very similar to those reported in Panel C and as such need not be reported separately. This implies that investors in the UK, Germany, and France may not improve the efficiencies of their HMD portfolios by investing in equity assets traded in most foreign markets. Sharpe Ratios (defined as the ratio of excess return to the standard deviation of return) also measure portfolio performance by assessing whether one portfolio is preferred over another – i.e. another measure of the economic benefits of a portfolio. De Roon & Nijman (2001) shows that if there is intersection (i.e. $\alpha = 0$), then there is no improvement in the Sharpe measure possible by including the additional asset (foreign index) in the investor's portfolio. Therefore, the UK, German, and French investors (who are already home biased) may not prefer portfolios containing the foreign market indices over portfolios of domestically traded assets.

[217] De Roon et al (2001) provides the simulated rejection rates of the Wald Test statistic when there are short sales constraints on the new assets (foreign indices) only, for 50 years of monthly data (600 observations).
[218] Note that in the case of Finland, the null of spanning is rejected at the 5% significance level only.

Section 4.5: The Evolution of Diversification Benefits.

This section attempts to determine whether the ability to mimic foreign indices has changed in recent years.

Time-varying equity returns correlations.

Several studies report significant time-variation in equity return correlations.[219] An unstable correlation structure would suggest that the efficient frontier is continuously changing, and therefore, the ability to mimic foreign market indices with domestically traded assets may be changing. The crucial issue here is whether the time variation manifests a trending behaviour i.e. are the correlations between our HMD portfolios and the foreign market indices increasing over time, thereby suggesting reducing IPD benefits?

Errunza et al (1999) investigates this issue using two methods: an unconditional correlation analysis between the most augmented HMD portfolios and the underlying foreign market index over three non-overlapping subperiods of equal length, and the generalised dynamic covariance (GDC) structure of Kroner & Ng (1998). Finding, under the first method, a tendency for emerging markets (EMs) correlations to increase through time whereas developed markets (DMs) correlations have generally not increased through time, Errunza et al (1999) find results under the second method inconclusive. While the null of constant correlation cannot be rejected for most EMs, the alternative hypothesis of quadratic (or time-varying) correlation can neither be rejected even though they find evidence that the time-varying correlation model outperforms the fixed correlation model using likelihood ratio statistic.

In addition to the sub-period unconditional correlation analysis, this study applies the Dynamic Conditional Correlation (DCC) analysis, as described in the previous chapter.

[219] See Shawky et al (1997) and the references therein, and Engle & Sheppard (2001) for evidence.

Results.

In pursuit of the objective to determine whether there is a trending behaviour in the time variation of HMD benefits, the results of the unconditional correlation between the foreign indices and their most augmented HMD portfolio over two non-overlapping subperiods are presented in Table 4.4 below.[220]

Table 4.4a suggests the UK investor's ability to mimic DM indices with HMD instruments has generally increased except in the cases of Ireland and New Zealand. Again the evidence generally suggests that DMs have become increasingly integrated (except Austria, Ireland, and New Zealand) with the UK market. However, the ability to mimic AEMs (except Korea, Mexico, and Taiwan) with the domestically traded assets has reduced, even though they have become more correlated with the UK market index. The evidence for EMs is also mixed: the ability to mimic five of the 12 EMs – Argentina, Malaysia, Peru, Russia, and Thailand, has not only reduced significantly, but they also appear to have become less integrated with the UK market.

Evidence from Table 4.4b shows that the ability to mimic DMs, AEMs, and EMs with equity assets traded on the German stock market increased (except for Austria and Argentina) over the two subperiods even as they (foreign markets) became more integrated with the German Market. Similar results can also be observed in Table 4.4c. Over the two subperiods, the ability to mimic DMs and AEMs with HMD tools traded in France increased (except for Austria, Ireland, and New Zealand) as the markets became more integrated with the French equity market. Again as in the UK, the ability to mimic the stock indices of Argentina, Peru, Russia, Colombia, Malaysia, and Thailand reduces in the second sub period, although the latter three countries have become increasingly integrated with the French Market.

Overall, regardless of whether the correlations between our HMD portfolios and the foreign market indices increased over time or not, evidence shows that international equity markets are becoming more integrated (with few exceptions), thus suggesting a reduction in IPD benefits.

[220] Unconditional correlations between the foreign indices and the domestic market index (in brackets) – are reported to see also any trending behaviour in IPD benefits.

Following the application of the DCC model of Engle (2002) to investigate time variation in the correlations, the null hypothesis of dynamic correlation cannot be rejected in all cases, given the significance of the associated DCC parameters. The time series of the conditional correlations between the foreign market indices, the domestic indices, and the most augmented diversification portfolios are plotted in Appendix C5. An attempt is also made to provide some explanations for the fluctuations where possible.

The UK Investor.

Appendix) C5(a) reinforces evidence on the ability to mimic foreign indices with domestically traded assets, showing higher correlations as domestic portfolios are augmented with CFs and Cross-listed assets. Evidence in Appendix C5(a) closely mirrors findings in Table 4.4a: the gains (if any) of international diversification involving assets traded in large DMs appears to be disappearing since an increasing trend is observable in index level correlations, except for smaller DMs – Australia, Austria, Finland, Ireland, and New Zealand which show no clear trending behaviour despite substantial time variation in correlations, in line with Longin & Solnik (1995) which provides evidence of unstable correlation structure among seven major countries. The increasing correlation between the UK market index and the world portfolio suggests reducing IPD benefits. With the exception of Brazil, index level correlations between the UK and AEMs also show an increasing trend. However, the story is different with most EMs: no clear trend, except the rising correlations with indices of Colombia and India. This means that EMs are still potential sources of IPD benefits on the basis of index level correlations. It is important to note that the trends observed here will not necessarily continue into the future.

As an attempt to explain time variation in the mimicking portfolios, the continuous decline in the conditional correlation between the market index of Argentina and its underlying AD1 portfolio especially from 2000 may not be unconnected to the series of economic woes and political crises in the country during that period, leading to the imposition of capital controls (prohibiting foreign investment in key economic sectors) in January 2002.[221] The convergence of HMD correlations to domestic market correlations around January 2002 demonstrates the implications of capital controls on the ability the mimic the underlying index. Appendix C5(a) also suggests that the declining trend in the conditional correlation between the indices of Brazil and Israel, and their mimicking portfolios is primarily due to the poorer performance of their respective CFs (which are regional CFs anyways) in tracking the two indices, given that correlations with their mimicking portfolios D2 do not suggest a declining ability to mimic the markets. However this is not the case with the South African index. The declining HMD/index correlations especially from January 2001 may have been ignited by the introduction of foreign investment restrictions in key sectors around that time (e.g. ceiling foreign investment in banking to 15 percent).One observes sharp rises in the correlations between the AD1 portfolios and the indices of Argentina, Brazil, Mexico, Korea, Malaysia, and India from mid-1997, perhaps in response to the Asian financial crises which affected world markets, (emerging markets in particular).[222] Given that no visible trend can be observed in the case of Malaysia and Thailand (to a lesser extent), the decline in the ability to mimic the Malaysian market suggested under the earlier sub-period unconditional correlation analysis appears to be the result of the Asian crisis occurring during the first sub-period. In the case of Peru, political and economic crises may also be responsible for the decline in the ability to mimic the Peruvian market index.[223] There is also mixed evidence on the general trend of HMD/DM indices correlations, although a rising trend is noticeable for the larger countries.

The German Investor

Appendix C5(b) does not show a clear pattern in the index level correlations of the German CDAX and EM indices as in Table 4.4b. Whilst China, Colombia, and India show a clear rising trend, others do not despite considerable time variation. Mixed

[221]The management of the Latin America CF may have reduced (or withdrawn) investments in Argentine equities due to the crises, disabling the ability to mimic the Argentine index. The fact that the correlations between the Argentine index and the underling portfolio D2 does not drastically reduce may support this view.

[222] Empirical evidence suggests that markets are more correlated in periods of high market volatility. In the case of India, the sharp and continuous rise through most of 1997 may also be due to the 1997 liberalisation of the Indian market through a series of policies including the increase of-foreign ownership to 30 percent, perhaps enabling the UK-listed CF to make further investments.

[223] For instance, the political crises of January 2000 which saw the ouster of President Fujimori led to massive capital outflows from the country. Note also the decline in the index level correlations.

results are also found for AEMs and DMs. Therefore it is difficult to reach conclusions on the future diversification benefits of investing in assets based in foreign markets. The sharp rise in equity market correlations (especially AEMs and DMs) following the September 11, 2001 attacks on the USA is noted. Conditional correlations between EM indices and their underlying mimicking portfolios also show substantial time variation, even though many do not a trend. The declining ability to mimic the Argentine market may not be surprising as discussed above. The correlation between Chile and its portfolio D2 rises from 1997, perhaps in response to the new investment reforms especially on foreign ownership. Prior to 1998, it does not appear that home diversification was better able to mimic the Polish market index. Things however changed after December 1997, when foreign firms were allowed seats directly on the Warsaw Stock Exchange (WSE) and the Banking Act (January 1998), intended to bring Poland's banking regime in line with EU and international standards went into effect. With the exception of Mexico, the ability to mimic AEM indices with HMD is rising, even where index-level correlations show no such trend as in the case of Brazil and Israel. Based on Appendix C5(b), the benefits of HMD may have been boosted (from January 1998) by the Israeli government's abolition of limits placed on holdings of foreign securities, foreign money market instruments, and foreign currency. Generally, the ability to mimic DMs with HMD shows a rising trend, even where index-level correlations do not follow a similar pattern, as in the case of Japan, Denmark, Norway, and Finland. German HMD portfolio correlations with the Finnish and Italian markets significantly increased at the commencement of the EMU in January 1999.

<u>The French Investor.</u>

Appendix C5(c) does not show a clear trend for Brazil, South Africa, Malaysia, Peru, Russia, and Turkey. For all other AEMs and EMs, there is a rising trend (except Argentina which shows a declining tendency). There is also a rising trend in DM index correlations with the SBF-250, except those of Austria, Ireland, New Zealand, and Japan where no clear pattern is visible. A sharp drop in index correlations with the large EMU partners (Belgium, Germany, the Netherlands, Spain, and to a lesser extent Italy) at the introduction of the single currency in January 1999 is noted, and is perhaps not surprising since if currency volatility increases the correlation among equity markets[224] then a reduction in currency volatility (as among EMU states) may also lead to a reduction in equity market correlations. The impact of the US terrorist attack in September 2001 on equity market correlations is also noted. Overall, it is again difficult to conclude on the future of international portfolio diversification based on these results. Interestingly, the euro launch sharply increased mimicking portfolio correlations with the Italian and Spanish indices in January 1999. Apart from Australia, Austria, Ireland and New Zealand, the mimicking portfolios/DM indices correlations are on the uptrend. Evidence on the increasing ability to mimic the less developed markets is also mixed.

The results in Appendix C5 suggest significant time variation in conditional correlations in line with previous studies. From the analysis above, it seems that the gains from international diversification based on the index level correlations are more volatile than gains from the HMD portfolios, especially for DMs, in line with Errunza et al (1999).

Section 4.6: Does the EMU offer any extra diversification benefits?

This section; (a) discusses issues concerning the potential of diversification across the entire eurozone, (b) measures the gains over diversification within single EMU countries, and (c) analyses whether any extra benefits of eurozone diversification is likely to persist.

The Potentials of Eurozone Diversification for the eurozone investor.

Empirical evidence[225] suggests that exchange rate risk is a crucial factor in IPD. Kaplanis & Schaefer (1991) suggests that without the management of foreign exchange risks, internationally diversified portfolios may be riskier than portfolios entirely domestic. In fact, Levy & Limka (1994) shows that contrary to common belief or assumption, it is not necessarily true that exchange-rate hedged portfolio risks are smaller than those of the unhedged or partially hedged portfolio risks. The

[224] See Eun & Resnick (1988).
[225] See for instance Eun & Resnick (1988, 2001), and Ziobrowski & Ziobrwoski (1995) for further details.

introduction of the single euro currency within the EU in January 1999 in essence eliminated exchange rate related restrictions in investors' portfolio composition within the eurozone countries. In a speech[226] in March 2002, the Vice President of the ECB, Mr. C Noyer notes "*the euro's arrival in 1999 brought about fundamental changes in the way governments, financial institutions, and the private sector operate in the financial markets in the euro area and the rest of the world........the euro has also acted as a catalyst in the process of financial integration by widening and deepening the euro area financial market....*" (p.8). The European Commission also notes that apart from the euro currency, a growing internationalisation of equity issuance, increased cross-border mergers and acquisitions, and the consolidation of formal stock exchanges (e.g. the creation of Euronext, which merged the Amsterdam, Brussels, Paris, and Lisbon stock exchanges), have stimulated cross-border equity investments within the eurozone[227] thereby suggesting a reduction in eurozone equity home bias.[228]

One may expect that the EMU would lead to an increase in integration of European Stock Markets, such that diversification benefits across eurozone countries may have reduced significantly.[229] Noyer (2002) notes a high and increasing degree of synchronisation of economic activity within the euro area, not only over a longer period of time but also in recent years such that the degree of convergence appears to be approaching the levels recorded among states and regions of the USA.[230] It is important to state however, that the elimination of currency risks may not necessarily imply increased integration because national stock markets may still be segmented by national regulations, transaction and information costs, and other asymmetric factors. The EMU may therefore be viewed as a remover of barriers to intra-eurozone diversification, perhaps making it more attractive for portfolio diversification purposes.

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[226] See Noyer (2002) in references.

[227] See Directorate-General for Economic and Financial Affairs (2002) for further evidence on trends across EMU stock markets..

[228] See also Hardouvelis et al (2002a) and Baele et al (2004) on the decrease in eurozone home bias.

[229] Due to the impact of globalisation on international equity markets, it may be difficult to ascribe increased euro area equity market integration to EMU factors alone.

[230] See also Yang et al (1999), Fratzscher (2001), and Baele et al (2004) for further evidence on European stock market integration.

Empirical studies also present strong evidence to suggest that there is increased convergence in equity returns of the same sector across different countries of the EMU, but that convergence across different sectors is small in comparison,[231] suggesting again that country effects in portfolio diversification are becoming smaller and industrial effects larger in the Eurozone.[232] The implication of this to the eurozone investor is that the diversification benefits from investing in a French economic sector (e.g. cyclical goods sector) may not be significantly different from benefits of investing in the same sector in Germany or in any other eurozone country. Even if the diversification benefits are significantly different, the difference should be reducing over time, as country effects supposedly decrease. However, diversifying across the entire eurozone industrial indices may yield benefits over and above individual member state's industrial diversification, and may better mimic foreign market indices. Country effects in intra-eurozone portfolio diversification may be small if individual EMU countries are considered, but may still be substantial when aggregated as in eurozone data. An empirical investigation of this issue will not only contribute to the growing literature on country versus sectoral effects in EMU portfolio diversification, but will also provide evidence on the potential benefits of diversifying across the entire eurozone sectors rather than across a single eurozone country's sectors.

From the FTSE All-World indices, weekly returns on the 10 economic groups (based on level 3 industry classifications) i.e. resources, basic, general, cyclical goods, non-cyclical goods, cyclical services, non-cyclical services, utilities, financials, and information technology indices, are collected from January 1999 to March 2004 (274 observations) for the Eurobloc, Germany, and France. This broader industrial classification is used to minimise any bias that may arise from a variation in the number of industries represented within each country, since returns data on all ten economic groups are available for the two countries and the entire eurozone. The europhoric investor's mimicking portfolios are the fitted values from a regression of the each foreign market index on the Eurobloc's ten sectoral indices, as in equation (4.1). Mimicking portfolios of the eurosceptics are constructed in similar fashion.

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[231] See Directorate-General for Economic and Financial Affairs (2002) and Hardouvelis et al (2002b).
[232] Again, it is difficult to suggest that this is strictly due to EMU factors because Emiris (2004) finds evidence of increased sectoral convergence worldwide.

Table 4.5 shows that there is substantial diversification benefit to the German or French investor who invests across eurozone sectors rather than diversifying across their individual country sectors. The evidence shows that europhoric's ability to mimic foreign indices is higher than that of the eurosceptics (except in the case of Pakistan and the French Eurosceptic), thus suggesting that the EMU provides some extra diversification benefits. For instance, the unconditional correlations between the Mexico's index and the mimicking portfolios of the Europhoric, German, and French Eurosceptics are 0.74, 0.55, and 0.62 respectively. As expected, there does not appear to be much difference between the mimicking performance of the German and French cross-sectoral portfolios (except in the case of Austria) from 1999[233] and may suggest EMU effects. Interestingly, the equity market indices of the other EMU member states are more correlated with their underlying eurosceptics' mimicking portfolios than with the Eurobloc market index, again suggesting that industrial diversification dominates country diversification within the EMU.

Evidence from Table 4.6 also suggests that the hypothesis of spanning cannot be rejected for any foreign market index and the world portfolio using eurozone assets unlike those of Germany and France, thus suggesting that it is possible for investors within the eurozone to exhaust the benefits of an internationally diversified portfolio by investing across the entire eurozone sectors. As shown in Tables 4.3b and 4.3c, the most augmented portfolios (including industrial indices, MNCs stocks, and cross-listed equities) in Germany and France do not span all their underlying foreign indices, especially EMs, even when market frictions are considered.[234] The spanning abilities (with respect to the foreign market indices) of German sectoral indices and those of France are almost equivalent whether there are constraints on short sales or not, except that the French indices span the market indices of Norway and Thailand whereas spanning is rejected with German data when there are no constraints on short-selling.

233 Although not reported here, there are significant differences in the mimicking industrial portfolios of the German and French investor prior to 1999.

234 Note that the results in Tables 5 and 8 are not directly comparable since they are based on different data sets, from Jan 1994 – Mar 2004, and from Jan 1999 to Mar 2004 respectively. To make comparisons more robust, this study tests spanning using Table 5 assets also from Jan 1999 to Mar 2004. Though not presented here, the results are largely similar.

Is this extra eurozone diversification benefit fading away?

Figure 4.1 below plots the dynamic conditional correlation between the foreign market indices and their underlying portfolios of the europhoric and eurosceptic investors. If the correlations are converging, it may be an indication that the extra diversification benefits (as far as industrial diversification is concerned) is declining over time thus suggesting that it may be possible to exhaust eurozone diversification benefits by investing across a single member country's industries. In addition, this would again suggest that country factors affecting EMU portfolio diversification may be diminishing.

First, this study comments on the similarities between French and German industrial diversification portfolios. From Figure 4.1, it is difficult to tell the difference between the French and German mimicking portfolios of all AEMs and EMs, except those of Chile, Colombia, Pakistan, and Thailand. There are also a few differences when the mimicking portfolios of DMs are considered although crucially, the time variations in the correlations between the German and French mimicking portfolios, and their underlying foreign markets are mirror images in most cases.[235]

Figure 4.1 suggests that the gains from investing across the eurozone's industries are more (less) volatile than the gains from the eurosceptics' mimicking portfolios for most DMs (AEMs and EMs). Moreover, the conditional correlations between the europhoric portfolios and their underlying markets do not show any clear trend over time regardless of their significant time variation, except those of Japan, Israel, Korea, and China, where the correlations are rising over time.

The evidence for and against a diminishing 'extra' eurozone diversification benefits is mixed. The conditional correlations between the two eurosceptics' mimicking portfolios and the foreign market indices have converged (at least one of them) to those between the europhoric's mimicking portfolios and the market indices of eleven markets namely Austria, Canada, Hong Kong, Ireland, Sweden, USA, Korea, Mexico, Argentina, Pakistan, and Poland. In most cases, the convergence occurred during

[235] These differences are more pronounced (especially for the EMs) after September 2001.The French mimicking portfolios generally (not always) dominate those of the German investor (in terms of ability to mimic foreign markets), even if these differences are generally statistically and economically trivial as spanning tests suggest in Table 8.

2003. Results for some other countries show increasing divergence after an initial convergence at certain periods (for example Peru), while others like Japan and China are becoming increasingly different, all in favour of the eurozone diversification.

More importantly, the ability of the eurosceptics' portfolios (especially the French investor) to mimic their underlying EMU countries is approaching that of europhoric's portfolio, although very slowly as in the cases of Belgium, Finland, and Spain.[236] The convergence was boosted by the events of September 11, 2001. In general, owing to this mixed evidence, one cannot conclude that diversifying in a single EMU country may yield the same benefits as the entire eurozone diversification.[237] Note also that the eurosceptics portfolios are based on the industries of France and Germany – the largest economies within the eurozone. Substantial 'extra' diversification benefits may still exist for investors' in the smaller EMU countries who invest across the eurozone. In general, one point is clear: eurozone diversification is very attractive for investors in the eurozone.

Section 4.7: Summary.

The main objective of this chapter is clear: is international portfolio diversification still worthwhile for the UK, German, and French investors? Using weekly stock returns of domestic industry portfolios, multinational companies, country funds, and cross-listed securities over the period January 1994 to March 2004 to construct home made diversification portfolios, it appears that these home-biased investors are better able to mimic foreign market indices, than suggested by the national stock index correlations. However, findings should not be viewed as evidence on the demise of IPD benefits because investments in specific foreign equity assets (rather than indices) may contribute significantly to the efficiency of the domestic investor's portfolio. Diversification across industries and MNCs are important sources of home made diversification benefits. Stocks of multinational companies are quite useful in

[236] From the trends in correlations, it is difficult to tell whether actual convergence will occur in most cases.

[237] Although, remember from Table 8 that the hypotheses of spanning cannot be rejected for most EMU markets, using German and French industrial assets.

mimicking the foreign equity markets in which they (the MNCs) have significant operations.

Various tests of mean-variance spanning show that the investors may not benefit significantly by including foreign market indices in their portfolio sets. In fact the null hypothesis of spanning cannot be rejected for each of the 37 foreign indices and the world portfolio using UK industrial assets, not to mention the other domestically traded assets. A UK investor may therefore exhaust the benefits of IPD by diversifying across UK industries. Unlike the UK, the sources of HMD benefits in Germany, and to a lesser extent, France are the international stocks listed on their respective stock exchanges. At least twenty four of the 37 foreign indices are spanned by German (and French) domestically traded assets, suggesting that international portfolio diversification still substantially dominates home diversified portfolios in these two countries. However, these extra gains from IPD disappear when market frictions such as short sales constraints are considered.

Using the dynamic conditional correlation analysis, one does not observe a clear-cut trending pattern in all correlations between the foreign indices and their most-augmented diversification portfolios, even though there is rise in many cases. The general evidence suggests that international equity markets (especially developed markets) have become increasingly integrated. Substantial time-variations exist in correlations between emerging market returns and HMD portfolios of the three European investors, as a result of changes in political and economic climate, national and global events, and changes in market restrictions on foreign equity ownership, in line with previous studies.

The potential effect of European economic and monetary union on domestic diversification benefits is also assessed here. Even though the scope of HMD may be restricted within each EMU member state, the erstwhile home biased investor who takes advantage of the removal of exchange rates risks and other investment barriers by diversifying across sectors of the entire eurozone is bound to increase the mean variance efficiency of his portfolio. The ability of such ‘europhoric’ investor to mimic foreign equity indices is far and above the mimicking capabilities of French and German investors who continue to be ‘eurosceptics’ by diversifying only within their individual countries. In fact, the spanning tests suggest that diversification gains over and above those obtainable by eurozone diversification are statistically and economically insignificant. Another interesting finding is that it does not appear that these 'extra' eurozone diversification benefits will decline in the near future, despite evidence of increasing integration (or reducing country factors) among EMU member equity markets.

Solnik (1974), a key study on the benefits of international portfolio diversification asks: why not diversify internationally rather than domestically? In light of these findings and the problems associated with IPD, one can say to the European investors: why diversify internationally when domestic diversification provides similar benefits? Empirical evidence is encouraged from other equity markets.

List of Tables and Figures.

Table 4.1a: Summary statistics of weekly returns from Jan. 1994 – Mar. 2004 (in UK Sterling).

	Mean	Standard Deviation	Minimum	Maximum
Developed Markets				
Australia	0.00175	0.02415	-0.10481	0.08267
Austria	0.00128	0.02337	-0.07821	0.07777
Belgium	0.00171	0.02636	-0.08944	0.12464
Canada	0.00198	0.02866	-0.11673	0.12959
Denmark	0.00182	0.02342	-0.10911	0.08113
Finland	0.00451	0.05298	-0.24226	0.22576
France	0.00168	0.02853	-0.10463	0.11614
Germany	0.00133	0.03222	-0.11811	0.13878
Hong Kong	0.00042	0.03872	-0.19794	0.15807
Ireland	0.00204	0.02775	-0.12414	0.15963
Italy	0.00199	0.03496	-0.13290	0.20007
Japan	0.00011	0.03231	-0.10696	0.11472
New Zealand	0.00166	0.02967	-0.11852	0.15102
Netherlands	0.00123	0.02922	-0.09593	0.12597
Norway	0.00167	0.03014	-0.13924	0.15094
Spain	0.00234	0.03036	-0.11955	0.15648
Sweden	0.00271	0.03763	-0.15613	0.21929
Switzerland	0.00181	0.02682	-0.11221	0.14055
UK	0.00133	0.02190	-0.08460	0.10517
USA	0.00195	0.02687	-0.11051	0.09011
Average	**0.00177**	**0.0303**		
Adv. Emerging Markets.				
Brazil	0.00214	0.05530	-0.25092	0.21468
Israel	0.00189	0.03629	-0.13150	0.13107
Korea	0.00262	0.06325	-0.39904	0.35419
Mexico	0.00138	0.04953	-0.22390	0.23704
South Africa	0.00185	0.03680	-0.14456	0.13101
Taiwan	0.00024	0.04493	-0.14015	0.22246
Average	**0.00169**	**0.0477**		
Emerging Markets				
Argentina	0.00083	0.05747	-0.28647	0.29738
Chile	0.00065	0.03469	-0.14149	0.19409
China	0.00233	0.04865	-0.20963	0.24070
Colombia	0.00087	0.04206	-0.18082	0.21964
India	0.00071	0.03929	-0.15269	0.15418
Malaysia	-0.00013	0.04978	-0.23307	0.41880
Pakistan	0.00106	0.05153	-0.20546	0.23231
Peru	0.00262	0.04381	-0.18856	0.24754
Poland	0.00087	0.05632	-0.24815	0.29882
Russia	0.00417	0.07308	-0.30565	0.62928
Thailand	-0.00026	0.06768	-0.22853	0.34441
Turkey	0.00519	0.08771	-0.52474	0.44502
Average	**0.00157**	**0.0543**		

Table 4.1b: Summary statistics of weekly returns from Jan. 1994 – Mar. 2004 (in Euros).

	Mean	Standard Deviation	Minimum	Maximum
Developed Markets				
Australia	0.00206	0.02530	-0.10742	0.07921
Austria	0.00129	0.02195	-0.10111	0.06474
Belgium	0.00170	0.02580	-0.10282	0.13960
Canada	0.00230	0.02996	-0.11785	0.10828
Denmark	0.00209	0.02311	-0.11169	0.09661
Finland	0.00507	0.05411	-0.24170	0.24884
France	0.00175	0.02854	-0.11699	0.11514
Germany	0.00135	0.03165	-0.13026	0.14163
Hong Kong	0.00074	0.03995	-0.18752	0.15820
Ireland	0.00225	0.02799	-0.13350	0.14374
Italy	0.00279	0.03801	-0.13538	0.34209
Japan	0.00039	0.03245	-0.11582	0.11240
New Zealand	0.00169	0.02988	-0.12067	0.16751
Netherlands	0.00151	0.02944	-0.09758	0.12148
Norway	0.00193	0.02970	-0.14174	0.15353
Spain	0.00279	0.03063	-0.11545	0.15893
Sweden	0.00298	0.03751	-0.14563	0.20261
Switzerland	0.00207	0.02606	-0.12756	0.15692
UK	0.00167	0.02442	-0.08172	0.12103
USA	0.00228	0.02863	-0.11070	0.09688
Average	**0.00204**	**0.03075**		
Adv. Emerging Markets.				
Brazil	0.00262	0.05662	-0.25199	0.21788
Israel	0.00221	0.03721	-0.12525	0.11940
Korea	0.00296	0.06431	-0.40261	0.36855
Mexico	0.00171	0.05060	-0.22896	0.24023
South Africa	0.00213	0.03678	-0.14117	0.14466
Taiwan	0.00057	0.04597	-0.14724	0.23331
Average	**0.00203**	**0.0486**		
Emerging Markets				
Argentina	0.00113	0.05782	-0.28256	0.29137
Chile	0.00097	0.03578	-0.14289	0.18838
China	0.00260	0.04848	-0.20525	0.21443
Colombia	0.00121	0.04349	-0.17701	0.22977
India	0.00100	0.03958	-0.15074	0.14530
Malaysia	0.00018	0.05056	-0.23696	0.41646
Pakistan	0.00138	0.05225	-0.21406	0.21813
Peru	0.00292	0.04425	-0.18479	0.24152
Poland	0.00114	0.05618	-0.24712	0.29106
Russia	0.00423	0.07306	-0.29967	0.60736
Thailand	0.00016	0.06805	-0.23289	0.35864
Turkey	0.00545	0.08742	-0.52166	0.45390
Average	**0.001864**	**0.0547**		

Table 4.2a: Unconditional Correlations of UK HMD portfolios with Foreign Market Returns.

I1, I2, and the FTSE All-Share are the local companies' index, the small-cap index, and the UK FTSE All-share index respectively. D1 denotes diversification portfolios based on industrial indices. Dm is a diversification portfolio selected from the market indices I1 and I2, and MNCs using stepwise regressions. D2 is a diversification portfolio selected from the market indices, industrial indices and MNCs using stepwise regressions. AD1 are augmented portfolios in which D2 is augmented with CFs, and AD2 are portfolios in which AD1 is augmented with the country's representative cross-listed securities.

	I1	I2	FTSE All-Share	D1	Dm	D2	AD1	AD2
Developed Markets								
Australia	0.49	0.53	0.55	0.65	0.66	0.71	--	0.72
Austria	0.34	0.37	0.38	0.52	0.56	0.59	--	--
Belgium	0.58	0.39	0.61	0.72	0.71	0.74	0.75	--
Canada	0.50	0.52	0.61	0.69	0.71	0.72	--	0.74
Denmark	0.52	0.49	0.57	0.63	0.65	0.68	0.68	--
Finland	0.49	0.41	0.55	0.68	0.71	0.71	0.71	--
Germany	0.67	0.55	0.73	0.79	0.79	0.81	0.83	--
France	0.67	0.54	0.77	0.81	0.82	0.82	0.84	0.846
Hong Kong	0.45	0.39	0.53	0.64	0.77	0.78	0.792	0.797
Ireland	0.54	0.51	0.59	0.65	0.67	0.68	0.69	0.70
Italy	0.54	0.49	0.60	0.61	0.64	0.65	0.66	--
Japan	0.26	0.24	0.33	0.46	0.52	0.53	0.81	
Netherlands	0.69	0.51	0.78	0.85	0.86	0.86	0.88	0.88
New Zealand	0.31	0.37	0.37	0.47	0.53	0.55	0.65	--
Norway	0.46	0.57	0.55	0.62	0.67	0.68	0.69	0.70
Spain	0.61	0.51	0.67	0.71	0.72	0.73	0.75	--
Sweden	0.59	0.59	0.67	0.76	0.76	0.77	0.79	--
Switzerland	0.61	0.43	0.67	0.75	0.75	0.75	0.77	--
USA	0.62	0.52	0.70	0.78	0.77	0.78	0.861	0.869
Adv. Emerging Markets								
Brazil	0.32	0.36	0.41	0.52	0.52	0.53	0.70	--
Israel	0.27	0.37	0.34	0.45	0.47	0.49	0.59	0.63
Korea	0.32	0.31	0.36	0.53	0.56	0.59	0.60	--
Mexico	0.37	0.39	0.46	0.56	0.57	0.60	0.68	--
South Africa	0.34	0.43	0.43	0.55	0.73	0.75	0.79	0.84
Taiwan	0.23	0.26	0.28	0.51	0.51	0.56	0.64	--

	I1	I2	FTSE All-Share	D1	Dm	D2	AD1	AD2
Emerging Markets								
Argentina	0.29	0.31	0.35	0.46	0.46	0.47	0.55	--
Chile	0.32	0.37	0.38	0.51	0.54	0.56	0.66	--
China	0.10	0.12	0.14	0.37	0.39	0.40	0.48	--
Colombia	0.14	0.18	0.17	0.31	0.32	0.38	0.39	--
India	0.18	0.31	0.24	0.39	0.45	0.45	0.52	
Malaysia	0.16	0.16	0.21	0.38	0.43	0.46	0.54	0.57
Pakistan	0.05	0.10	0.08	0.29	0.27	0.29	--	--
Peru	0.16	0.24	0.21	0.33	0.39	0.40	0.49	--
Poland	0.25	0.34	0.31	0.44	0.44	0.45	0.48	--
Turkey	0.22	0.26	0.26	0.37	0.38	0.43	--	--
Russia	0.27	0.37	0.37	0.57	0.58	0.61	0.64	--
Thailand	0.23	0.21	0.28	0.45	0.50	0.55	0.72	--
World	0.71	0.59	0.81	0.83	0.83	0.86	0.87	

Table 4.2b: Unconditional Correlation of German HMD portfolios with Foreign Market Returns.

I1, I2, and CDAX are the local companies' index, the small-cap index, and the German CDAX general index respectively. D1 denotes diversification portfolios based on industrial indices. Dm is a diversification portfolio selected from the market indices I1 and I2, and MNCs using stepwise regressions. D2 is a diversification portfolio selected from the market indices, industrial indices and MNCs using stepwise regressions. AD1 are augmented portfolios in which D2 is augmented with CFs, and AD2 are portfolios in which AD1 is augmented with the country's representative cross-listed securities.

	I1	I2	CDAX	D1	Dm	D2	AD1	AD2
Developed Markets								
Australia	0.48	0.44	0.50	0.54	0.57	0.57	--	0.60
Austria	0.45	0.39	0.39	0.54	0.62	0.63	--	0.70
Belgium	0.69	0.50	0.63	0.70	0.76	0.76	--	0.78
Canada	0.58	0.44	0.63	0.64	0.67	0.68	--	0.71
Denmark	0.58	0.52	0.60	0.60	0.67	0.67	--	0.80
Finland	0.53	0.38	0.59	0.63	0.66	0.68	--	0.68
UK	0.69	0.51	0.70	0.72	0.74	0.74	0.84	0.88
France	0.81	0.57	0.80	0.80	0.83	0.83	--	0.89
Hong Kong	0.49	0.39	0.50	0.51	0.54	0.54	0.59	--
Ireland	0.56	0.51	0.56	0.60	0.65	0.65	--	0.75
Italy	0.56	0.48	0.63	0.64	0.74	0.75	--	0.87
Japan	0.32	0.27	0.33	0.38	0.41	0.42	0.52	0.80
Netherlands	0.82	0.58	0.78	0.80	0.84	0.84	--	0.92
New Zealand	0.35	0.33	0.38	0.41	0.44	0.48	--	--
Norway	0.53	0.47	0.57	0.57	0.67	0.67	--	0.74
Spain	0.70	0.55	0.74	0.76	0.79	0.79	--	0.87
Sweden	0.72	0.54	0.76	0.78	0.79	0.80	--	0.87
Switzerland	0.70	0.48	0.69	0.74	0.76	0.77	--	0.86
USA	0.65	0.48	0.68	0.69	0.71	0.72	0.75	0.89
Adv. Emerging Markets								
Brazil	0.45	0.39	0.46	0.48	0.51	0.52	0.68	--
Israel	0.37	0.35	0.40	0.40	0.49	0.49	--	--
Korea	0.35	0.29	0.37	0.44	0.43	0.45	--	0.81
Mexico	0.42	0.34	0.46	0.46	0.49	0.49	0.59	--
South Africa	0.44	0.36	0.46	0.51	0.52	0.52	--	0.72
Taiwan	0.33	0.30	0.35	0.43	0.46	0.48	0.59	0.59

	I1	I2	CDAX	D1	Dm	D2	AD1	AD2
Emerging Markets								
Argentina	0.35	0.27	0.36	0.39	0.41	0.42	--	--
Chile	0.39	0.32	0.39	0.46	0.45	0.46	--	--
China	0.16	0.18	0.17	0.28	0.29	0.30	--	0.40
Colombia	0.24	0.23	0.20	0.29	0.31	0.34	--	--
India	0.26	0.26	0.30	0.32	0.38	0.38	--	0.47
Malaysia	0.23	0.19	0.23	0.29	0.32	0.32	0.38	--
Pakistan	0.10	0.13	0.10	0.22	0.26	0.30	--	--
Peru	0.24	0.25	0.26	0.30	0.36	0.35	--	--
Poland	0.34	0.29	0.37	0.39	0.42	0.42	--	0.46
Turkey	0.23	0.27	0.23	0.32	0.35	0.36	--	0.37
Russia	0.39	0.34	0.40	0.51	0.54	0.56	--	0.77
Thailand	0.26	0.24	0.27	0.28	0.35	0.35	0.50	0.56
World	0.76	0.57	0.78	0.78	0.80	0.81	--	--

Table 4.2c: Unconditional Correlations of French HMD portfolios with Foreign Market Returns.

I1, I2, and SBF250 are the local companies' index, the small-cap index, and the French SBF250 index respectively. D1 denotes diversification portfolios based on industrial indices. Dm is a diversification portfolio selected from the market indices I1 and I2, and MNCs using stepwise regressions. D2 is a diversification portfolio selected from the market indices, industrial indices and MNCs using stepwise regressions. AD1 are augmented portfolios in which D2 is augmented with CFs, and AD2 are portfolios in which AD1 is augmented with the country's representative cross-listed securities.

	I1	I2	SBF250	D1	Dm	D2	AD1	AD2
Developed Markets								
Australia	0.50	0.48	0.53	0.59	0.61	0.62	--	
Austria	0.38	0.39	0.34	0.46	0.55	0.56	--	
Belgium	0.69	0.47	0.65	0.74	0.78	0.78	--	0.81
Canada	0.65	0.50	0.68	0.69	0.73	0.73	--	0.75
Denmark	0.56	0.52	0.58	0.61	0.63	0.64	--	
Finland	0.54	0.41	0.60	0.69	0.76	0.77	--	0.92
Germany	0.81	0.64	0.81	0.82	0.85	0.86	--	0.91
Hong Kong	0.49	0.42	0.52	0.55	0.56	0.59	--	
Ireland	0.55	0.48	0.56	0.61	0.63	0.65	--	
Italy	0.60	0.55	0.68	0.64	0.75	0.75	--	0.76
Japan	0.38	0.30	0.38	0.47	0.50	0.50	--	0.80
Netherlands	0.83	0.59	0.80	0.82	0.86	0.87	--	0.94
New Zealand	0.36	0.37	0.39	0.52	0.51	0.55	--	
Norway	0.54	0.54	0.59	0.63	0.69	0.72	--	0.79
Spain	0.72	0.57	0.76	0.77	0.80	0.79	--	0.80
Sweden	0.72	0.60	0.75	0.78	0.81	0.81	--	0.83
Switzerland	0.69	0.49	0.70	0.75	0.77	0.77	--	0.83
UK	0.75	0.54	0.76	0.77	0.79	0.80	--	0.84
USA	0.70	0.49	0.70	0.71	0.75	0.75	--	0.88
Adv. Emerging Markets								
Brazil	0.45	0.38	0.47	0.49	0.53	0.56	--	
Israel	0.38	0.37	0.40	0.44	0.47	0.48	--	
Korea	0.36	0.33	0.39	0.48	0.50	0.50	--	
Mexico	0.49	0.40	0.51	0.52	0.55	0.57	--	
South Africa	0.43	0.41	0.45	0.53	0.57	0.58	--	0.67
Taiwan	0.32	0.31	0.35	0.45	0.47	0.50	--	

	I1	I2	SBF250	D1	Dm	D2	AD1	AD2
Emerging Markets								
Argentina	0.38	0.33	0.39	0.44	0.47	0.48	--	
Chile	0.41	0.35	0.42	0.51	0.48	0.52	--	
China	0.15	0.16	0.17	0.36	0.31	0.35	--	
Colombia	0.21	0.20	0.22	0.31	0.31	0.32	--	
India	0.28	0.26	0.32	0.43	0.39	0.43	--	
Malaysia	0.24	0.21	0.24	0.37	0.39	0.41	--	
Pakistan	0.11	0.10	0.11	0.26	0.24	0.26	--	
Peru	0.24	0.27	0.26	0.36	0.34	0.39	--	
Poland	0.33	0.35	0.37	0.41	0.44	0.46	--	
Turkey	0.23	0.26	0.25	0.34	0.35	0.38	--	
Russia	0.36	0.36	0.37	0.50	0.53	0.55	--	
Thailand	0.27	0.26	0.28	0.38	0.42	0.48	--	
World	0.80	0.59	0.82	0.83	0.85	0.85	--	

Table 4.3a: Tests of Mean-Variance Spanning (UK).

Reports of the p-values associated with spanning tests of Huberman & Kandel (1987) (Panel A), Ferson et al (1993) GMM test (Panel B), De Roon et al (2001) (Panel C), and change in the Sharpe Ratio (Panel D) over the entire sample period. Benchmark Set I includes four of 31 industrial portfolios that maximise the degree of spanning. Set II includes four assets from 31 industrial portfolios and 42 MNCs. Set III includes four assets from 31 industries, 42 MNCs, Country Funds and Cross-listed securities.

UK Investor	Panel A H-K Spanning Test (OLS)			Panel B GMM Wald Test			Panel C Spanning test (No short sales)		
Developed Markets:	**Set I**	**Set II**	**Set III**	**Set I**	**Set II**	**Set III**	**Set I**	**Set II**	**Set III**
Australia	0.13	0.31	0.60	0.33	0.44	0.54	0.27	0.35	0.87
Austria	0.14	0.33	n/a	0.39	0.52	n/a	0.64	0.40	n/a
Belgium	0.36	0.47	0.49	0.33	0.45	0.66	0.29	0.44	0.51
Canada	0.23	0.24	0.31	0.80	0.76	0.84	0.17	0.33	0.30
Denmark	0.13	0.31	0.35	0.48	0.77	0.87	0.08	0.35	0.45
Finland	0.18	0.36	0.68	0.34	0.34	0.42	0.05	0.05	0.07
France	0.67	0.72	0.74	0.58	0.78	0.82	0.61	0.66	0.65
Germany	0.87	0.92	0.96	0.79	0.84	0.85	0.90	0.91	0.91
Hong Kong	0.12	0.56	0.61	0.33	0.34	0.66	0.29	0.66	0.71
Ireland	0.57	0.72	0.87	0.23	0.43	0.92	0.30	0.42	0.51
Italy	0.34	0.36	0.40	0.43	0.51	0.60	0.43	0.45	0.51
Japan	0.18	0.32	0.43	0.21	0.33	0.34	0.59	0.60	0.74

Netherlands	0.40	0.52	0.68	0.67	0.67	0.68	0.88	0.91	0.97
New Zealand	0.21	0.31	0.52	0.67	0.71	0.82	0.67	0.69	0.98
Norway	0.41	0.42	0.87	0.34	0.16	0.43	0.32	0.43	0.91
Spain	0.25	0.28	0.29	0.37	0.43	0.65	0.32	0.35	0.39
Sweden	0.33	0.52	0.79	0.65	0.71	0.78	0.22	0.55	0.79
Switzerland	0.62	0.66	0.67	0.98	0.87	0.92	0.33	0.69	0.75
USA	0.61	0.68	0.89	0.49	0.62	0.78	0.08	0.23	0.81

	H-K Spanning Test (OLS)			GMM Wald Test			Spanning Test (No short sales)		
Adv. Emerging Markets:	**Set I**	**Set II**	**Set III**	**Set I**	**Set II**	**Set III**	**Set I**	**Set II**	**Set III**
Brazil	0.18	0.31	0.87	0.44	0.57	0.78	0.87	0.91	0.98
Israel	0.73	0.76	0.81	0.26	0.41	0.54	0.49	0.63	0.80
Korea	0.31	0.52	0.78	0.54	0.61	0.67	0.33	0.42	0.33
Mexico	0.48	0.49	0.82	0.43	0.51	0.77	0.34	0.93	0.94
South Africa	0.51	0.54	0.88	0.36	0.42	0.34	0.61	0.61	0.88
Taiwan	0.32	0.41	0.61	0.48	0.48	0.64	0.52	0.73	0.79

	H-K Spanning Test (OLS)			GMM Wald-test			Spanning Test (No short sales)		
Emerging Markets:	**Set I**	**Set II**	**Set III**	**Set I**	**Set II**	**Set III**	**Set I**	**Set II**	**Set III**
Argentina	0.26	0.30	0.64	0.37	0.36	0.77	0.90	0.91	0.92
Chile	0.88	0.89	0.95	0.56	0.66	0.84	0.89	0.93	0.93
China	0.16	0.32	0.44	0.21	0.32	0.43	0.36	0.43	0.53
Colombia	0.71	0.77	0.83	0.38	0.43	0.65	0.89	0.92	0.95
India	0.16	0.32	0.76	0.13	0.20	0.24	0.96	0.97	0.98
Malaysia	0.51	0.56	0.76	0.32	0.48	0.56	0.61	0.63	0.68
Pakistan	0.13	0.21	n/a	0.44	0.47	n/a	0.90	0.91	0.94
Peru	0.65	0.71	0.72	0.32	0.42	0.49	0.28	0.44	0.76
Poland	0.42	0.44	0.87	0.31	0.43	0.56	0.88	0.92	0.94
Russia	0.35	0.40	0.52	0.44	0.44	0.54	0.45	0.67	0.77
Thailand	0.28	0.34	0.74	0.20	0.31	0.34	0.58	0.60	0.62
Turkey	0.42	0.55	n/a	0.22	0.23	0.33	0.02	0.34	n/a
World	0.17	0.31	0.82	0.65	0.63	0.76	0.39	0.56	0.57

Table 4.3b: Tests of Mean-Variance Spanning (Germany).

Reports of the p-values associated with spanning tests of Huberman & Kandel (1987) (Panel A), Ferson et al (1993) GMM test (Panel B), De Roon et al (2001) (Panel C), and change in the Sharpe Ratio (Panel D) over the entire sample period. Benchmark Set I includes four of 21 industrial portfolios that maximise the degree of spanning. Set II includes four assets from 21 industrial portfolios and 26 MNCs. Set III includes four assets from 21 industries, 22 MNCs, Country Funds and Cross-listed securities.

German Investor	Panel A H-K Spanning Test (OLS)			Panel B GMM Wald Test			Panel C Spanning Test (no short sales)		
Developed Markets:	**Set I**	**Set II**	**Set III**	**Set I**	**Set II**	**Set III**	**Set I**	**Set II**	**Set III**
Australia	0.0001	0.0001	0.005	0.000	0.000	0.03	0.13	0.33	0.44
Austria	0.0001	0.0001	0.07	0.000	0.008	0.12	0.52	0.56	0.65
Belgium	0.21	0.39	0.43	0.23	0.46	0.47	0.28	0.33	0.41
Canada	0.0001	0.009	0.06	0.10	0.26	0.30	0.01	0.09	0.14
Denmark	0.0001	0.0001	0.11	0.000	0.018	0.32	0.006	0.04	0.15
Finland	0.12	0.16	0.39	0.34	0.41	0.65	0.08	0.12	0.89
France	0.009	0.001	0.16	0.22	0.39	0.63	0.14	0.23	0.64
UK	0.001	0.001	0.87	0.000	0.10	0.47	0.32	0.44	0.48
Hong Kong	0.0001	0.001	0.47	0.09	0.19	0.32	0.11	0.13	0.22
Ireland	0.0001	0.0001	0.018	0.000	0.08	0.11	0.13	0.17	0.21
Italy	0.006	0.0001	0.39	0.10	0.16	0.23	0.18	0.20	0.31
Japan	0.0001	0.0001	0.32	0.000	0.009	0.41	0.33	0.36	0.71

Netherlands	0.03	0.09	0.33	0.18	0.47	0.48	0.54	0.56	0.71
New Zealand	0.0001	0.002	n/a	0.000	0.000	n/a	0.44	0.56	n/a
Norway	0.0001	0.001	0.48	0.000	0.12	0.67	0.31	0.34	0.44
Spain	0.0001	0.001	0.37	0.000	0.02	0.45	0.07	0.13	0.45
Sweden	0.04	0.12	0.96	0.52	0.55	0.88	0.24	0.33	0.39
Switzerland	0.001	0.009	0.08	0.03	0.29	0.67	0.15	0.18	0.21
USA	0.0001	0.0001	0.13	0.000	0.18	0.23	0.41	0.45	0.47

	H-K Spanning Test (OLS)			GMM Wald Test			Spanning Test (no short sales)		
Adv. Emerging Markets:	**Set I**	**Set II**	**Set III**	**Set I**	**Set II**	**Set III**	**Set I**	**Set II**	**Set III**
Brazil	0.000	0.000	0.33	0.000	0.000	0.42	0.11	0.32	0.43
Israel	0.0001	0.003	n/a	0.000	0.000	n/a	0.32	0.44	0.51
Korea	0.12	0.23	0.75	0.16	0.34	0.88	0.53	0.54	0.59
Mexico	0.0001	0.001	0.35	0.000	0.09	0.67	0.79	0.83	0.89
South Africa	0.0001	0.001	0.10	0.002	0.008	0.16	0.41	0.45	0.61
Taiwan	0.0001	0.011	0.74	0.29	0.33	0.67	0.79	0.81	0.97

Emerging Markets:	H-K Spanning Test (OLS)			GMM Wald Test			Spanning Test (no short sales)		
	Set I	Set II	Set III	Set I	Set II	Set III	Set I	Set II	Set III
Argentina	0.008	0.018	n/a	0.28	0.42	n/a	0.43	0.51	n/a
Chile	0.000	0.000	n/a	0.000	0.000	n/a	0.12	0.23	n/a
China	0.000	0.000	0.008	0.000	0.000	0.019	0.08	0.09	0.13
Colombia	0.000	0.000	n/a	0.000	0.000	n/a	0.01	0.04	n/a
India	0.0001	0.003	0.01	0.000	0.009	0.02	0.84	0.89	0.91
Malaysia	0.0001	0.003	0.10	0.003	0.02	0.13	0.32	0.41	0.54
Pakistan	0.0001	0.0001	n/a	0.000	0.000	n/a	0.13	0.31	n/a
Peru	0.0001	0.0001	n/a	0.000	0.000	n/a	0.03	0.03	n/a
Poland	0.12	0.27	0.57	0.09	0.42	0.69	0.34	0.41	0.63
Russia	0.35	0.43	0.90	0.33	0.41	0.61	0.09	0.18	0.65
Thailand	0.0001	0.0001	0.78	0.000	0.000	0.78	0.33	0.42	0.45
Turkey	0.001	0.001	0.07	0.22	0.89	0.90	0.00	0.04	0.18
World	0.0001	0.0001	n/a	0.000	0.000	n/a	0.22	0.31	n/a

Table 4.3c: Tests of Mean-Variance Spanning (France).

Reports of the p-values associated with spanning tests of Huberman & Kandel (1987) (Panel A), Ferson et al (1993) GMM test (Panel B), De Roon et al (2001) (Panel C), and change in the Sharpe Ratio (Panel D) over the entire sample period. Benchmark Set I includes four of 26 industrial portfolios that maximise the degree of spanning. Set II includes four assets from 26 industrial portfolios and 31 MNCs. Set III includes four assets from 26 industries, 31 MNCs, and Cross-listed securities.

French Investor	Panel A H-K Spanning Test (OLS)			Panel B GMM Wald Test			Panel C Spanning Test (no short sales)		
Developed Markets:	**Set I**	**Set II**	**Set III**	**Set I**	**Set II**	**Set III**	**Set I**	**Set II**	**Set III**
Australia	0.0001	0.0001	n/a	0.000	0.03	n/a	0.28	0.31	0.46
Austria	0.0001	0.0001	n/a	0.000	0.008	n/a	0.45	0.46	0.51
Belgium	0.03	0.09	0.19	0.14	0.23	0.34	0.53	0.55	0.81
Canada	0.07	0.16	0.32	0.21	0.32	0.59	0.29	0.29	0.33
Denmark	0.0001	0.003	n/a	0.000	0.009	n/a	0.22	0.32	n/a
Finland	0.23	0.44	0.79	0.29	0.33	0.76	0.02	0.09	0.41
UK	0.02	0.10	0.21	0.13	0.24	0.32	0.61	0.66	0.71
Germany	0.09	0.14	0.18	0.14	0.18	0.23	0.77	0.77	0.81
Hong Kong	0.06	0.09	0.12	0.14	0.32	0.43	0.58	0.62	0.62
Ireland	0.0001	0.005	0.12	0.01	0.08	0.29	0.32	0.33	0.48
Italy	0.11	0.16	0.39	0.25	0.43	0.76	0.43	0.49	0.76
Japan	0.0001	0.0001	0.21	0.0001	0.04	0.39	0.31	0.35	0.45

Netherlands	0.08	0.21	0.52	0.57	0.67	0.81	0.99	0.99	0.99
New Zealand	0.0001	0.0001	n/a	0.03	0.13	n/a	0.10	0.13	n/a
Norway	0.11	0.16	0.25	0.21	0.29	0.36	0.62	0.65	0.76
Spain	0.20	0.29	0.42	0.19	0.21	0.31	0.13	0.33	0.43
Sweden	0.0001	0.08	0.26	0.13	0.32	0.43	0.18	0.24	0.27
Switzerland	0.06	0.08	0.11	0.07	0.19	0.22	0.45	0.47	0.48
USA	0.009	0.17	0.24	0.000	0.29	0.43	0.25	0.33	0.81

	HK Spanning Test (OLS)			**GMM Wald Test**			**Spanning Test (no short sales)**		
	Set I	**Set II**	**Set III**	**Set I**	**Set II**	**Set III**	**Set I**	**Set II**	**Set III**
Brazil	0.0001	0.0001	n/a	0.000	0.000	n/a	0.47	0.52	n/a
Israel	0.0001	0.0001	n/a	0.000	0.008	n/a	0.09	0.33	n/a
Korea	0.09	0.41	n/a	0.12	0.32	n/a	0.48	0.65	n/a
Mexico	0.11	0.23	n/a	0.23	0.55	n/a	0.37	0.99	n/a
South Africa	0.000	0.09	0.27	0.000	0.24	0.36	0.32	0.41	0.44
Taiwan	0.06	0.11	n/a	0.13	0.24	n/a	0.31	0.44	n/a

Emerging Markets:	H-K Spanning Test (OLS)			GMM Wald Test			Spanning Test (no short sales)		
	Set I	Set II	Set III	Set I	Set II	Set III	Set I	Set II	Set III
Argentina	0.18	0.34	n/a	0.17	0.31	n/a	0.32	0.43	n/a
Chile	0.000	0.003	n/a	0.009	0.02	n/a	0.32	0.32	n/a
China	0.000	0.001	n/a	0.000	0.000	n/a	0.45	0.47	n/a
Colombia	0.000	0.000	n/a	0.000	0.000	n/a	0.43	0.65	n/a
India	0.000	0.000	n/a	0.000	0.000	n/a	0.67	0.79	n/a
Malaysia	0.000	0.000	n/a	0.001	0.008	n/a	0.12	0.55	n/a
Pakistan	0.000	0.000	n/a	0.000	0.000	n/a	0.12	0.21	n/a
Peru	0.000	0.000	n/a	0.000	0.000	n/a	0.01	0.035	n/a
Poland	0.11	0.39	n/a	0.14	0.44	n/a	0.36	0.48	n/a
Russia	0.07	0.11	n/a	0.21	0.32	n/a	0.52	0.62	n/a
Thailand	0.13	0.22	n/a	0.21	0.52	n/a	0.13	0.55	n/a
Turkey	0.11	0.20	n/a	0.55	0.61	n/a	0.009	0.35	n/a
World	0.000	0.000	n/a	0.000	0.000	n/a	0.63	0.65	n/a

Table 4.4a: Unconditional Correlation over Subperiods (UK).

The table presents weekly unconditional correlation figures between each foreign market index and its most augmented diversification portfolio over two non-overlapping subperiods of nearly equal lengths i.e. January 1994 – December 1998, and January 1999 – March 2004. The unconditional correlation between a foreign market index and the UK FTSE-All Share index are reported in brackets.

	Subperiods	
Developed Markets	**Jan. 1994 – Dec. 1998**	**Jan. 1999 – Mar. 2004**
Australia	0.69 (0.55)	0.75 (0.56)
Austria	0.59 (0.50)	0.58 (0.30)
Belgium	0.66 (0.56)	0.80 (0.63)
Canada	0.72 (0.63)	0.74 (0.60)
Denmark	0.60 (0.53)	0.73 (0.59)
Finland	0.61 (0.51)	0.74 (0.57)
France	0.76 (0.69)	0.88 (0.82)
Germany	0.77 (0.65)	0.85 (0.77)
Hong Kong	0.78 (0.67)	0.79 (0.58)
Ireland	0.76 (0.67)	0.66 (0.53)
Italy	0.54 (0.45)	0.79 (0.75)
Japan	0.81 (0.35)	0.82 (0.32)
Netherlands	0.85 (0.72)	0.89 (0.81)
New Zealand	0.71 (0.47)	0.59 (0.31)
Norway	0.67 (0.54)	0.74 (0.58)
Spain	0.73 (0.64)	0.77 (0.69)
Sweden	0.70 (0.61)	0.84 (0.70)
Switzerland	0.71 (0.60)	0.81 (0.71)
USA	0.81 (0.62)	0.89 (0.74)
DM Average	**0.71 (0.57)**	**0.77 (0.60)**
Adv. Emerging Markets		
Brazil	0.73 (0.41)	0.67 (0.42)
Israel	0.64 (0.27)	0.57 (0.41)
Korea	0.47 (0.30)	0.74 (0.43)
Mexico	0.65 (0.38)	0.71 (0.56)
South Africa	0.84 (0.43)	0.75 (0.46)
Taiwan	0.66 (0.27)	0.66 (0.29)
AEM Average	**0.66 (0.34)**	**0.67 (0.42)**
Emerging Markets		
Argentina	0.72 (0.40)	0.40 (0.32)
Chile	0.67 (0.38)	0.66 (0.41)
China	0.44 (0.06)	0.45 (0.21)
Colombia	0.37 (0.20)	0.36 (0.15)
India	0.37 (0.12)	0.55 (0.32)
Malaysia	0.62 (0.25)	0.41 (0.20)
Pakistan	0.28 (0.06)	0.31 (0.11)
Peru	0.49 (0.22)	0.41 (0.13)
Poland	0.45 (0.29)	0.55 (0.38)
Russia	0.68 (0.47)	0.59 (0.33)
Thailand	0.77 (0.32)	0.70 (0.29)
Turkey	0.37 (0.25)	0.48 (0.27)
EM Average	**0.52 (0.25)**	**0.49 (0.26)**

Table 4.4b: Unconditional Correlation over Subperiods (Germany).

The table presents weekly unconditional correlation figures between each foreign market index and its most augmented diversification portfolio over two non-overlapping subperiods of nearly equal lengths i.e. January 1994 – December 1998, and January 1999 – March 2004. Correlations with the German CDAX General index are reported in brackets.

	Subperiods	
Developed Markets	**Jan. 1994 – Dec. 1998**	**Jan. 1999 – Mar. 2004**
Australia	0.51 (0.44)	0.69 (0.52)
Austria	0.74 (0.62)	0.68 (0.35)
Belgium	0.72 (0.68)	0.81 (0.69)
Canada	0.66 (0.57)	0.73 (0.59)
Denmark	0.67 (0.56)	0.87 (0.59)
Finland	0.59 (0.57)	0.71 (0.51)
France	0.86 (0.72)	0.91 (0.86)
Hong Kong	0.57 (0.44)	0.61 (0.55)
Ireland	0.69 (0.56)	0.86 (0.57)
Italy	0.87 (0.47)	0.88 (0.63)
Japan	0.73 (0.27)	0.88 (0.36)
Netherlands	0.87 (0.76)	0.94 (0.85)
New Zealand	0.42 (0.32)	0.47 (0.42)
Norway	0.66 (0.56)	0.80 (0.53)
Spain	0.81 (0.69)	0.92 (0.72)
Sweden	0.75 (0.69)	0.93 (0.74)
Switzerland	0.83 (0.70)	0.89 (0.71)
UK	0.82 (0.63)	0.91 (0.72)
USA	0.81 (0.58)	0.90 (0.68)
DM Average	**0.71 (0.57)**	**0.81 (0.61)**
Adv. Emerging Markets		
Brazil	0.69 (0.46)	0.72 (0.47)
Israel	0.39 (0.42)	0.53 (0.44)
Korea	0.74 (0.27)	0.89 (0.43)
Mexico	0.57 (0.34)	0.63 (0.56)
South Africa	0.71 (0.48)	0.74 (0.46)
Taiwan	0.46 (0.27)	0.66 (0.37)
AEM Average	**0.60 (0.35)**	**0.69 (0.44)**
Emerging Markets		
Argentina	0.45 (0.42)	0.39 (0.31)
Chile	0.43 (0.37)	0.50 (0.43)
China	0.30 (0.07)	0.47 (0.22)
Colombia	0.35 (0.20)	0.34 (0.22)
India	0.36 (0.15)	0.53 (0.32)
Malaysia	0.36 (0.20)	0.45 (0.26)
Pakistan	0.27 (0.02)	0.35 (0.18)
Peru	0.35 (0.30)	0.36 (0.21)
Poland	0.40 (0.32)	0.62 (0.42)
Russia	0.75 (0.50)	0.79 (0.35)
Thailand	0.61 (0.27)	0.58 (0.31)
Turkey	0.33 (0.16)	0.41 (0.28)
EM Average	**0.41 (0.24)**	**0.48 (0.29)**

Table 4.4c: Unconditional Correlation over Subperiods (France).

The table presents weekly unconditional correlation figures between each foreign market index and its most augmented diversification portfolio over two non-overlapping subperiods of nearly equal lengths i.e. January 1994 – December 1998, and January 1999 – March 2004. Correlations with the French SBF-250 index are reported in brackets.

	Subperiods	
Developed Markets	**Jan. 1994 – Dec. 1998**	**Jan. 1999 – Mar. 2004**
Australia	0.56 (0.49)	0.67 (0.53)
Austria	0.57 (0.49)	0.55 (0.29)
Belgium	0.70 (0.68)	0.86 (0.70)
Canada	0.73 (0.62)	0.76 (0.66)
Denmark	0.55 (0.47)	0.68 (0.61)
Finland	0.83 (0.48)	0.97 (0.58)
Germany	0.87 (0.72)	0.93 (0.86)
Hong Kong	0.53 (0.43)	0.65 (0.55)
Ireland	0.67 (0.57)	0.64 (0.53)
Italy	0.59 (0.54)	0.89 (0.65)
Japan	0.79 (0.34)	0.81 (0.40)
Netherlands	0.91 (0.75)	0.95 (0.88)
New Zealand	0.57 (0.43)	0.54 (0.30)
Norway	0.77 (0.57)	0.81 (0.57)
Spain	0.78 (0.73)	0.83 (0.72)
Sweden	0.77 (0.65)	0.86 (0.76)
Switzerland	0.79 (0.65)	0.86 (0.71)
UK	0.79 (0.70)	0.87 (0.79)
USA	0.85 (0.61)	0.90 (0.75)
DM Average	**0.71 (0.57)**	**0.79 (0.62)**
Adv. Emerging Markets		
Brazil	0.54 (0.43)	0.57 (0.50)
Israel	0.37 (0.29)	0.57 (0.45)
Korea	0.42 (0.29)	0.58 (0.43)
Mexico	0.48 (0.35)	0.68 (0.61)
South Africa	0.65 (0.44)	0.68 (0.44)
Taiwan	0.40 (0.26)	0.55 (0.36)
AEM Average	**0.47 (0.34)**	**0.60 (0.46)**
Emerging Markets		
Argentina	0.56 (0.44)	0.42 (0.33)
Chile	0.47 (0.37)	0.57 (0.47)
China	0.34 (0.07)	0.35 (0.23)
Colombia	0.37 (0.20)	0.28 (0.23)
India	0.25 (0.21)	0.54 (0.34)
Malaysia	0.43 (0.23)	0.40 (0.29)
Pakistan	0.27 (0.04)	0.27 (0.19)
Peru	0.41 (0.32)	0.35 (0.17)
Poland	0.40 (0.28)	0.57 (0.44)
Russia	0.61 (0.44)	0.49 (0.34)
Thailand	0.52 (0.28)	0.43 (0.36)
Turkey	0.34 (0.18)	0.41 (0.27)
EM Average	**0.41 (0.25)**	**0.42 (0.30)**

Table 4.5: Benefits of Euro Zone Diversification.

The table presents the unconditional correlation figures (Jan. 1999 to March 2004) between the various investors' portfolios and the foreign market indices. The 'Europhoric' investor is the one that diversifies across the 10 economic groups (based on level 3 industrial classifications) of the entire euro zone. The 'Eurosceptics' diversify across the 10 economic groups of their respective countries only i.e. Germany and France.

	Europhoric Investor	German Eurosceptic	French Eurosceptic	Euro bloc Index
Developed Markets.				
Australia	0.72	0.57	0.63	0.59
Austria	0.60	0.41	0.31	0.26
Belgium	0.89	0.69	0.75	0.68
Canada	0.78	0.66	0.72	0.69
Denmark	0.70	0.62	0.63	0.65
Finland	0.96	0.69	0.73	0.67
France	0.97	0.82	--	0.94
Germany	0.97	--	0.84	0.91
Hong Kong	0.71	0.57	0.61	0.61
Ireland	0.71	0.61	0.59	0.58
Italy	0.88	0.82	0.84	0.81
Japan	0.62	0.38	0.46	0.39
Netherlands	0.97	0.95	0.91	0.88
New Zealand	0.57	0.41	0.47	0.38
Norway	0.73	0.57	0.66	0.66
Spain	0.92	0.88	0.89	0.84
Sweden	0.88	0.78	0.84	0.81
Switzerland	0.89	0.76	0.78	0.77
UK	0.87	0.75	0.82	0.82
USA	0.85	0.73	0.77	0.77
Adv. Emerging Markets				
Brazil	0.64	0.51	0.56	0.50
Israel	0.65	0.44	0.48	0.47
Korea	0.65	0.47	0.53	0.49
Mexico	0.74	0.55	0.62	0.62
South Africa	0.61	0.56	0.52	0.50
Taiwan	0.52	0.46	0.43	0.40
Emerging Markets				
Argentina	0.40	0.38	0.35	0.36
Chile	0.64	0.47	0.53	0.47
China	0.38	0.32	0.30	0.25
Colombia	0.49	0.28	0.32	0.23
India	0.53	0.38	0.44	0.39
Malaysia	0.39	0.34	0.38	0.32
Pakistan	0.30	0.29	0.36	0.18
Peru	0.51	0.30	0.24	0.22
Poland	0.61	0.49	0.53	0.50
Turkey	0.40	0.31	0.33	0.30
Russia	0.49	0.41	0.41	0.36
Thailand	0.53	0.34	0.50	0.35
World	0.91	0.80	0.85	0.87

Table 4.6: Tests of Mean-Variance Spanning (Eurozone).

Report of the p-values associated with spanning tests of Huberman & Kandel (1987) (Panel A), Ferson et al (1993) GMM test (Panel B), De Roon et al (2001) (Panel C), and change in the Sharpe Ratio (Panel D) over the sample period January 1999 – March 2004. Columns named Eurozone, German, and French contain four of the 10 economic group portfolios of the Eurozone, Germany, and France respectively.

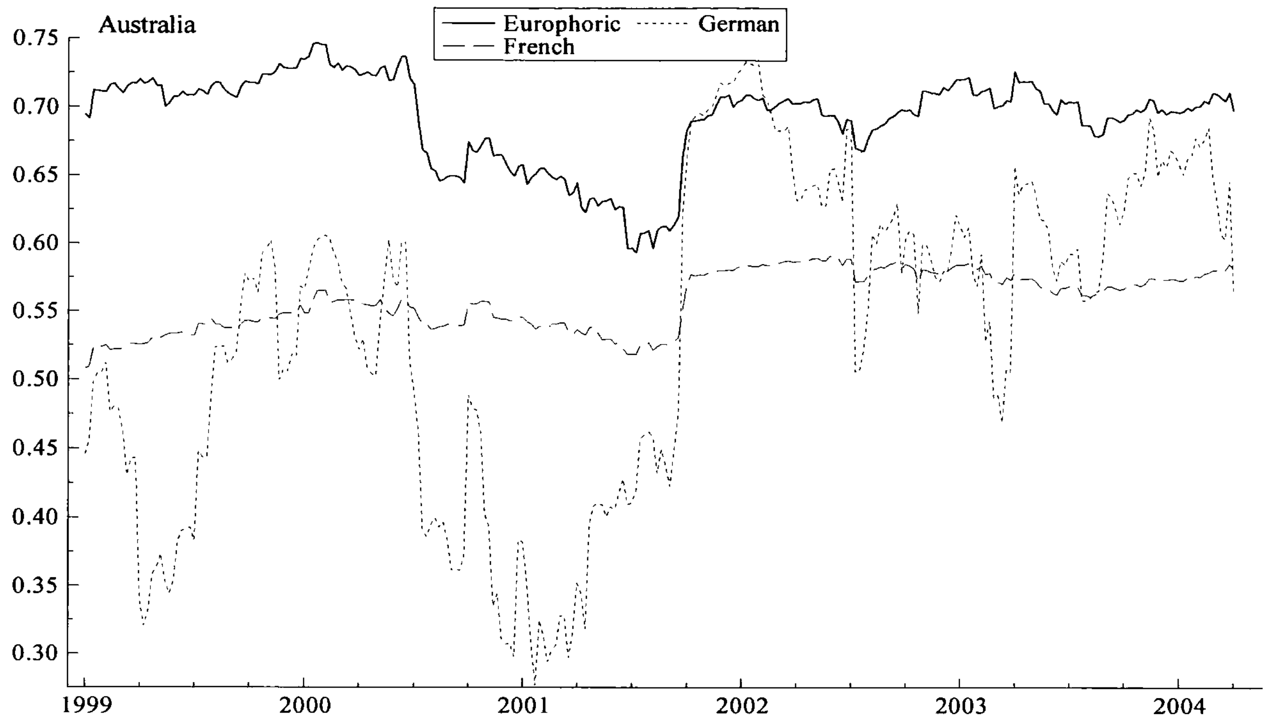
	Panel A H-K Spanning Test (OLS)			Panel B GMM Wald Test			Panel C Spanning Test (no short sales)		
Developed Markets:	**Eurozone**	**German**	**French**	**Eurozone**	**German**	**French**	**Eurozone**	**German**	**French**
Australia	0.32	0.000	0.000	0.44	0.000	0.000	0.42	0.22	0.34
Austria	0.44	0.000	0.000	0.36	0.000	0.000	0.21	0.09	0.13
Belgium	0.67	0.28	0.18	0.56	0.34	0.55	0.64	0.43	0.87
Canada	0.18	0.06	0.08	0.23	0.18	0.22	0.33	0.23	0.32
Denmark	0.21	0.000	0.000	0.43	0.000	0.000	0.22	0.34	0.43
Finland	0.79	0.32	0.34	0.67	0.44	0.29	0.56	0.24	0.31
UK	0.44	0.000	0.000	0.34	0.000	0.000	0.33	0.44	0.27
Germany	0.87	---	0.14	0.44	---	0.54	0.33	0.21	0.22
Hong Kong	0.13	0.09	0.21	0.33	0.19	0.24	0.41	0.51	0.32
Ireland	0.15	0.000	0.000	0.23	0.000	0.01	0.27	0.18	0.54
Italy	0.68	0.07	0.45	0.59	0.17	0.65	0.31	0.22	0.23
Japan	0.55	0.0001	0.000	0.67	0.000	0.000	0.16	0.34	0.12

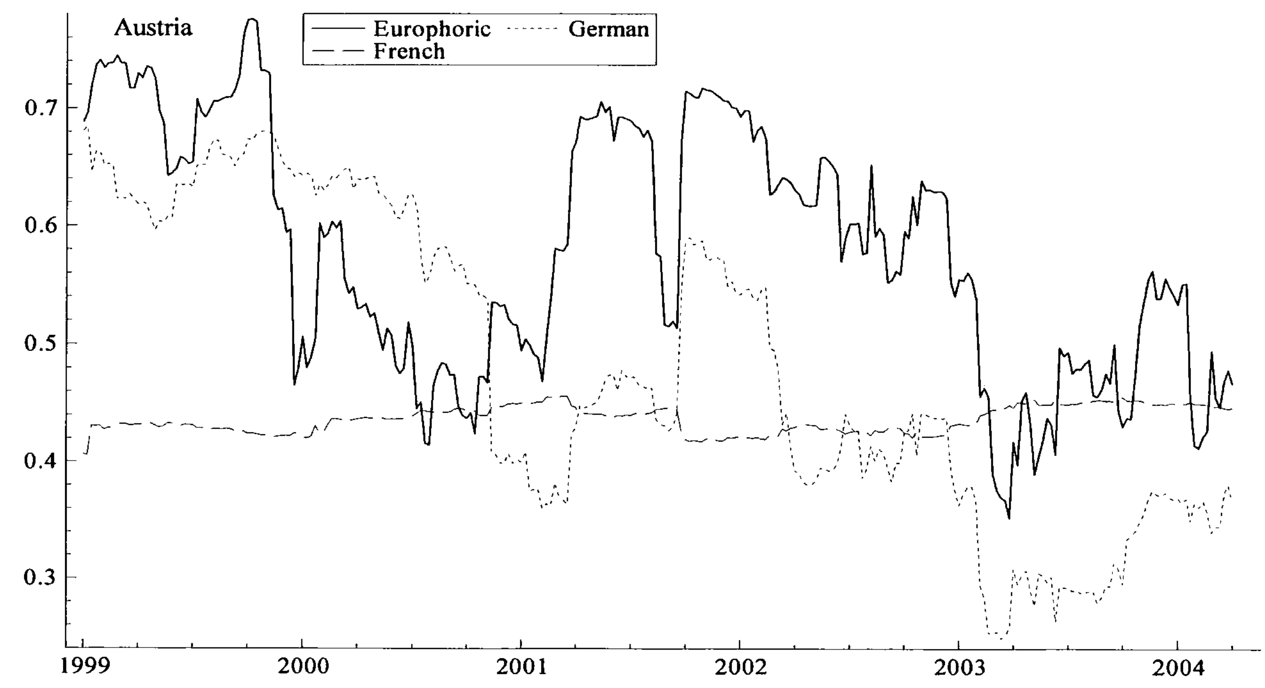
Netherlands	0.43	0.23	0.33	0.65	0.38	0.54	0.09	0.21	0.31
New Zealand	0.21	0.000	0.000	0.43	0.000	0.000	0.15	0.09	0.12
Norway	0.27	0.000	0.18	0.44	0.000	0.31	0.32	0.06	0.14
Spain	0.76	0.02	0.34	0.87	0.09	0.26	0.45	0.33	0.43
Sweden	0.33	0.08	0.09	0.45	0.33	0.34	0.33	0.55	0.21
Switzerland	0.43	0.21	0.12	0.59	0.22	0.17	0.61	0.22	0.22
USA	0.25	0.000	0.000	0.28	0.000	0.000	0.67	0.21	0.33
France	0.43	0.33	---	0.42	0.43	---	0.86	0.13	---

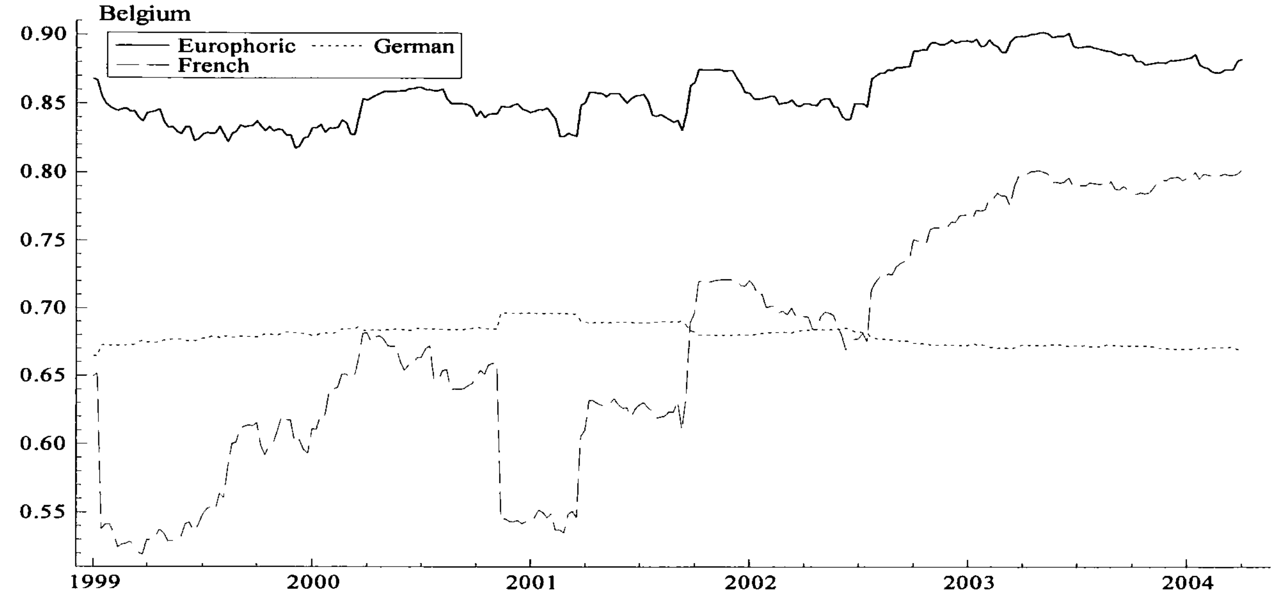
	HK Spanning Test (OLS)			GMM Wald Test			Spanning Test (no short sales)		
Adv. Emerging Markets:	**Eurozone**	**German**	**French**	**Eurozone**	**German**	**French**	**Eurozone**	**German**	**French**
Brazil	0.89	0.25	0.21	0.43	0.27	0.42	0.33	0.33	0.32
Israel	0.32	0.000	0.000	0.76	0.000	0.000	0.19	0.22	0.54
Korea	0.31	0.32	0.23	0.68	0.29	0.22	0.12	0.11	0.21
Mexico	0.41	0.11	0.16	0.56	0.41	0.23	0.34	0.24	0.23
South Africa	0.39	0.000	0.000	0.55	0.002	0.000	0.28	0.31	0.09
Taiwan	0.50	0.02	0.18	0.45	0.16	0.36	0.32	0.22	0.18

Emerging Markets:	H-K Spanning Test (OLS)			GMM Wald Test			Spanning Test (no short sales)		
	Eurozone	**German**	**French**	**Eurozone**	**German**	**French**	**Eurozone**	**German**	**French**
Argentina	0.77	0.009	0.16	0.58	0.02	0.27	0.33	0.41	0.21
Chile	0.14	0.000	0.000	0.41	0.000	0.009	0.45	0.43	0.32
China	0.23	0.000	0.000	0.32	0.000	0.000	0.67	0.13	0.17
Colombia	0.16	0.000	0.000	0.54	0.000	0.000	0.21	0.09	0.12
India	0.22	0.18	0.12	0.34	0.31	0.22	0.22	0.19	0.22
Malaysia	0.67	0.000	0.09	0.77	0.02	0.11	0.54	0.45	0.21
Pakistan	0.32	0.000	0.000	0.34	0.000	0.000	0.48	0.32	0.34
Peru	0.19	0.000	0.000	0.17	0.000	0.000	0.28	0.04	0.02
Poland	0.87	0.22	0.37	0.86	0.39	0.44	0.89	0.76	0.33
Russia	0.34	0.35	0.48	0.33	0.33	0.51	0.32	0.21	0.33
Thailand	0.55	0.000	0.31	0.58	0.000	0.32	0.45	0.32	0.54
Turkey	0.19	0.28	0.19	0.20	0.49	0.55	0.33	0.17	0.16
World	0.36	0.000	0.000	0.38	0.000	0.000	0.78	0.34	0.35

Figure 4.1: Dynamic Conditional Correlations (DCC) between foreign market indices and diversification portfolios of (a) the German and French eurosceptic investors (who invest across sectors in their respective countries only, and (b) europhoric investors (who invest across Eurozone sectors).



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German
French
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0.55
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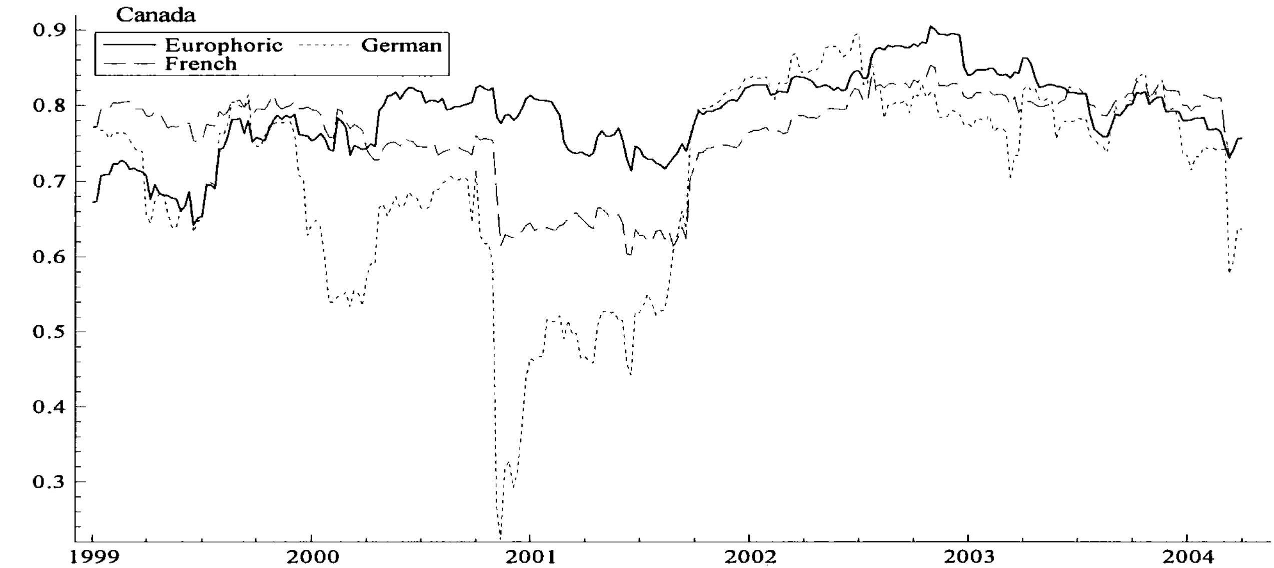
2000
2001
2002
2003
2004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German
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0.3
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2001
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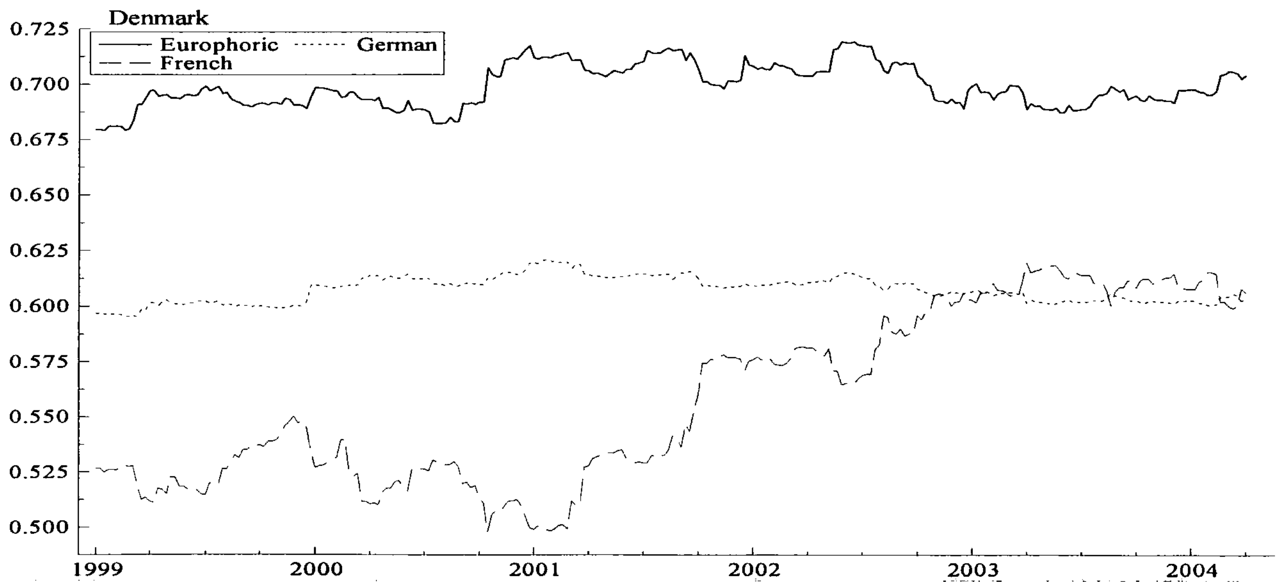
2003
2004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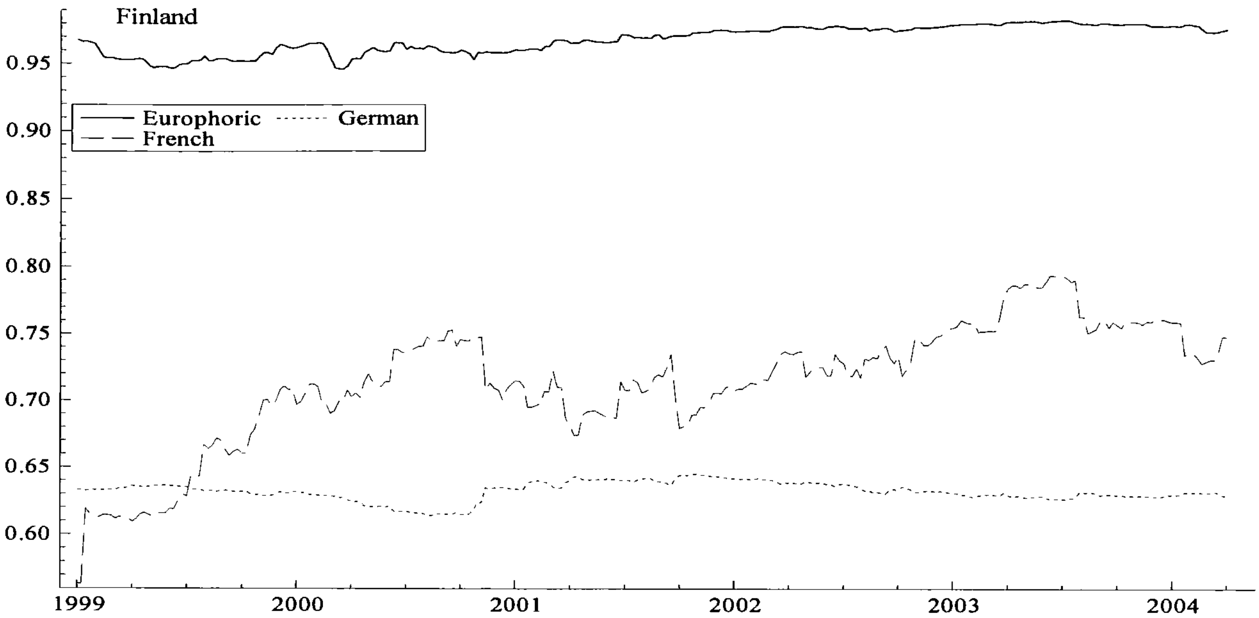
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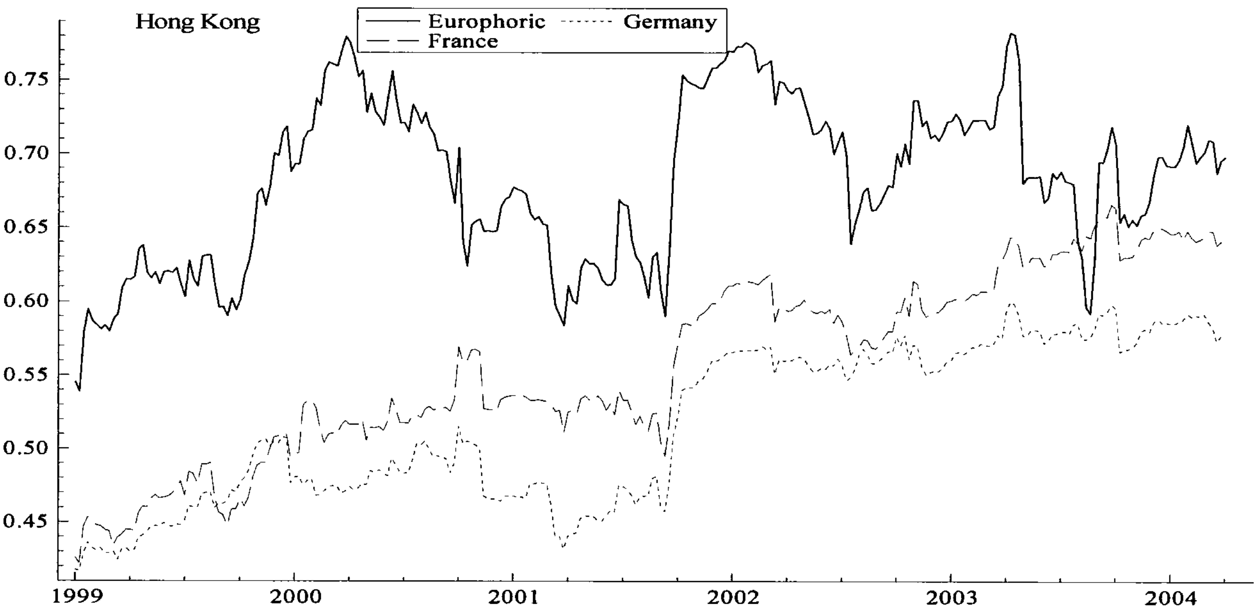
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France
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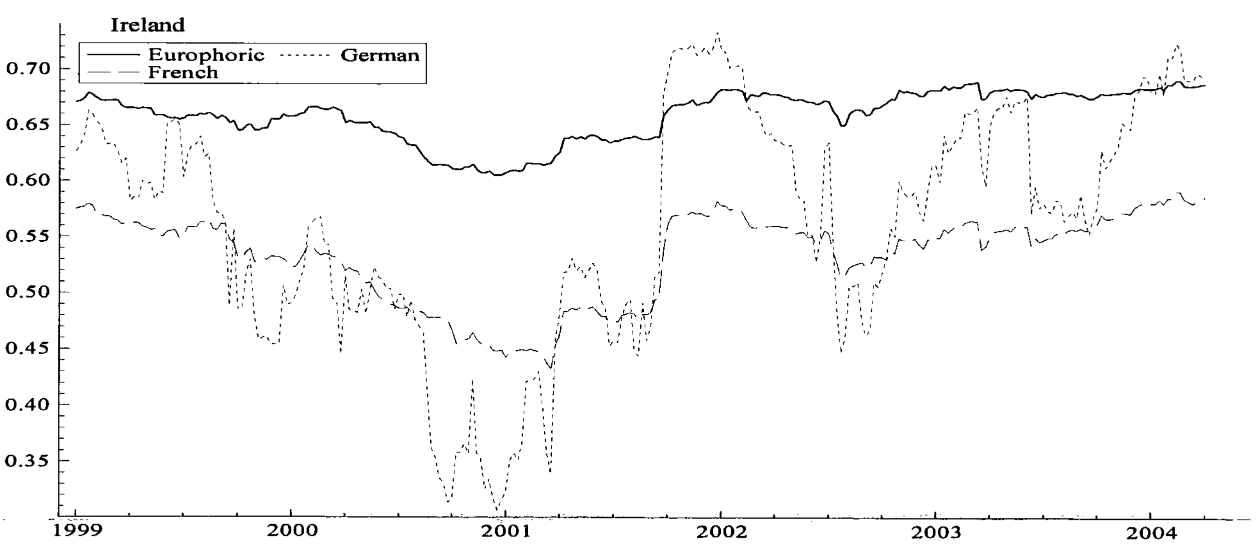
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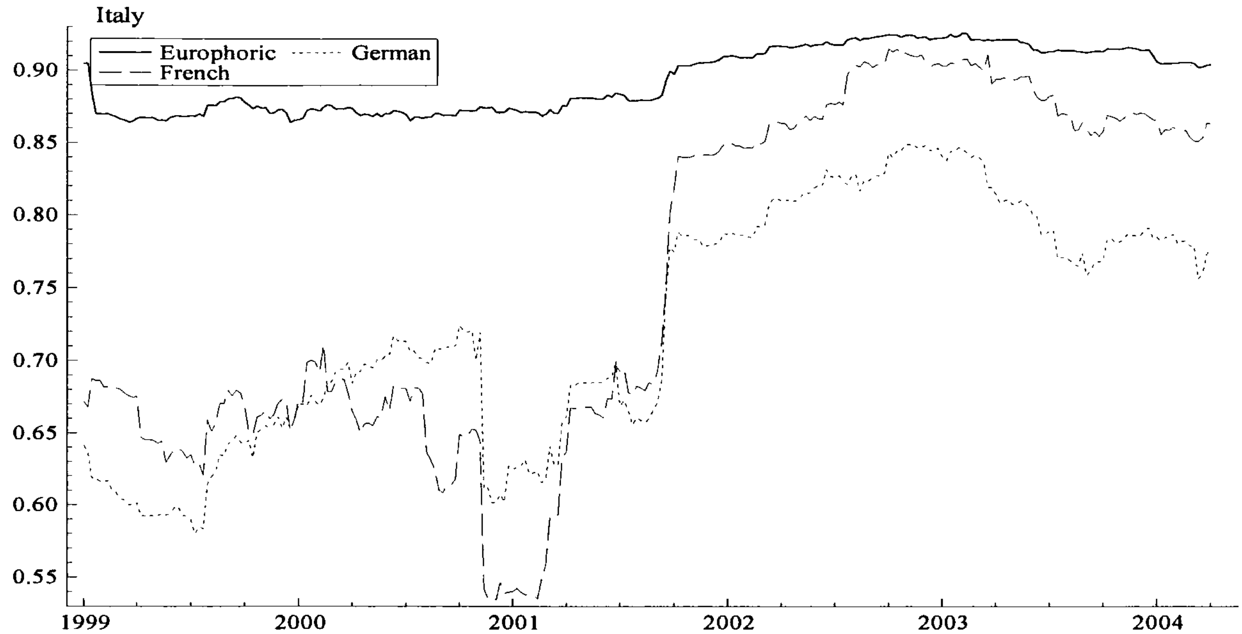
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Europhoric
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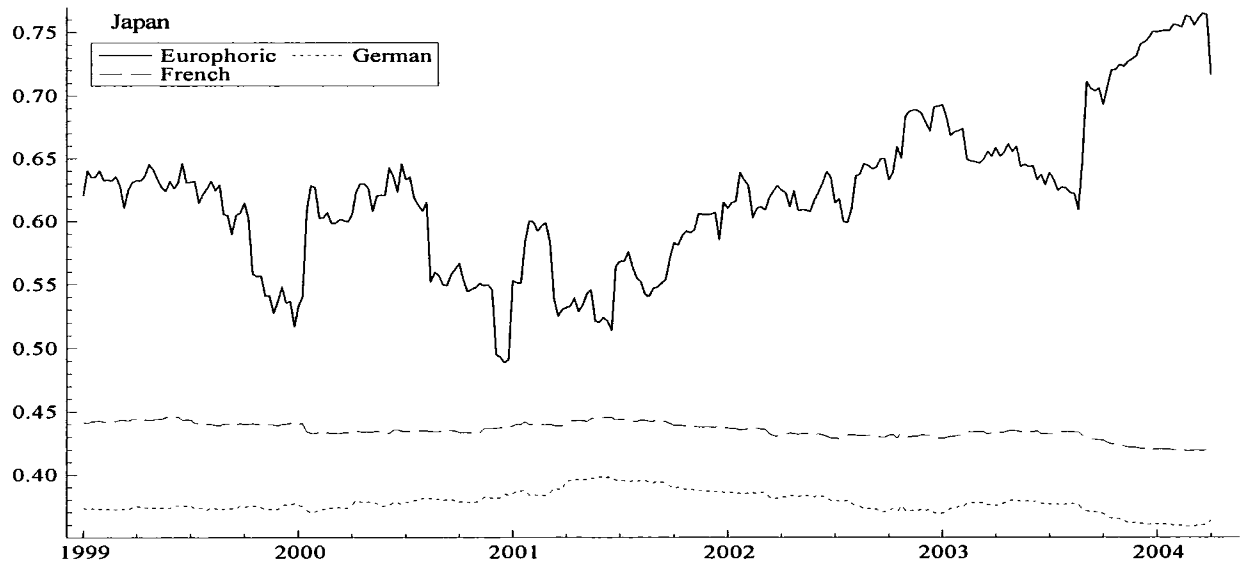
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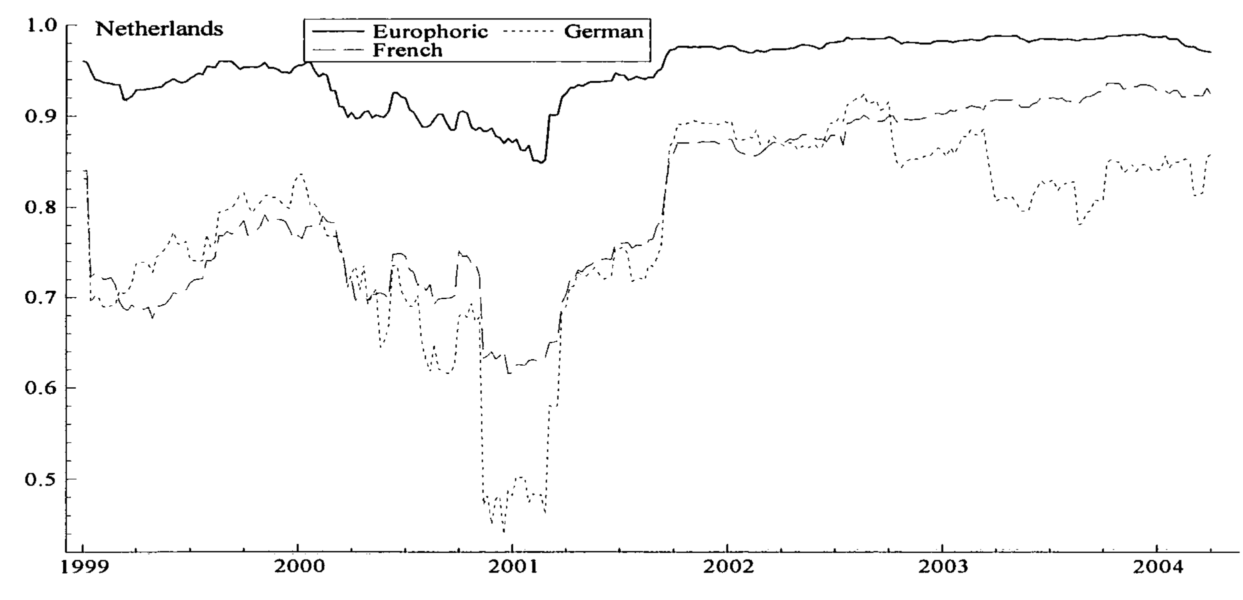
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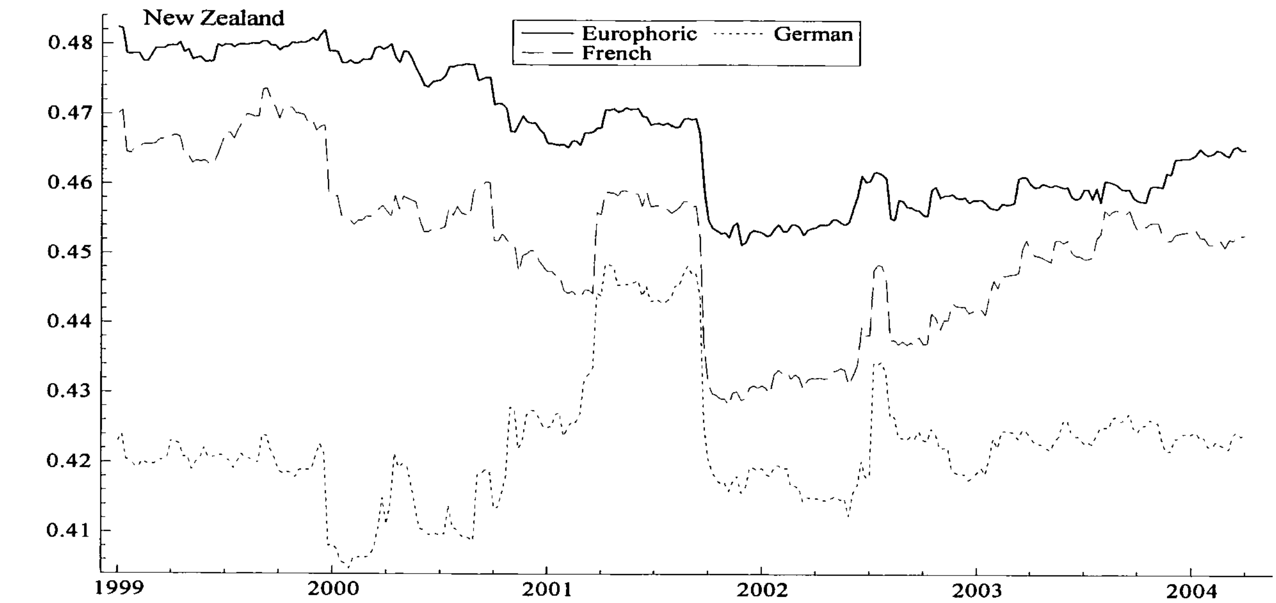
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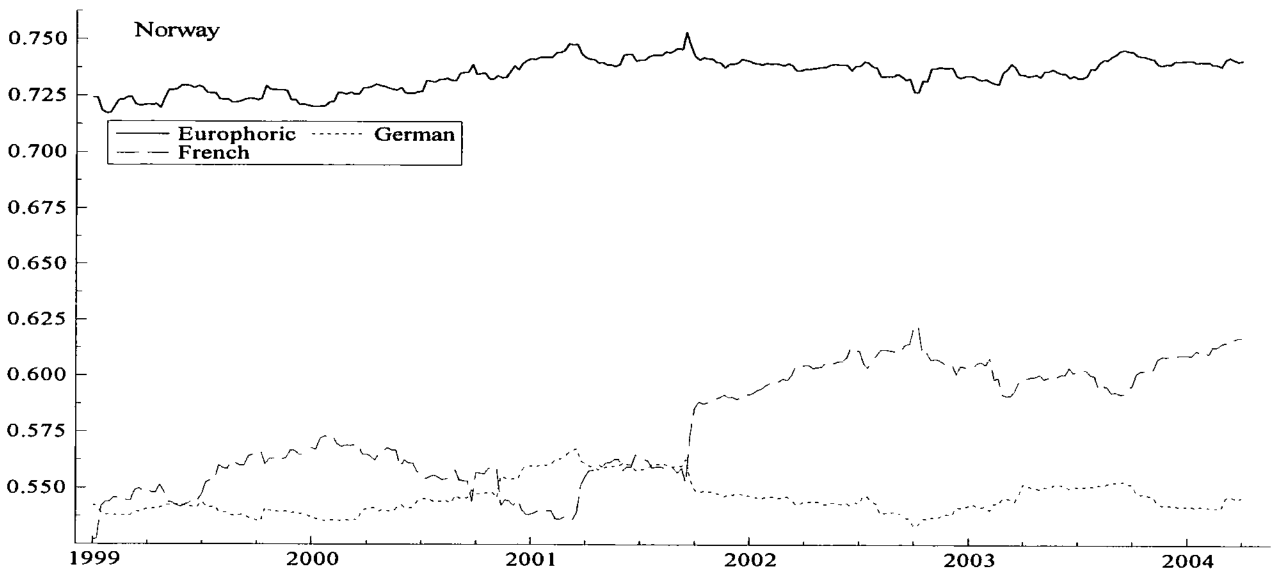
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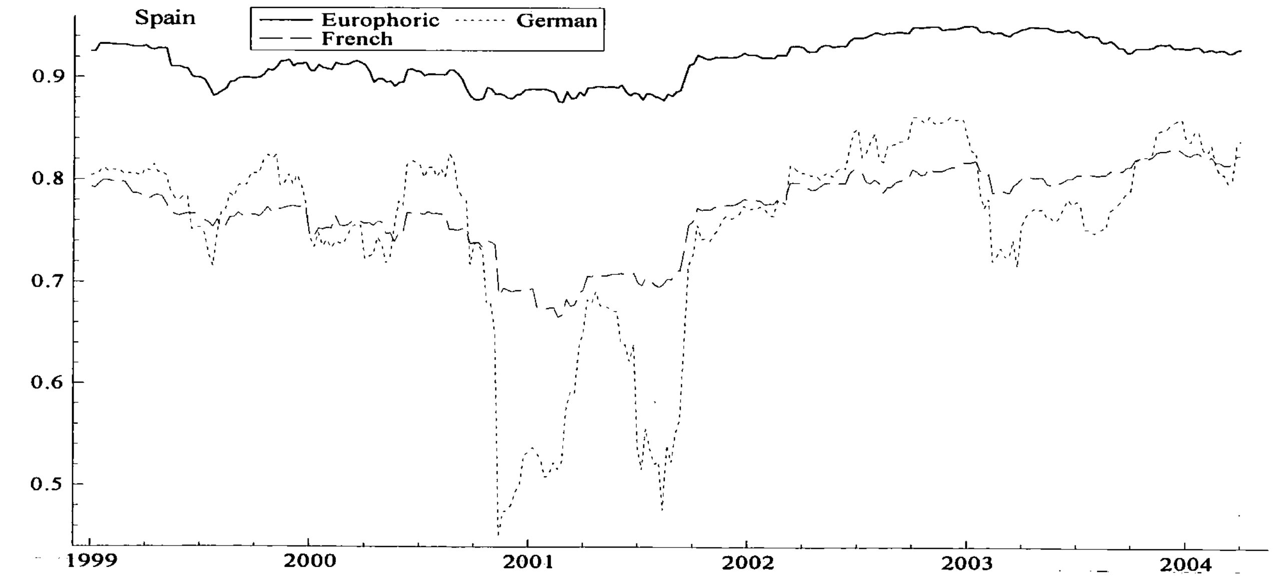
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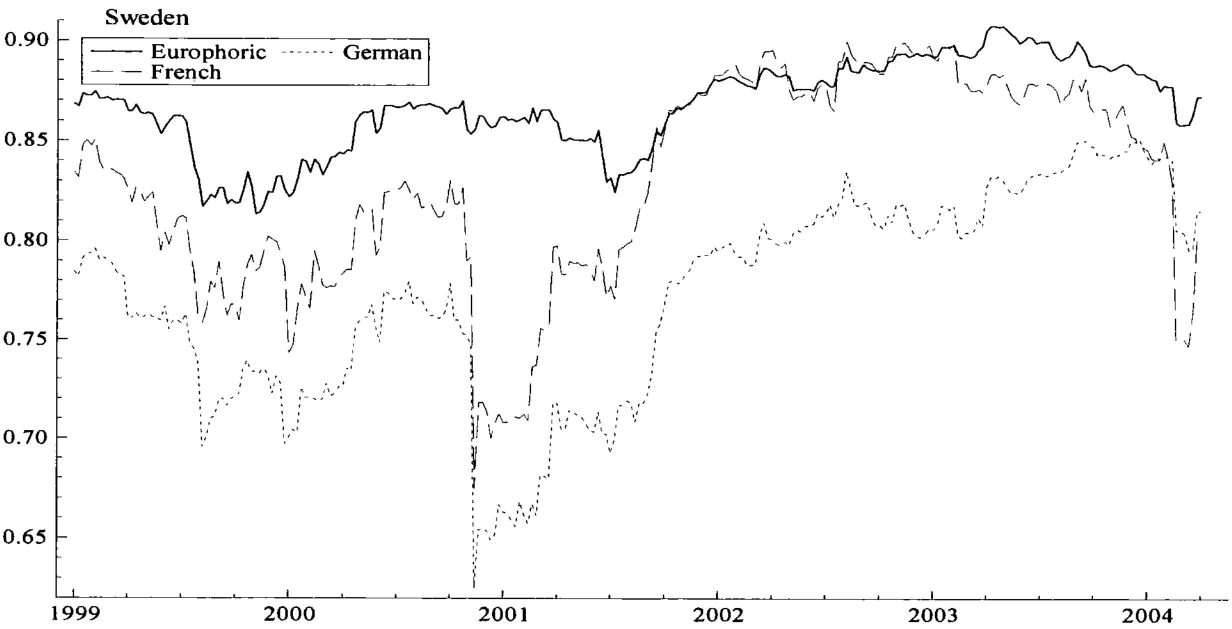
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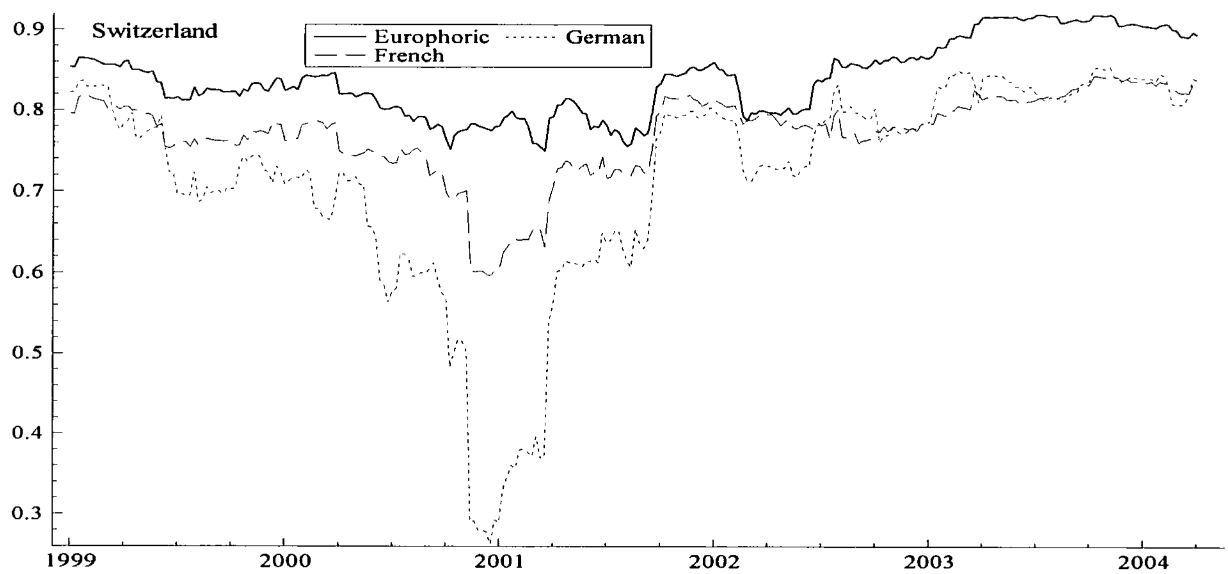
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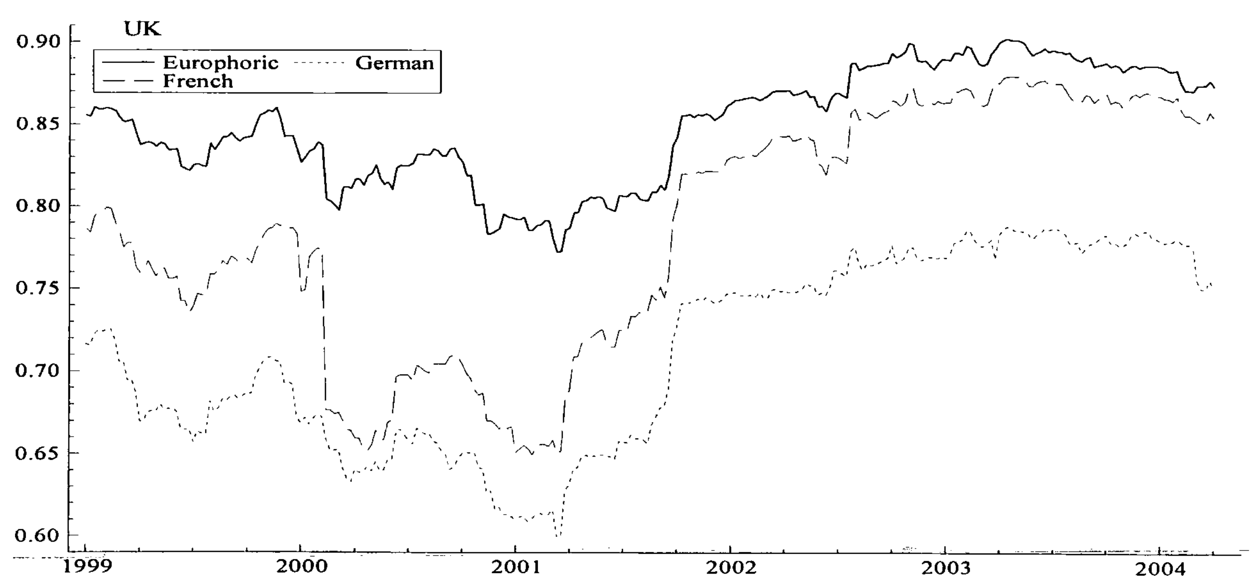
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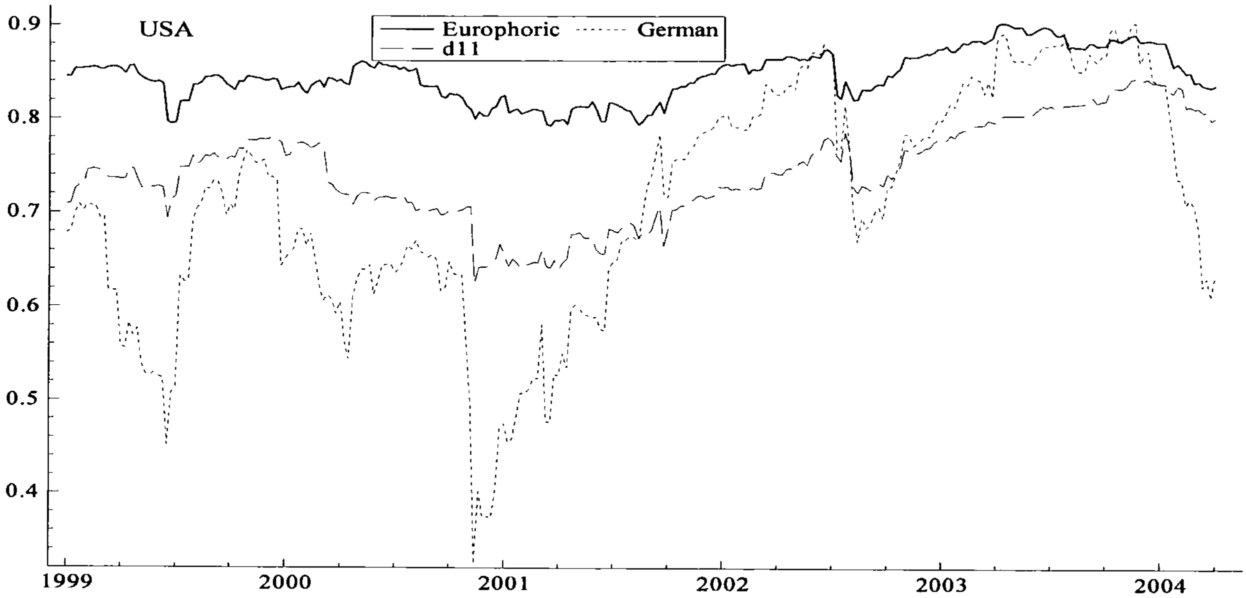
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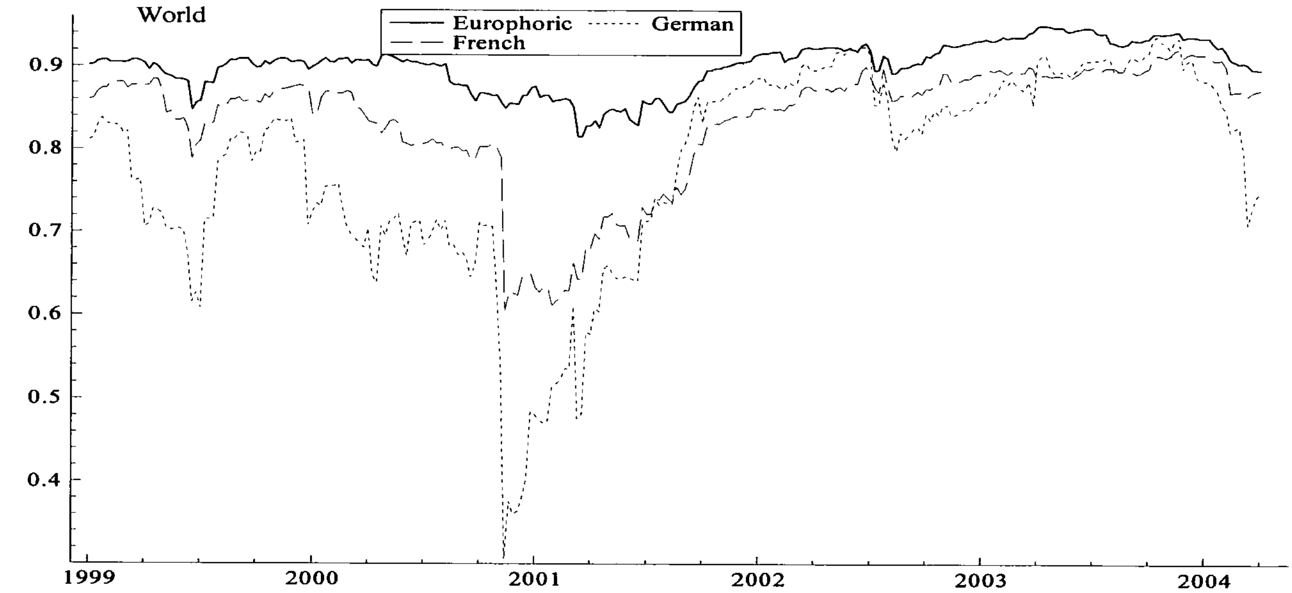
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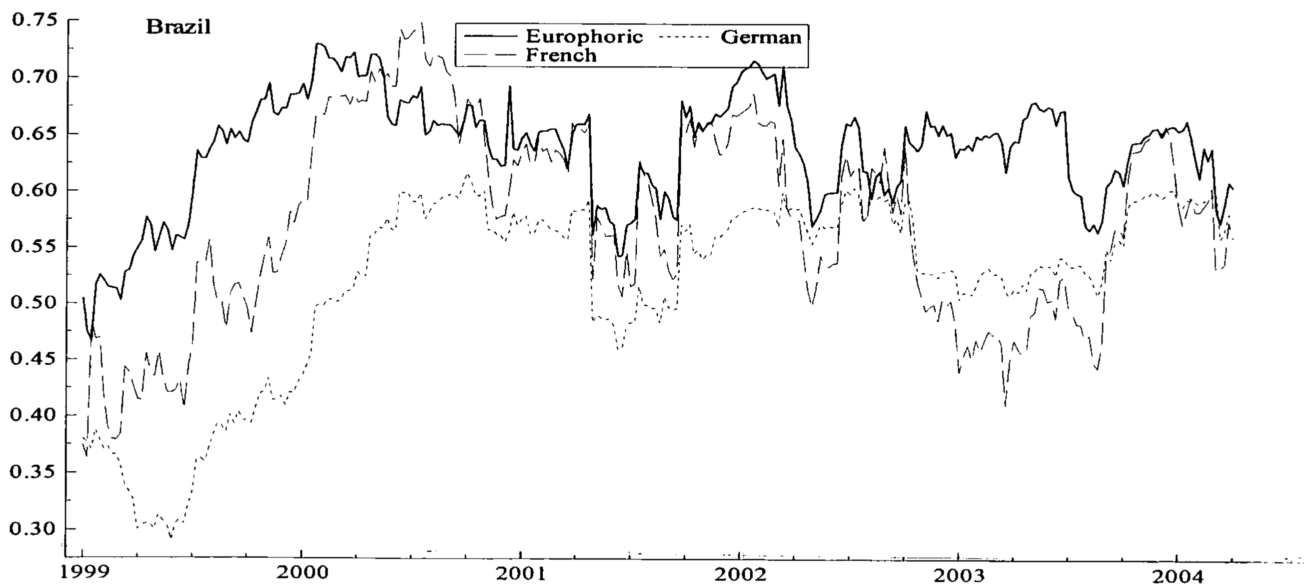
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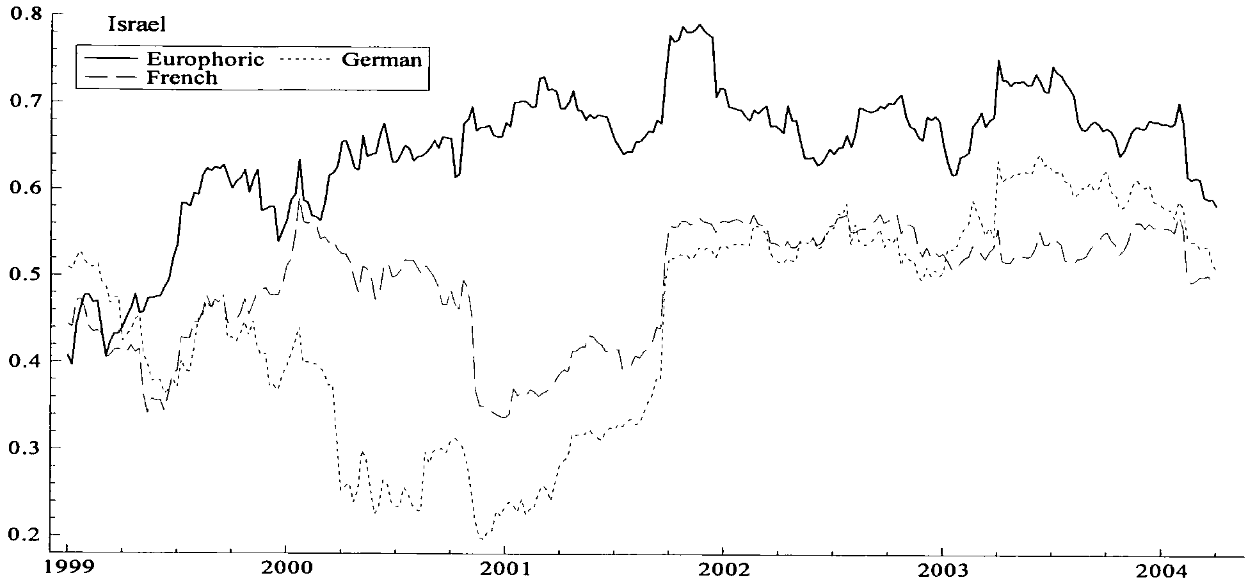
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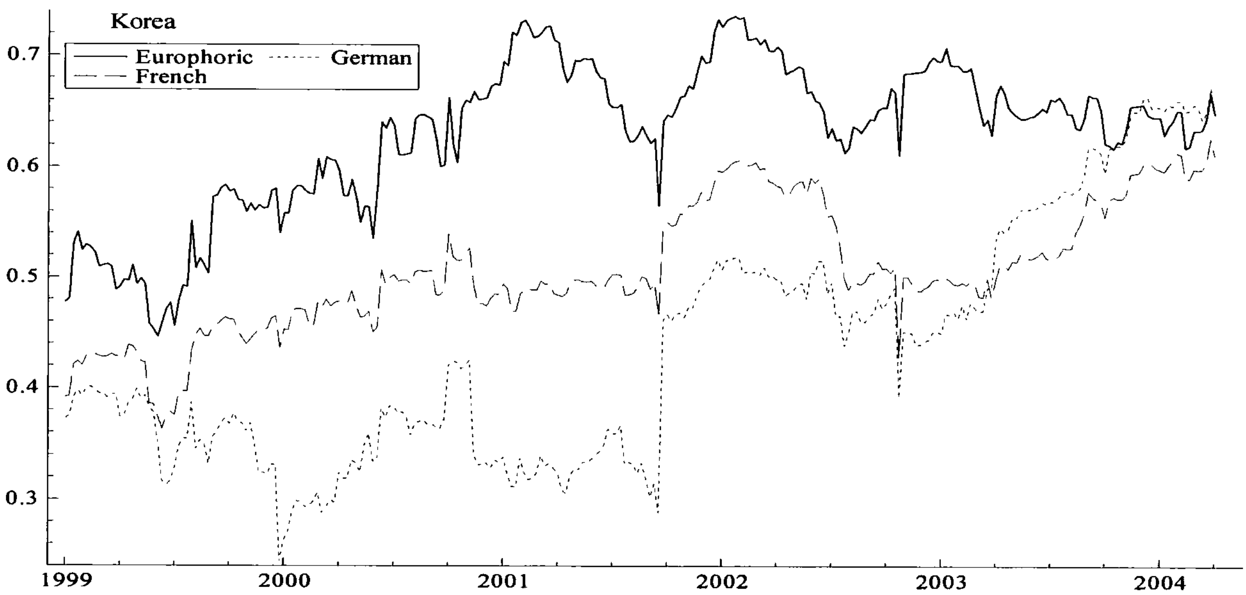
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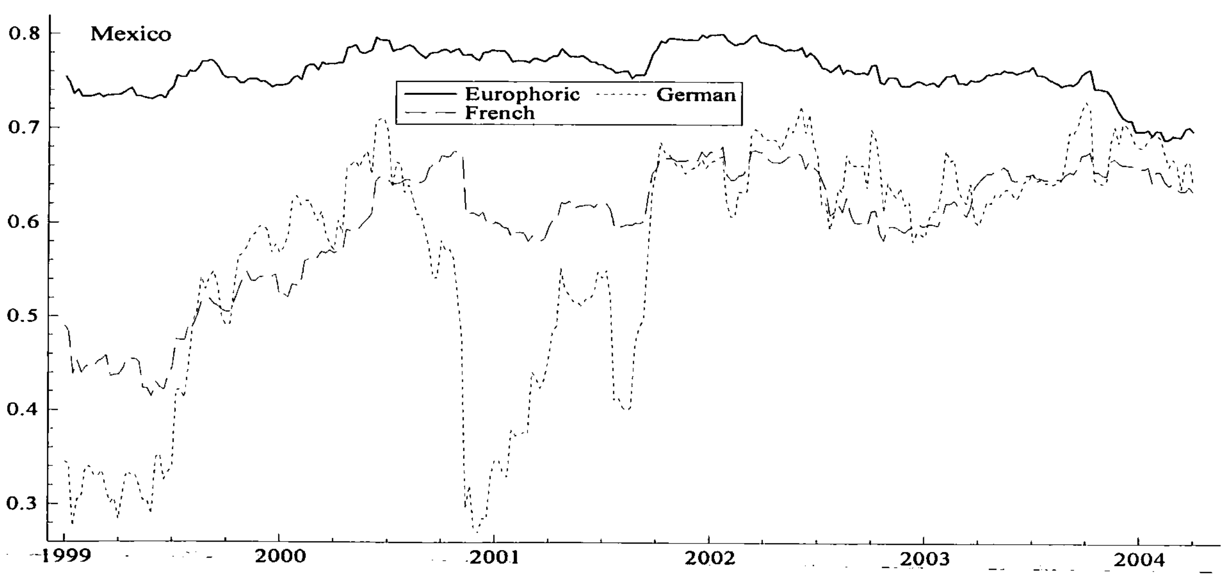
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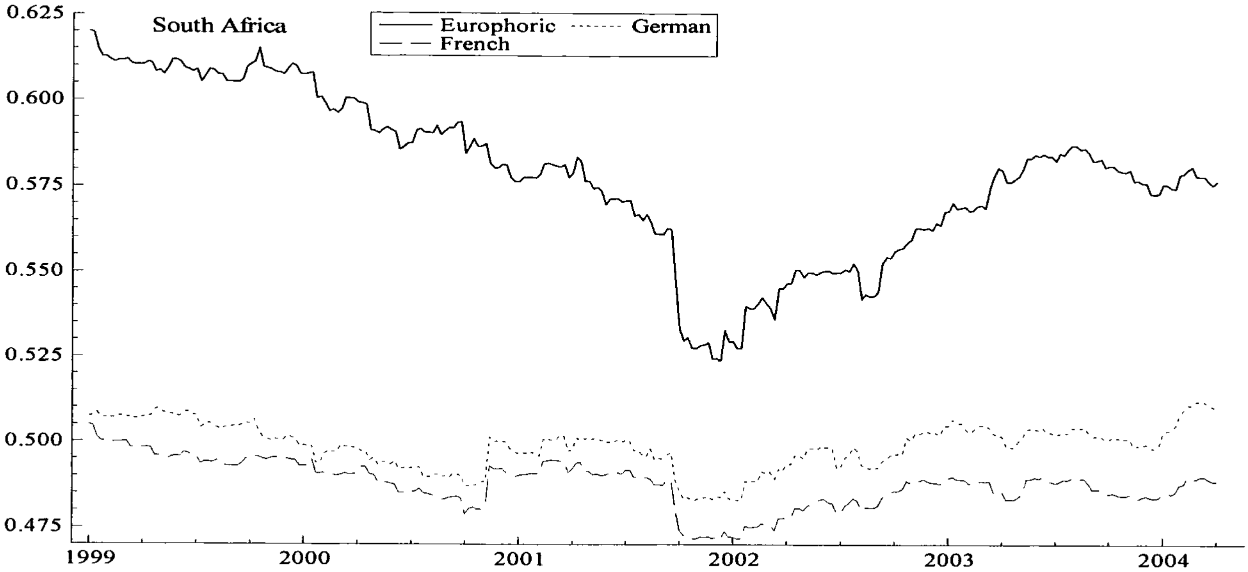
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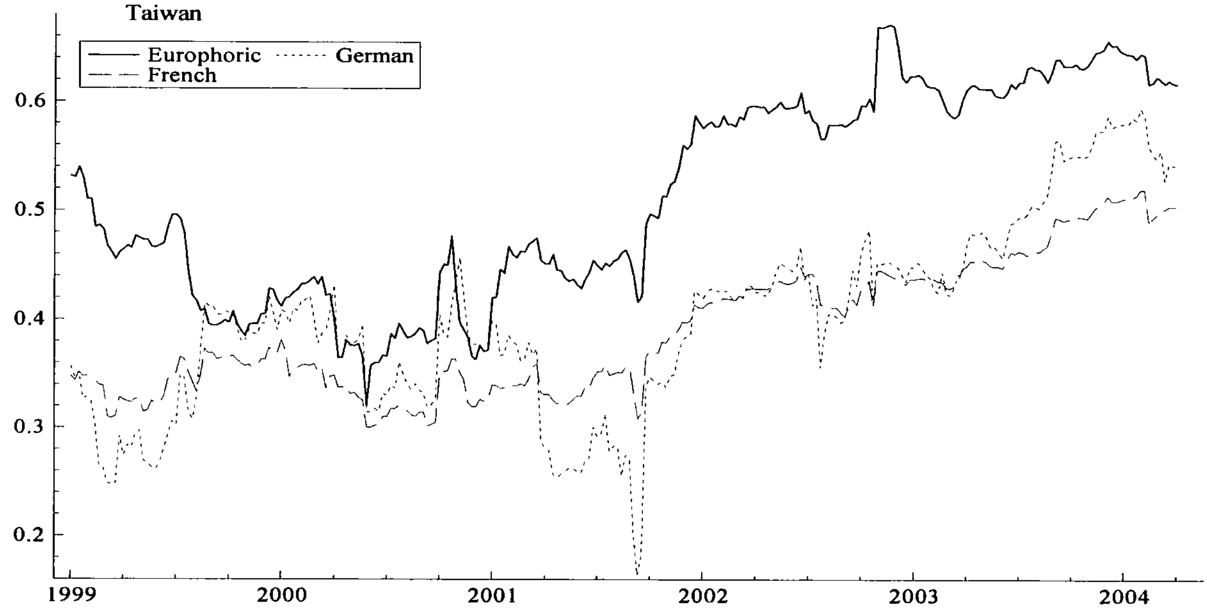
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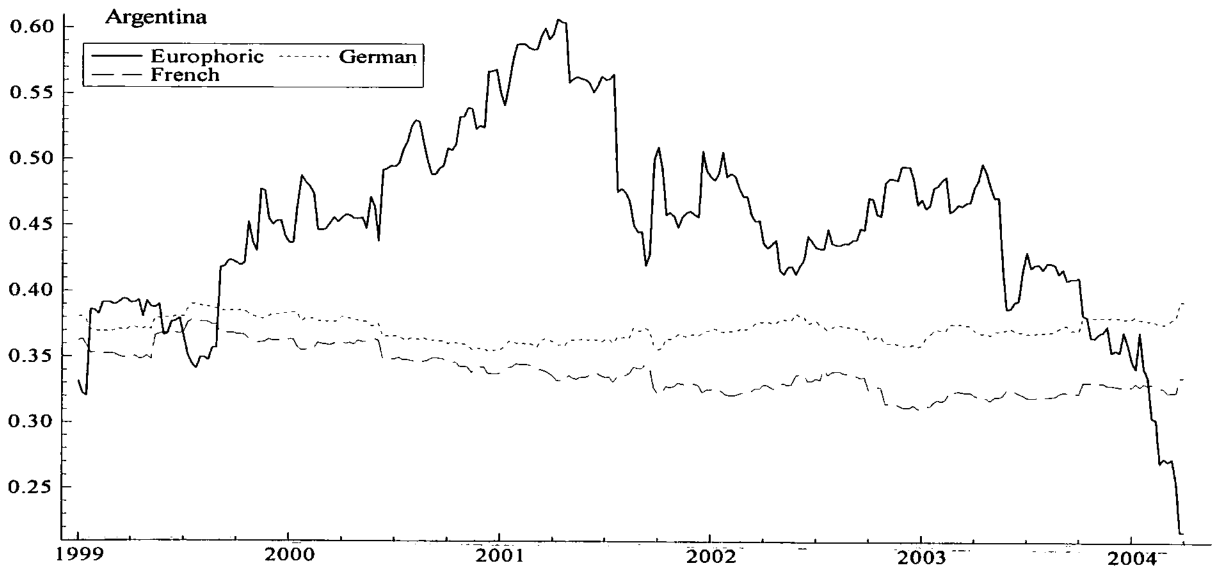
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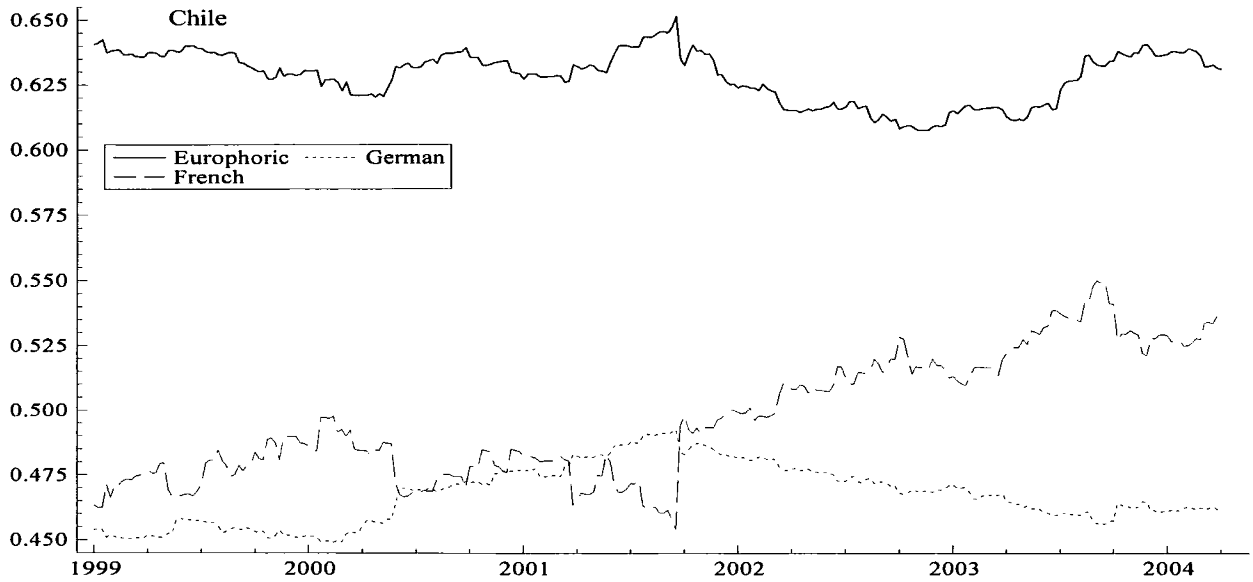
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French
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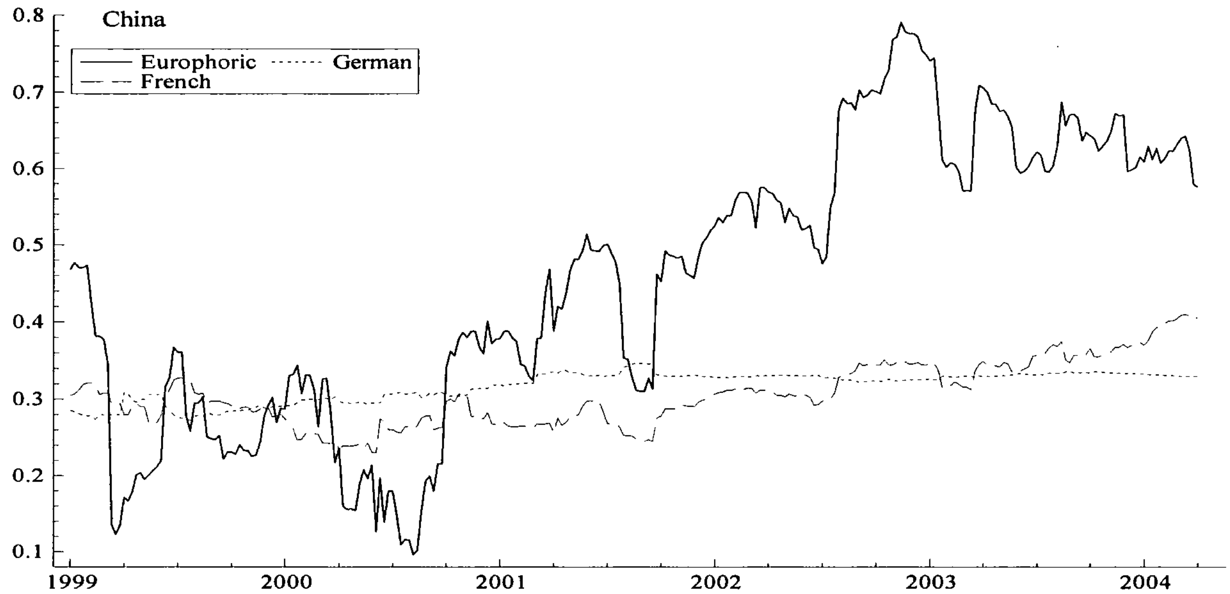
2002
2003
2004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Europhoric
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0.8
0.7
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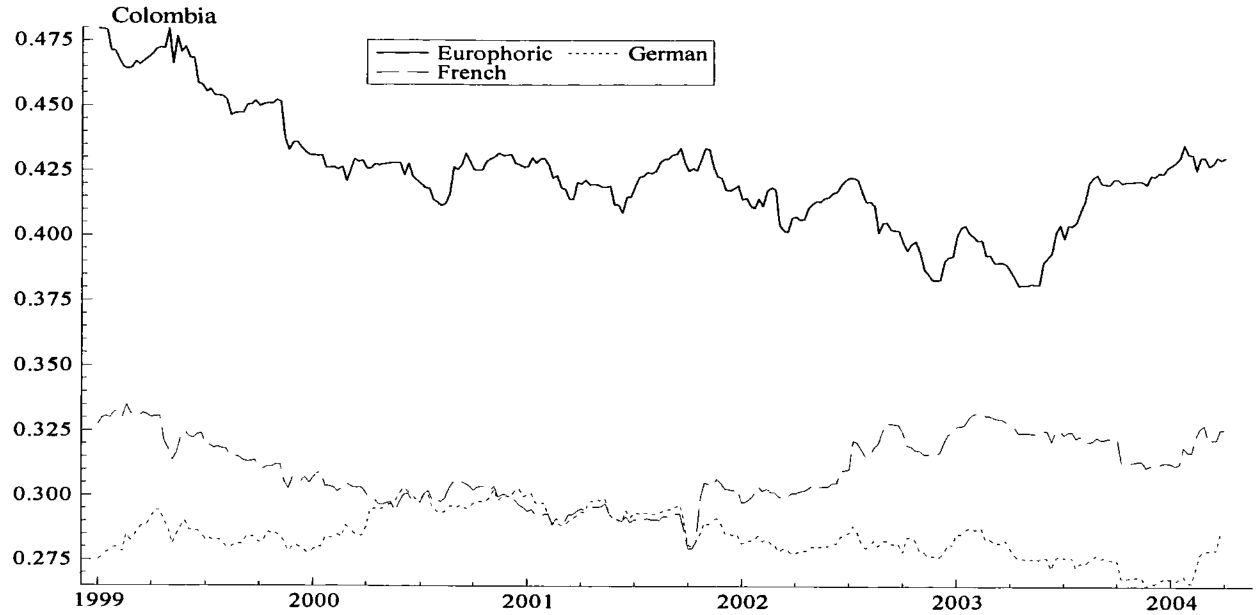
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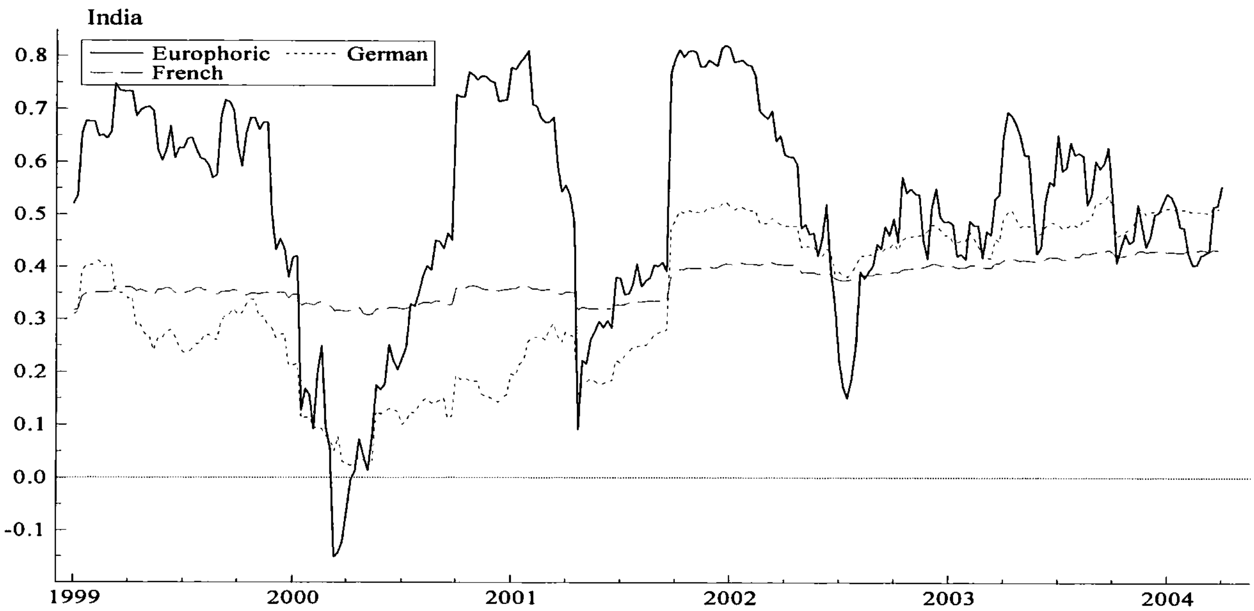
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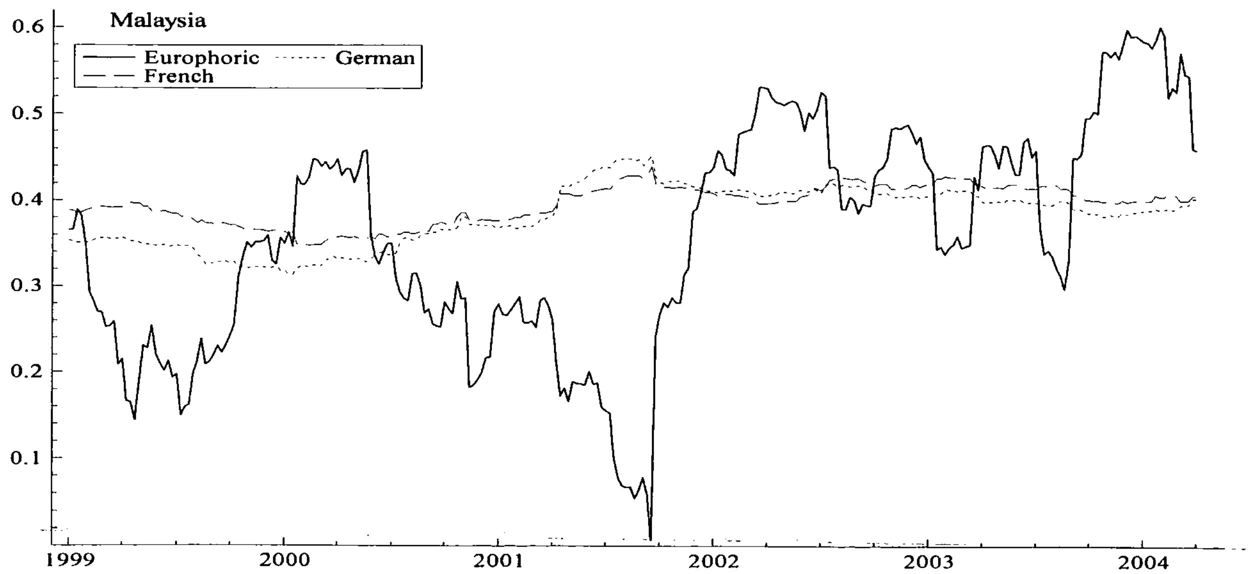
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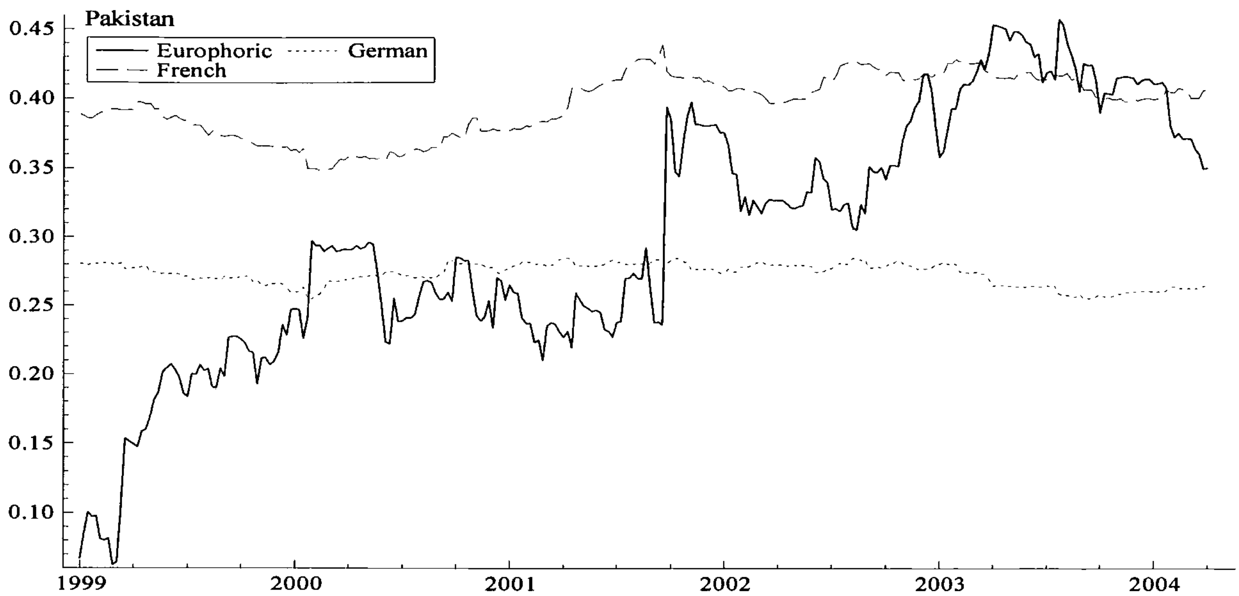
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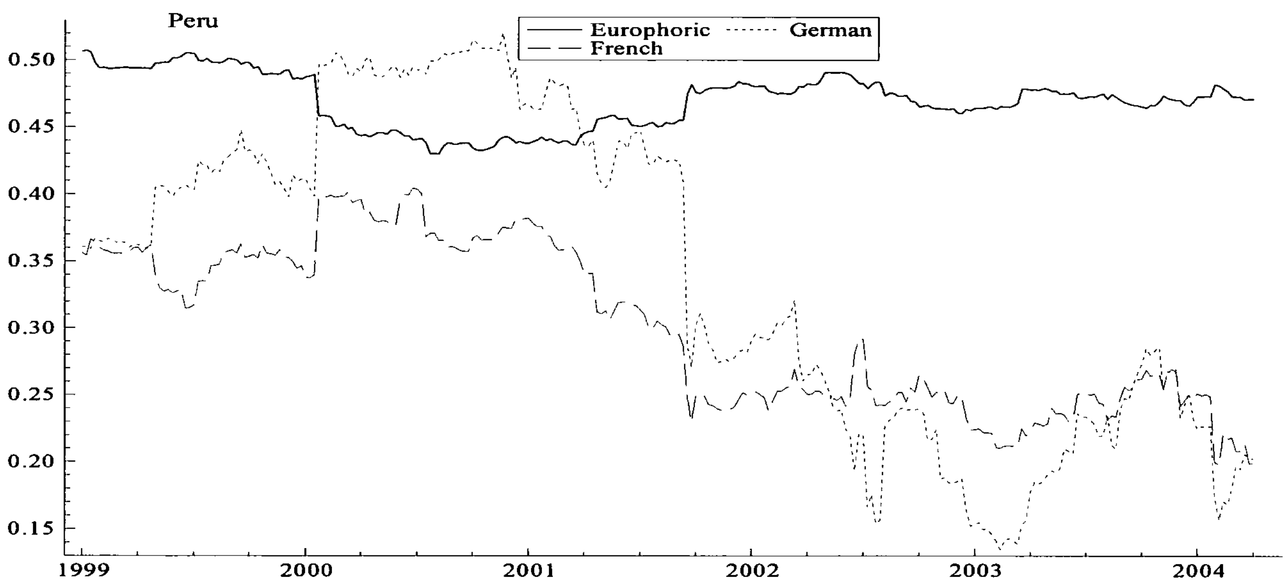
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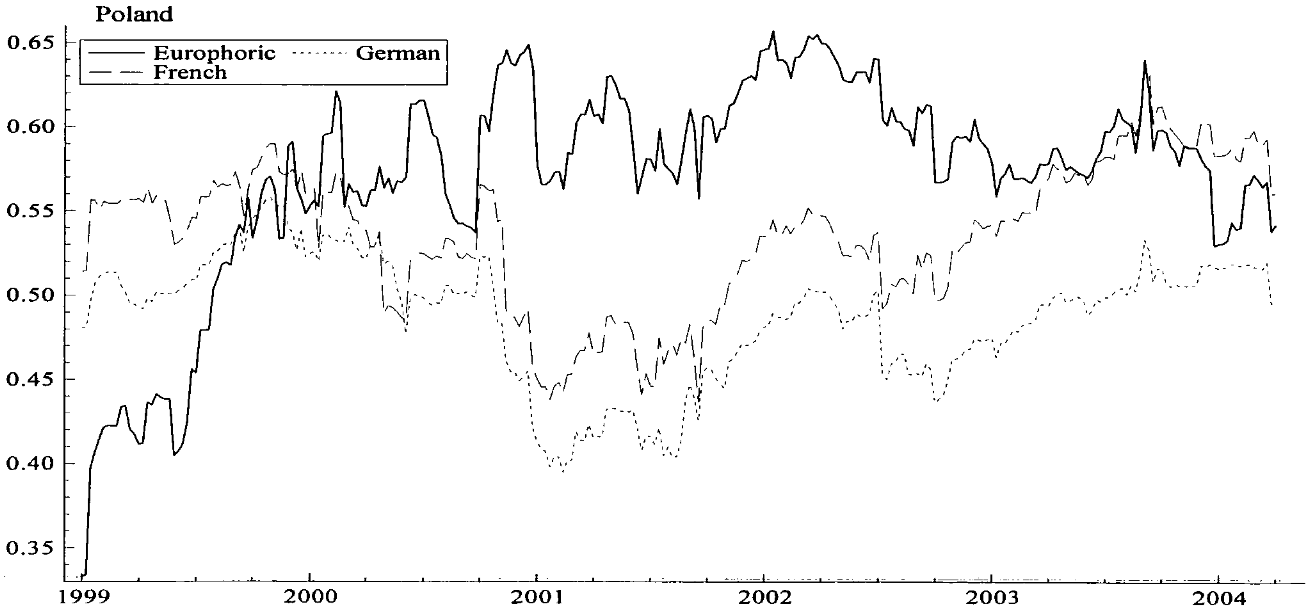
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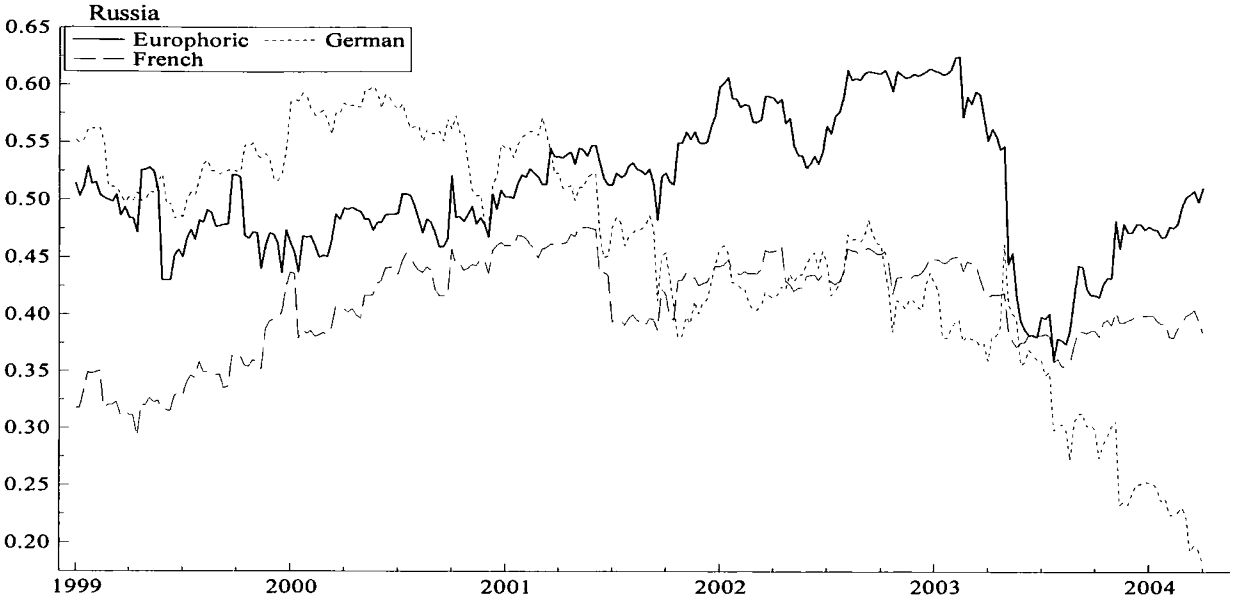
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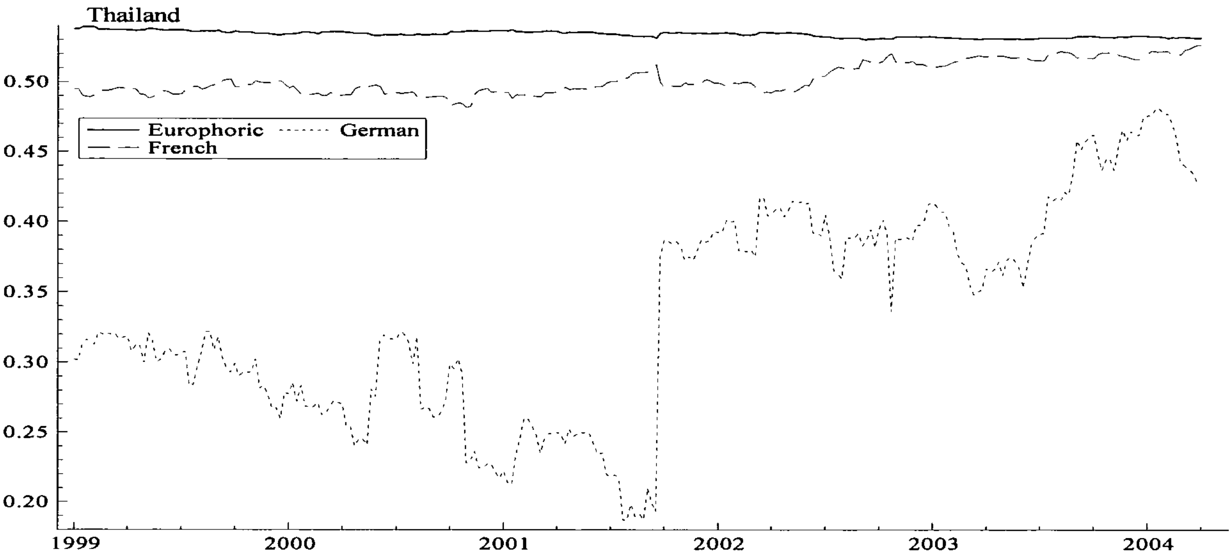
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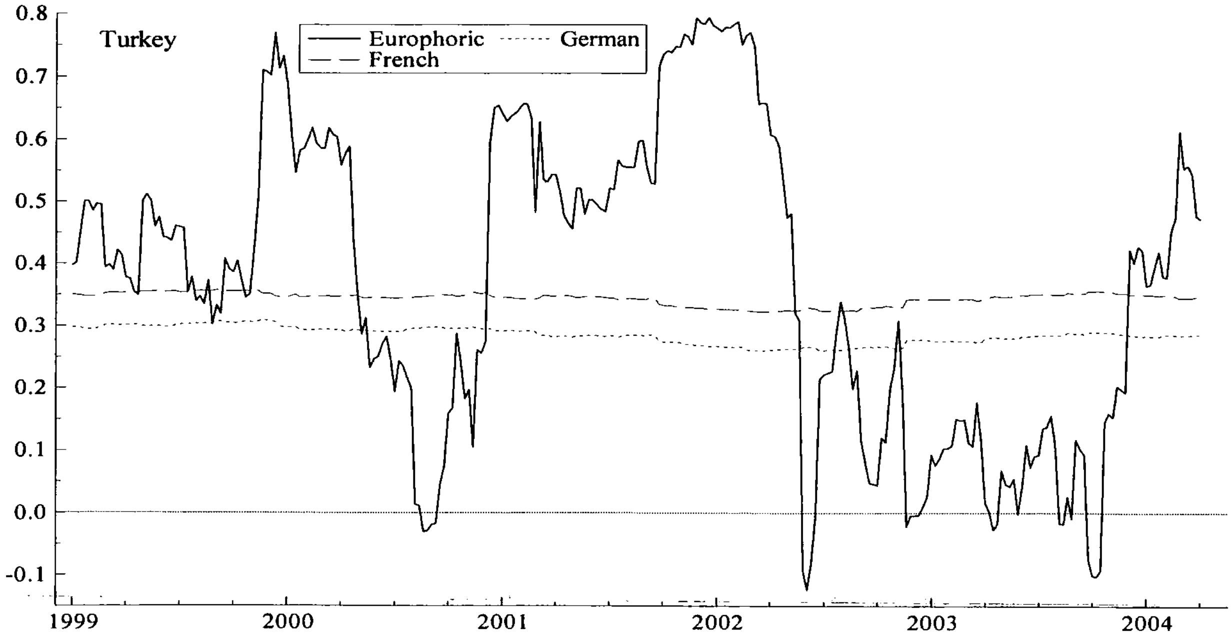
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Summary and Conclusions

This thesis addresses some outstanding issues in literature pertaining to: causal links between exchange rates and stock prices; the pricing of exchange rate risks in equity markets and the implications of the European Economic and Monetary Union (EMU) on both exchange rates and total equity market risk premia in some participating and non-participating countries and effects on equity market integration; and finally, the potential benefits of intra-country equity portfolio diversification in three European equity markets (and the entire eurozone) as an alternative to cross-country equity acquisitions which are susceptible to currency risks amongst other inherent risks.

Chapter 2 applies cointegration and granger-causality models to investigate whether identified directions of causality between exchange rate changes and market index movements are robust to industrial characteristics, in light of the general view held in theoretical models of exchange rates determination and previous empirical studies that they are. The evidence is in support of both the traditional approach that exchange rates granger-cause stock prices and the portfolio approach that stock prices granger-cause exchange rates in the countries considered. This is evidence that the two variables may encourage some predictability in each other. However, the fact that the direction of causality in each country (a) may vary with industry when the country's stock market index is disaggregated into industry portfolios (i.e. industry-specific), (b) is subject to time variations with the possibility of a change in causality sign, and, (c) is subject to the choice of exchange rates base currency and the influence of external equity market movements; may undermine the usefulness of causality information to economic agents, particularly domestic policy-makers.

Notwithstanding, the results from the US market have significant implications. Firstly, the tendency for US stock price movements to granger-cause US dollar rates, regardless of stock market disaggregation, time period, and exchange rate information, provides an explanation for the insignificance of the exchange rate exposure coefficient in US firms as found in many previous studies (e.g. Jorion, 1990). This 'rigidity' in the direction of causality in the US market may result from US economic *closeness* in comparison to other countries in the study, and the dominance of the US stock market. Secondly and consequentially, the tendency for stock price movements to lead exchange rates vis-à-vis the US dollar in all the countries suggests that the US equity market movements has a major impact on the direction of causality between exchange rates and equity prices in other markets. Thirdly therefore, for future research on the causality between exchange rates and stock prices especially in non-USA countries to be useful to economic agents and policy-makers, the research methodology must seriously address the potential implications of external market influences on the results. The real impact of such external market movements can only be assessed when comparisons are made with the results of causality tests between exchange rates and stock price movements that arise from domestic conditions only i.e. idiosyncratic movements. As suggested by Vassalou (2000), idiosyncratic movements in exchange rates can be derived from residuals of a regression of the domestic currency values on the currencies of major trading partner. The same procedure can be used to derive idiosyncratic equity market movements.

Evidence in Chapter 3 shows that more than half of equity return variations in all six countries are explained by the macroeconomic variables innovations, in line with the '*acid test*' of the empirical validity of the APT suggested in Antoniou et al (1998b),. Importantly, the crucial APT cross-equation pricing restrictions i.e. the null hypotheses that the prices of risk are the same for all assets in each country cannot be rejected. With respect to the main objectives, the evidence shows that exchange rate risk is significantly priced in equity markets. However, the plausibility of the notion that fixing exchange rates and adopting a single currency (as under the EMU) will reduce currency risks is debatable, at least from an equity market perspective. Prior to the commencement of the EMU, currency risks were of little importance in the French equity market. After a short period of romance with the new currency, the perception of market agents changed. The exchange rate risk premium rose sharply with an unprecedented level of volatility in both France and Germany. Although this rise (though steady in this case) is also noticeable in the Italian equity market, the volatility that characterised the Lira exchange rate premium pre-1999 cannot be seen. On the other hand, evidence from the Netherlands shows a decline in the currency risk premium perhaps courtesy of the nature of its foreign trade. On the currency risk premium front therefore, the larger EMU countries of France and Germany do not appear to have benefited from their joining the EMU so far. However, at the introduction of the euro banknotes and coins in January 2002, there is a sharp fall in the currency risk premiums in France and Germany, and more stability can be seen in the premiums for the Netherlands and Italy. With the exception of Germany, the total equity market premiums in the eurozone countries have reduced significantly since the commencement of the EMU, suggesting a downturn in the risk premia associated with other macroeconomic variables, notably inflation. Both currency and total equity market premia for the UK declined over the period, whereas the US market does not appear to have been affected by the EMU.

In general, it appears that the eurozone equity markets considered have responded somewhat differently to the euro single currency, giving some credibility to the notion put forward by Frankel (1999) that no single currency regime is right for all countries or at all times. Therefore, exchange rates arrangements as under the EMU may not necessarily reduce currency risks. Policy directed towards other risk-bearing macroeconomic variables such as inflation may be necessary to reduce the total equity market risk premium. However, since only three and a half years of post-EMU data is analysed, it may be too early to judge the currency risk effects of the monetary union and even the single currency.

Over the last three decades, the benefits of diversifying equity portfolios internationally have been sounded in many quarters, even if such practice has not been overwhelmingly embraced. It is widely believed that cross-country equity acquisitions reduce total portfolio risks without sacrificing expected returns. Evidence in Chapter 4 reverses this view by bringing to light diversification benefits that can accrue to investors in the UK, France, and Germany who diversify within their domestic equity markets only. As suggested by correlation analysis and tests of mean-variance spanning, the potential of home diversification is significantly enhanced by the stocks of multinational companies, country funds, and cross-listed securities, such that any extra benefit from investing internationally is insignificant. This however does not declare the death of international portfolio diversification, but rather suggest that exchange rate risks and other risks directly associated with international equity acquisitions may be avoided at very little cost to the European investor. Again as demonstrated, the EMU offers unprecedented diversification benefits to the eurozone investor, and more importantly, this benefit does not appear to be diminishing.

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Appendix A: Appendix to Chapter Two.

Appendix A1: The causality test between changes in exchange rates and changes in stock prices, including interest rates differentials.

H_0: stock-/→exch H_0: exch-/→stock	**Whole sample period**		**High Oil Prices (1)**		**Black Monday (2)**		**After-Crash (3)**		**Asian Flu (4)**		**Post-EMU (5)**	
	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value	Causal Sign	p-value
GMY -/→ SGMY	_	0.009***	n/a	0.77	+	0.04**	_	0.003***	n/a	0.89	n/a	0.87
SGMY -/→ GMY	n/a	0.17	+	0.08*	n/a	0.86	+	0.03**	+	0.04**	n/a	0.43
JPN -/→ SJPN	n/a	0.95	n/a	----	n/a	0.46	n/a	0.51	_	0.02**	n/a	0.86
SJPN -/→ JPN	n/a	0.85	n/a	----	n/a	0.85	+	0.03**	n/a	0.35	n/a	0.81
AUS -/→ SAUS	n/a	0.30	n/a	0.14	n/a	0.23	n/a	0.25	+	0.007***	n/a	0.22
SAUS -/→ AUS	n/a	0.27	n/a	0.54	n/a	0.21	n/a	0.31	n/a	0.45	n/a	0.61
USA-/→SUSA(4)	n/a	0.44	n/a	0.96	n/a	0.44	n/a	0.60	n/a	0.50	n/a	0.86
USA-/→SUSA(1)	n/a	0.41	n/a	0.96	n/a	0.95	n/a	0.32	n/a	0.90	n/a	0.77
SUSA -/→ USA	n/a	0.34	_	0.006***	_	0.83	+	0.006***	+	0.03**	+	0.02**
HKN -/→ SHKN	n/a	0.101	n/a	----	n/a	0.21	n/a	0.49	+	0.04**	n/a	0.21
SHKN -/→ HKN	n/a	0.49	n/a	----	n/a	0.68	n/a	0.71	n/a	0.43	n/a	0.29
SIN -/→ SSIN	_	0.001***	n/a	0.99	_	0.02**	n/a	0.48	_	0.006***	n/a	0.16
SSIN -/→ SIN	n/a	0.24	n/a	0.23	n/a	0.88	n/a	0.40	_	0.05**	n/a	0.32

Note: -/→ implies does not Granger-cause. *** = 1% significance level, ** = 5% significance level, * = 10% significance level. The p-values reported are those derived from testing the linear restrictions (null hypotheses) in equation (2.4). Where the p-values are significant, the signs of causality (+/-) are reported. Due to data unavailability, our interest rates data for 4 of the six countries had the following start dates: US (01/01/81), Singapore (01/01/82), Hong Kong (01/01/86), and Japan (01/01/86 to 06/2001). It is thus recognised that direct comparisons with table 3 results for the whole sample period may be hampered.

Appendix B: Appendix to Chapter Three.

Appendix B1: Results from Non-linear least square Recursive ARIMA models.

ITALY

Factors	Stationarity Test			Modelling Results				
Whole Sample (80:1 – 02:6)	**ADF (τ-value)**	**PP**	**Seasonality Test (combined test)**	**ARIMA Model (p, d, q) X (P, D, Q)**	**Structural changes & Outliers**	**Diagnostics**		
						JB	**Port**	**Arch(1,1)**
Real Industrial Production (logs)	4.94***	6.12 (0.31)	No Seasonality	(1,0,1)	08/84 (AO) 01/88 (AO)	0.75 (0.68)	32.38 (0.20)	0.058 (0.80)
Real Retail Sales (logs)	6.78***	6.55 (0.17)	Seasonality Present	$(1,0,1) X (1,0,1)_{12}$	01/84 (LS)	1.01 (0.60)	32.98 (0.41)	1.22 (0.23)
Real Money Supply (logs)	5.79***	4.89 (0.44)	Seasonality Present	$(1,0,1) X (1,0,1)_{12}$	12/89 (AO)	4.25 (0.19)	40.44 (0.14)	0.42 (0.51)
Real Exports (logs)	4.83***	6.99 (0.35)	Seasonality Present	$(0,0,1) X (1,0,1)_{12}$	03/81 (AO)	4.83 (0.12)	40.39 (0.14)	2.47 (0.11)
Real Imports (logs)	4.56***	6.42 (0.22)	Seasonality Present	$(1,0,0) X (1,0,1)_{12}$	01/81 (TC) 12/85 (AO)	0.86 (0.65)	45.26 (0.09)	0.03 (0.84)

Exchange rates (logs)	2.39	3.01 (0.25)	No Seasonality	(1,1,1)	10/81 (AO) 07/85 (AO) 10/92 (AO) 04/94 (AO) 08/95 (AO)	2.47 (0.29)	40.06 (0.17)	0.48 (0.486)
Term Structure	3.56^{**}	4.88 (0.51)	No Seasonality	(2,0,0)	10/81 (LS) 01/88 (AO) 03/91 (LS) 10/92 (AO)	3.60 (0.19)	42.58 (0.17)	2.18 (0.21)
Default Risk	3.84^{**}	5.13 (0.48)	No Seasonality	(2,0,0)	10/92 (AO) 05/93 (AO)	4.15 (0.13)	31.15 (0.65)	0.08 (0.77)
Change in CPI (log)	4.23^{***}	6.12 (0.56)	Seasonality Present	$(1,0,1) X (0,0,1)_{12}$	03/80 (AO) 08/82 (AO) 04/94 (AO)	4.34 (0.11)	39.71 (0.23)	0.58 (0.44)
Real Tax Revenue (log)	7.32^{***}	8.13 (0.84)	Seasonality Present	$(1,0,1) X (1,0,0)_{12}$	05/98 (AO) 01/99 (AO) 08/99 (LS) 04/00 (AO)	3.60 (0.18)	39.86 (0.46)	2.18 (0.22)

All-Commodity Prices (log)	1.93	2.94 (0.23)	Seasonality Present	$(1,1,0) \times (1,0,1)_{12}$	12/85 (AO) 03/86 (LS) 07/87 (LS) 01/88 (AO) 01/90 (LS) 06/93 (LS) 07/95 (LS)	4.58 (0.11)	28.81 (0.76)	1.40 (0.23)

The critical values for the ADF test at 5% and 1% levels of significance are 3.42 and 3.99 respectively, such that *** = 1% significance level, ** = 5% significance level. Critical values for various λ (shown in parentheses) are from Table IV(b) provided by Perron (1989). For λ = 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, the 5% critical values are –3.68, -3.77, -3.76, -3.72, -3.76, -3.76, -3.80, -3.75, -3.69, respectively. The letters in parentheses under structural change and outliers represent the following: additive outliers (AO), level shifts (LS), and Temporary Change (TC) . The p-values of the various diagnostic tests are presented in parentheses.

FRANCE

Factors	Stationarity Test			Modelling Results				
Whole Sample (80:1 – 02:6)	ADF (τ-value)	PP	Seasonality Test (combined test)	ARIMA Model (p, d, q) **X** (P, D, Q)	Structural changes & Outliers	Diagnostics		
						JB	Port	Arch(1,1)
Real Industrial Production (logs)	6.439^{***}	7.13 (0.67)	No Seasonality	(1,0,1)	None	0.86 (0.65)	45.26 (0.09)	0.036 (0.84)
Real Retail Sales (logs)	11.56^{***}	16.32 (0.43)	Seasonality Present	$(0,0,1) X (1,0,0)_{12}$	11/89 (LS)	1.65 (0.44)	35.51 (0.31)	0.11 (0.73)
Real Money Supply (logs)	5.10^{***}	6.23 (0.11)	Seasonality Present	$(1,0,1) X (1,0,1)_{12}$	05/81 (TC) 07/82 (LS) 07/91(AO) 03/97 (AO)	2.18 (0.34)	42.38 (0.12)	1.09 (0.29)
Real Exports (logs)	9.52^{***}	12.11 (0.53)	Seasonality Present	$(1,0,0) X (1,0,1)_{12}$	None	1.65 (0.44)	32.90 (0.31)	0.94 (0.33)
Real Imports (logs)	6.83^{***}	7.11 (0.17)	Seasonality Present	$(1,0,0) X (1,0,1)_{12}$	01/84 (AO)	4.15 (0.12)	45.03 (0.18)	1.82 (0.17)

Exchange rates (logs)	2.91	3.03 (0.57)	No Seasonality	(1,1,0)	05/81 (AO) 06/82 (AO) 04/83 (AO) 04/86 (AO) 10/92 (AO) 05/95 (AO)	3.91 (0.15)	40.20 (0.25)	2.19 (0.22)
Term Structure	3.51**	4.86 (0.58)	No Seasonality	(1,0,1)	06/81 (AO) 04/93 (LS) 03/95 (LS) 04/02 (LS)	1.86 (0.41)	27.84 (0.76)	2.69 (0.11)
Default Risk	4.82***	7.34 (0.27)	No Seasonality	(1,0,1)	02/80 (AO) 05/84 (AO) 03/86 (AO) 05/96 (AO)	4.79 (0.09)	35.55 (0.39)	2.98 (0.21)
Change in CPI (log)	7.55***	11.48 (0.25)	Seasonality Present	$(1,0,1) X (1,0,1)_{12}$	06/82 (LS) 08/85 (LS)	3.21 (0.19)	31.23 (0.65)	0.11 (0.73)

All-Commodity Prices (log)	1.93	2.94 (0.23)	Seasonality Present	$(1,1,0) X (1,0,1)_{12}$	12/85 (AO) 03/86 (LS) 07/87 (LS) 01/88 (AO) 01/90 (LS) 06/93 (LS) 07/95 (LS)	4.58 (0.11)	28.81 (0.76)	1.40 (0.23)

The critical values for the ADF test at 5% and 1% levels of significance are 3.42 and 3.99 respectively, such that *** = 1% significance level, ** = 5% significance level. Critical values for various λ (shown in parentheses) are from Table IV(b) provided by Perron (1989). For λ = 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, the 5% critical values are –3.68, -3.77, -3.76, -3.72, -3.76, -3.76, -3.80, -3.75, -3.69, respectively. The letters in parentheses under structural change and outliers represent the following: additive outliers (AO), level shifts (LS), and Temporary Change (TC) . The p-values of the various diagnostic tests are presented in parentheses.

GERMANY

Factors	Stationarity Test		Seasonality Test (combined test)	Modelling Results				
Whole Sample (80:1 – 02:6)	ADF (τ-value)	PP		ARIMA Model	Structural changes & Outliers	Diagnostics		
						JB	Port	Arch(1,1)
Real Industrial Production (logs)	3.87**	5.36 (0.27)	No Seasonality	(1,0,1)	06/84 (AO)	0.53 (0.76)	47.19 (0.16)	1.87 (0.17)
Real Retail Sales (logs)	1.51	2.93 (0.47)	No seasonality	(2,1,1)	07/83 (AO) 07/90 (AO) 01/91 (AO) 01/93 (AO)	4.65 (0.24)	43.15 (0.13)	2.93 (0.09)
Real Money Supply (logs)	1.78	1.99 (0.47)	Seasonality Present	$(0,1,1) X (1,0,1)_{12}$	03/83 (AO) 07/90 (AO) 01/91 (AO) 10/92 (AO) 01/93 (AO)	4.23 (0.21)	33.16 (0.33)	0.05 (0.81)
Real Exports (logs)	2.83	3.01 (0.35)	Seasonality Present	$(0,1,1) X (1,0,1)_{12}$	01/88 (AO)	1.16 (0.55)	44.31 (0.19)	0.62 (0.43)

Real Imports (logs)	2.26	3.02 (0.57)	Seasonality Present	$(1,1,1) X (1,0,1)_{12}$	01/88 (AO) 01/93 (AO) 06/89 (AO)	0.96 (0.61)	46.26 (0.09)	0.21 (0.64)
Exchange rates (logs)	2.11	2.96 (0.67)	No Seasonality	(1,1,0)	10/81 (AO) 03/95 (AO)	5.00 (0.08)	31.845 (0.62)	0.22 (0.48)
Term Structure	2.29	4.22 (0.38)	No Seasonality	(1,0,1)	01/81 (AO) 10/81 (LS) 08/88 (LS)	3.46 (0.20)	36.92 (0.33)	2.08 (0.15)
Default Risk	1.93	3.99 (0.72)	No Seasonality	(2,1,0)	12/81 (AO) 05/96 (AO)	2.47 (0.29)	33.47 (0.47)	0.08 (0.76)
Change in CPI (log)	7.02***	8.97 (0.48)	Seasonality Present	$(1,0,0) X (0,0,1)_{12}$	07/82 (LS) 01/91 (AO) 01/93 (AO)	2.89 (0.22)	42.34 (0.14)	0.83 (0.36)
Real Tax Revenue (log)	5.45***	6.22 (0.49)	Seasonality Present	$(1,0,1) X (1,0,1)_{12}$	04/88 (AO) 01/91 (LS) 06/95 (LS) 11/98 (AO)	2.47 (0.29)	35.77 (0.43)	0.69 (0.40)

All-Commodity Prices (log)	1.93	2.94 (0.23)	Seasonality Present	$(1,1,0) \times (1,0,1)_{12}$	12/85 (AO) 03/86 (LS) 07/87 (LS) 01/88 (AO) 01/90 (LS) 06/93 (LS) 07/95 (LS)	4.58 (0.11)	28.81 (0.76)	1.40 (0.23)

The critical values for the ADF test at 5% and 1% levels of significance are 3.42 and 3.99 respectively, such that *** = 1% significance level, ** = 5% significance level. Critical values for various λ (shown in parentheses) are from Table IV(b) provided by Perron (1989). For λ = 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, the 5% critical values are –3.68, -3.77, -3.76, -3.72, -3.76, -3.76, -3.80, -3.75, -3.69, respectively. The letters in parentheses under structural change and outliers represent the following: additive outliers (AO), level shifts (LS), and Temporary Change (TC) . The p-values of the various diagnostic tests are presented in parentheses.

USA

Factors	Stationarity Test			Modelling Results				
Whole Sample (80:1 – 02:6)	**ADF (τ-value)**	**PP**	**Seasonality Test (combined test)**	**ARIMA Model**	**Structural changes & Outliers**	**Diagnostics**		
						JB	**Port**	**Arch(1,1)**
Real Industrial Production (logs)	2.69	2.73 (0.48)	No Seasonality	(1,1,0)	04/80 (AO) 01/81 (AO) 02/82 (AO) 10/90 (A0) 08/98 (AO) 01/01 (AO)	4.58 (0.10)	28.81 (0.76)	1.40 (0.23)
Real Retail Sales (logs)	6.78***	7.77 (0.01)	Seasonality Present	$(1,0,0) X (1,0,1)_{12}$	03/80 (LS)	0.06 (0.96)	22.98 (0.65)	0.70 (0.40)
Real Money Supply (logs)	4.54***	4.99 (0.26)	Seasonality Present	$(1,0,1) X (1,0,1)_{12}$	01/81 (AO) 11/84 (AO) 01/86 (TC) 11/99 (AO) 01/00 (LS)	3.35 (0.31)	30.44 (0.44)	2.12 (0.22)

Real Exports (logs)	3.05	3.11 (0.28)	Seasonality Present	$(1,1,0) X (1,0,1)_{12}$	01/86 (AO)	2.90 (0.32)	45.3 (0.11)	0.001 (0.97)
Real Imports (logs)	3.98***	4.56 (0.43)	Seasonality Present	$(1,0,0) X (1,0,1)_{12}$	NONE	3.018 (0.39)	40.26 (0.20)	2.19 (0.14)
Exchange rates (logs)	2.39	3.10 (0.24)	No Seasonality	(1,1,0)	10/85 (AO)	4.16 (0.13)	37.39 (0.35)	1.58 (0.20)
Term Structure	4.56***	6.21 (0.11)	No Seasonality	(1,0,1)	11/80 (LS) 08/82 (AO) 04/01 (TC)	3.98 (0.13)	33.89 (0.52)	1.75 (0.18)
Default Risk	3.84**	4.44 (0.47)	No Seasonality	(1,0,1)	12/80 (AO) 07/90 (TC) 11/98 (LS)	4.16 (0.13)	30.39 (0.25)	1.69 (0.19)
Change in CPI (log)	4.65***	4.72 (0.21)	Seasonality Present	$(1,0,0) X (1,0,1)_{12}$	10/81 (LS) 06/82 (AO)	4.34 (0.11)	39.71 (0.23)	0.58 (0.44)
Real Tax Revenue (log)	7.32***	9.23 (0.3)	Seasonality Present	$(1,0,0) X (1,0,1)_{12}$	06/82 (LS) 04/86 (AO) 05/00 (AO) 07/01 (LS)	3.37 (0.26)	39.72 (0.46)	2.90 (0.41)

All-Commodity Prices (log)	1.93	2.94 (0.23)	Seasonality Present	$(1,0,0) X (1,0,1)_{12}$	12/85 (AO) 03/86 (LS) 07/87 (LS) 01/88 (AO) 01/90 (LS) 06/93 (LS) 07/95 (LS)	4.58 (0.11)	28.81 (0.76)	1.40 (0.23)

The critical values for the ADF test at 5% and 1% levels of significance are 3.42 and 3.99 respectively, such that *** = 1% significance level, ** = 5% significance level. Critical values for various λ (shown in parentheses) are from Table IV(b) provided by Perron (1989). For λ = 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, the 5% critical values are –3.68, -3.77, -3.76, -3.72, -3.76, -3.76, -3.80, -3.75, -3.69, respectively. The letters in parentheses under structural change and outliers represent the following: additive outliers (AO), level shifts (LS), and Temporary Change (TC) . The p-values of the various diagnostic tests are presented in parentheses.

THE NETHERLANDS

Factors	Stationarity Test		Seasonality Test (combined test)	Modelling Results				
Whole Sample (80:1 – 02:6)	ADF (τ-value)	PP		ARIMA Model	Structural changes & Outliers	Diagnostics		
						JB	Port(36)	Arch(1,1)
Real Industrial Production (logs)	4.19***	6.44 (0.5)	No Seasonality	(1,0,1)	11/85 (AO) 02/90 (AO) 03/91 (AO) 12/00 (AO) 12/01 (AO)	2.10 (0.34)	42.38 (0.11)	0.011 (0.91)
Real Retail Sales (logs)	7.52***	11.26 (0.25)	Seasonality Present	$(1,0,0)\ X\ (1,0,1)_{12}$	02/85 (AO) 10/85 (AO)	2.72 (0.35)	25.98 (0.47)	0.53 (0.46)
Real Money Supply (logs)	2.79	4.68 (0.33)	Seasonality Present	$(1,0,1)\ X\ (1,0,1)_{12}$	01/83 (AO) 07/87 (AO) 03/98 (AO)	1.46 (0.48)	38.44 (0.19)	0.06 (0.80)
Real Exports (logs)	4.83***	6.66 (0.35)	Seasonality Present	$(1,0,1)\ X\ (1,0,1)_{12}$	01/88 (AO)	1.14 (0.56)	37.41 (0.22)	2.79 (0.11)
Real Imports (logs)	4.95***	8.12 (0.35)	Seasonality Present	$(1,0,0)\ X\ (1,0,0)_{12}$	01/88 (AO)	1.93 (0.37)	38.50 (0.21)	1.45 (0.22)

Exchange rates (logs)	1.98	2.11 (0.11)	No Seasonality	(1,1,0)	09/81 (TC) 03/95 (AO)	1.17 (0.55)	32.39 (0.59)	0.005 (0.94)
Term Structure	2.19	2.22 (0.61)	No Seasonality	(1,1,1)	02/83 (TC) 07/83 (AO) 10/93 (LS) 12/01 (AO)	4.81 (0.09)	42.65 (0.17)	2.66 (0.19)
Default Risk	4.20***	5.84 (0.52)	No Seasonality	(1,0,1)	07/81 (AO) 02/92 (AO) 07/92 (AO) 12/98 (TC) 09/99 (AO)	3.15 (0.23)	32.15 (0.25)	0.08 (0.77)
Change in CPI (log)	9.01***	10.03 (0.31)	Seasonality Present	$(1,0,1) \times (1,0,1)_{12}$	07/86 (AO) 01/87 (AO) 01/01 (AO)	2.25 (0.32)	40.86 (0.12)	0.05 (0.81)

All-Commodity Prices (log)	1.93	2.94 (0.23)	Seasonality Present	$(1,0,0) \times (1,0,1)_{12}$	12/85 (AO) 03/86 (LS) 07/87 (LS) 01/88 (AO) 01/90 (LS) 06/93 (LS) 07/95 (LS)	4.58 (0.11)	28.81 (0.76)	1.40 (0.23)

The critical values for the ADF test at 5% and 1% levels of significance are 3.42 and 3.99 respectively, such that *** = 1% significance level, ** = 5% significance level. Critical values for various λ (shown in parentheses) are from Table IV(b) provided by Perron (1989). For λ = 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, the 5% critical values are –3.68, -3.77, -3.76, -3.72, -3.76, -3.76, -3.80, -3.75, -3.69, respectively. The letters in parentheses under structural change and outliers represent the following: additive outliers (AO), level shifts (LS), and Temporary Change (TC) . The p-values of the various diagnostic tests are presented in parentheses.

UK

Factors	Stationarity Test			Modelling Results				
Whole Sample (80:1 – 02:6)	ADF (τ-value)	PP	Seasonality Test (combined test)	ARIMA Model	Structural changes & Outliers	Diagnostics		
						JB	Port	Arch(1,1)
Real Industrial Production (logs)	5.13***	6.77 (0.31)	No Seasonality	(1,0,1)	04/84 (LS) 07/85 (AO) 01/87 (AO) 06/02 (AO)	3.37 (0.18)	38.92 (0.22)	0.54 (0.46)
Real Retail Sales (logs)	8.37***	12.22 (0.66)	Seasonality Present	$(1,0,1) \times (1,0,1)_{12}$	03/92 (AO) 01/95 (AO)	2.61 (0.27)	29.41 (0.20)	0.10 (0.74)
Real Money Supply (logs)	1.79	3.11 (0.55)	No Seasonality	(0,1,1)	02/83 (AO) 05/92 (LS) 04/98 (AO) 01/02 (TC)	2.09 (0.35)	37.44 (0.24)	0.29 (0.58)
Real Exports (logs)	8.22***	10.29 (0.29)	Seasonality Present	$(1,0,0) \times (1,0,1)_{12}$	08/86 (AO) 01/88 (AO)	0.56 (0.75)	40.11 (0.14)	0.50 (0.47)
Real Imports (logs)	6.46***	7.12 (0.25)	Seasonality Present	$(1,0,0) \times (1,0,1)_{12}$	08/85 (AO) 08/97 (AO)	2.50 (0.28)	43.26 (0.09)	2.69 (0.10)

Exchange rates (logs)	2.39	2.55 (0.48)	No Seasonality	(1,1,1)	04/83 (TC) 10/92 (AO) 02/93 (AO)	3.46 (0.17)	39.50 (0.31)	3.48 (0.06)
Term Structure	3.56**	5.13 (0.48)	No Seasonality	(1,0,1)	07/84 (AO) 02/85 (AO) 01/88 (AO) 06/88 (AO) 10/92 (AO)	5.10 (0.07)	29.29 (0.73)	0.014 (0.90)
Default Risk	3.84**	4.87 (0.48)	No Seasonality	(1,0,1)	02/84 (AO) 11/86 (AO) 04/90 (AO) 04/99 (AO) 10/92 (AO) 05/93 (AO)	5.94 (0.06)	29.70 (0.72)	2.32 (0.12)
Change in RPI (log)	4.23***	5.13 (0.28)	Seasonality Present	$(1,0,0) X (1,0,1)_{12}$	04/80 (AO) 02/82 (LS) 06/88 (LS)	4.23 (0.12)	32.68 (0.27)	1.47 (0.22)

Real Tax Revenue (log)	14.92***	17.99 (0.07)	Seasonality Present	$(1,0,1) X (1,0,1)_{12}$	08/81 (LS) 09/81 (LS) 09/80 (AO)	0.86 (0.65)	41.69 (0.13)	0.35 (0.55)
All-Commodity Prices (log)	1.93	2.94 (0.23)	Seasonality Present	$(1,0,0) X (1,0,1)_{12}$	12/85 (AO) 03/86 (LS) 07/87 (LS) 01/88 (AO) 01/90 (LS) 06/93 (LS) 07/95 (LS)	4.58 (0.11)	28.81 (0.76)	1.40 (0.23)

The critical values for the ADF test at 5% and 1% levels of significance are 3.42 and 3.99 respectively, such that *** = 1% significance level, ** = 5% significance level. Critical values for various λ (shown in parentheses) are from Table IV(b) provided by Perron (1989). For λ = 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, the 5% critical values are –3.68, -3.77, -3.76, -3.72, -3.76, -3.76, -3.80, -3.75, -3.69, respectively. The letters in parentheses under structural change and outliers represent the following: additive outliers (AO), level shifts (LS), and Temporary Change (TC) . The p-values of the various diagnostic tests are presented in parentheses.

Appendix B2: Results from the Kalman Filter process

UK.

Series	Model	Diagnostics		
		Llung-Box Q-Statistic	R^2	**Predictive failure Test**
Real Industrial Production (logs)	Unobserved Components	17.41 (0.18)	0.99	6.61 (0.88)
Real Retail Sales (logs)	Unobserved Components	9.77 (0.71)	0.98	4.92 (0.96)
Real Money Supply (logs)	AR(2)	5.17 (0.97)	0.91	8.97 (0.70)
Real Exports (logs)	AR(3)	8.31 (0.82)	0.94	11.41 (0.49)
Real Imports (logs)	AR(3)	10.66 (0.63)	0.95	18.30 (0.11)
Exchange rates (logs)	Unobserved Components	17.62 (0.17)	0.99	2.66 (0.99)
Term Structure	Unobserved Components	15.07 (0.37)	0.95	1.83 (0.99)
Default Risk	Unobserved Components	9.43 (0.73)	0.82	4.89 (0.96)
Change in CPI (log) - π	AR(1)	15.81 (0.32)	0.90	11.06 (0.52)
Real Tax Revenue (log)	Unobserved Components	10.92 (0.61)	0.79	9.22 (0.68)
All-Commodity Prices (log)	AR(2)	16.47 (0.17)	0.93	2.89 (0.99)

Figures in parentheses under diagnostics represent the p-values of the tests.

GERMANY.

Series	Model	Diagnostics		
		Llung-Box Q-Statistic	**R^2**	**Predictive failure Test**
Real Industrial Production (logs)	Unobserved Components	10.88 (0.62)	0.92	3.42 (0.99)
Real Retail Sales (logs)	Unobserved Components	9.77 (0.71)	0.95	5.19 (0.95)
Real Money Supply (logs)	Unobserved Components	8.97 (0.77)	0.99	6.98 (0.85)
Real Exports (logs)	AR(3)	10.64 (0.64)	0.94	11.41 (0.49)
Real Imports (logs)	AR(3)	12.97 (0.45)	0.95	18.43 (0.10)
Exchange rates (logs)	AR(1)	13.66 (0.47)	0.99	2.01 (0.99)
Term Structure	Unobserved Components	7.39 (0.88)	0.93	9.63 (0.64)
Default Risk	AR(1)	11.47 (0.64)	0.93	11.48 (0.48)
Change in CPI (log) - π	AR(1)	10.12 (0.68)	0.82	9.74 (0.63)
Real Tax Revenue (log)	AR(2)	18.82 (0.12)	0.92	8.21 (0.76)
All-Commodity Prices (log)	AR(2)	16.47 (0.17)	0.93	2.89 (0.99)

Figures in parentheses under diagnostics represent the p-values of the tests.

USA.

Series	Model	Diagnostics		
		Llung-Box Q-Statistic	**R^2**	**Predictive failure Test**
Real Industrial Production (logs)	AR(2)	13.77 (0.46)	0.99	5.76 (0.92)
Real Retail Sales (logs)	AR(1)	11.49 (0.48)	0.98	3.88 (0.98)
Real Money Supply (logs)	AR(1)	14.64 (0.26)	0.99	4.89 (0.96)
Real Exports (logs)	AR(3)	7.56 (0.91)	0.99	1.41 (0.99)
Real Imports (logs)	AR(3)	9.17 (0.76)	0.98	2.33 (0.99)
Exchange rates (logs)	Unobserved Components	12.08 (0.59)	0.97	8.16 (0.77)
Term Structure	Unobserved Components	7.63 (0.86)	0.88	7.63 (0.81)
Default Risk	AR(1)	15.85 (0.32)	0.85	6.28 (0.90)
Change in CPI (log) - π	Unobserved Components	16.77 (0.21)	0.73	11.12 (0.51)
Real Tax Revenue (log)	AR(2)	6.89 (0.90)	0.92	4.32 (0.97)
All-Commodity Prices (log)	AR(2)	16.47 (0.17)	0.93	2.89 (0.99)

Figures in parentheses under diagnostics represent the p-values of the tests.

FRANCE

Series	Model	Diagnostics		
		Llung-Box Q-Statistic	**R^2**	**Predictive failure Test**
Real Industrial Production (logs)	Unobserved Components	16.33 (0.23)	0.99	4.89 (0.96)
Real Retail Sales (logs)	Unobserved Components	13.34 (0.42)	0.98	4.02 (0.98)
Real Money Supply (logs)	Unobserved Components	8.28 (0.76)	0.89	6.64 (0.88)
Real Exports (logs)	Unobserved Components	16.43 (0.22)	0.96	7.68 (0.80)
Real Imports (logs)	AR(2)	13.11 (0.43)	0.95	5.55 (0.93)
Exchange rates (logs)	AR(2)	13.37 (0.41)	0.98	4.11 (0.98)
Term Structure	AR(1)	12.29 (0.58)	0.89	4.44 (0.97)
Default Risk	Unobserved Components	16.81 (0.26)	0.74	5.72 (0.92)
Change in CPI (log) - π	Unobserved Components	18.45 (0.14)	0.93	9.20 (0.68)
All-Commodity Prices (log)	AR(2)	16.47 (0.17)	0.93	2.89 (0.99)

Figures in parentheses under diagnostics represent the p-values of the tests.

THE NETHERLANDS.

Series	**Model**	**Diagnostics**		
		Llung-Box Q-Statistic	$\mathbf{R^2}$	**Predictive failure Test**
Real Industrial Production (logs)	AR(2)	14.11 (0.36)	0.83	3.47 (0.99)
Real Retail Sales (logs)	Unobserved Components	11.65 (0.55)	0.96	6.11 (0.91)
Real Money Supply (logs)	AR(1)	17.44 (0.14)	0.99	3.86 (0.98)
Real Exports (logs)	Unobserved Components	10.44 (0.65)	0.96	2.68 (0.99)
Real Imports (logs)	Unobserved Components	11.48 (0.57)	0.95	4.91 (0.96)
Exchange rates (logs)	AR(1)	10.49 (0.72)	0.99	3.29 (0.99)
Term Structure	Unobserved Components	15.59 (0.34)	0.94	8.66 (0.73)
Default Risk	Unobserved Components	12.23 (0.58)	0.72	1.75 (0.99)
Change in CPI (log) - π	Unobserved Components	9.70 (0.64)	0.81	6.48 (0.88)
All-Commodity Prices (log)	AR(2)	16.47 (0.17)	0.93	2.89 (0.99)

Figures in parentheses under diagnostics represent the p-values of the tests.

ITALY

Series	Model	Diagnostics		
		Llung-Box Q-Statistic	**R^2**	**Predictive failure Test**
Real Industrial Production (logs)	Unobserved Components	18.63 (0.13)	0.99	4.09 (0.98)
Real Retail Sales (logs)	AR(1)	15.57 (0.21)	0.97	1.25 (1.00)
Real Money Supply (logs)	AR(2)	14.44 (0.34)	0.97	7.32 (0.83)
Real Exports (logs)	AR(1)	12.87 (0.45)	0.92	6.86 (0.86)
Real Imports (logs)	AR(1)	11.11 (0.60)	0.85	5.21 (0.95)
Exchange rates (logs)	Unobserved Components	12.08 (0.59)	0.99	1.41 (0.99)
Term Structure	Unobserved Components	11.92 (0.53)	0.88	6.71 (0.87)
Default Risk	Unobserved Components	16.66 (0.21)	0.92	9.08 (0.69)
Change in CPI (log) - π	AR(2)	12.66 (0.47)	0.88	9.25 (0.68)
Real Tax Revenue (log)	Unobserved Components	14.9 (0.31)	0.86	3.33 (0.99)
All-Commodity Prices (log)	AR(2)	16.47 (0.17)	0.93	2.89 (0.99)

Figures in parentheses under diagnostics represent the p-values of the tests.

Appendix B3: Correlation among Kalman-Filtered Macroeconomic Innovations.

Germany.

	CP	UNEXINF	ER	TS	DR	RIP	RRS	RMS	RIMP	REXP	RTAX	EXINF
CP	1.0											
UNEXINF	0.06	1.0										
ER	0.001	-0.10	1.0									
TS	-0.03	-0.06	0.05	1.0								
DR	0.03	0.03	0.02	-0.01	1.0							
RIP	0.02	-0.20*	-0.11	-0.02	-0.02	1.0						
RRS	-0.009	-0.31*	0.01	0.02	-0.004	0.33*	1.0					
RMS	-0.05	-0.29*	0.09	-0.07	-0.004	0.09	0.28*	1.0				
RIMP	-0.08	-0.12	-0.03	0.08	0.15*	0.17*	0.36*	0.17*	1.0			
REXP	0.03	-0.04	-0.03	0.10	0.14*	0.28*	0.30*	0.08	0.68*	1.0		
RTAX	0.001	0.006	0.01	-0.04	-0.16*	0.02	0.005	0.10	0.005	-0.04	1.0	
EXINF	-0.08	-0.02	-0.04	0.01	0.08	0.02	0.02	-0.02	0.02	0.07	0.001	1.0

* denotes significance at 5% critical level.

United Kingdom.

	CP	UNEXINF	ER	TS	DR	RIP	RRS	RMS	RIMP	REXP	RTAX	EXINF
CP	1.0											
UNEXINF	-0.04	1.0										
ER	-0.03	-0.002	1.0									
TS	0.06	-0.05	0.01	1.0								
DR	0.09	-0.17*	-0.02	0.04	1.0							
RIP	0.05	0.08	-0.06	-0.02	0.01	1.0						
RRS	0.05	-0.14*	-0.03	0.04	0.02	0.10	1.0					
RMS	-0.01	-0.04	-0.06	0.01	-0.03	-0.07	0.02	1.0				
RIMP	-0.02	0.10	0.06	-0.04	-0.04	0.06	-0.05	-0.01	1.0			
REXP	0.02	0.05	-0.07	-0.01	-0.14	-0.01	-0.16*	-0.04	0.36*	1.0		
RTAX	-0.008	-0.02	0.02	-0.05	-0.05	-0.02	0.07	-0.04	0.07	0.14*	1.0	
EXINF	0.04	-0.009	-0.005	0.04	0.04	-0.06	-0.20*	-0.11	-0.12	-0.01	0.05	1.0

* denotes significance at 5% critical level.

Italy.

	CP	UNEXINF	ER	TS	DR	RIP	RRS	RMS	RIMP	REXP	RTAX	EXINF
CP	1.0											
UNEXINF	0.17*	1.0										
ER	0.08	0.02	1.0									
TS	-0.13	0.01	-0.02	1.0								
DR	-0.001	0.03	0.11	-0.11	1.0							
RIP	0.09	-0.10	0.09	0.004	-0.06	1.0						
RRS	-0.08	-0.01	0.04	0.14*	-0.09	0.07	1.0					
RMS	-0.004	-0.10	-0.04	-0.01	-0.02	0.17*	0.01	1.0				
RIMP	-0.14*	-0.004	-0.08	0.08	0.05	-0.08	0.002	-0.10	1.0			
REXP	-0.06	0.06	-0.02	-0.12	0.06	0.09	-0.01	-0.22*	0.55	1.0		
RTAX	0.02	0.01	-0.13	-0.02	0.07	-0.11	-0.02	-0.11	0.02	0.06	1.0	
EXINF	0.04	0.13	0.03	-0.05	-0.03	-0.04	0.04	0.03	-0.03	-0.09	0.03	1.0

* denotes significance at 5% critical level.

USA

	CP	UNEXINF	ER	TS	DR	RIP	RRS	RMS	RIMP	REXP	RTAX	EXINF
CP	1.0											
UNEXINF	0.11	1.0										
ER	0.01	-0.08	1.0									
TS	-0.008	0.08	-0.006	1.0								
DR	0.01	-0.04	0.04	0.001	1.0							
RIP	-0.04	-0.29*	0.24*	-0.07	-0.03	1.0						
RRS	-0.01	0.02	0.10	0.004	-0.07	0.08	1.0					
RMS	0.04	-0.10	-0.05	-0.09	0.06	0.08	-0.05	1.0				
RIMP	0.02	0.18*	-0.09	0.03	-0.04	-0.10	0.28*	0.03	1.0			
REXP	0.04	0.12	-0.03	0.005	-0.05	0.11	0.23*	0.001	0.27*	1.0		
RTAX	-0.08	0.05	-0.02	-0.01	-0.05	0.08	0.26*	-0.01	0.19*	0.23*	1.0	
EXINF	0.01	-0.08	-0.003	0.12*	-0.004	-0.12*	0.14*	-0.12*	0.12	0.02	-0.05	1.0

* denotes significance at 5% critical level.

France.

	CP	UNEXINF	ER	TS	DR	RIP	RRS	RMS	RIMP	REXP	EXINF
CP	1.0										
UNEXINF	-0.02	1.0									
ER	0.07	0.04	1.0								
TS	0.01	-0.009	-0.04	1.0							
DR	0.11	-0.09	0.008	-0.15*	1.0						
RIP	0.05	-0.16*	-0.03	0.02	-0.03	1.0					
RRS	-0.04	0.05	-0.03	0.01	-0.10	0.08	1.0				
RMS	-0.10	-0.07	0.01	0.04	-0.03	-0.07	0.03	1.0			
RIMP	-0.001	-0.05	-0.09	0.04	0.04	0.30*	0.14*	-0.10	1.0		
REXP	0.004	0.09	-0.03	0.07	-0.03	0.26*	0.08	-0.04	0.60*	1.0	
EXINF	0.05	-0.23*	-0.12	-0.003	0.11	0.02	-0.10	-0.11	-0.02	-0.03	1.0

* denotes significance at 5% critical level.

The Netherlands.

	CP	UNEXINF	ER	TS	DR	RIP	RMS	RRS	RIMP	REXP	EXINF
CP	1.0										
UNEXINF	0.12	1.0									
ER	0.01	-0.07	1.0								
TS	0.005	0.04	-0.02	1.0							
DR	0.03	0.006	0.03	-0.16*	1.0						
RIP	-0.09	-0.02	0.06	-0.06	-0.01	1.0					
RMS	-0.06	-0.16*	0.01	0.17*	0.006	0.04	1.0				
RRS	-0.06	-0.08	0.07	0.06	-0.13*	0.01	0.08	1.0			
RIMP	-0.06	0.08	0.11	-0.03	-0.03	0.01	0.05	0.16*	1.0		
REXP	-0.07	0.04	-0.04	-0.03	-0.07	0.11	0.07	-0.19*	0.58*	1.0	
EXINF	-0.02	-0.03	0.05	0.04	0.04	-0.15*	-0.03	-0.10	-0.09	-0.06	1.0

* denotes significance at 5% critical level

Appendix C: Appendix to Chapter Four.

Appendix C1: List of Countries.

Developed Markets (DMs)	Advanced Emerging Markets (AEMs)	Emerging Markets (EMs)
Australia	Brazil	Argentina
Austria	Israel	Chile
Belgium	Korea	China
Canada	Mexico	Colombia
Denmark	South Africa	India
France	Taiwan	Malaysia
Finland		Pakistan
Germany		Peru
Hong Kong		Poland
Ireland		Russia
Italy		Thailand
Japan		Turkey
Netherlands		
New Zealand		
Norway		
Spain		
Sweden		
Switzerland		
UK		
USA		

Appendix C2(a): UK List of Eligible Securities.

(A) Multinational Corporations (MNCs)

United Kingdom

M1	Astra Zeneca	M22	Cable & Wireless
M2	Barclays	M23	Cadbury Schwepps
M3	British Petroleum	M24	EMI Group
M4	Diageo	M25	Hanson
M5	Glaxo Smithkline	M26	Imperial Chemical Industry
M6	HSBC Holdings	M27	Invensys
M7	Reuters	M28	Lonmin
M8	Vodafone	M29	Misys
M9	British American Tobacco	M30	Pearson
M10	Rio Tinto	M31	Peninsular & Oriental
M11	Shell Transport & Trading	M32	Rank Group
M12	Unilever	M33	Reckitt Benckiser
M13	Anglo American	M34	Rexam
M14	Aegis Group	M35	Rolls-Royce Group
M15	Allied Domecq	M36	Sage Group
M16	Amvescap	M37	Smith & Nephew
M17	BAE Systems	M38	Standard Chartered
M18	BBA Group	M39	Tate & Lyle
M19	Exel	M40	United Business Media
M20	British Airways	M41	WPP
M21	Bunzl	M42	Wolseley

(B) Industrial Indices (level 4 classification)

United Kingdom

I1	Oil and Gas	I22	Food and Drug Retailers
I2	Chemicals	I23	Telecommunication Services
I3	Construction & Building Material	I24	Electricity
I4	Forestry and Paper	I25	Banks
I5	Steel & Other Metals	I26	Insurance
I6	Aerospace & Defence	I27	Life Assurance
I7	Diversified Industries	I28	Investment Companies
I8	Electronic & Electrical Equipment	I29	Real Estate
I9	Automobile & Parts	I30	Specialty & Other Finance
I10	Household Goods and Textiles	I31	Information Technology Hardware
I11	Beverages		
I12	Food Producers & Processors		
I13	Health		
I14	Personal Care & Household Prods		
I15	Pharmaceuticals & Biotechnology		
I16	Tobacco		
I17	General Retailers		
I18	Leisure & Hotels		
I19	Media & Entertainment		
I20	Support Services		
I21	Transport		

(C) International Companies Listed on the UK Stock Exchange (Cross Listings)

		Start Date
Australia		
1	Centamin Egypt Npv	12/01
2	Clover Corporation	05/01
3	Dwyka Diamonds	12/01
4	Fosters Group	01/73
5	Goodman Fielder	12/87
6	National Australia .Bank	01/73
7	Portman	01/01
8	Virotec International	07/01
Canada		
1	BCE	06/88
2	Mano River Resources	03/00
3	Mitel	02/82
4	Oilexco	12/03
5	Turbo Genset 'A'	07/00
France		
1	Euro Disney Sca	11/89
Hong Kong		
1	Hong Kong Land	02/96
2	Vtech Holdings	10/91
Ireland		
1	Abbey	04/79
2	Alphyra Group	05/97
3	Aminex	07/95
4	Arcon Intl.Res.	10/83
5	Barlo Group	08/92
6	Cpl Resources	06/99
7	Dragon Oil	06/86
8	Fbd Holdings	10/89
9	Fyffes	05/83
10	Glanbia	05/90
11	Glencar Mining	04/94
12	Iwp International	04/89
13	Kenmare Res.	04/89
14	Kingspan Group	06/89
15	Mcinerney Holdings	01/97
16	Minmet	06/93
17	Norish	07/88
18	Petroceltic Intl.	06/84
19	Qualceram Shires	04/97
20	Thirdforce	12/97
21	Unidare	07/88
22	United Drug	03/92
Israel		
1	Batm Adv.Comms.	07/96
2	Pilat Tech.Intl.	12/96
3	Technoplast Inds.	02/97

Malaysia		
1	Highlands & Lowlands	01/69
2	Kuala Lumpur Kepong	09/73
3	Petaling Tin	01/73
4	Riverview Rubber	01/73
5	Tanjong	01/69
The Netherlands		
1	Haslemere Nv	10/00
2	Robeco	06/73
3	Rolinco	06/73
Norway		
1	Frontline	12/64
2	Hafslund 'A'	06/89
3	Norsk Hydro	12/74
South Africa		
1	Afn.Rainbow Mrls.	01/73
2	Gold Fields	01/73
3	Harmony Gold Mining	01/73
4	Sappi	06/92
5	Stilfontein Gdmng.	01/73
6	Vogelstruisbult Mtl.	01/73
United States		
1	American Express	09/79
2	Anheuser-Busch	08/87
3	AT & T Corp.	01/84
4	Dover	11/73
5	Invu	01/04
6	Massey Enterprises	01/73
7	Musedia	01/85
8	Rockwell Intl.Cla.	02/82
9	Sara Lee Corp.	08/87
10	Schlumberger	01/83
11	Sears Roebuck	10/90
12	Sothebys 'A'	05/88
13	Tenneco New	07/77
14	Torchmark Corp.	09/87
15	Transamerica	04/73
16	Verizon Comms.	02/84

(D) Managed Country Funds – UK.

Developed Markets:

Ireland – Gartmore Irish Growth.

Hong Kong – JPMF Asian Smaller Countries

Japan – Ballie Gifford Japan

New Zealand – New Zealand Fund:

USA – Edinburgh US Tracker

Austria, Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Norway, Spain, Sweden, Switzerland – F&C Eurotrust

Emerging Markets:

Israel – Advance Developing Markets Fund

Korea – Korea Europe Fund.

South Africa – Old Mutual South Africa.

Taiwan – Taiwan Fund.

India – JPMF India

China – JPMF Chinese

Poland – Eastern European Fund.

Argentina, Brazil, Chile, Colombia, Mexico, & Peru – Deutsche Latin America

Malaysia, and Pakistan – JPMF Asian Smaller Countries.

Thailand – Thailand Fund.

World – Edinburgh Worldwide

(E) Benchmark Indices:

(1) FTSE Local UK Index.

(2) Cazenove & Rosenberg Smaller Companies Index (UK)

Appendix C2(b): German List of Eligible Securities

(A) Multinational Corporations (MNCs)

Germany

M1	Allianze AG	M22	MLP
M2	BASF	M23	TUI
M3	BAYER	M24	Volkswagen AG
M4	Daimler Chrysler	M25	Porsche
M5	Deutsche Bank	M26	Commerzbank
M6	Siemens		
M7	BMW		
M8	SAP		
M9	Altana		
M10	Lufthansa		
M11	Linde		
M12	MAN		
M13	BCA		
M14	Schering		
M15	Thyssen Krupp		
M16	Adidas-Salomon		
M17	Continental		
M18	Fresenius Medicare		
M19	Heidelbergcement		
M20	RWE		
M21	Henkel		

(B) Industrial Classification (Level 4 classification)

Germany

I1	Chemicals
I2	Construction & Building Material
I3	Diversified Industries
I4	Electronic & Electrical Equipment
I5	Engineering & Machinery
I6	Automobile & Parts
I7	Household Goods and Textiles
I8	Personal Care & Household Prods
I9	Pharmaceuticals & Biotechnology
I10	General Retailers
I11	Transport
I12	Telecommunication Services
I13	Banks
I14	Insurance
I15	Information Technology Hardware
I16	Software and Computer Services
I17	Electricity
I18	Aerospace & Defence
I19	Food Producers & Processors
I20	Health
I21	Oil and Gas

(B) International Companies Listed on the German Stock Exchange (Cross Listings)

		Start Date
Australia		
1	BHP Billiton (ADR)	09/88
2	Fosters Group	01/01
3	Gympie Gold	07/02
4	Hardman Resources	08/00
5	Portman	02/00
Austria		
1	OMV	09/88
2	VA Technologie	04/96
Belgium		
1	AGFA-Geveart	06/99
2	Almanij	04/98
3	UCB	03/98
4	Solvay	11/88
5	KBC BKVS	07/98
Canada		
1	Alcan Inc	10/97
2	Barrick Gold Corp	01/89
3	Bema Gold Corp	11/96
China		
1	Beijing Datang Power	02/00
2	China Petroleum & Petrochemical	11/00
Denmark		
1	Novo-Nordisk AS	10/78
2	TDC	11/95
Finland		
1	Nokia	09/88
France		
1	Air Liquide	06/98
2	Alcatel SA	09/88
3	Aventis SA	11/97
4	AXA SA (ADR)	09/01
5	BNP Paribas SA	10/94
6	Carrefour SA	09/88
7	Saint-Gobain	09/96
8	France Telecom	10/97
9	Groupe Danone SA	04/89
10	Lafarge SA	09/88
Hong Kong		
1	Hong Kong Land Holdings	06/89
India		
1	Ashok Leyland	09/00
2	CESC (GDR)	03/98

3	State Bank of India	01/97
Ireland		
1	Allied Irish Bank	02/98
2	Bank of Ireland	01/97
3	CRH	06/98
4	Horizon Technology	07/00
5	IAWS Group	02/00
Italy		
1	Enel	09/88
2	San Paolo	07/96
3	Telecom Italia	12/88
4	Unicredito Italian	02/90
Japan		
1	All-Nippon Airways	08/98
2	Daiwa Securities	09/88
3	Fujitsu	08/96
4	Honda Motor Company	02/90
5	Mitsubishi Corp.	11/96
6	Nippon Telephone & Telegraph Co.	07/96
7	Toyota Motor Company	09/88
Korea		
1	Hyundai Motor	09/97
2	KT Corp (ADR)	09/97
3	Posco (ADR)	11/96
4	Samsung (GDR)	07/97
5	SK Telekom	05/97
The Netherlands		
1	ABN AMRO Holding	08/90
2	Aegon NV	09/88
3	Ahold NV	09/88
4	Akzo Nobel	09/88
5	ASML Holding	03/98
6	DSM NV	02/90
7	Hagemeyer	03/98
8	Heineken	09/88
9	ING Groep	01/00
Norway		
1	Norsk Hydro ASA	01/98
2	Statoil	07/01
Poland		
1	AGORA	03/99
2	Bank Millenium	11/97
3	Prokom Software (GDR)	01/98
Russia		
1	AO TATNEFT	01/97

2	Lukoil OAO	06/96
South Africa		
1	ASBA Group	01/96
2	Barloworld	09/88
3	Goldfields (ADR)	09/88
4	Harmony Goldmines (ADR)	05/95
5	Impala Platinum (ADR)	09/88
Spain		
1	Endesa	09/88
2	Iberdrola	01/88
3	Repsol	05/89
4	Telefonica	11/97
Sweden		
1	Electrolux AB	09/88
2	Sandvik AB	09/99
3	Skandia Insurance	11/97
4	Volvo AB	04/78
5	Ericsson	01/97
6	Hennes & Mauritz	06/96
7	Nordea Bank	02/00
8	Swedish Match	07/98
Switzerland		
1	BB Biotech	11/97
2	BB Medtech	12/97
3	Micronas Semiconductors	4/99
4	Nestle	06/93
5	Credit Suisse	09/88
6	Roche Holdings	10/88
7	Richemont	02/97
8	The Swatch Group	06/95
Taiwan		
1	Asia Cement Corp	12/97
2	Asustek Computers	07/01
Thailand		
1	Thai Airways	07/97
Turkey		
1	Efes Sinai Yatirim	08/99
2	Turkiye Is Bankasi	06/00
3	Yapi Ve Kredi Bank	12/00
4	Turk Tuborg	10/94
United Kingdom		
1	British Airways (ADR)	03/90
2	Barclays	06/95
3	Diageo	05/96

4	Glaxo Smithkline	01/01
5	Astrazeneca	07/97
6	BAE systems	05/97
7	British Gas (ADR)	02/90
8	British Telecom	09/88
9	Marks & Spencer	01/96
10	Next	10/96
11	Reuters	09/88
12	Rio Tinto	
13	Vodafone	
United States		
1	Abbott Laboratories	09/88
2	ALCOA Inc	09/88
3	American Express	09/88
4	AT&T Corp	09/88
5	Bellsouth Corp	09/88
6	Boeing Co	09/88
7	Colgate-Palmolive	09/88
8	Exxon Mobil	07/96
9	Ford Motor	09/88
10	General Electric	09/88
11	General Motors	07/94
12	IBM	06/94
13	Merrill Lynch	
14	Pfizer Inc	

(C) Managed Country Funds – Germany.

Developed Markets:	Start Date
Japan – Japan Asia Investment:	12/99
UK – Deutsche GS UK All-Share Equity Tracker:	11/88
USA – Deutsche GS US All-Share Equity Tracker:	06/00
Emerging Markets:	
Mexico Fund:	05/85
Brazil Fund:	05/89
Malaysia Fund:	07/96
Taiwan Fund:	04/89
Thai Fund – Thailand:	04/89

(D) Benchmark Indices:

(1) FTSE Local Germany Index.

(2) Cazenove & Rosenberg Smaller Companies Index (Germany)

Appendix C2(c): French List of Eligible Securities.

(A) Multinational Corporations (MNCs)

France

M1	Alcatel	M22	Peugeot
M2	Avensis	M23	Renault
M3	AXA	M24	Pinault
M4	BNP Paribas	M25	Publicis
M5	Carrefour	M26	Sagem
M6	L'Oreal	M27	Schneiderelte
M7	Suez SA	M28	Sodexho Alliance
M8	Total SA	M29	Thales
M9	Vivendi Universal	M30	Valeo
M10	Danone	M31	Vinci
M11	Sanofi-Synthelabo		
M12	LVMH		
M13	ST Microelectronics		
M14	Accor		
M15	Cap Gemini		
M16	Christian Dior		
M17	Essilor		
M18	Air Liquide		
M19	Lafarge		
M20	Michelin		
M21	Pernod		

(B) Industrial Indices (Level 4 classification)

France

I1	Oil and Gas	I22	Insurance
I2	Chemicals	I23	Real Estate
I3	Construction & Building Material	I24	Specialty & Other Finance
I4	Steel & Other Metals	I25	Information Technology Hardware
I5	Aerospace & Defence	I26	Software and Computer Services
I6	Diversified Industries		
I7	Electronic & Electrical Equipment		
I8	Automobile & Parts		
I9	Household Goods and Textiles		
I10	Beverages		
I11	Food Producers & Processors		
I12	Health		
I13	Personal Care & Household Prods		
I14	Pharmaceuticals & Biotechnology		
I15	General Retailers		
I16	Leisure & Hotels		
I17	Media & Entertainment		
I18	Support Services		
I19	Transport		
I20	Food and Drug Retailers		
I21	Banks		

(B) International Companies Listed on the French Stock Exchange (Cross Listings)

		Start Date
Belgium		
1	Dexia	11/99
2	Econocom Group	09/00
Canada		
1	Barrick Gold	04/89
2	Inco	04/89
3	Placer Dome	04/89
Finland		
1	Nokia	04/89
Germany		
1	Allianz AG	06/98
2	BASF AG	04/89
3	Bayer SVN	04/89
4	Bayer Hypo Und VBK	04/89
5	DAB Bank	01/01
6	DaimlerChrysler	11/98
7	Deutsche Bank	04/89
8	Lycos Europe	02/01
Italy		
1	Fedon	04/98
2	Fiat Spa	12/89
Japan		
1	Hitachi	04/89
2	Honda Motor	02/90
3	Ito Yokado	04/89
4	Nikko Securities	01/90
5	Sanyo Elec.	04/89
6	Sharp Corp.	05/89
7	Sony Corp	04/89
The Netherlands		
1	ABN AMRO Holding	09/90
2	ING Groep	03/91
3	Phillips Electronics	03/89
4	Rodamco Asia	11/99
5	Royal Dutch	04/89
Norway		
1	Norsk Hydro ASA	04/89
South Africa		
1	Anglo-Gold Ashanti	04/89
2	Durban Rood Deep	10/97
3	Goldfields Ltd	04/89
4	Harmony Goldmines	04/89
Spain		
1	Altadis	12/99

2	Amadeus Glb	12/99
3	Banco Popular Espanol	05/89
Sweden		
1	SKF BF	04/89
Switzerland		
1	Adecco	08/96
2	AGTA Record	05/98
3	Nestle	05/90
United Kingdom		
1	All Unichem	06/98
2	Amvescap	09/98
3	Aviva	12/89
4	BP	04/89
5	Diageo	02/98
6	HSBC Holdings	07/00
7	Kingfisher	06/96
8	Rio Tinto	04/89
9	Shell Trans.	04/89
United States		
1	Altria Gp.	04/89
2	American.Express	04/89
3	Amer.Intl.Gp.	07/90
4	AT& T	04/89
5	Atmel Corporation	09/00
6	Caterpillar	04/89
7	Colgate-Palm.	04/89
8	Dow Chemical	05/89
9	Du Pont Nemours	04/89
10	Ford Motor	04/89
11	General Electric	04/89
12	General Motors	04/89
13	Goodyear Tire	04/89
14	IBM Cert	04/89
15	ITT Industries	04/89
16	Latonia Inv.	12/90
17	McDonalds	04/89
18	Merck	04/89
19	Merrill Lynch	01/90
20	Oxis International	05/97
21	Procter & Gamble	01/90
22	Pfizer	04/89
23	Salomon Brothers	04/89
24	Sara Lee Corp.	03/90
25	Schlumberger	04/89

(D) Benchmark Indices:

(1) FTSE Local France Index.

(2) Cazenove & Rosenberg Smaller Companies Index (France)

Appendix C3: Summary statistics of weekly returns (Local Currency).

	Mean	Standard Deviation	Minimum	Maximum
Developed Markets				
Australia	0.00181	0.01690	-0.05826	0.05511
Austria	0.00129	0.02195	-0.10111	0.06474
Belgium	0.00170	0.02580	-0.10282	0.13960
Canada	0.00223	0.02338	-0.10502	0.10998
Denmark	0.00204	0.02312	-0.11236	0.09619
Finland	0.00507	0.05411	-0.24170	0.24884
France	0.00175	0.02854	-0.11699	0.11514
Germany	0.00135	0.03165	-0.13026	0.14163
Hong Kong	0.00080	0.03725	-0.19000	0.14957
Ireland	0.00225	0.02799	-0.13350	0.14374
Italy	0.00279	0.03801	-0.13538	0.34209
Japan	0.00015	0.02648	-0.09500	0.08726
New Zealand	0.00113	0.02276	-0.08172	0.09832
Netherlands	0.00169	0.02988	-0.12067	0.16751
Norway	0.00184	0.02751	-0.15417	0.14332
Spain	0.00279	0.03063	-0.11545	0.15893
Sweden	0.00279	0.03363	-0.13864	0.19110
Switzerland	0.00194	0.02699	-0.12830	0.17992
UK	0.00136	0.02191	-0.08460	0.10517
USA	0.00225	0.02346	-0.11527	0.07702
Average	**0.00195**	**0.0285**		
Adv. Emerging Mkts.				
Brazil	0.00446	0.04824	-0.22996	0.21780
Israel	0.00300	0.03206	-0.11217	0.11538
Korea	0.00307	0.05267	-0.16989	0.19323
Mexico	0.00361	0.03922	-0.15432	0.19299
South Africa	0.00278	0.02896	-0.11369	0.12163
Taiwan	0.00105	0.04092	-0.13287	0.22685
Average	**0.00299**	**0.0403**		
Emerging Markets				
Argentina	0.00307	0.05400	-0.19323	0.29795
Chile	0.00160	0.03023	-0.15864	0.19087
China	0.00272	0.04754	-0.20311	0.21224
Colombia	0.00333	0.03814	-0.14598	0.19469
India	0.00163	0.03686	-0.12474	0.15480
Malaysia	0.00054	0.04122	-0.17766	0.32407
Pakistan	0.00258	0.05090	-0.20433	0.23885
Peru	0.00376	0.04165	-0.16027	0.24603
Poland	0.00224	0.05300	-0.24601	0.30934
Russia	0.00433	0.08925	-0.30183	0.61815
Thailand	0.00052	0.06419	-0.17739	0.30338
Turkey	0.01302	0.07805	-0.27586	0.38000
Average	**0.00327**	**0.0520**		

Appendix C4(a): UK investors' Composition of Diversification Portfolios for the Developed and Emerging Markets.

Diversification portfolios Dm are based on stepwise regression procedures over two UK indices (indices) and 42 multinational corporations (MNCs). Portfolio D2 includes assets in Dm and 31Level 4 industrial indices (industries). The numbers in each column correspond to the identification in Table I. Augmented diversification portfolios AD1 and AD2 are obtained by augmenting portfolio D2 with each country's country fund and cross-listed equities respectively. AD1s are the fitted values from the regression $R_{I,t} = \Phi_1 R_{D2,t} + \Phi_2 R_{C,t} + \varepsilon_{I,t}$ and AD2s are the fitted values from the regression $R_{I,t} = \Phi_1 R_{D2,t} + \Phi_2 R_{CF,t} + \Phi_3 R_{CLST,t} + \varepsilon_{I,t}$. $R_{I,t}$ are *I*th market returns, $R_{D2,t}$ are D2 returns, $R_{CF,t}$ are country fund returns and $R_{CLST,t}$ are returns on cross-listed equities. Columns two, three, and four report the parameter estimates (t-statistics) for these regressions. Columns five, six, and seven report the composition of portfolios Dm and D2 (based on results from stepwise regressions). Column eight reports significant cross-listed assets from the list in Table I (* denotes the cross-listed asset used in the regression to estimate Φ_3).

Country	Φ_1	Φ_2	Φ_3	Indices	Industries	MNCs	Cross-listings
Developed Markets							
Australia:							
Dm				2	---	M6, M10, M28, M39, M30	
D2				2	I1, I5, I14, I21	M6, M10, M28, M39, M30	
AD2	0.977	---	0.351				4*, 5, 7
	(22.81)		(7.89)				
Austria:							
Dm				2		M6, M12, M30, M31, M34	
D2				2	I28, I27, I31	M6, M12, M30, M31, M34	
AD1	0.922	0.01	---				
	(8.06)	(0.64)					

Belgium:							
Dm				---	---	M36, M33, M17, M9, M30	
D2					I26, I3, I12, I25	M36, M30, M17, M11	
AD1	0.85	0.10	---				
	(19.08)	(4.09)					
Canada:							
Dm				1, 2	---	M16, M5, M13, M36, M19,	
D2				1, 2	I28, I25, I29	M13, M16, M5, M36, M19	
AD2	0.98	---	0.03				2*
	(28.74)		(1.70)				
Denmark:							
Dm				2, 1	---	M14, M41, M39, M34, M13, M35	
D2				2	I20,I28, I10,I26	M41, M14, M35, M39	
AD1	0.89	0.11	---				
	(15.89)	(4.40)					
Finland:							
Dm				1	---	M14, M36, M10, M41, M31, M32	
D2				2	I20,I28, I10,I26	M41, M14, M35, M39	
AD1	0.88	0.12	---				
	(17.51)	(2.15)					

France:							
Dm				1	---	M20, M11, M36, M37, M31, M23	
D2				1, 2	I22, I28, I21, I24	M36, M11, M23, M37	
AD1	0.86	0.17	---				
	(21.88)	(6.83)					
AD2	0.821	0.14	0.02				1*
	(21.64)	(5.64)	(2.13)				
Germany:							
Dm				1, 2	---	M20, M16, M9, M26, M35, M36	
D2				---	I28, I22, I5, I10, 12	M20, M16, M9, M26, M35	
AD1	0.751	0.291	---				
	(18.22)	(9.85)					
Hong Kong:							
Dm				2	---	M6, M7, M37, M38, M31, M33	
D2				2	I28, I9, I30, I14	M6, M38, M33, M37	
AD1	0.901	0.199	---				
	(23.87)	(5.79)					
AD2	0.891	0.17	0.02				1*
	(22.54)	(5.27)	(1.09)				

Ireland:							
Dm				2		M25, M31, M12, M2, M21, M18	
D2				2	I19, I29, I13, I20	M25, M31, M12, M2, M21, M18	
AD1	0.94	0.0789	---				
	(17.53)	(1.94)					
AD2	0.918	0.04	0.21				4, 5*, 7
	(21.99)	(1.70)	(7.11)				
Italy:							
Dm				1, 2		M9,.M24, M21, M31, M36, M8	
D2				2	I28, I16, I29, I21	M7, M21, M24, M13, M1	
AD1	0.82	0.17	---				
	(15.24)	(4.56)					
Japan:							
Dm				1		M6, M10, M24, M34, M31, M42 M1, M17, M32	
D2				1	I28, I3, I21	M6, M10, M34, M24, M42, M1	
AD1	0.2634	0.6317	---				
	(5.47)	(29.19)					

Netherlands:							
Dm				1		M11, M9, M12, M36, M41, M20	
D2				1	I16, I3, I27, I10, I26, I22, I18	M11, M20, M12, M41, M36	
AD1	0.84	0.143	---				
	(30.26)	(7.56)					
AD2	0.8411	0.16	0.02				2*
	(32.63)	(7.58)	(1.70)				
N. Zealand:							
Dm				2		M6, M39, M41, M13, M9, M10 M21, M35	
D2				2, 1	I30, I23, I8	M6, M39, M41, M13, M10	
AD1	0.671	0.439	---				
	(10.10)	(10.70)					
Norway:							
Dm				2		M28, M15, M7, M12, M31, M38, M32, M37, M41	
D2				2	I1, I24, I31, I15, I25	M28, M15, M7, M12, M31	
AD1	0.704	0.18	---				
	(13.87)	(5.02)					

AD2	0.67 (12.69)	0.18 (5.10)	0.03 (2.51)				1*, 3
Spain:							
Dm				1, 2		M36, M22, M29, M1, M24, M34, M9	
D2				2	I28, I22, I25, I12, I26	M22, M29, M24	
AD1	0.80 (16.02)	0.19 (5.79)	---				
Sweden:							
Dm				2, 1		M36, M10, M20, M42, M34, M14, M30, M9	
D2				2, 1	I28, I24, I22, I20, I16, I14, I27, I1, I3	M36, M20, M10, M42, M14, M2	
AD1	0.797 (17.28)	0.241 (6.60)	---				
Switzerland:							
Dm				1, 2		M12, M9, M20, M19, M17, M8, M11	
D2					I2, I22, I26, I19	M12, M20, M19, M17, M8	

AD1	0.89	0.11	---				
	(22.51)	(4.18)					
USA:							
Dm				1, 2		M16, M36, M25, M2, M38, M12, M29	
D2				1, 2	I28, I7, I25, I5, I4, I16	M36, M12, M16, M9	
AD1	0.4501	0.527	---				
	(10.92)	(18.43)					
AD2	0.4885	0.501	0.111				6*, 9, 10
	(11.75)	(16.45)	(8.32)				

Advanced Emerging Markets

Country	Φ_1	Φ_2	Φ_3	Indices	Industries	MNCs	Cross-listings
Brazil:							
Dm				2		M20, M40, M6, M34, M13, M41	
D2				2	I17, I4, I18, I10	M20, M34, M13, M40, M6	
AD1	0.45	0.668	---				
	(7.60)	(18.31)					

Israel:							
Dm				2		M25, M7, M1, M18, M24, M14, M6, M2	
D2				2	I28, I22, I12, I24	M25, M1, M18, M24, M40, M2	
AD1	0.7708 (11.45)	0.467 (10.91)	---				
AD2	0.7332 (10.84)	0.42 (10.52)	0.12 (7.43)				1, 2, 3*
Korea:							
Dm				---		M6, M38, M31, M13, M4, M24, M15, M29, M2	
D2				---	I28, I25, I9, I8, I11	M6, M31, M13, M38, M24	
AD1	0.628 (12.11)	0.343 (10.73)	---				
Mexico:							
Dm				2, 1		M23, M7, M37, M6, M20, M18	
D2				2	I10, I22, I29, I7	M10, M37, M20, M23, M6	
AD1	0.62 (11.41)	0.45 (11.11)	---				

South Africa:							
Dm				2, 1		M13, M6, M36, M32, M35, M27	
D2				2, 1	I10, I9, I7, I31, I8	M13, M35, M36, M32	
AD1	0.768	0.313	----				
	(21.01)	(9.15)					
AD2	0.672	0.266	0.096				3*, 4
	(17.65)	(8.65)	(5.44)				
Taiwan:							
Dm				1		M6, M27, M31, M4, M10, M37	
D2				---	I28, I2, I11, I29	M38, M31, M37, M10, M20, M6	
AD1	0.861	0.579	---				
	(14.19)	(8.57)					

Emerging Markets

Country	Φ_1	Φ_2	Φ_3	Indices	Industries	MNCs	Cross-listings
Argentina:							
Dm				2		M9, M18, M20, M26, M24, M37	
D2				2	I10, I29, I16, I17	M9, M42, M18, M28, M20, M6	
AD1	0.411	0.56	---				
	(7.22)	(13.75)					

Chile:						
Dm				2, 1		M20, M12, M18, M41, M31, M37
D2				2	I28, I10, I29, I9, I7	M38, M20, M32, M12, M9
AD1	0.531	0.311	---			
	(8.65)	(10.29)				
China:						
Dm				1		M6, M30, M26, M9, M37, M31
D2				1	I10, I3, I19, I26, I9	M6, M30, M13, M37
AD1	0.60	0.25	---			
	(8.35)	(6.69)				
Colombia:						
Dm				2		M16, M36, M3, M31, M13, M19
D2				2	I31, I30, I19, I14	M3, M16, M40
AD1	0.57	0.132	---			
	(4.57)	(3.83)				
India:						
Dm				2, 1		M9, M17, M41, M37
D2				2, 1	I2, I27	M9, M41, M17
AD1	0.896	0.065	---			
	(11.11)	(9.81)				

Malaysia:							
Dm				2, 1		M6, M13, M42, M23, M24, M28	
D2				2	I30, I20, I9, I17	M6, M13, M28, M23	
AD1	0.502	0.25	---				
	(7.17)	(4.38)					
AD2	0.484	0.24	0.02				1, 3, 4*
	(12.22)	(3.99)	(2.30)				
Pakistan:							
Dm				2		M10, M30, M16, M29, M18, M22	
D2				---	I13, I20	M10, M16, M30, M29	
AD1	0.54	0.02					
	(12.21)	(1.01)					
Peru:							
Dm				2, 1		M13, M6, M18, M28, M26, M1	
D2				2	I10, I17, I18, I22	M13, M6, M18, M28, M1	
AD1	0.63	0.26	---				
	(6.91)	(7.87)					
Poland:							
Dm				2, 1		M8, M13, M41, M33, M3	

D2				2	I22, I12	M8, M13, M41, M33, M3
AD1	0.73	0.22	---			
	(11.48)	(6.23)				
Turkey:						
Dm				2		M10, M24, M28, M39, M30, M31
D2					I31, I29, I18, I2	M10, M24, M1, M28, M39, M30
Thailand:						
Dm				---		M6, M13, M5, M38, M33, M28
D2				---	I18, I14, I30, I9	M6, M13, M38, M28
AD1	0.29	0.701	---			
	(6.15)	(17.07)				
Russia:						
Dm				2		M6, M34, M11, M25, M41
D2				2	I27, I17, I24, I3, I7	M6, M34, M31, M25, M15
AD1	0.93	0.177	---			
	(14.81)	(4.55)				
World:						
Dm				1,2		M16, M10, M2, M6, M36, M12

D2			1	I28, I22, I7	M10, M6, M36, M12, M16
AD1	0.87	0.117			
	(26.76)	(5.03)			

Appendix C4(b): German investors' Composition of Diversification Portfolios for the Developed and Emerging Markets

Diversification portfolios Dm are based on stepwise regression procedures over two German indices (indices) and 26 multinational corporations (MNCs). Portfolio D2 includes assets in Dm and 20 Level 4 industrial indices (industries). The numbers in each column correspond to the identification in Table I. Augmented diversification portfolios AD1 and AD2 are obtained by augmenting portfolio D2 with each country's country fund and cross-listed equities respectively. AD1s are the fitted values from the regression $R_{I,t} = \Phi_1 R_{D2,t} + \Phi_2 R_{C,t} + \varepsilon_{I,t}$ and AD2s are the fitted values from the regression $R_{I,t} = \Phi_1 R_{D2,t} + \Phi_2 R_{CF,t} + \Phi_3 R_{CLST,t} + \varepsilon_{I,t}$. $R_{I,t}$ are *I*th market returns, $R_{D2,t}$ are D2 returns, $R_{CF,t}$ are country fund returns and $R_{CLST,t}$ are returns on cross-listed equities. Columns two, three, and four report the parameter estimates (t-statistics) for these regressions. Columns five, six, and seven report the composition of portfolios Dm and D2 (based on results from stepwise regressions). Column eight reports significant cross-listed assets from the list in Table I (* denotes the cross listed asset used in the regression to estimate Φ_3).

Country	Φ_1	Φ_2	Φ_3	Indices	Industries	MNCs	Cross-listings
Developed Markets							
Australia:							
Dm				2, 1	---	M6, M13, M8, M12, M20	
D2				1	I4, I14, I1	M24, M13, M1, M6	
AD2	0.814	---	0.18				4*, 5
	(11.98)		(5.87)				
Austria:							
Dm				1		M21, M12, M4, M2, M8, M23	
D2				---	I3, I12, I13, I16	M21, M12, M4, M2, M8, M23	
AD2	0.655	---	0.243				1*, 2
	(13.48)		(8.24)				

Belgium:							
Dm				1	---	M5, M6, M9, M21, M22, M1, M8	
D2				---	I9, I14, I2, I6, I10	M5, M21, M9, M22, M6	
AD2	0.877		0.11				1, 3, 4*, 5
	(19.65)		(5.21)				
Canada:							
Dm				1	---	M25, M23, M22, M2, M17, M9	
D2				1, 2	I14, I15	M25, M2, M26, M23	
AD2	0.805	---	0.144				1, 2*, 3
	(18.46)		(4.81)				
Denmark:							
Dm				2		M7, M15, M2, M17, M9, M13,	
D2				2	I8, I12, I5, I7, I3	M7, M9, M23, M15	
AD2	0.74	---	0.133				1*, 2
	(15.89)		(4.44)				
Finland:							
Dm				1	---	M16, M20, M25, M3, M2, M18	
D2				1	I4, I3,I2, I14, I15	M19, M4, M11, M26, M1	
AD2	0.95	---	0.09				1*
	(22.82)		(1.68)				

France:							
Dm				1		M13, M9, M25, M17, M5, M14	
D2				1	I7, I14, I16	M13, M9, M25, M17	
AD2	0.522	---	0.02				2*, 3, 4, 5, 6, 10
	(13.49)		(2.13)				
Hong Kong:							
Dm				1, 2	---	M13, M6, M19, M12, M20, M11	
D2				1	I3	M13, M6, M19, M12, M11, M20	
AD2	0.94	---	0.16				1*
	(16,76)		(9.89)				
Ireland:							
Dm				2, 1		M13, M18, M16, M25	
D2				2, 1	I6, I7, I9	M13, M18, M1, M16, M25	
AD2	0.644	---	0.213				2*, 3, 4
	(13.56)		(6.56)				
Italy:							
Dm				1, 2		M9,.M24, M21, M31, M36, M8	
D2				1, 2	I6, I2, I5, I4, I11	M9, M24, M31, M8	

AD2	0.377	---	0.16				1, 2, 3*, 4
	(9.86)		(8.41)				
Japan:							
Dm				1		M4, M6, M5, M8, M1	
D2				1	I4, I5, I11	M4, M5, M8, M1	
AD1	0.755	0.144	---				
	(8.91)	(13.00)					
AD2	0.12	0.03	0.366				2, 3, 4, 5, 6, 7*
	(2.39)	(2.62)	(9.09)				
Netherlands:							
Dm				1		M9, M19, M13, M17, M16, M25	
D2				1, 2	---	M9, M19, M13, M17, M16, M25	
AD2	0.44	---	0.222				1*, 2, 3, 4, 6, 8
	(13.03)		(6.73)				
N. Zealand:							
Dm				2		M6, M21, M13, M11, M15, M24	
D2				2	I4, I11	M21, M13, M7, M11, M15	
Norway:							
Dm				2, 1		M13, M25, M5, M7, M4, M11	
D2				1	I4, I5, I14	M13, M25, M5, M7, M4, M11	

AD2	0.743	---	0.181				1*
	(18.09)		(7.49)				
Spain:							
Dm				1, 2		M10, M5, M9, M13, M4, M11	
D2				1	I12, I6, I7, I11, I4	M10, M5, M9, M13, M11	
AD2	0.55	---	0.213				2, 3*, 4
	(15.41)		(8.34)				
Sweden:							
Dm				1		M6, M20, M26, M5, M18, M22	
D2				1	I4, I14, I5	M20, M1, M26, M5, M22, M19	
AD2	0.49	---	0.09				1, 4*, 6, 8
	(10.98)		(1.90)				
Switzerland:							
Dm				---		M5, M25, M9, M10, M13, M15, M7, M1, M24, M6, M22	
D2				---	I9, I1, I12, I11, I3	M5, M20, M13, M10, M9	
AD2	0.488	---	0.143				1, 4, 5*, 7
	(12.60)		(4.06)				

UK:							
Dm				1		M25, M7, M13, M15, M16, M11, M23, M9,M19, M17	
D2				1	I7, I3, I1	M25, M7, M13, M15, M23, M11	
AD1	0.401	0.66	---				
	(8.89)	(17.11)					
AD2	0.22	0.455	0.11				2* 3, 4, 6, 10, 12, 13
	(5.86)	(13.41)	(6.01)				
USA:							
Dm				1		M25, M4, M9, M26, M18, M7, M8, M1	
D2				1	I14, I16, I13	M25, M4, M26, M18, M8	
AD1	0.788	0.301	---				
	(23.67)	(6.68)					
AD2	0.388	0.11	0.266				1, 2, 3, 4, 6, 8, 9*, 10,11
	(4.19)	(3.14)	(8.46)				

Advanced Emerging Markets

Country	Φ_1	Φ_2	Φ_3	Indices	Industries	MNCs	Cross-listings
Brazil:							
Dm				2, 1		M1, M9, M25, M21, M2, M3	

D2				2	I14, I8, I5, I10	M25, M12, M9	
AD1	0.611	0.47					
	(14.59)	(18.04)					
Israel:							
Dm				1, 2		M25, M23, M13, M12, M26, M3	
D2				1, 2	---	M25, M23, M13, M12, M26, M3	
Korea:							
Dm				2		M6, M4, M21, M18, M23, M5	
D2				2	I10, I8, I13, I1	M6, M4, M21, M23, M18, M7	
AD2	0.211	---	0.44				1, 2, 3, 4*, 5
	(2.31)		(8.62)				
Mexico:							
Dm				2, 1		M13, M24, M8	
D2				2	I14, I6, I10	M13, M8	
AD1	0.833	0.271	---				
	(14.49)	(14.88)					
South Africa:							
Dm				2		M13, M23, M11, M6, M7, M5, M18	

D2				2	I10	M13, M23, M11, M6, M18, M7, M2	
AD2	0.632 (12.10)	---	0.144 (6.43)				1, 2, 3*, 4
Taiwan:							
Dm				2		M12, M21, M13, M9, M11, M15	
D2				2	I15, I10, I8	M12, M21, M13, M9, M11	
AD1	0.73 (11.98)	0.311 (10.23)	---				
AD2	0.688 (11.08)	0.32 (13.92)	0.09 (2.98)				1*

Emerging Markets

Country	Φ_1	Φ_2	Φ_3	Indices	Industries	MNCs	Cross-listings
Argentina:							
Dm				1		M25, M16, M4, M8, M2, M13	
D2				1	I7, I6, I15, I5	M25, M16, M4, M8, M2, M13	
Chile:							
Dm				1		M25, M6, M24, M20, M9	
D2				1	I13, I16	M25, M6, M24, M20, M9	

China:							
Dm				---		M19, M7, M25, M17, M20, M6	
D2				---	I5, I6, I3	M19, M7, M25, M15, M17	
AD2	0.726	---	0.144				1, 2*
	(6.87)		(6.11)				
Colombia:							
Dm				2		M22, M12, M16, M18	
D2				2	I7, I8, I12, I9	M22, M12, M16, M21	
India:							
Dm				2		M25, M6, M13, M8, M9	
D2				2	I4, I8	M25, M13, M6, M8,	
AD2	0.855	---	0.21				3*
	(8.82)		(5.77)				
Malaysia:							
Dm				1		M13, M11, M15, M16, M18	
D2				1	I12, I9	M13, M16, M11, M15	
AD1	0.507	0.184					
	(7.40)	(7.63)					

Pakistan:							
Dm				2		M6, M24, M18, M4, M17, M25	
D2				2	I4, I12, I15, I5, I6	M24, M18, M4, M25	
Peru:							
Dm				1, 2		M6, M17, M24, M18, M4	
D2				1, 2	----	M6, M17, M24, M18, M4	
Poland:							
Dm				2, 1		M17, M21, M5, M16, M19, M24	
D2				2, 1	I13	M17, M21, M5, M16, M19, M24	
AD2	0.66	---	0.21				1, 2*, 3
	(10.38)		(7.89)				
Turkey:							
Dm				2		M4, M8, M5, M21	
D2				2	I4, I10	M4, M8, M5, M21	
AD2	0.882	---	0.143				2*, 3, 4
	(8.24)		(5.06)				
Thailand:							
Dm				2		M4, M13, M11, M18, M6	

D2				2	---	M4, M13, M11, M18, M6	
AD1	0.344	0.29					
	(4.78)	(10.39)					
AD2	0.22	0.233	0.22				1*
	(3.28)	(8.99)	(7.18)				
Russia:							
Dm				1		M16, M2, M5, M9, M14, M26, M7, M6, M19	
D2				1	I10, I7, I8, I1, I13, I3, I16, I15	M20, M7, M6,	
AD2	0.245	---	0.134				1*, 2
	(5.92)		(8.91)				
World:							
Dm				1		M25, M4, M9, M5, M13, M17	
D2				1	I14, I4, I15	M25, M4, M9, M17, M1, M6	

Appendix C4(c): French investors' Composition of Diversification Portfolios for the Developed and Emerging Markets

Diversification portfolios Dm are based on stepwise regression procedures over two UK indices (indices) and 31 multinational corporations (MNCs). Portfolio D2 includes assets in Dm and 26 Level 4 industrial indices (industries). The numbers in each column correspond to the identification in Table I. Augmented diversification portfolios AD1 and AD2 are obtained by augmenting portfolio D2 with each country's country fund and cross-listed equities respectively. AD1s are the fitted values from the regression $R_{I,t} = \Phi_1 R_{D2,t} + \Phi_2 R_{C,t} + \varepsilon_{I,t}$ and AD2s are the fitted values from the regression $R_{I,t} = \Phi_1 R_{D2,t} + \Phi_2 R_{CF,t} + \Phi_3 R_{CLST,t} + \varepsilon_{I,t}$. $R_{I,t}$ are *I*th market returns, $R_{D2,t}$ are D2 returns, $R_{CF,t}$ are country fund returns and $R_{CLST,t}$ are returns on cross-listed equities. Columns two, three, and four report the parameter estimates (t-statistics) for these regressions. Columns five, six, and seven report the composition of portfolios Dm and D2 (based on results from stepwise regressions). Column eight reports significant cross-listed assets from the list in Table I (* denotes the ADR used in the regression to estimate Φ_3).

Country	Φ_1	Φ_2	Φ_3	Indices	Industries	MNCs	Cross-listings
Developed Markets							
Australia:							
Dm				2		M16, M13, M25, M27, M31, M11	
D2				2	I4, I1, I24, I14	M16, M13, M25, M27, M31, M11	
Austria:							
Dm				2, 1		M30, M10, M11, M8, M7, M5, M1, M18	
D2				2	I24, I14, I17, I25	M30, M10, M19, M16, M24, M1	
Belgium:							
Dm				1		M28,M8, M10, M17, M19, M3,M7, M24, M23	
D2				1	I17, I22, I25, I18, I7	M8, M28, M18, M10, M17, M23	

AD2	0.761 (22.23)	---	0.133 (6,43)				1*
Canada:							
Dm				1		M13, M1, M31, M19, M27, M2	
D2				1	I1, I14, I4, I9, I25	M13, M19, M16, M31	
AD2	0.911 (25.20)	---	0.084 (4.81)				2*, 3
Denmark:							
Dm				2		M29, M18, M31, M15, M27, M24, M28, M17,M8	
D2				2	I6, I18, I26, I12, I4	M29, M24, M27, M23, M8	
Finland:							
Dm				1, 2		M13, M25, M24, M17,M5, M26, M31, M29	
D2				1, 2	I11, I9, I7, I1, I25	M13, M25, M5, M26, M17	
AD2	0.29 (15.11)	---	0.622 (45.56)				1*
Germany:							
Dm				1, 2		M3, M20, M26, M6, M9, M8, M2	

D2				1, 2	I6, I24, I23, I22	M5, M20, M8, M26, M9	
AD2	0.521	---	0.344				1, 2, 3. 6, 7*
	(18.65)		(4.32)				
Hong Kong:							
Dm				2	---	M12, M20, M24, M31, M25, M13	
D2				2	I9, I1, I15, I19, I24	M31, M20, M25, M13, M2, M3	
Ireland:							
Dm				2		M25, M4, M24, M19, M31	
D2				2	I8, I4, I15, I9, I25	M25, M3, M24, M31, M15, M19	
Italy:							
Dm				1, 2		M28, M6, M13, M15, M21, M10	
D2				1, 2	I21, I1, I22, I10,	M28, M13, M6, M10	
AD2	0.99	---	0.34				1, 2*
	(53.88)		(9.21)				
Japan:							
Dm				1		M12, M13, M21, M15, M28, M6, M18, M23	
D2				---	I24, I27	M12, M13, M21, M15, M28, M6	

AD2	0.33 (5.77)	---	0.143 (3.54)				1, 2, 4, 6, 7*
Netherlands:							
Dm				1, 2		M3, M9, M30, M29, M20, M6, M1	
D2				1, 2	I22, I6, I24, I25, I17, I23, I4, I1	M23, M6, M20, M28, M25, M29	
AD2	0.41 (13.58)	---	0.312 (4.73)				1*, 3, 5
N. Zealand:							
Dm				2		M12, M18, M17, M11, M22, M13	
D2				2	I4, I12, I14, I24, I1	M12, M17, M24, M2, M13	
Norway:							
Dm				2, 1		M25, M7, M29, M13, M5, M18	
D2				2, 1	I4, I1, I6, I21, I15	M25, M29, M13, M14, M18, M12	
AD2	0.65 (19.30)	---	0.301 (15.27)				1*
Spain:							
Dm				1		M4, M12, M20, M22, M17,M21	
D2				1	I21, I22, I12, I9, I3	M4, M12, M17, M21, M20	

AD2	0.96	---	0.06				3*
	(30.29)		(4.45)				
Sweden:							
Dm				1		M13, M26, M18, M9, M1, M17, M2	
D2				1	I3, I11, I17, I4, I14	M13, M26, M1, M19, M30	
AD2	0.95	---	0.07				1*
	(31.71)		(5.40)				
Switzerland:							
Dm				1		M17, M9, M14, M3, M17, M31	
D2				1	I17, I6, I16, I21, I11, I7, I4	M17, M2, M25, M29, M9, M3	
AD2	0.68	---	0.211				1, 3*
	(19.64)		(6.23)				
UK:							
Dm				1		M1, M14, M13, M8, M16, M2, M21	
D2				1	I17, I16, I25, I6	M1, M2, M25, M23, M25	
AD2	0.73		0.11				2, 3, 4*, 5, 6, 8, 9
	(21.83)		(5.89)				

USA:							
Dm				1		M13, M22, M3, M31, M4	
D2				2	I17, I6, I22, I15	M13, M31, M4, M22, M14	
AD2	0.34	---	0.26				2, 4, 5, 9*, 10, 12
	(10.14)		(5.87)				13, 14, 15 19, 20

Advanced Emerging Markets

Country	Φ_1	Φ_2	Φ_3	Indices	Industries	MNCs	Cross-listings
Israel:							
Dm				2		M13, M11, M5, M24, M26, M14	
D2				2	I14, I2, I20, I8, I9	M13, M24, M14, M26, M25, M18	
Korea:							
Dm				2		M13, M2, M20, M12, M17, M30	
D2				2	I9, I11, I24	M13, M2, M20, M12, 17	
Mexico:							
Dm				1		M13, M24, M23, M25, M5	
D2				1	I15, I2, I24, I17	M14, M13, M5, M4	

South Africa:							
Dm				1, 2		M7, M24, M12, M22, M5, M2, M31, M21, M29, M27	
D2				2	I4, I1, I15, I20, I5	M7, M24, M12, M22, M5	
AD2	0.842	---	0.32				1, 4*
	(16.91)		(8.21)				
Taiwan:							
Dm				2		M2, M13, M25, M24, M30, M21	
D2				2	I3, I6, I13, I25, I10	M2, M13, M25, M24, M30	

Emerging Markets

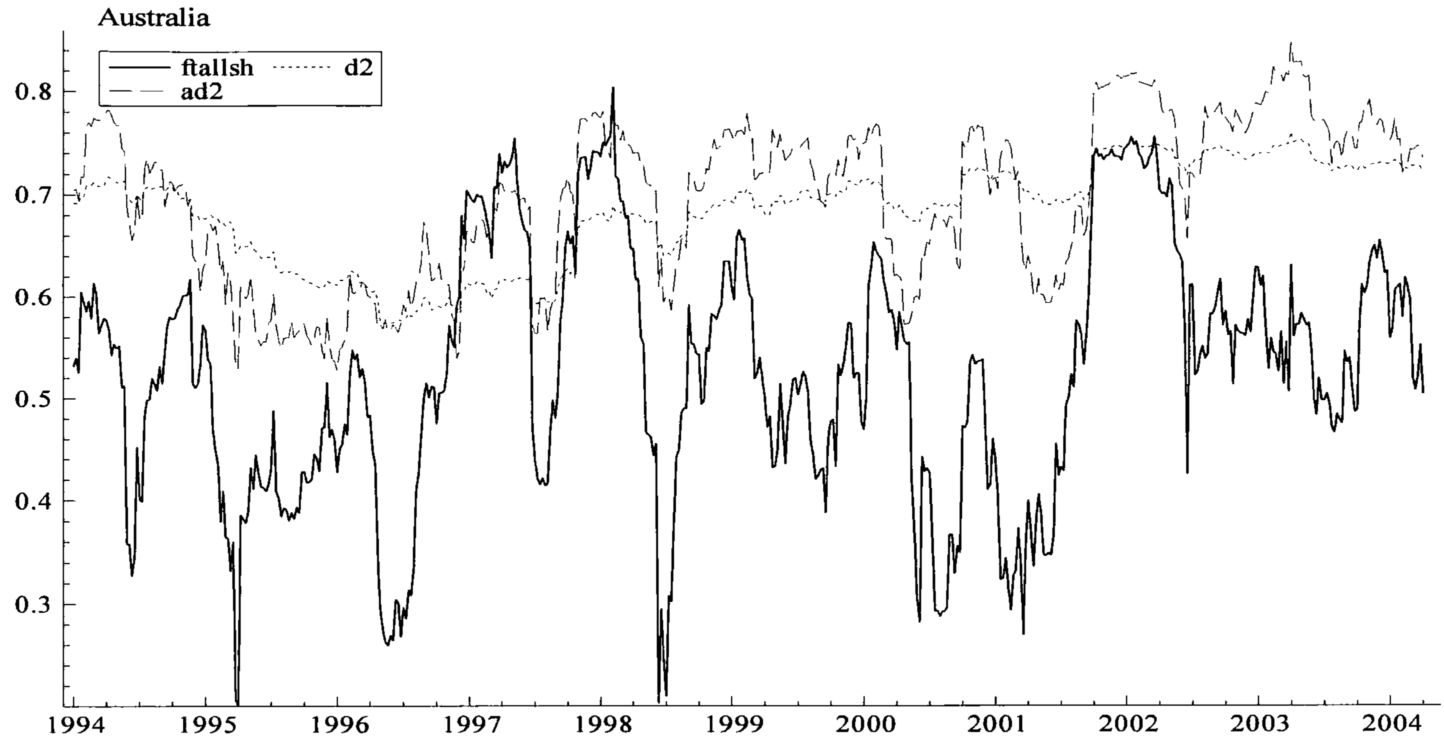
Country	Φ_1	Φ_2	Φ_3	Indices	Industries	MNCs	Cross-listings
Argentina:							
Dm				2, 1		M6, M28, M7, M8, M1, M2, M11, M20, M23, M4, M14, M22	
D2				2	I21, I23, I1, I13	M28, M7, M11, M5, M27	
Chile:							
Dm				1		M20, M24, M3, M5, M18, M11	
D2				---	I23, I24, I1, I2, I7	M6,M20, M30, M5, M24,M14	

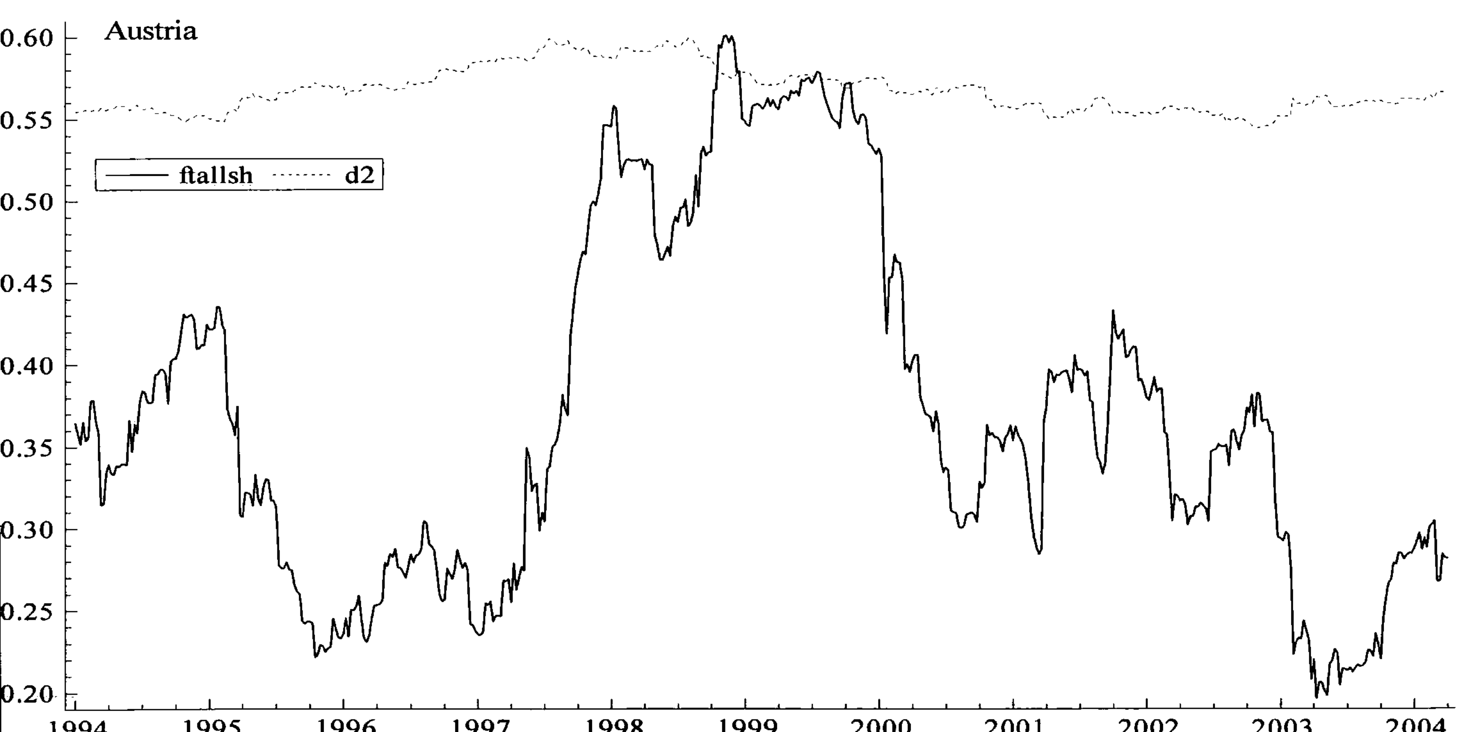
China:			
Dm	2		M5, M25, M2, M8, M31, M17
D2	---	I4, I20, I1, I24	M5, M2, M25, M17, M31
Colombia:			
Dm	2		M18, M2, M13, M8, M24, M31
D2	---	I24, I15, I16, I14	M18, M2, M13, M8, M24
India:			
Dm	1, 2		M30, M6, M5, M13
D2	1, 2	I13, I3, I5, I26, I19	M30, M29, M5, M1
Malaysia:			
Dm	1		M16, M2, M5, M19, M13, M26
D2	---	I1, I6, I12, I20, I2	M16, M5, M13, M17, M30
Pakistan:			
Dm	---		M25, M8, M10, M13, M20, M15, M31
D2		I7, I12, I18	M25, M8, M10, M13, M20

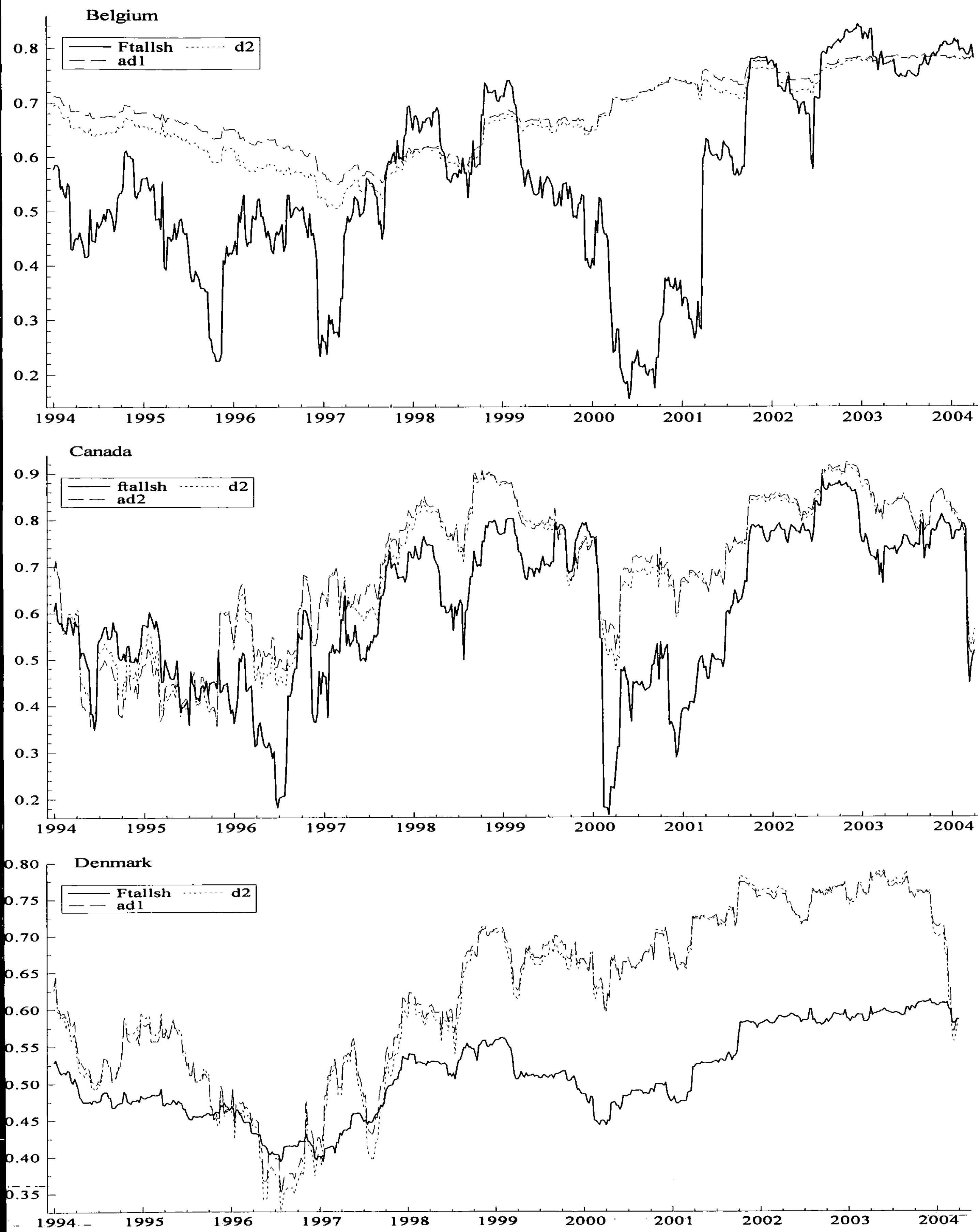
Peru:			
Dm	2, 1		M13, M25, M24, M3
D2	2	I24, I23, I22, I4	M13, M25, M24
Poland:			
Dm	2, 1		M15, M22, M20, M19, M31, M12
D2	2, 1	I26, I9, I17, I15	----
Turkey:			
Dm	2		M16, M25, M7, M14, M17, M26, M24, M20, M28
D2	---	I16, I11, I18, I21	M16, M25
Brazil:			
Dm	---		M20, M11, M18, M15, M8, M5
D2	---	I7, I6, I15, I26, I11	M11, M18, M5, M5
Thailand:			
Dm	---		M20, M12, M17, M18, M31, M4
D2		I12, I9, I21, I2	M18, M20, M31

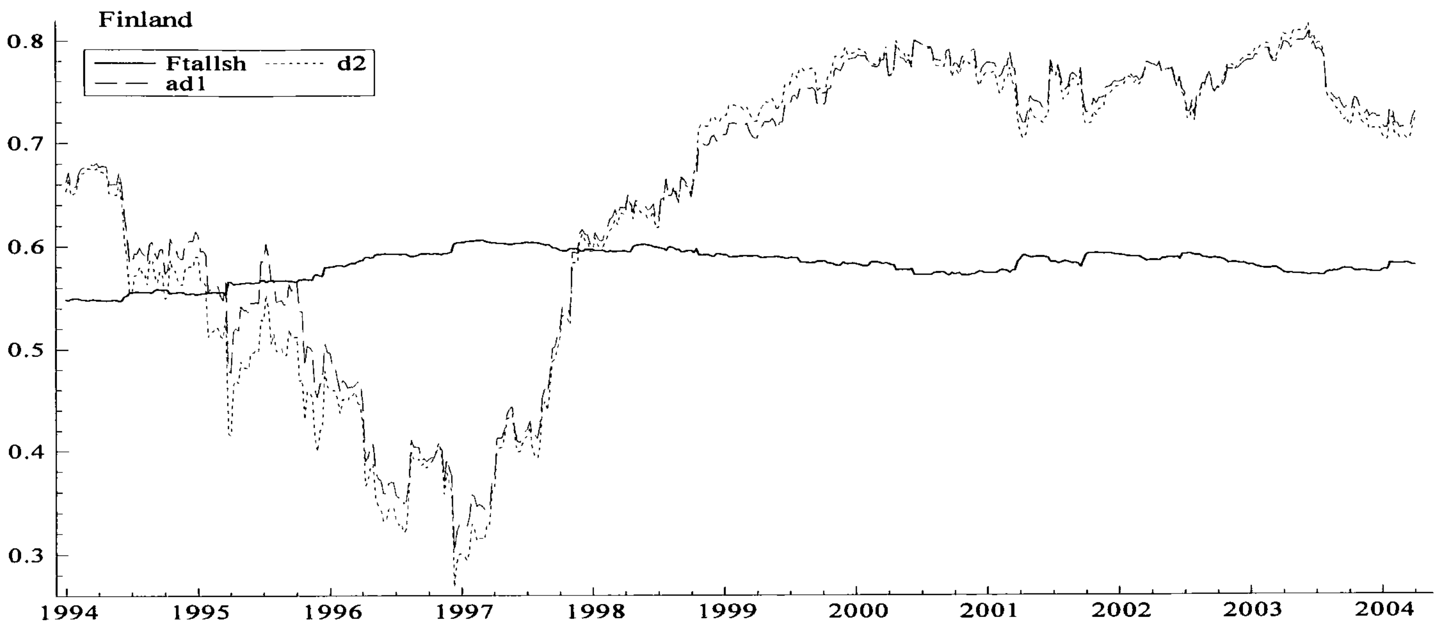
Russia:			
Dm	1		M18, M11, M12, M8, M15, M23
D2	---	I9, I14, I6, I24	M18, M20, M31
World:			
Dm	1		M13, M9, M3, M22, M8, M31, M30, M24, M12
D2	1, 2	I17, I6, I20	M13, M9, M3, M22, M8, M31

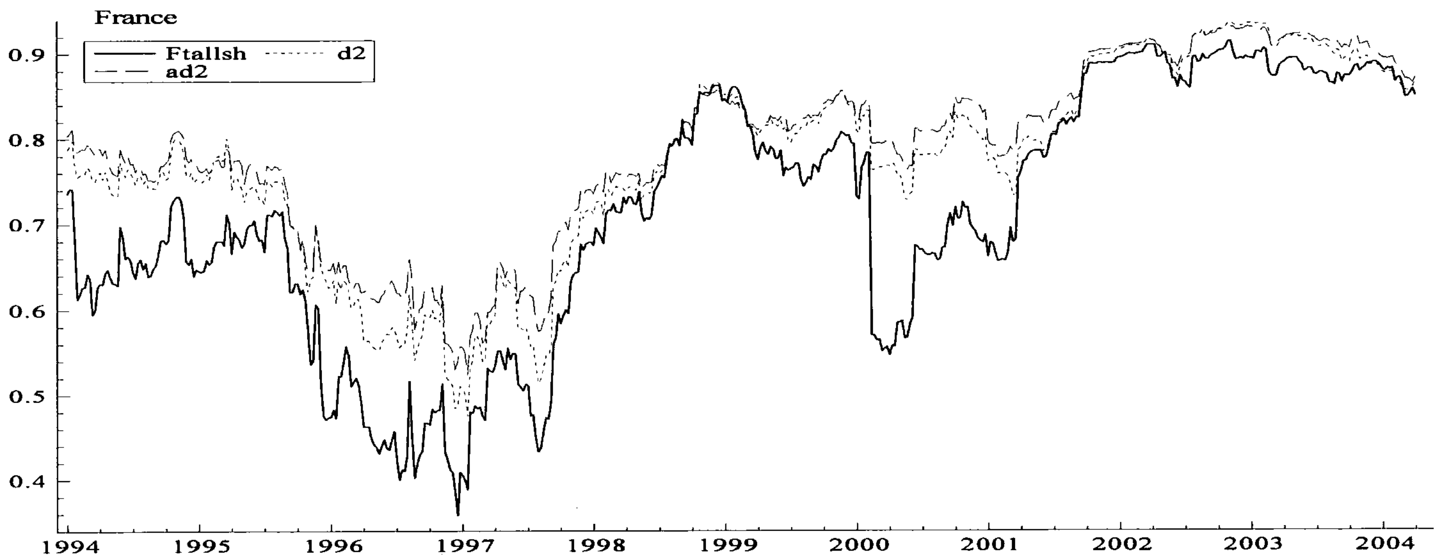
Appendix C5(a): **Dynamic Conditional Correlations (DCC) between foreign market indices and various diversification portfolios based on UK traded assets. 'Ftallsh' is the correlation between the foreign index and the UK FTSE-All Share Index.**

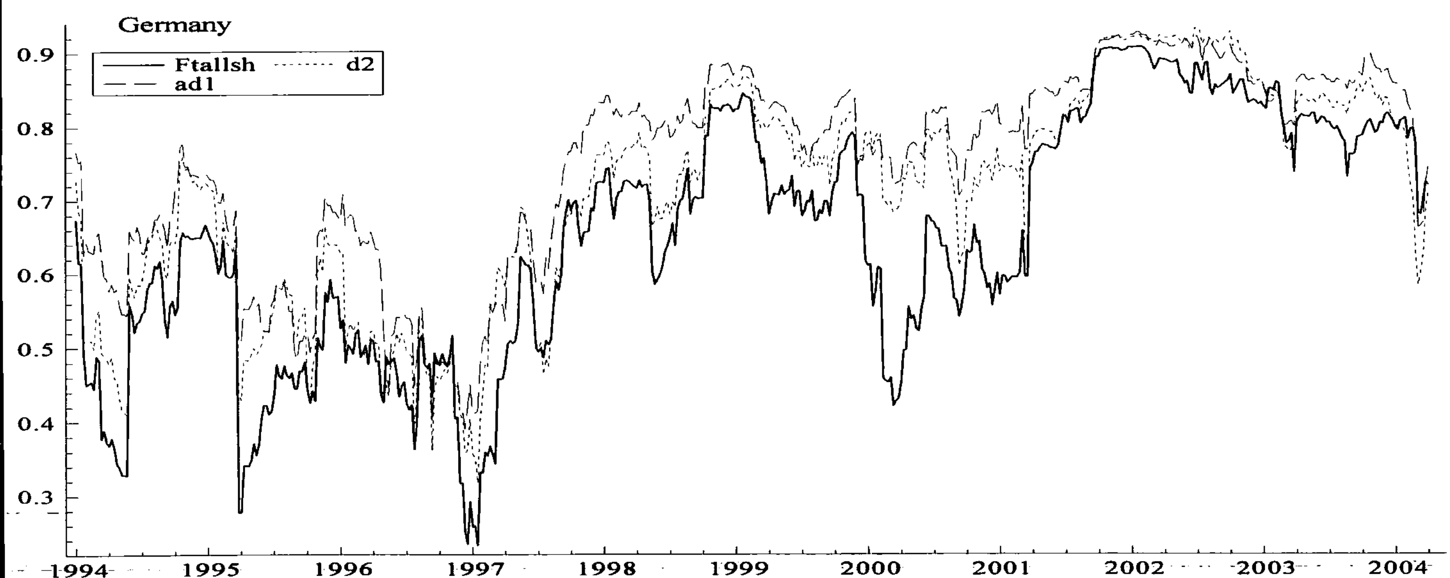


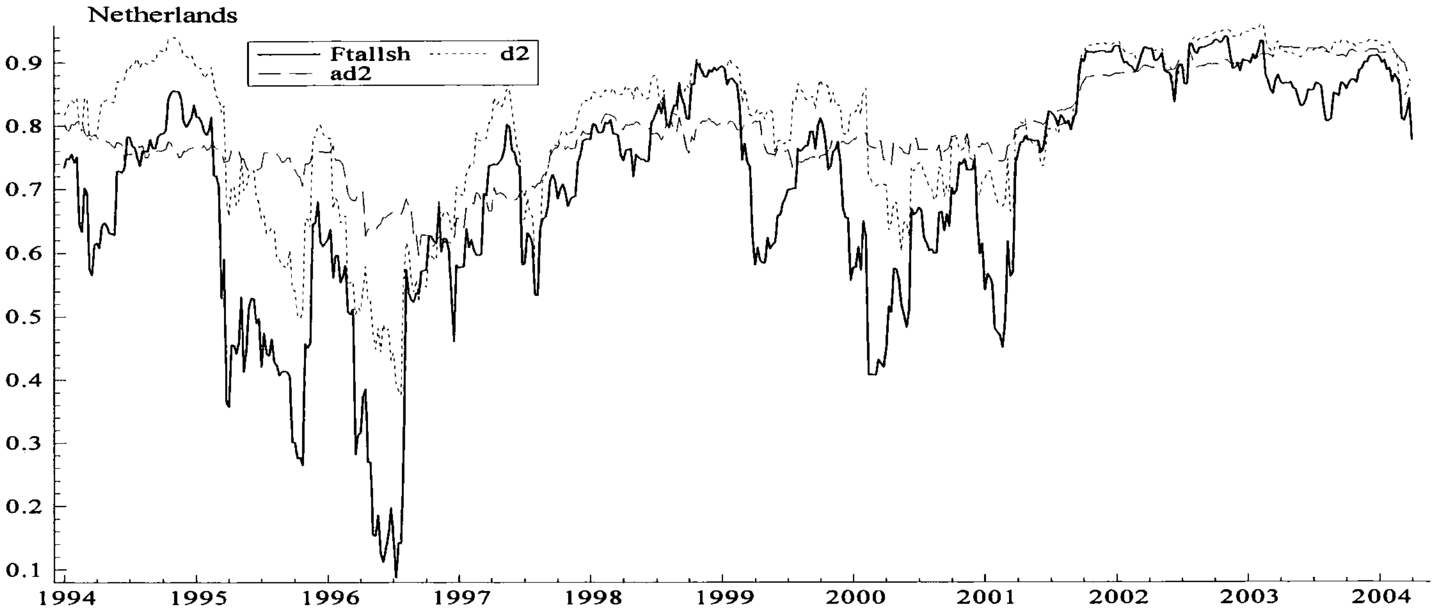


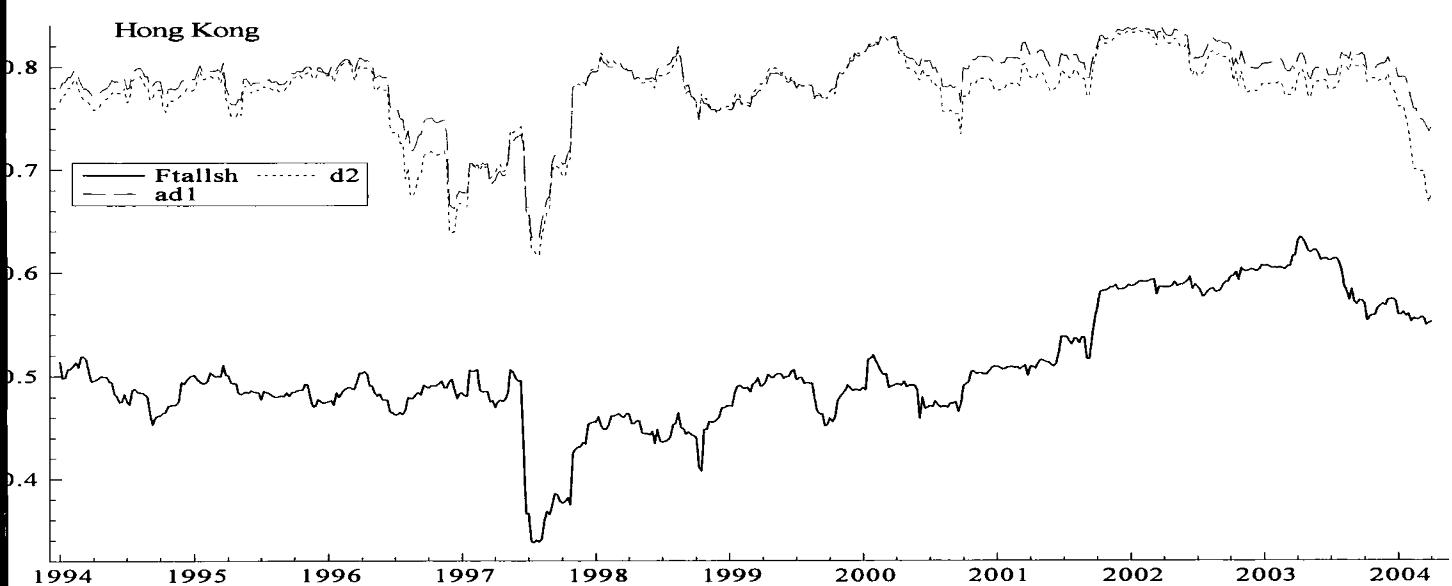

Belgium
Ftallsh
d2
ad1
0.8
0.7
0.6
0.5
0.4
0.3
0.2
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
Canada
ftallsh
d2
ad2
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
Denmark
Ftallsh
d2
ad1
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

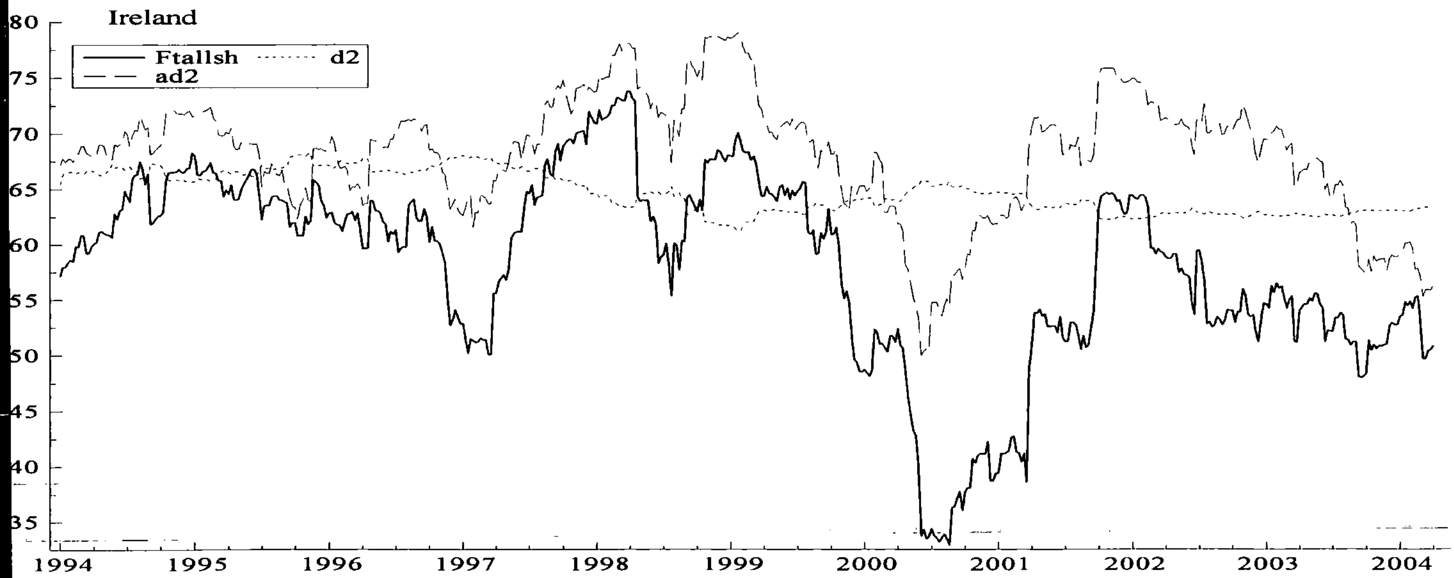

Finland
Ftallsh
d2
ad1
0.8
0.7
0.6
0.5
0.4
0.3
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

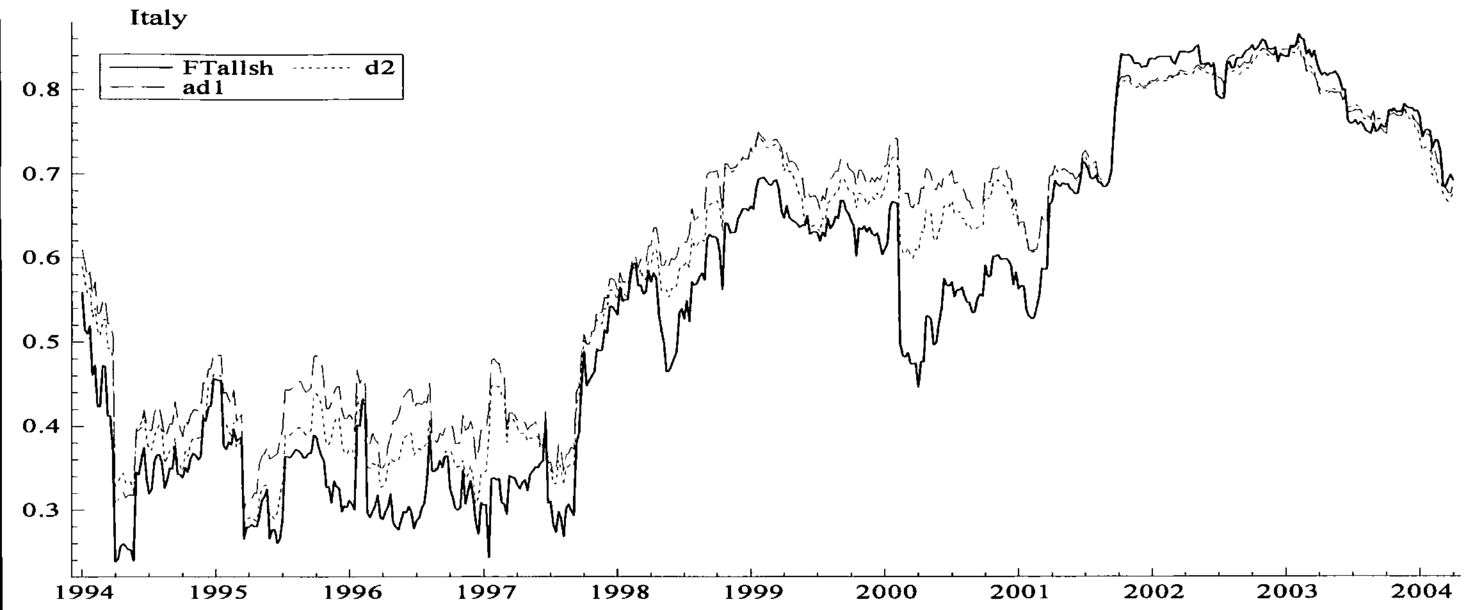

France
Ftallsh
d2
ad2
0.9
0.8
0.7
0.6
0.5
0.4
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

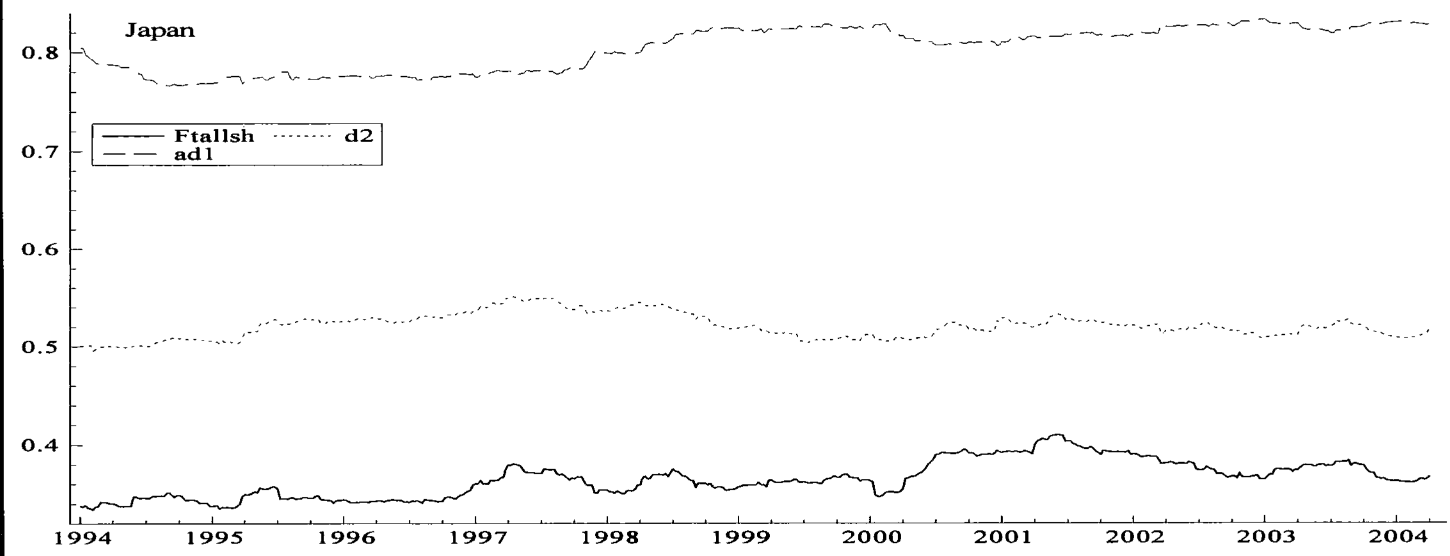

Germany
Ftallsh
d2
ad1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

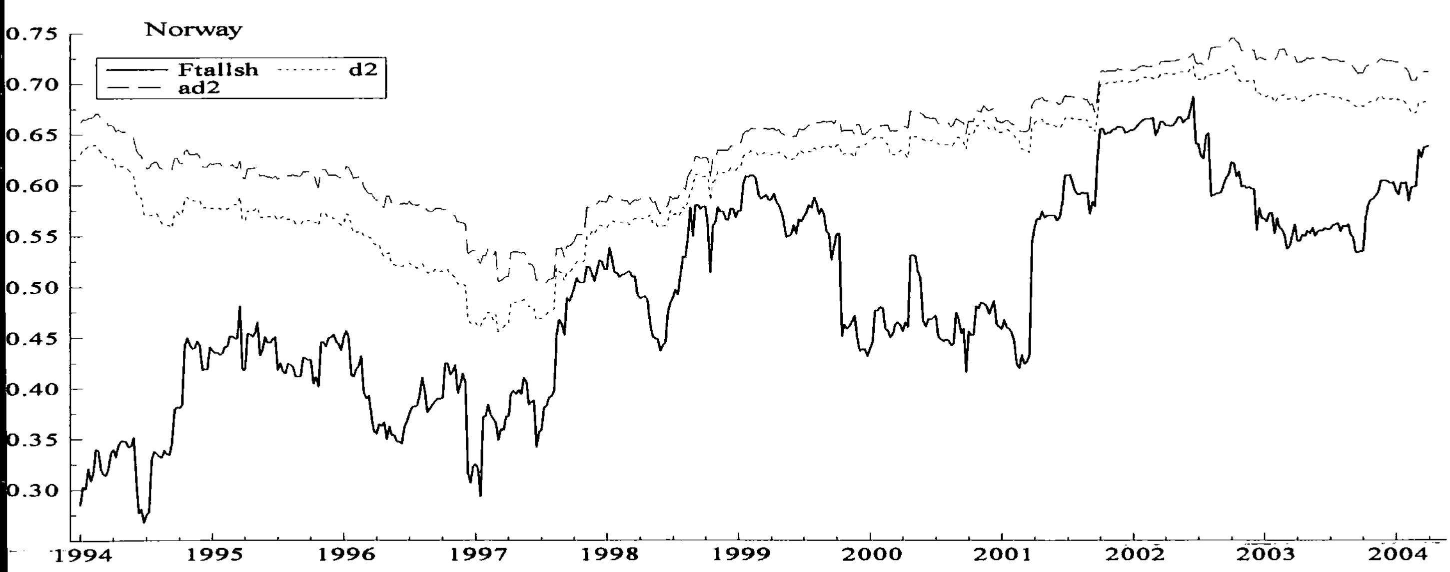

Netherlands
Ftallsh
d2
ad2
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004

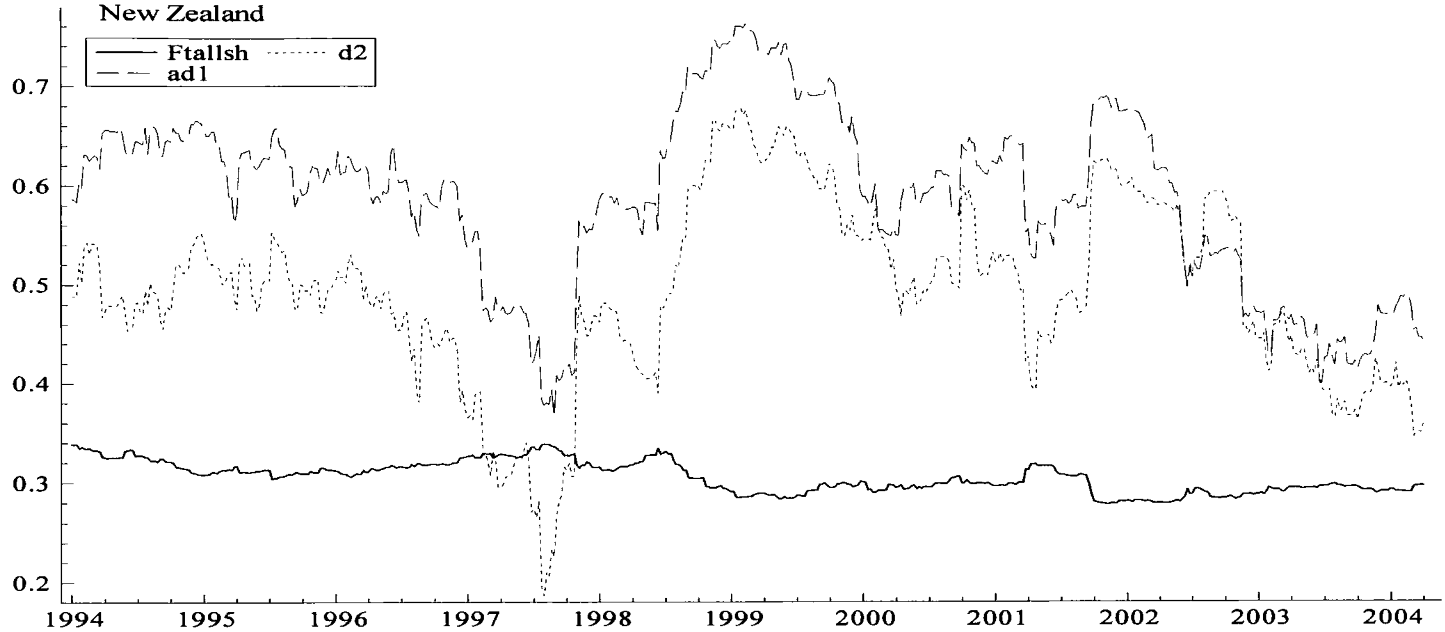

Hong Kong
Ftallsh
d2
ad1
1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004

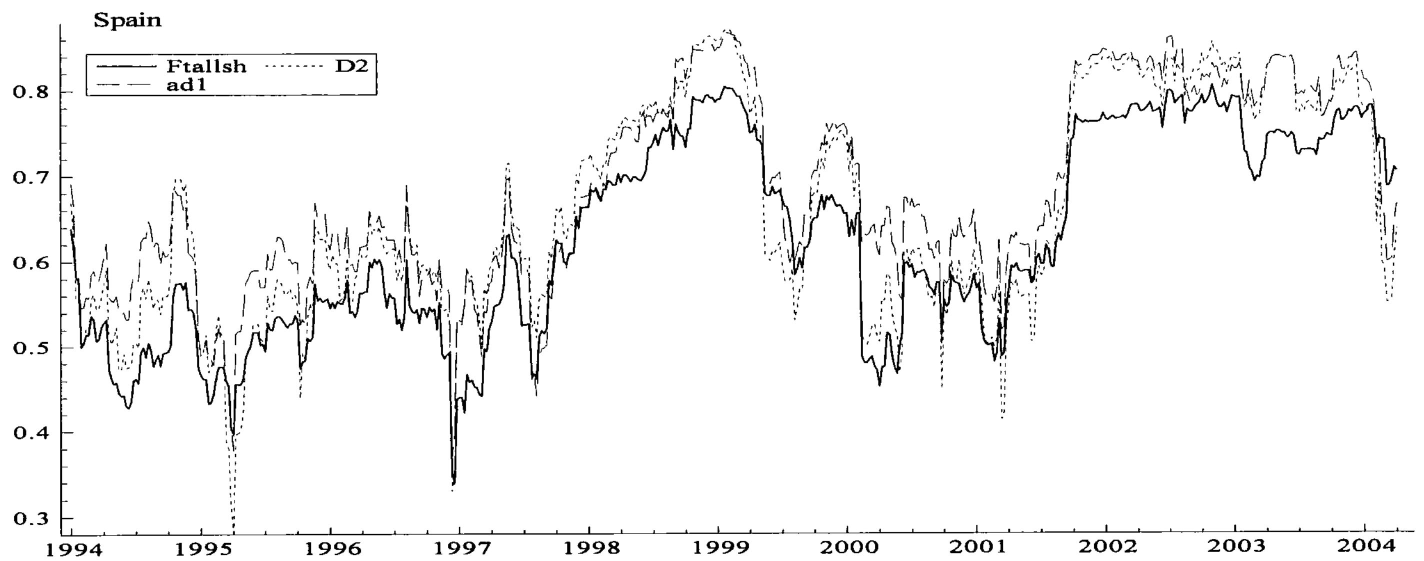

Ireland
Ftallsh
d2
ad2
80
75
70
65
60
55
50
45
40
35
1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004

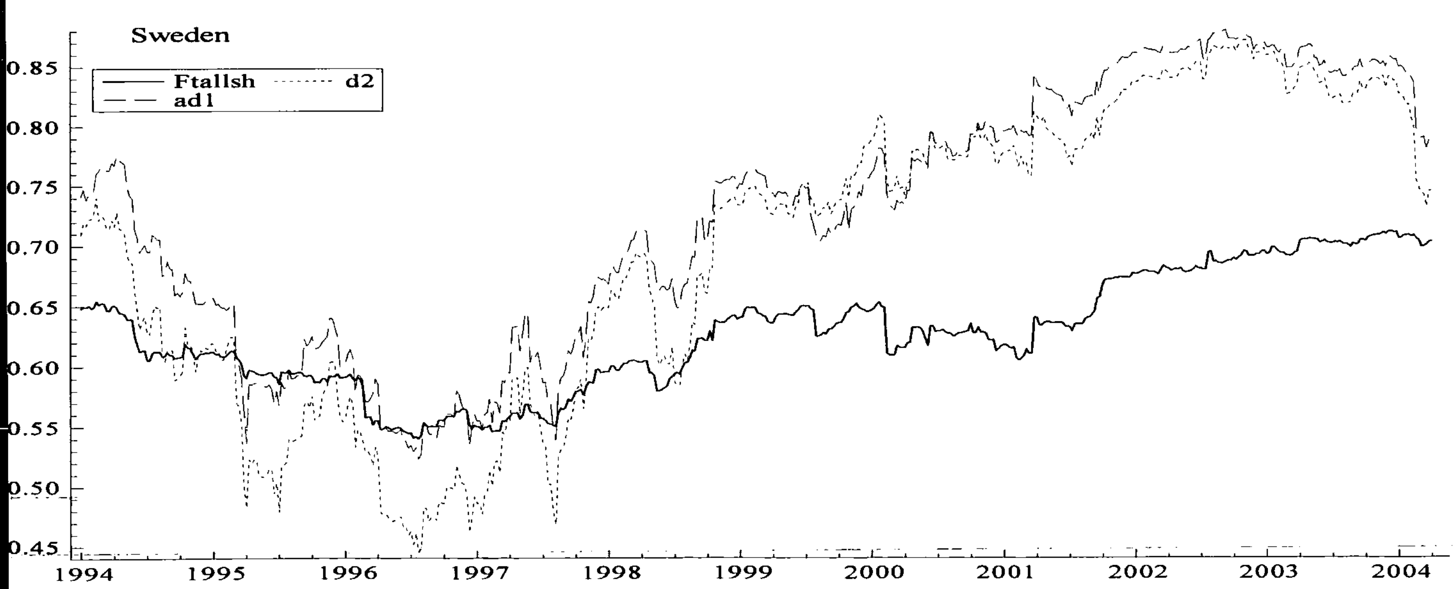

Italy
FTallsh
d2
ad1
0.8
0.7
0.6
0.5
0.4
0.3
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

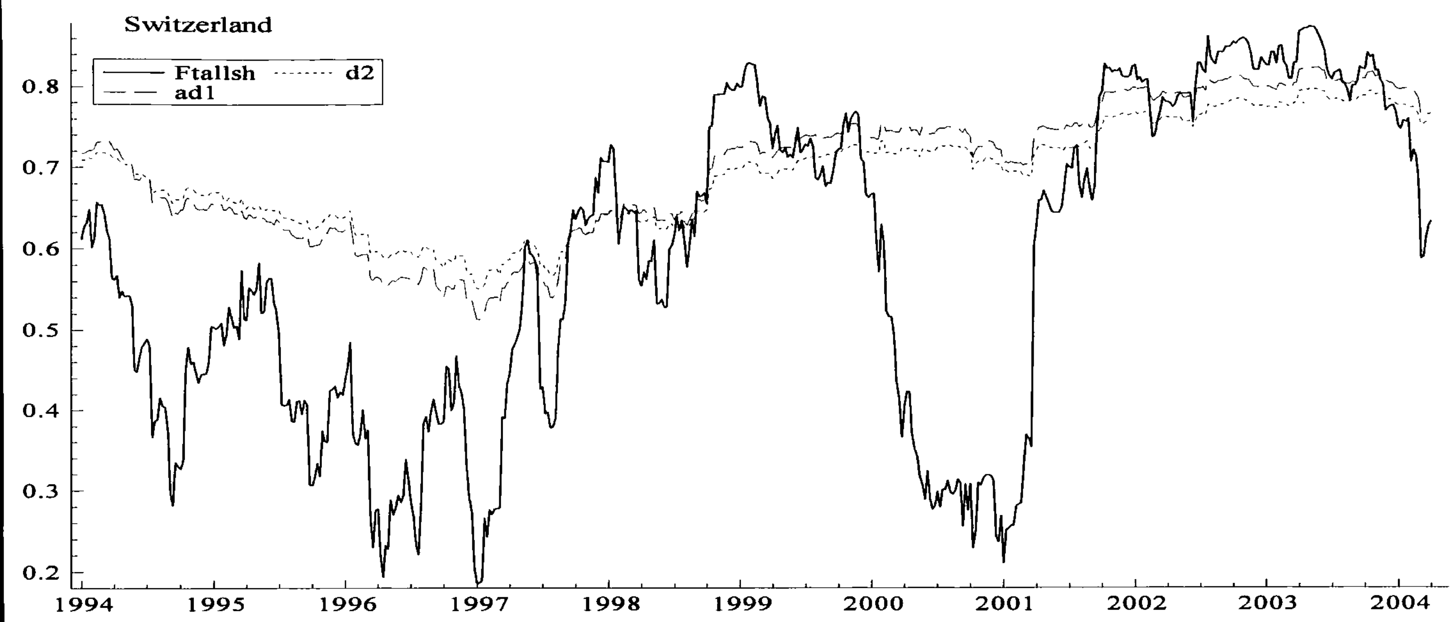

Japan
Ftallsh
d2
ad1
0.8
0.7
0.6
0.5
0.4
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

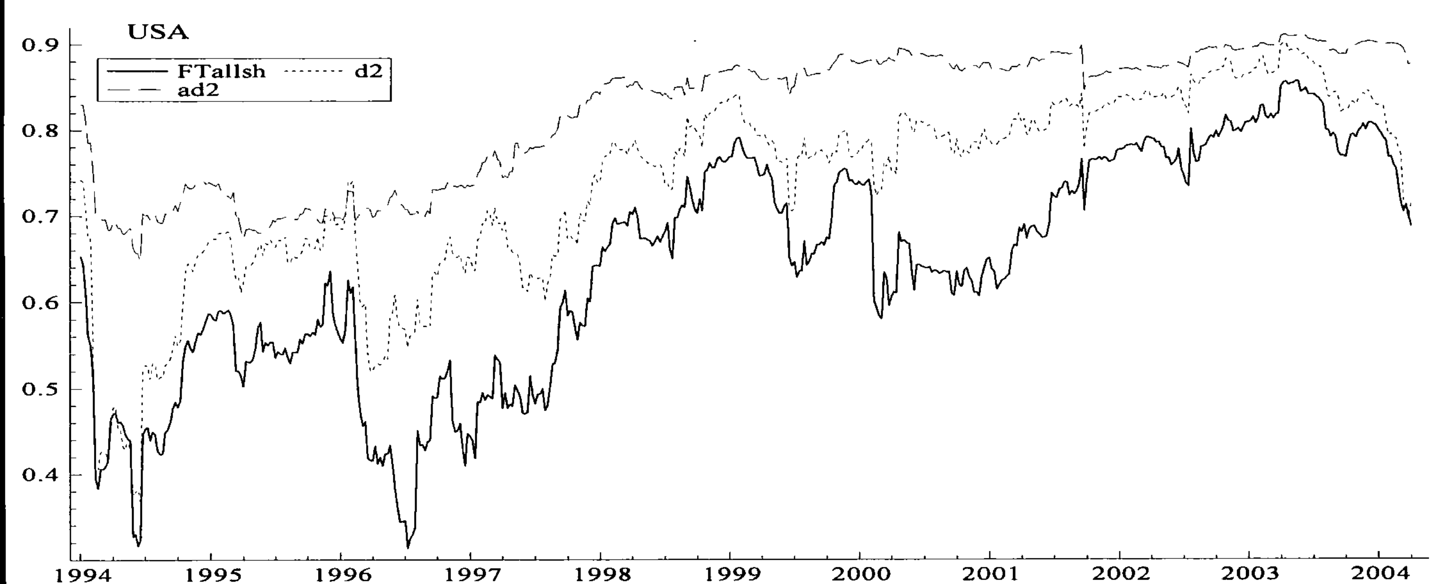

Norway
Ftallsh
d2
ad2
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

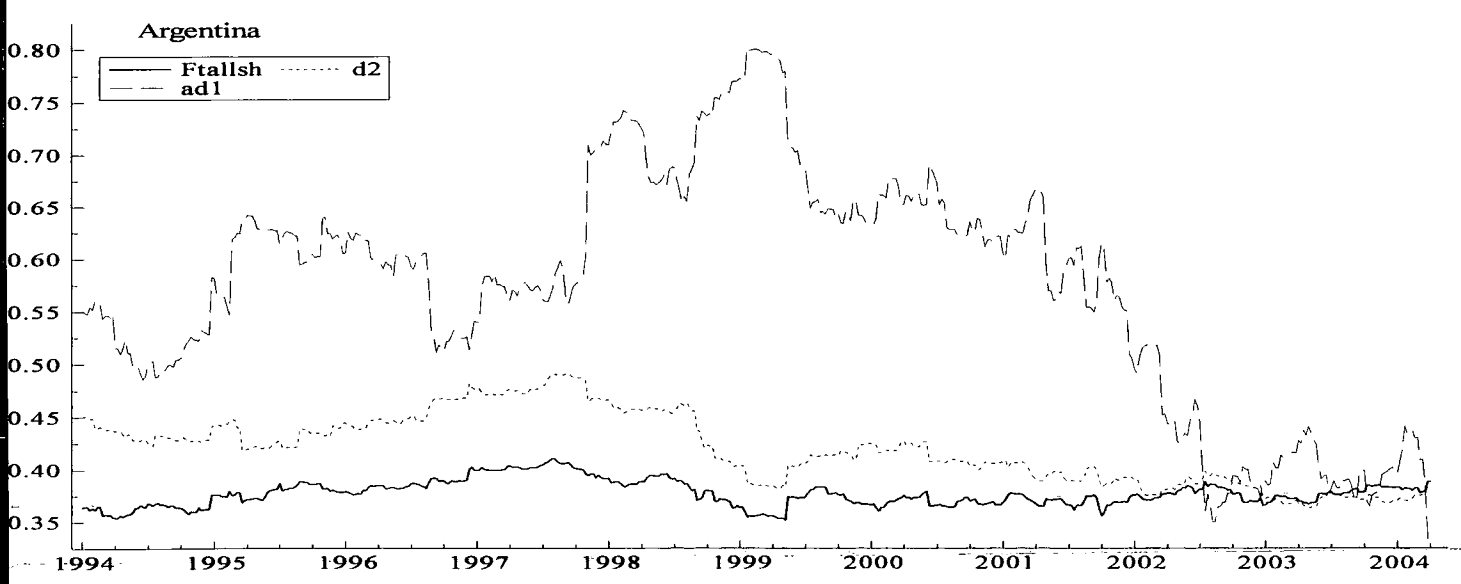

New Zealand
Ftallsh
d2
ad1
0.7
0.6
0.5
0.4
0.3
0.2
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

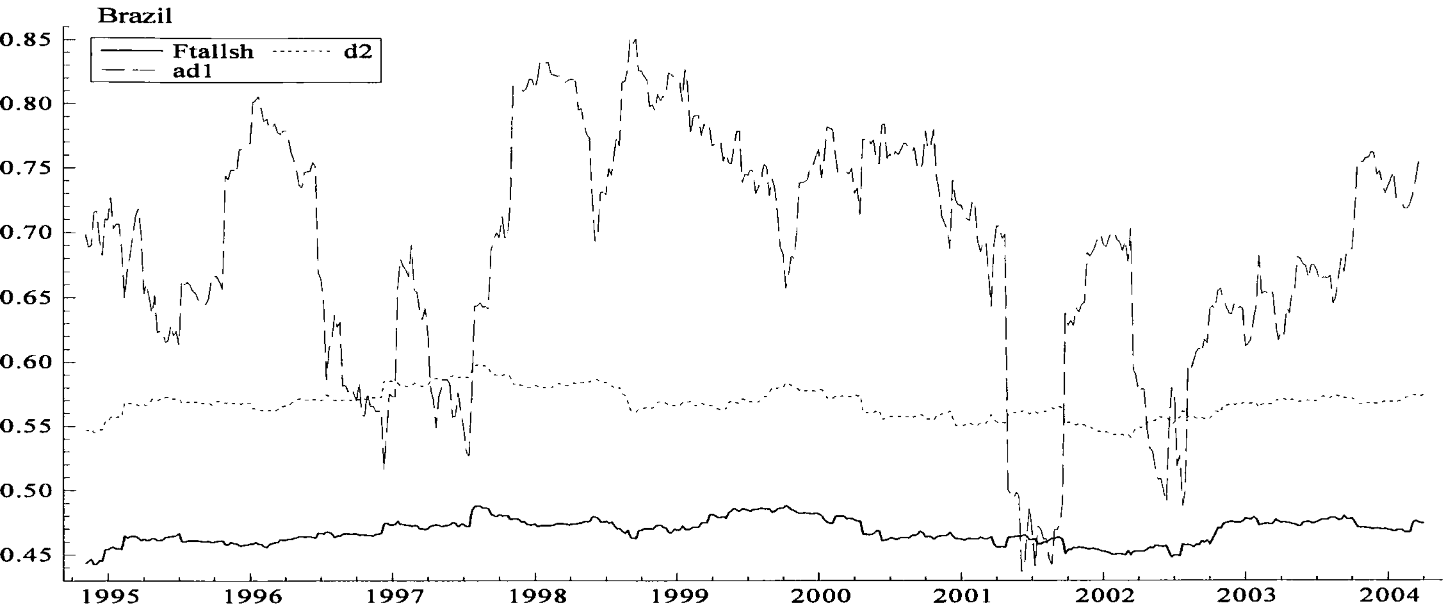

Spain
Ftallsh
D2
ad1
0.8
0.7
0.6
0.5
0.4
0.3
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

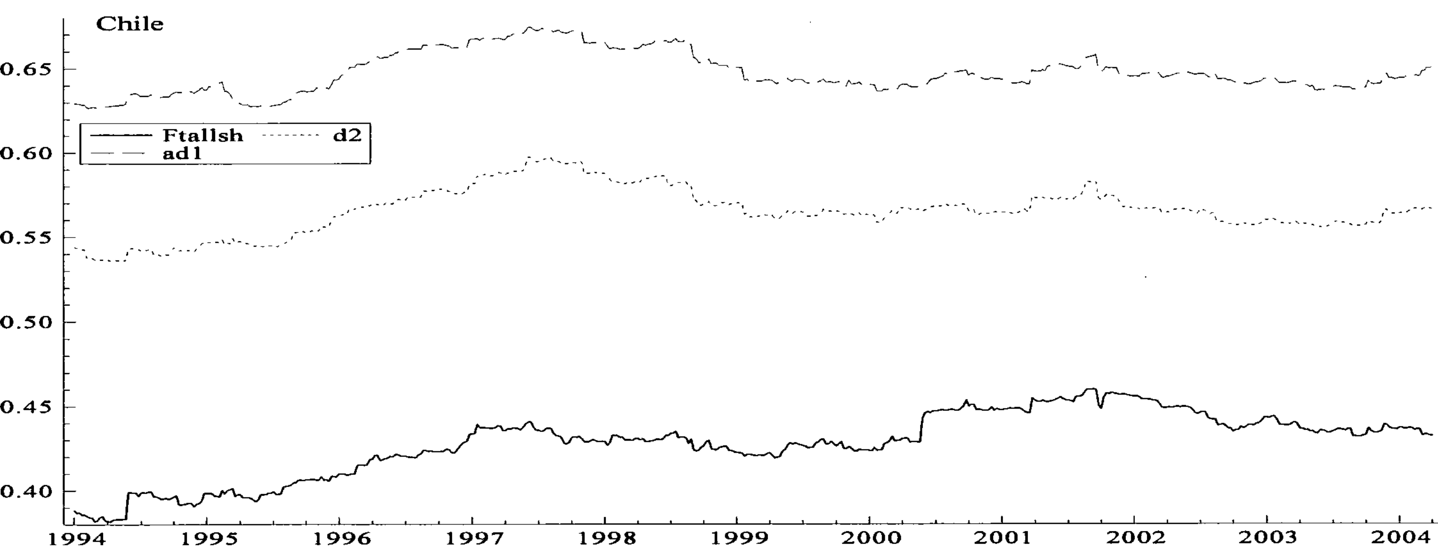

Sweden
Ftallsh
d2
ad1
0.85
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0.45
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

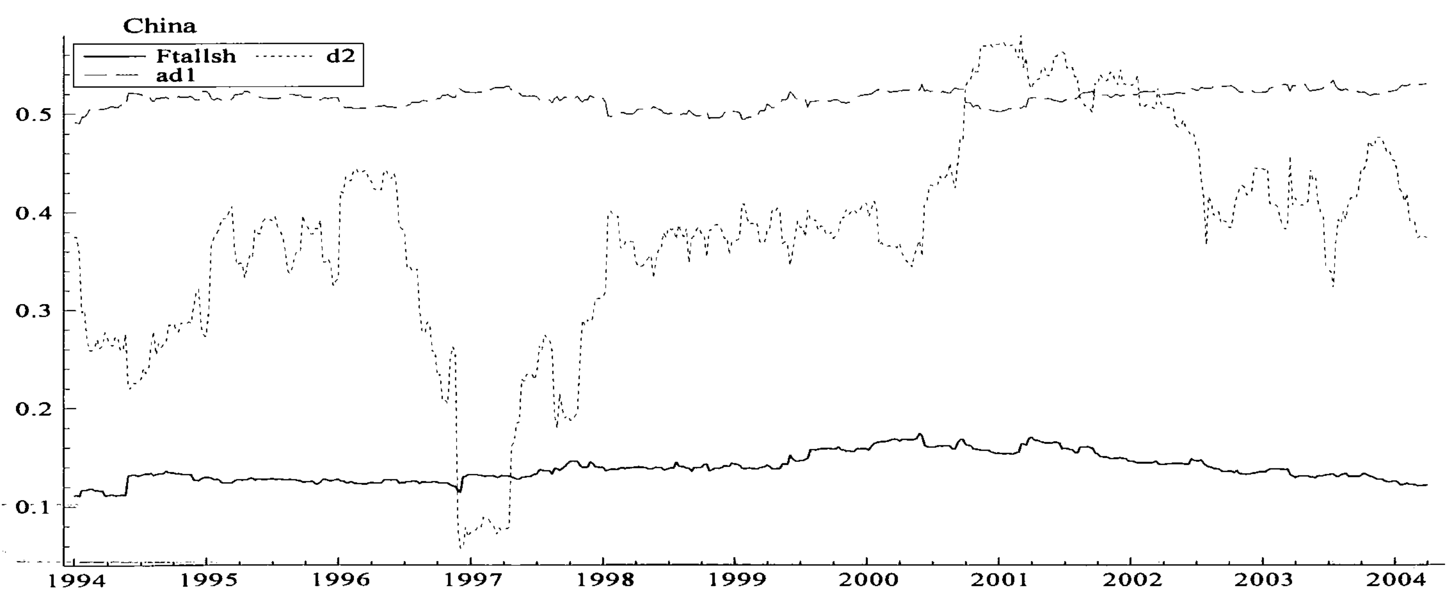

Switzerland
Ftallsh
d2
ad1
0.8
0.7
0.6
0.5
0.4
0.3
0.2
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

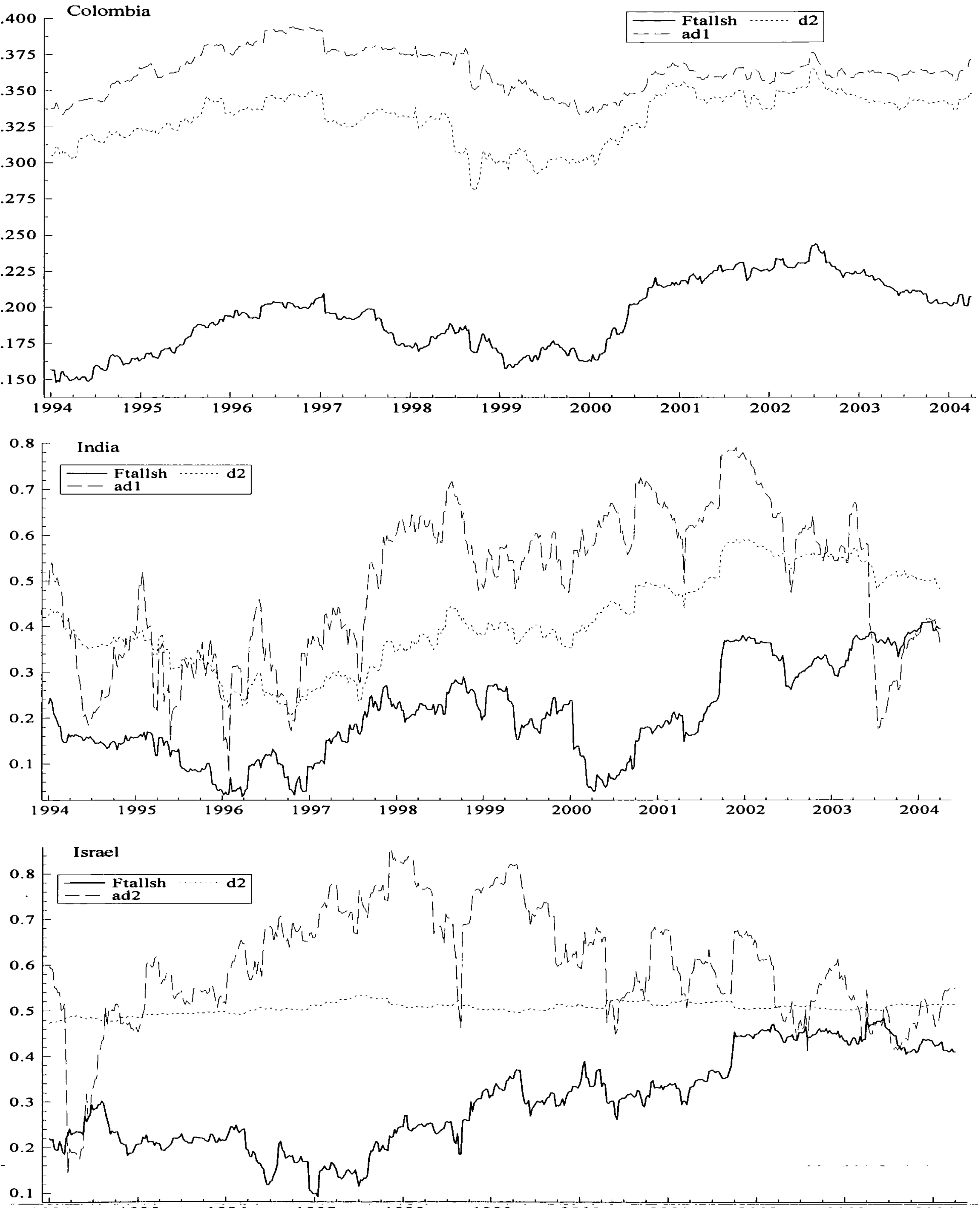

USA
FTallsh
d2
ad2
0.9
0.8
0.7
0.6
0.5
0.4
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

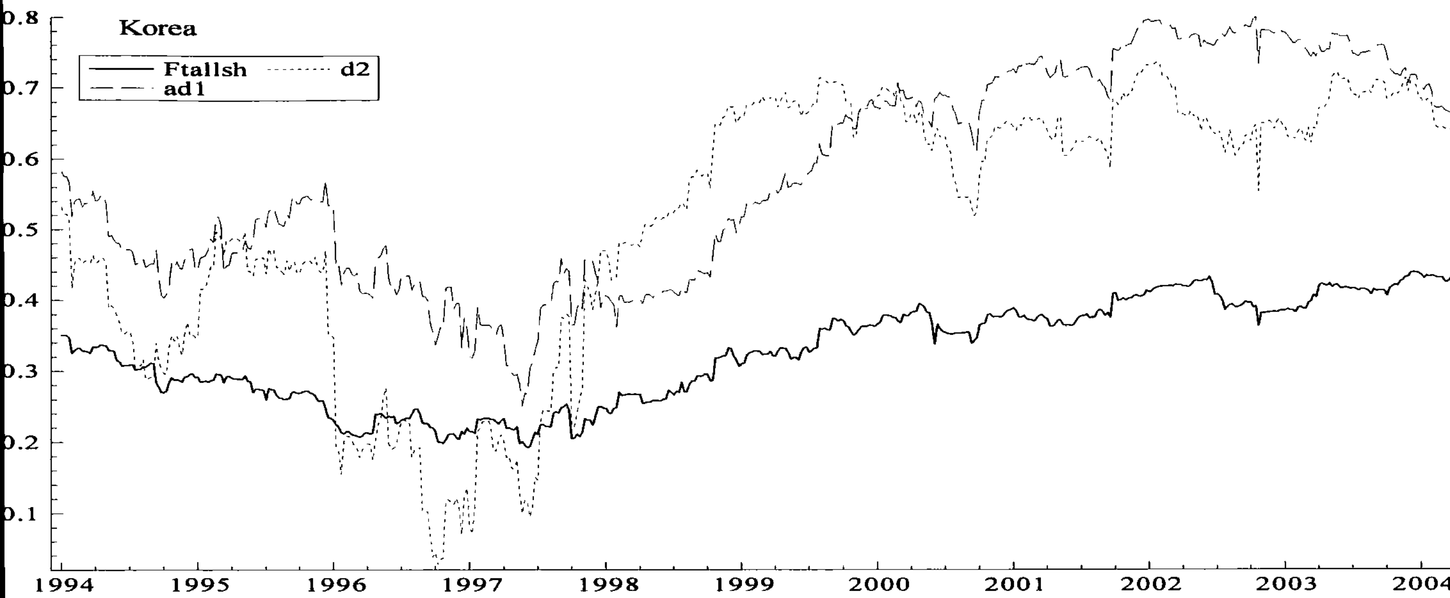

Argentina
Ftallsh
d2
ad1
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

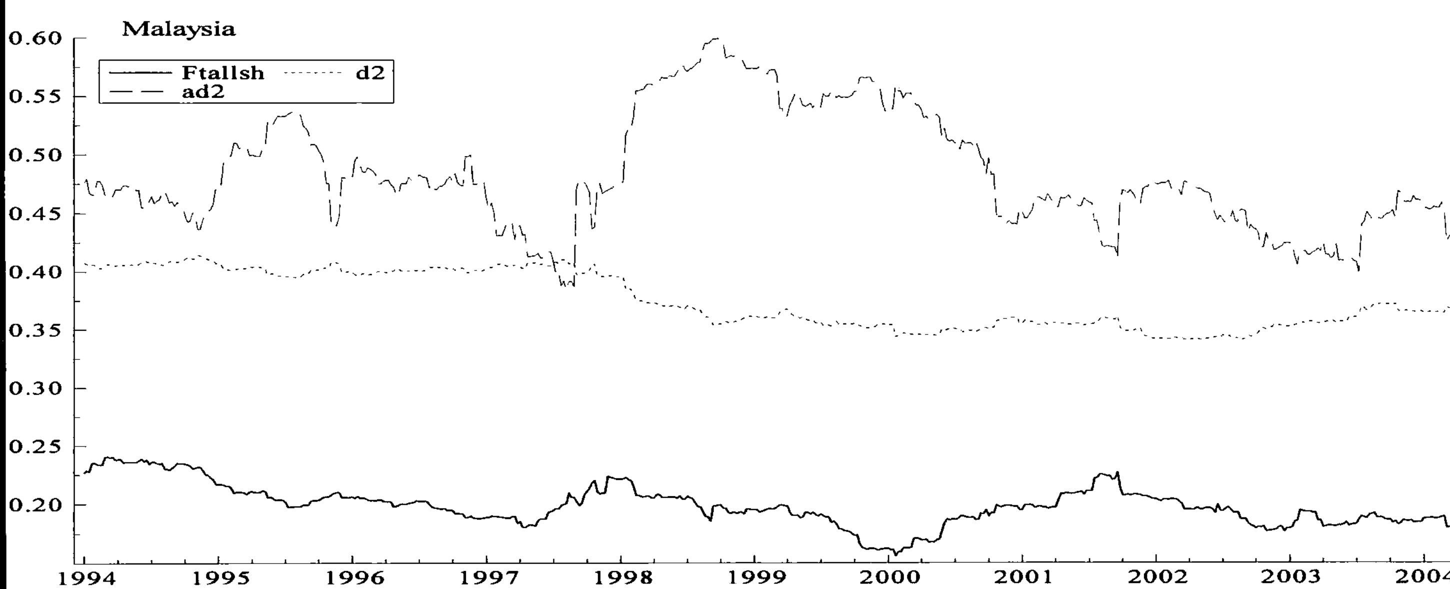

Brazil
Ftallsh
d2
ad1
0.85
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0.45
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

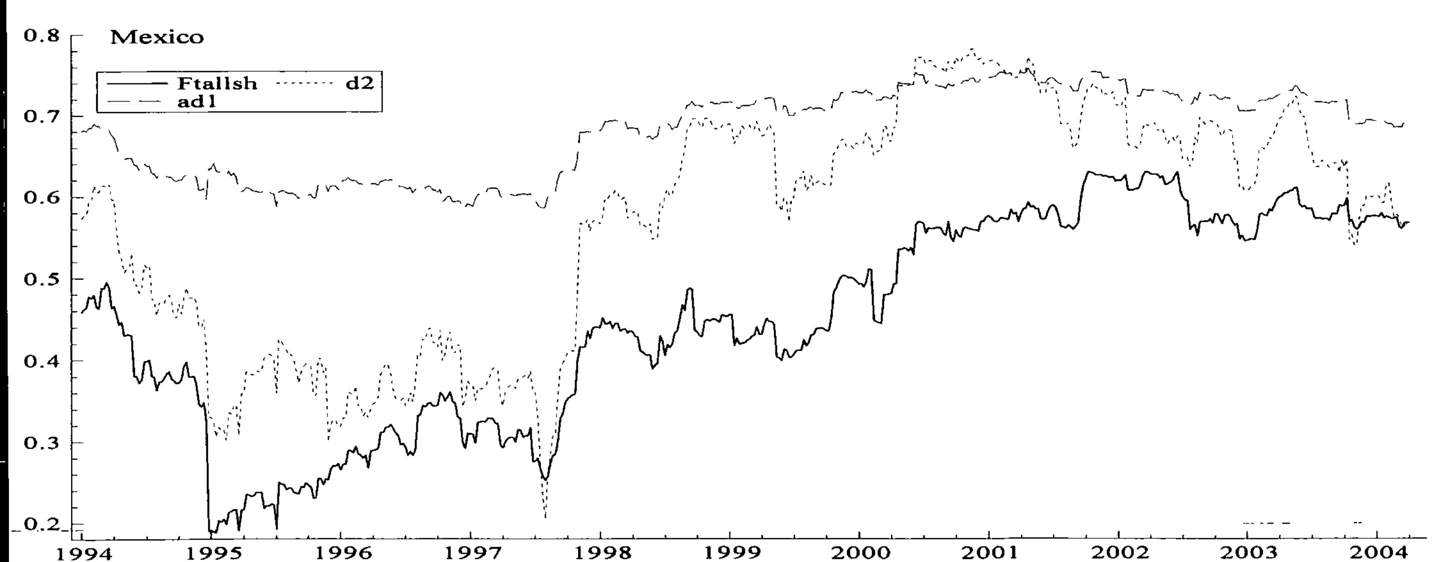

Chile
Ftallsh
d2
ad1
0.65
0.60
0.55
0.50
0.45
0.40
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

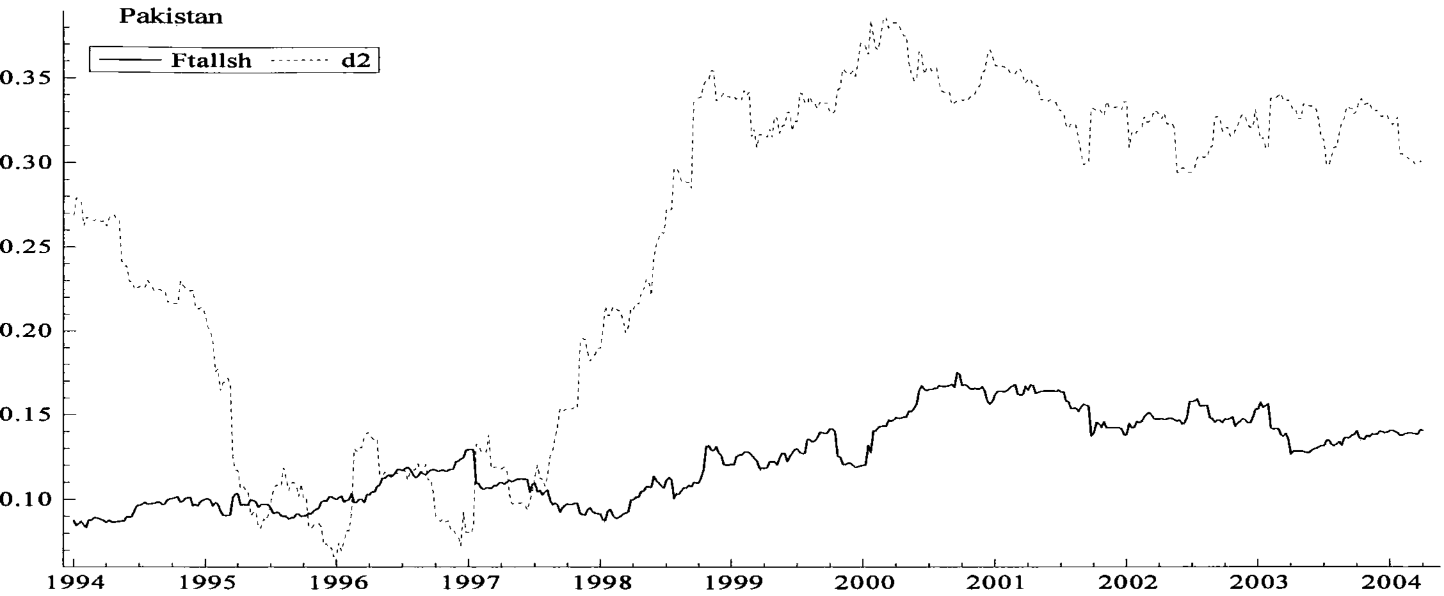

China
Ftallsh
d2
ad1
0.5
0.4
0.3
0.2
0.1
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

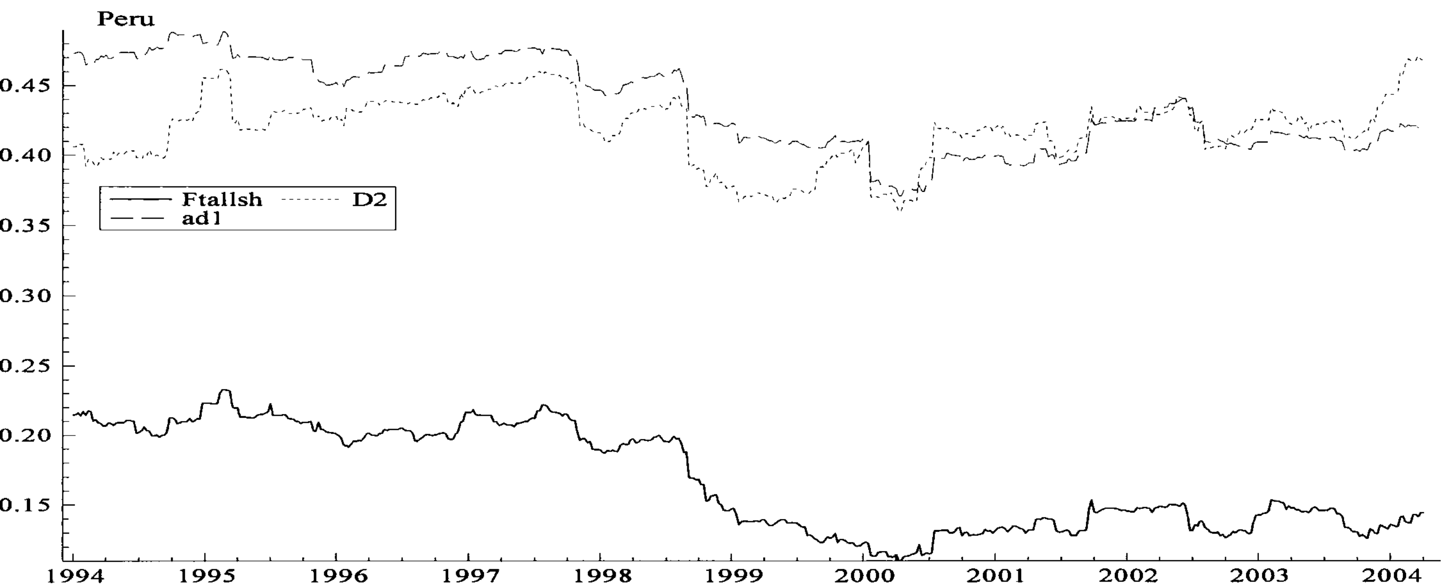

Colombia
Ftallsh
d2
ad1
.400
.375
.350
.325
.300
.275
.250
.225
.200
.175
.150
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
India
Ftallsh
d2
ad1
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
Israel
Ftallsh
d2
ad2

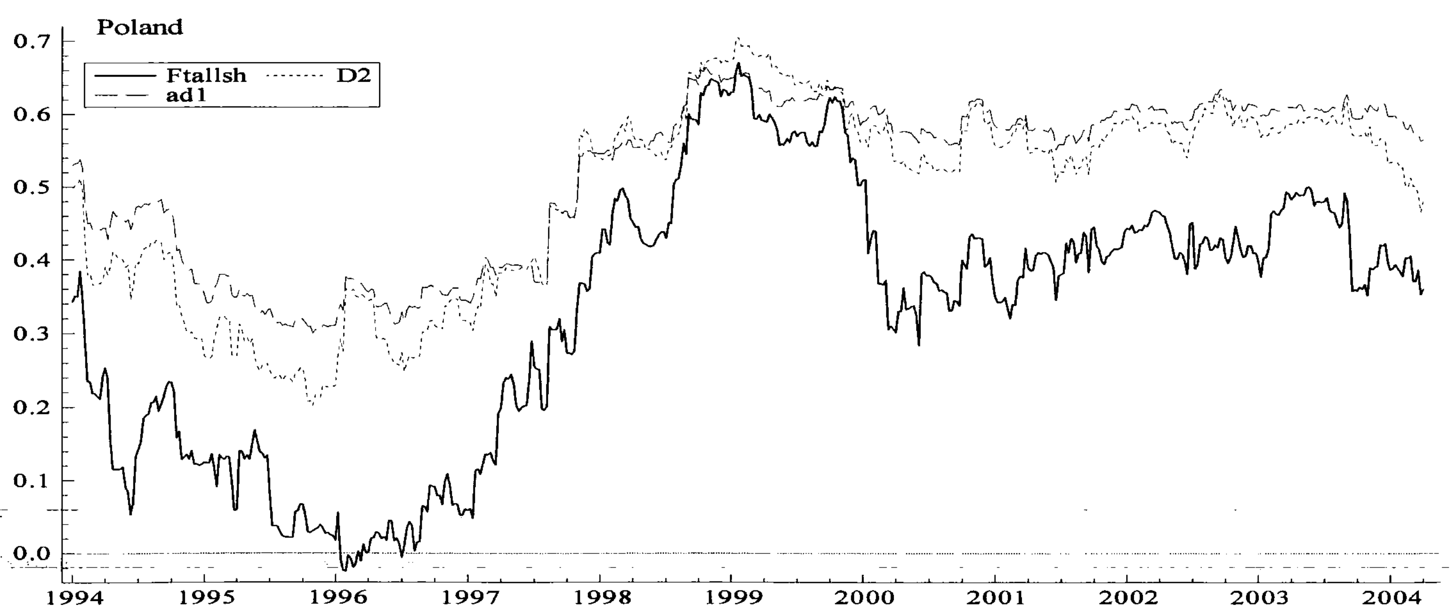

Korea
Ftallsh
d2
ad1
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

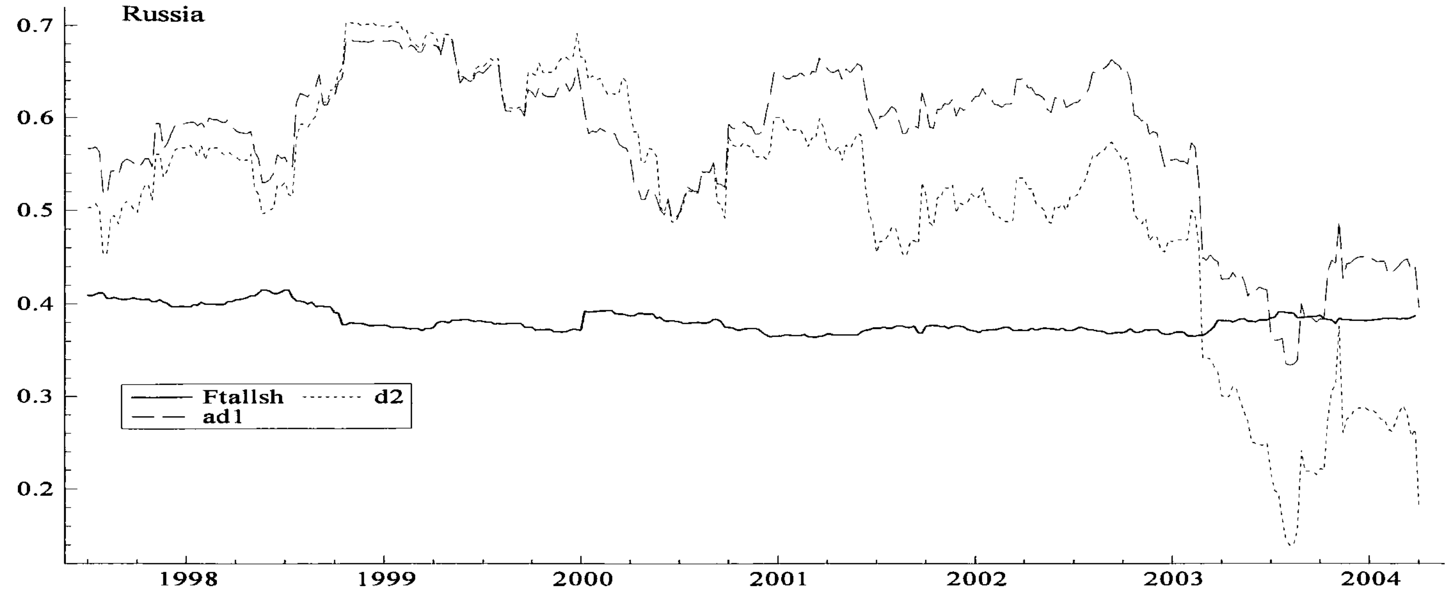

Malaysia
Ftallsh
d2
ad2
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

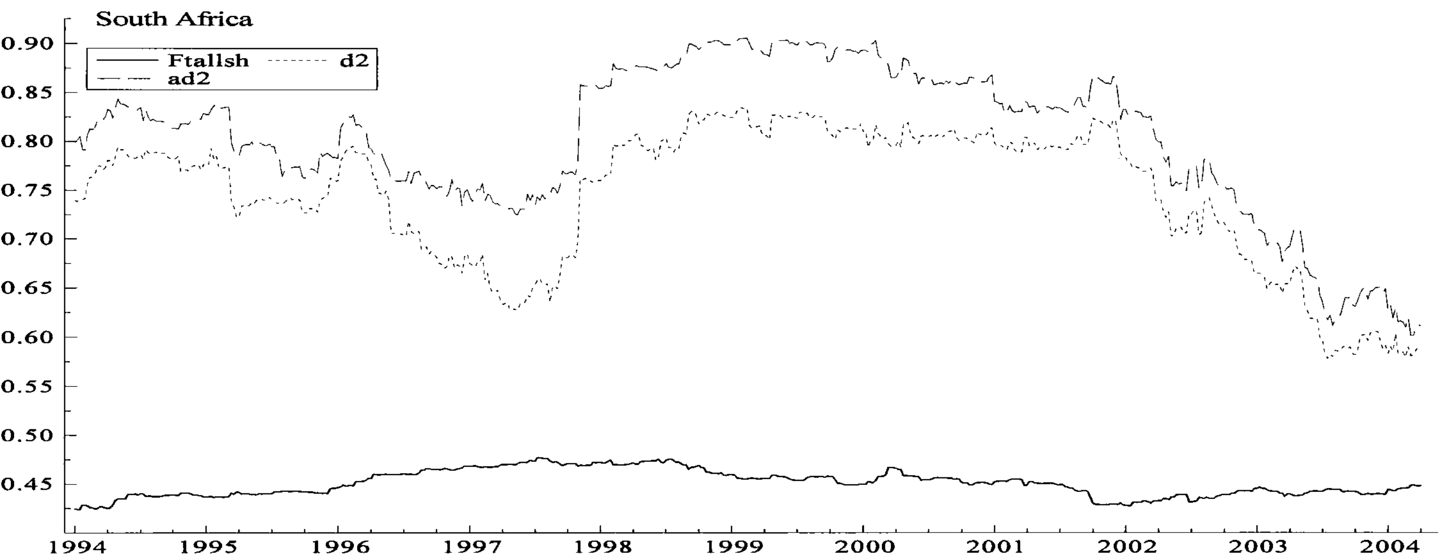

Mexico
Ftallsh
d2
ad1
0.8
0.7
0.6
0.5
0.4
0.3
0.2
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

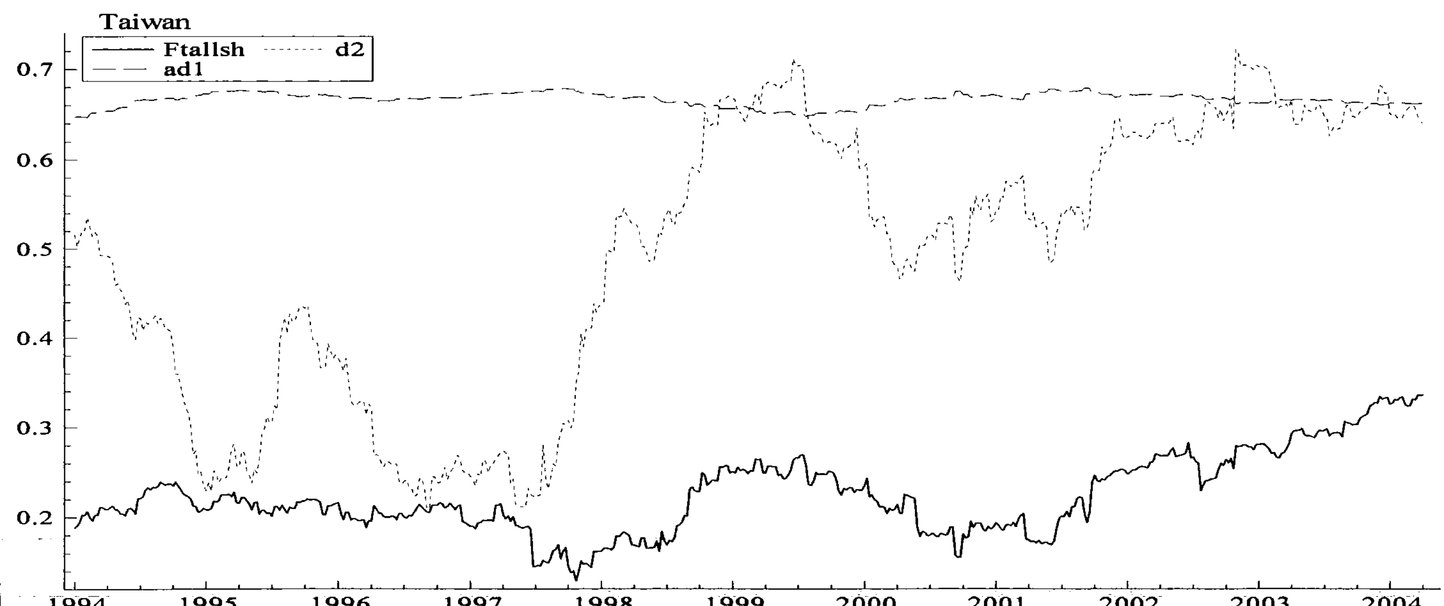

Pakistan
Ftallsh
d2
0.35
0.30
0.25
0.20
0.15
0.10
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

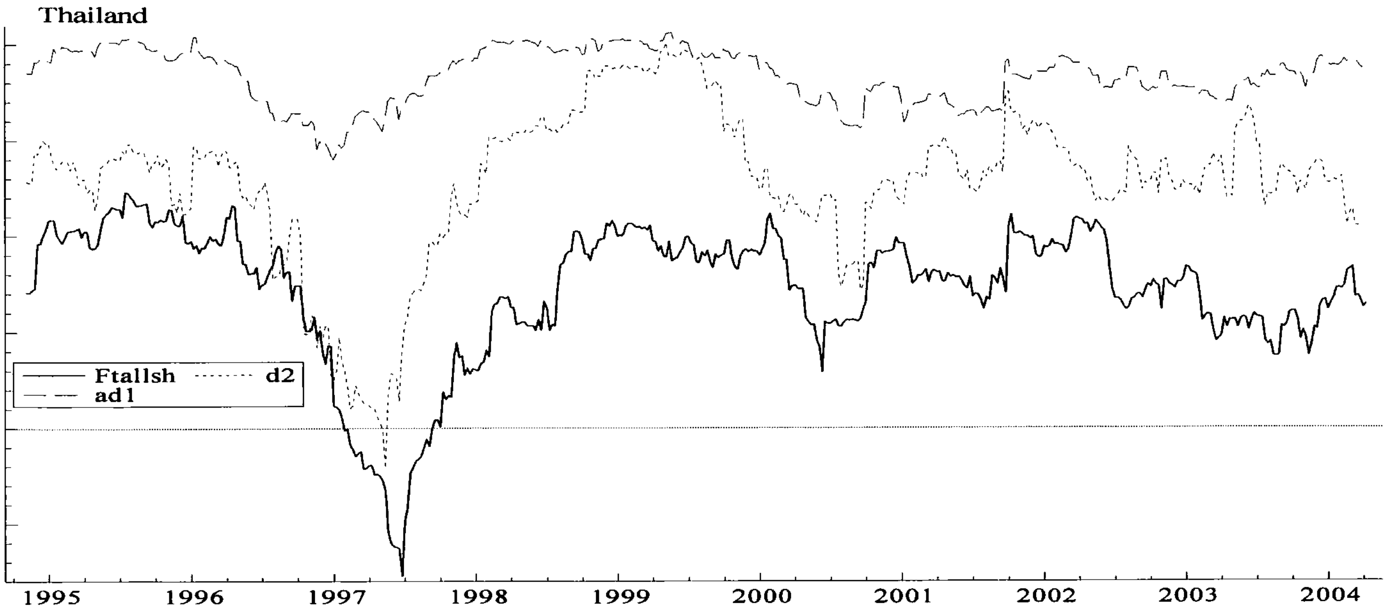

Peru
Ftallsh
D2
ad1
0.45
0.40
0.35
0.30
0.25
0.20
0.15
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

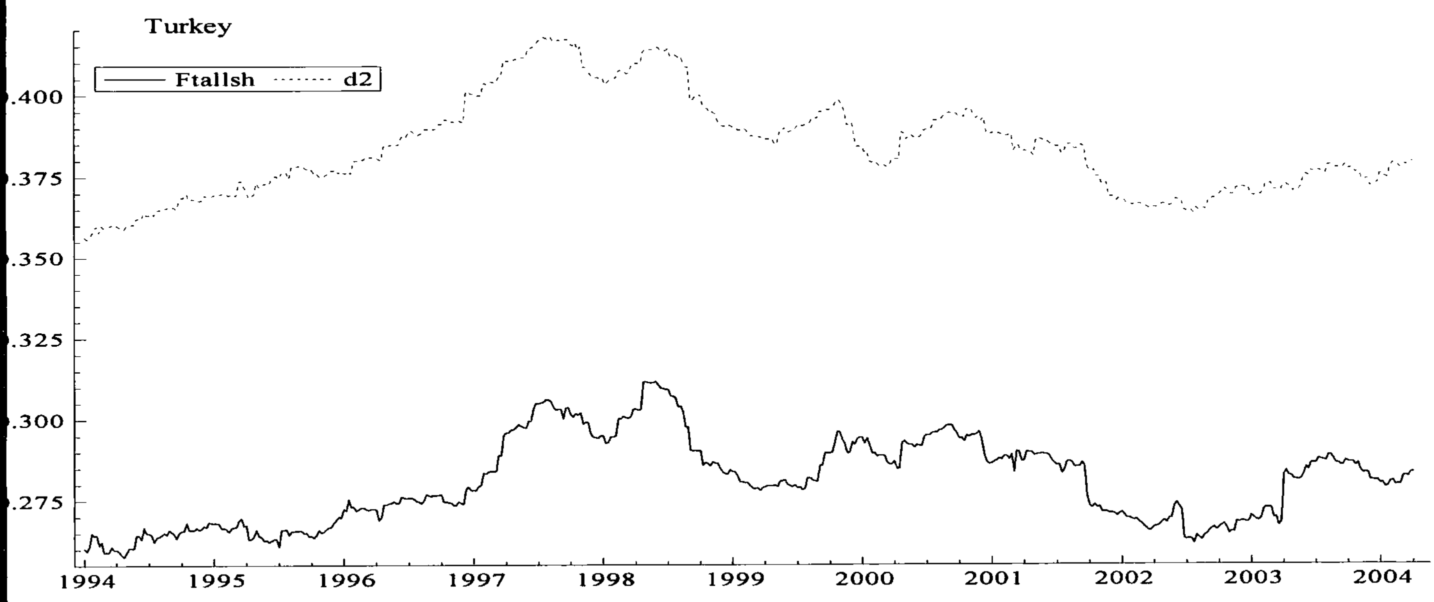

Poland
Ftallsh
D2
ad1
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

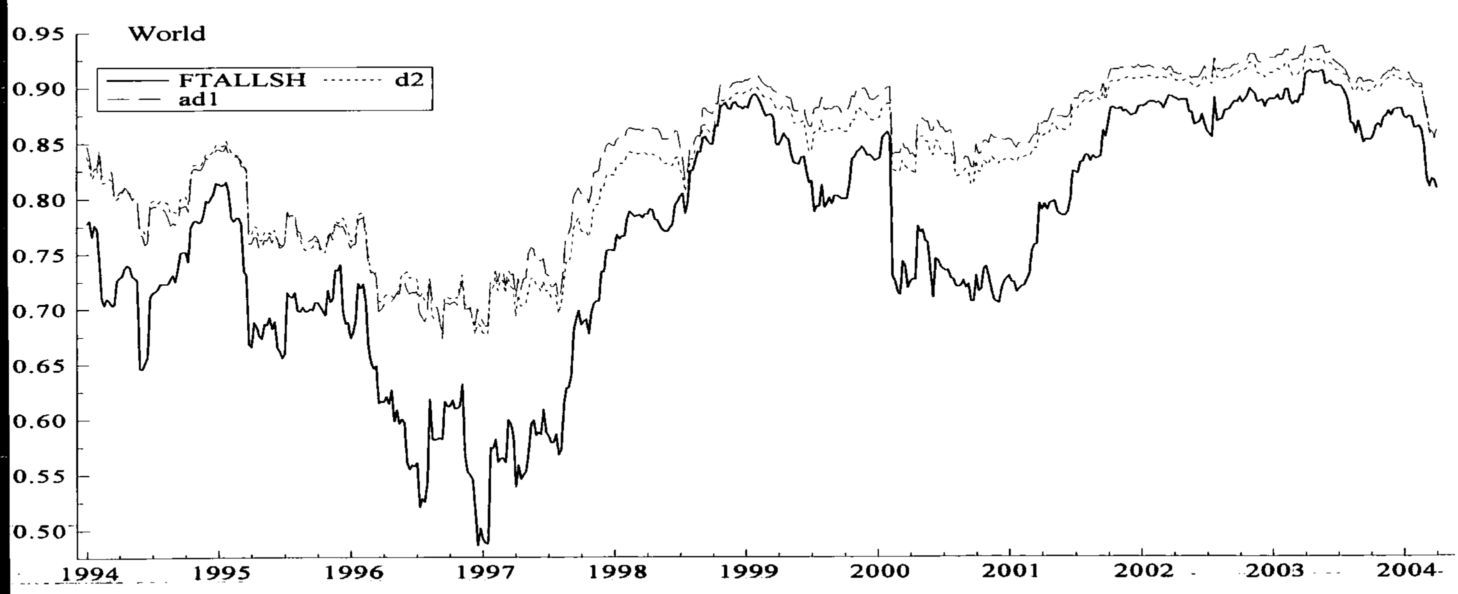

Russia
Ftallsh
d2
ad1
0.7
0.6
0.5
0.4
0.3
0.2
1998
1999
2000
2001
2002
2003
2004


South Africa
Ftallsh
d2
ad2
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0.45
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

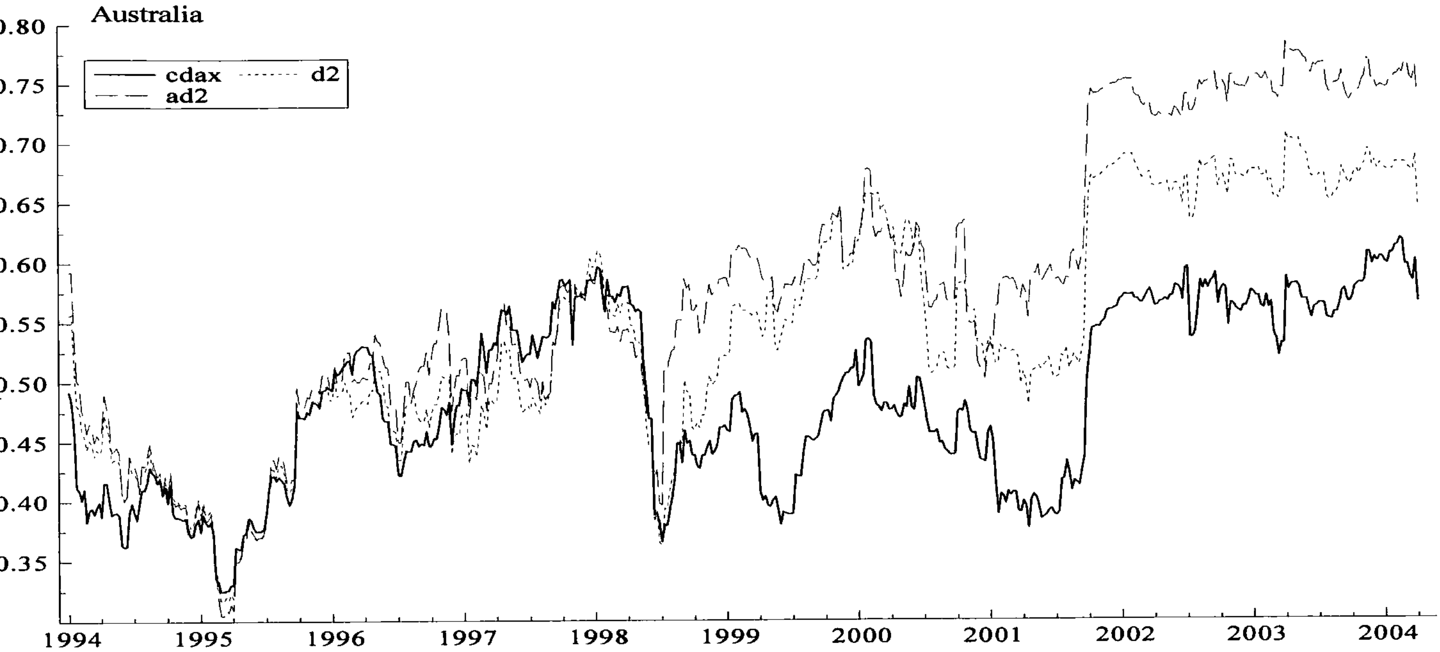

Taiwan
Ftallsh
d2
ad1
0.7
0.6
0.5
0.4
0.3
0.2
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

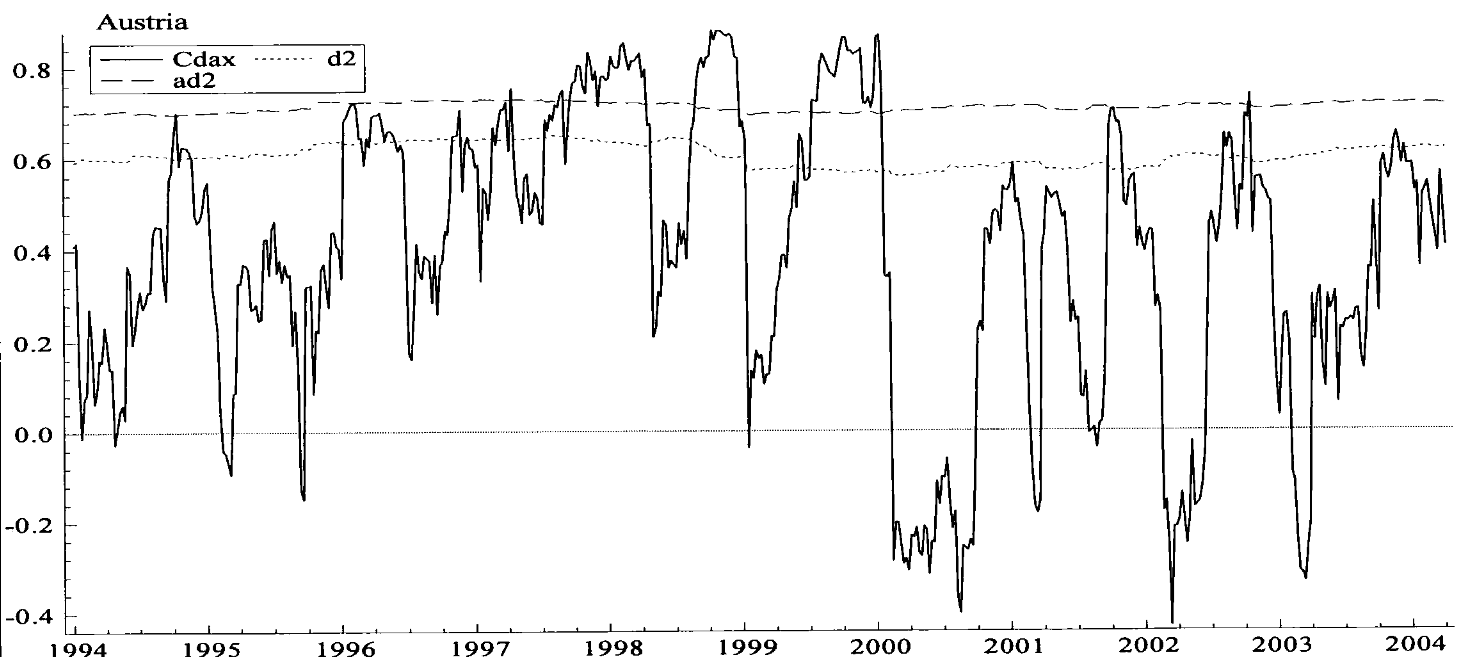

Thailand
Ftallsh
d2
ad1
0.8
0.6
0.4
0.2
0.0
-0.2
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

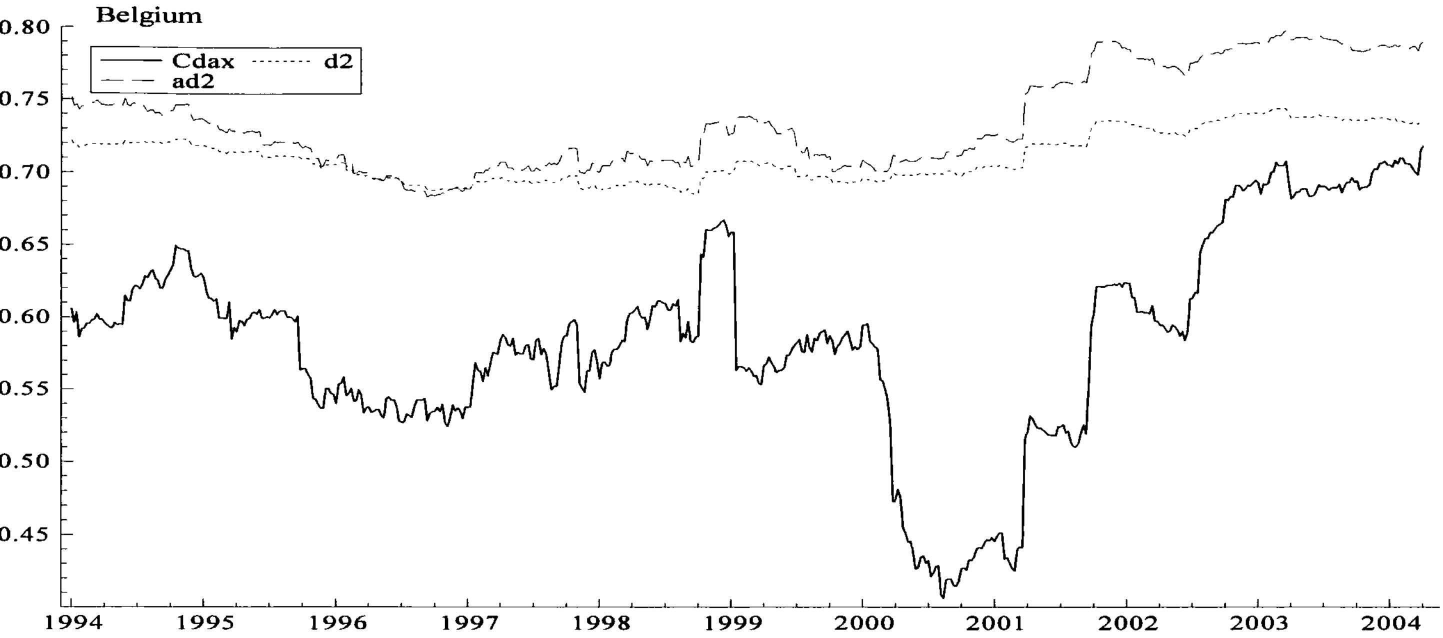

Turkey
Ftallsh
d2
.400
.375
.350
.325
.300
.275
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

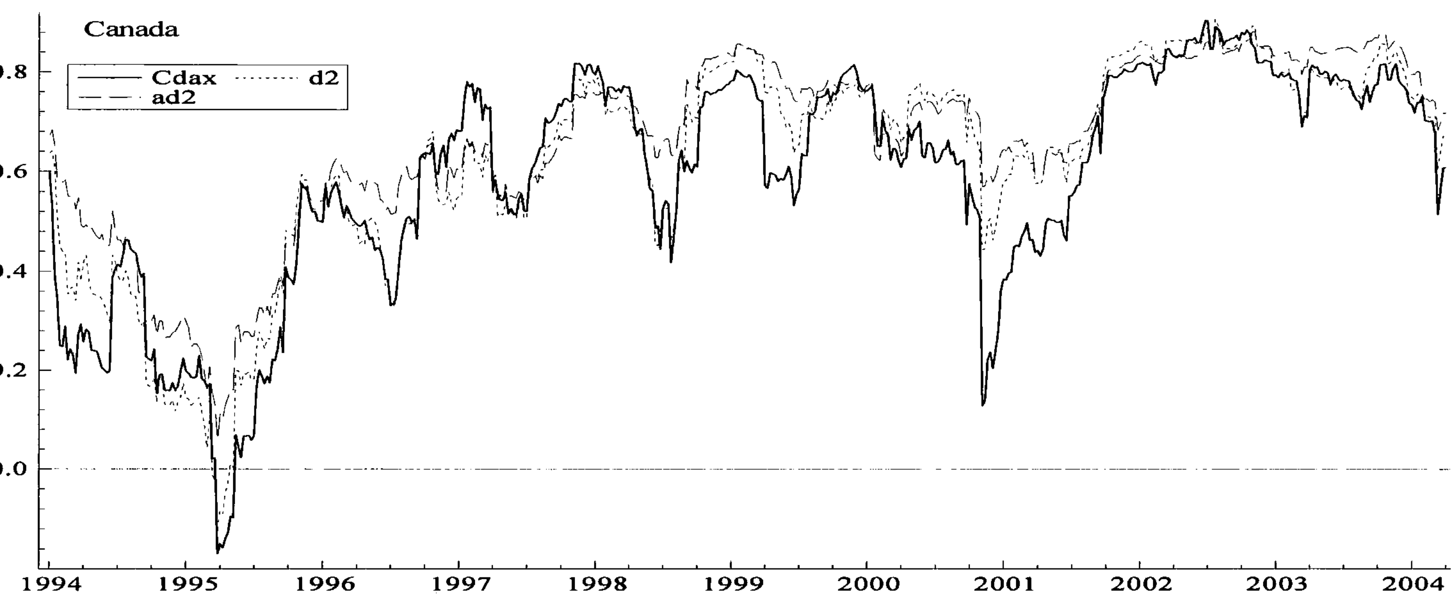

World
FTALLSH
d2
ad1
0.95
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0.55
0.50
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

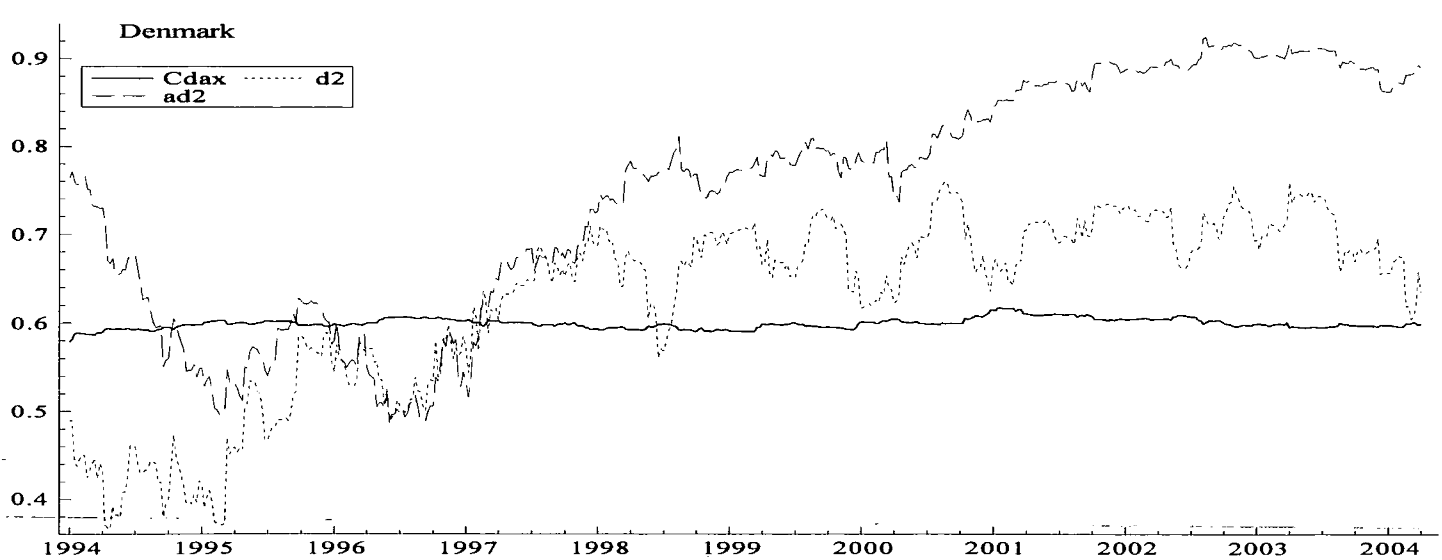
Appendix C5(b): <u>**Dynamic Conditional Correlations (DCC)** between foreign market indices and various diversification portfolios based on German traded assets. 'CDAX' is the correlation between the foreign index and the German CDAX General Index.</u>

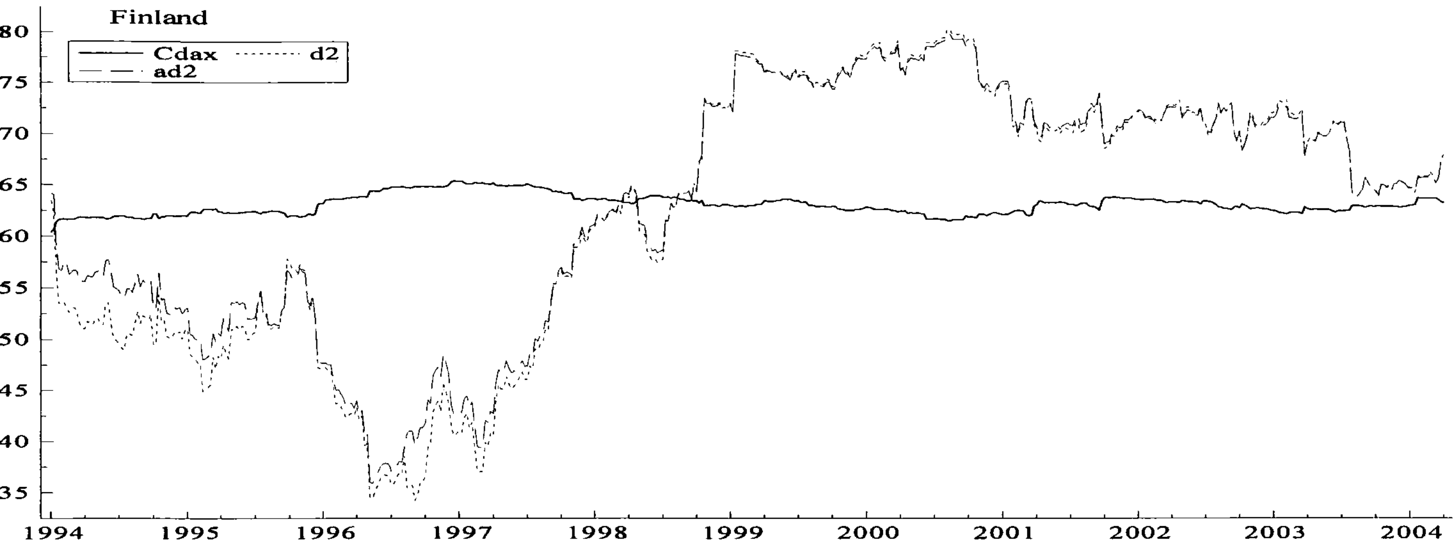


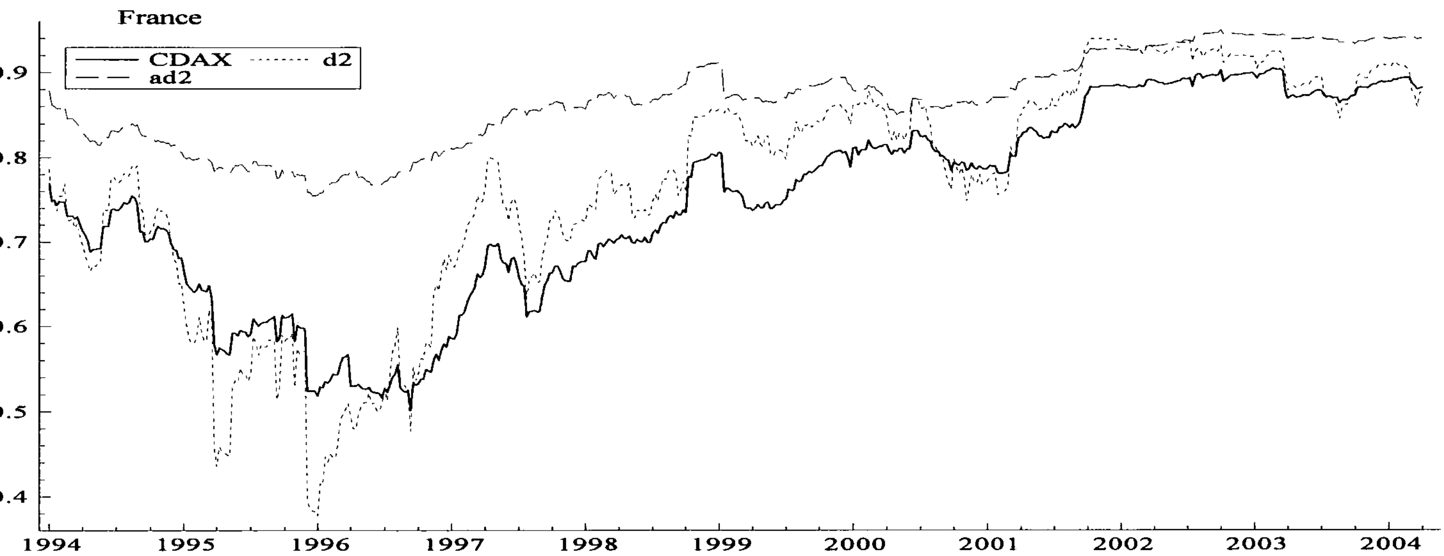


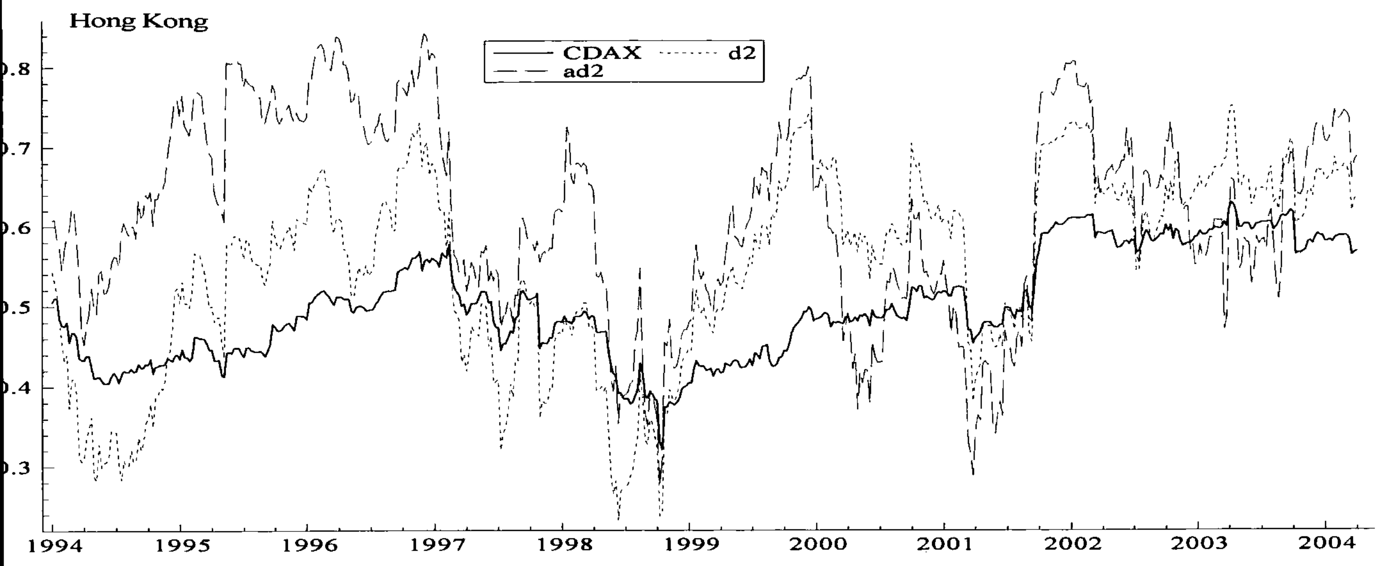

Belgium
Cdax
d2
ad2
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0.45
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

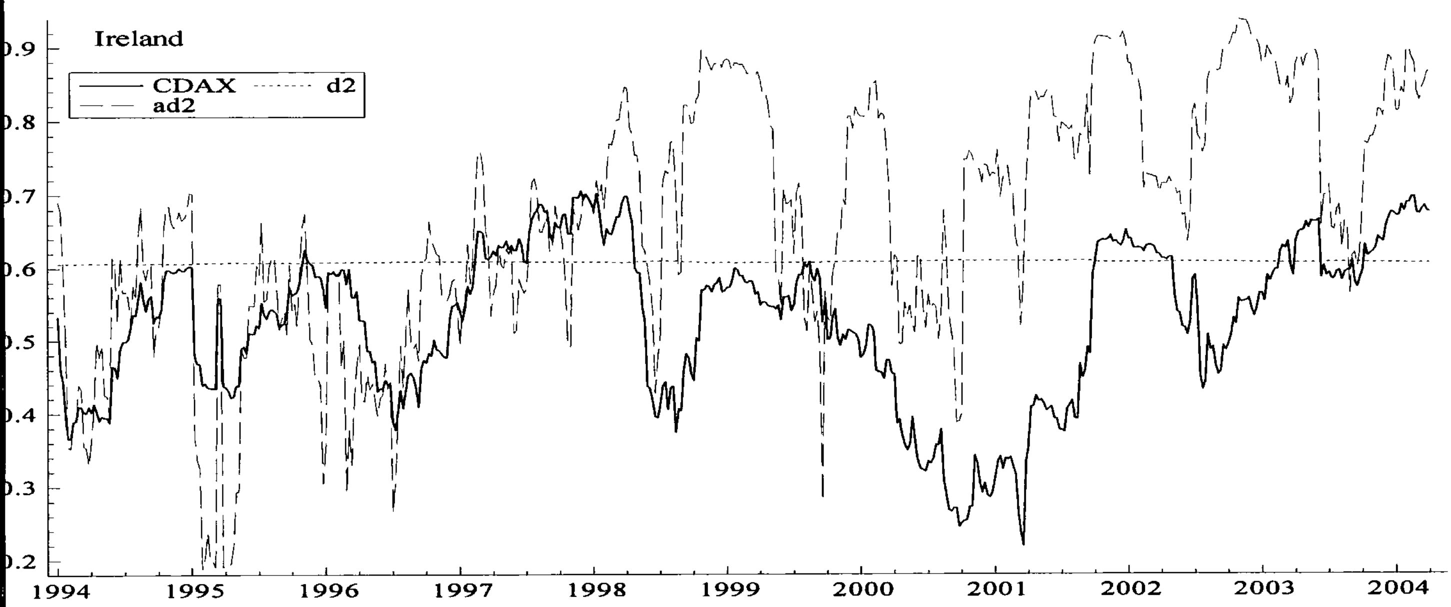

Canada
Cdax
d2
ad2
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

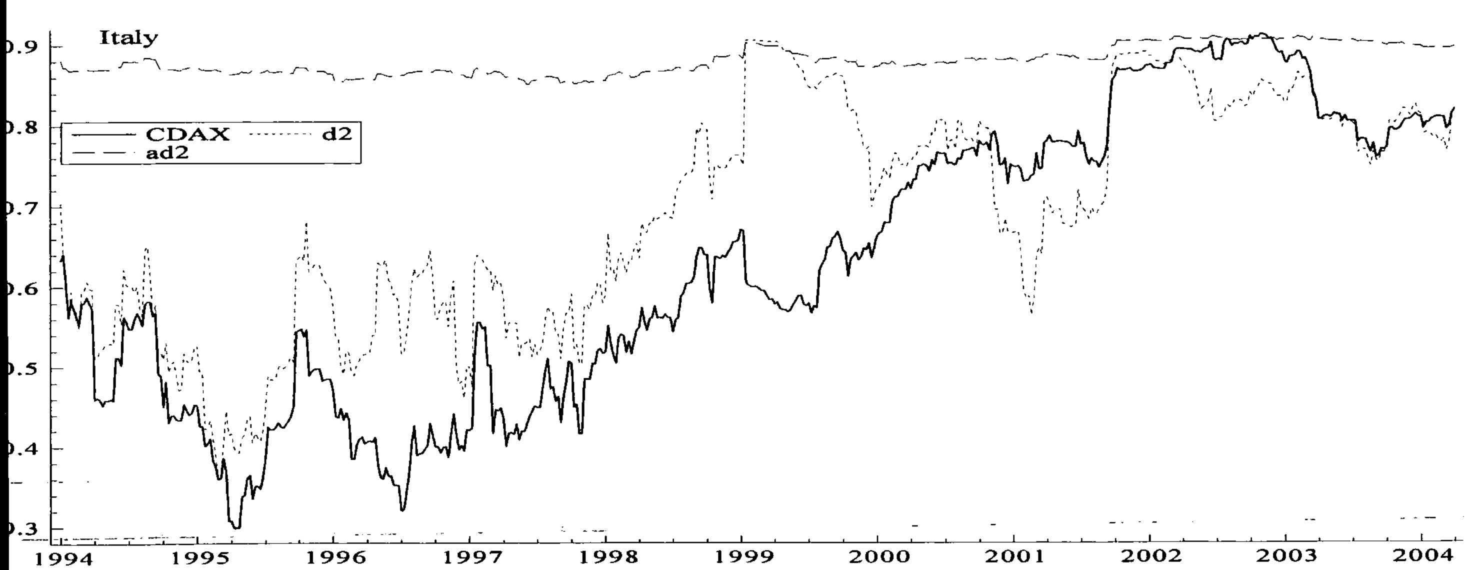

Denmark
Cdax
d2
ad2
0.9
0.8
0.7
0.6
0.5
0.4
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

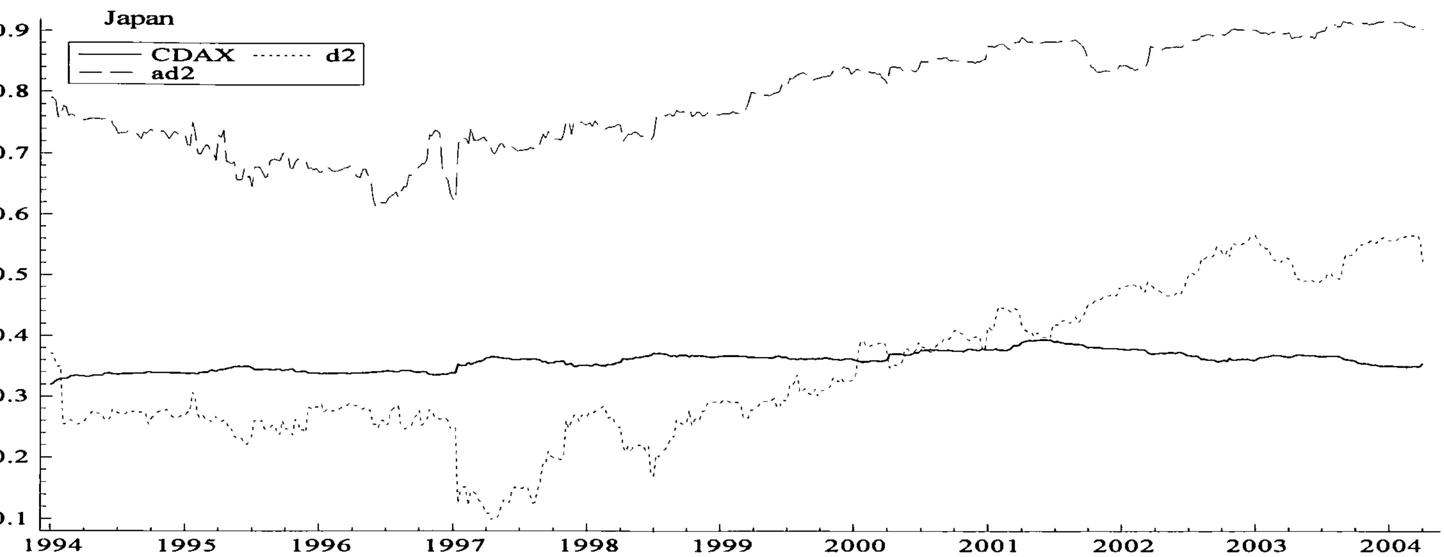

Finland
Cdax
d2
ad2
80
75
70
65
60
55
50
45
40
35
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004


France
CDAX
d2
ad2
.9
.8
.7
.6
.5
.4
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004


Hong Kong
CDAX
d2
ad2
.8
.7
.6
.5
.4
.3
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004


Ireland
CDAX
d2
ad2
.9
.8
.7
.6
.5
.4
.3
.2
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004


Italy
CDAX
d2
ad2
.9
.8
.7
.6
.5
.4
.3
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004


Japan
CDAX
d2
ad2
.9
.8
.7
.6
.5
.4
.3
.2
.1
1994
1995
1996
1997
1998
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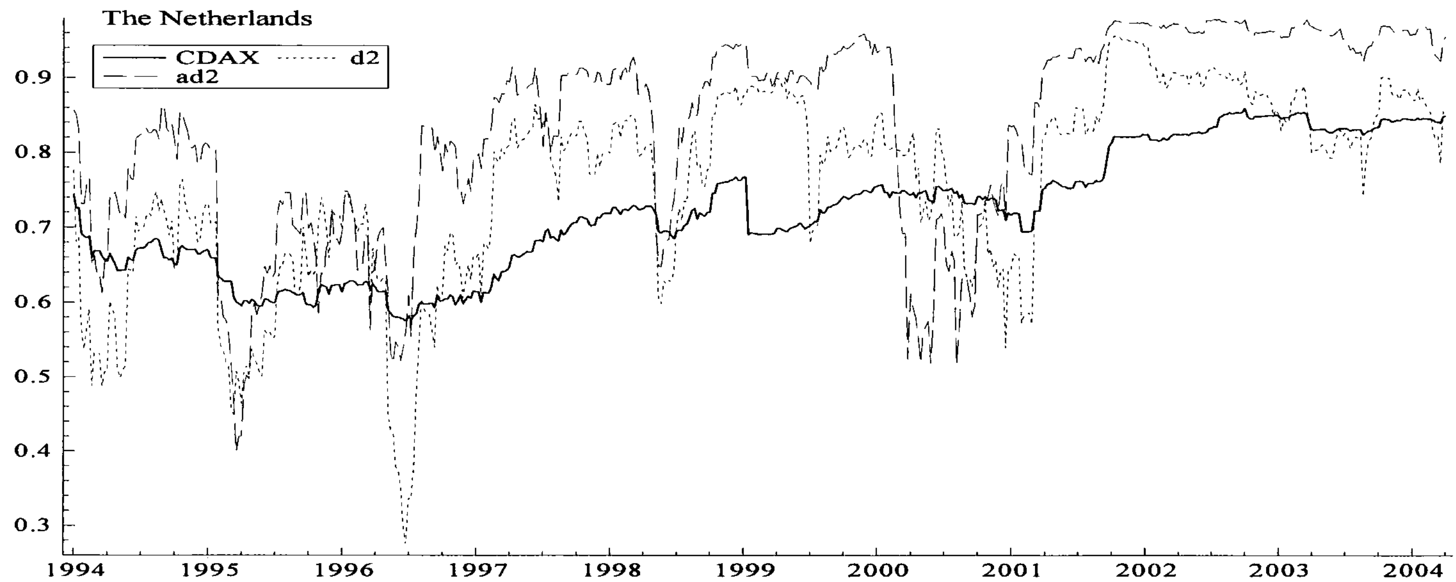
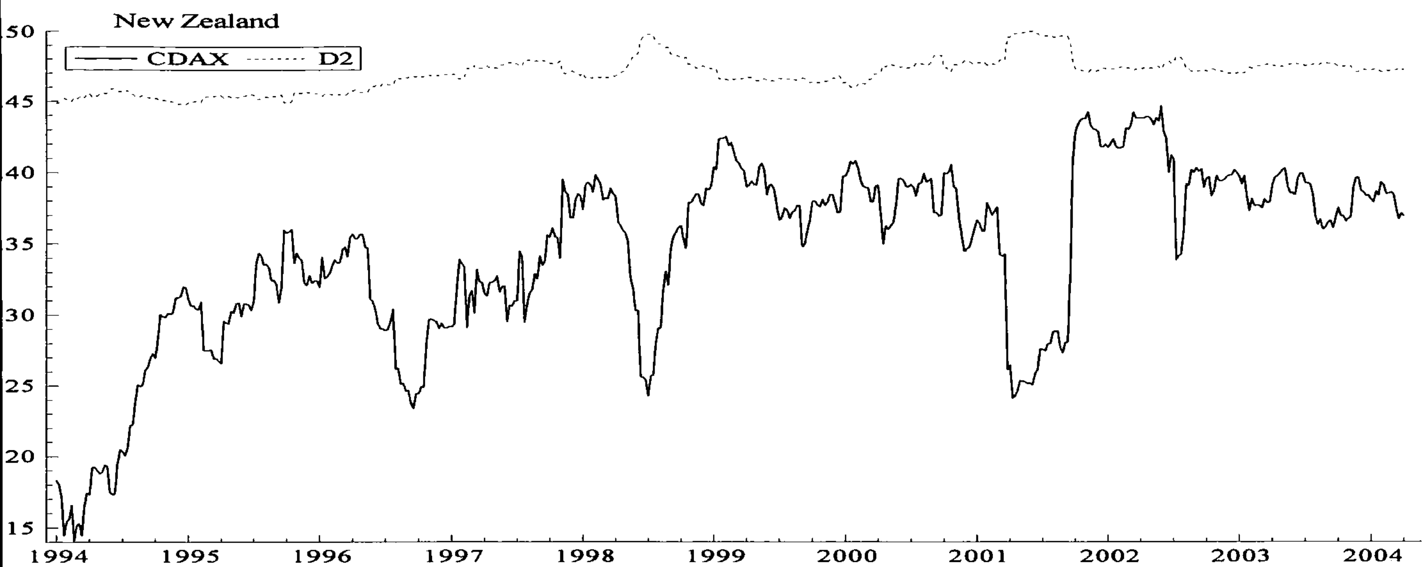
2001
2002
2003
2004


The Netherlands
CDAX
d2
ad2
0.9
0.8
0.7
0.6
0.5
0.4
0.3
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004


New Zealand
CDAX
D2
50
45
40
35
30
25
20
15
1994
1995
1996
1997
1998
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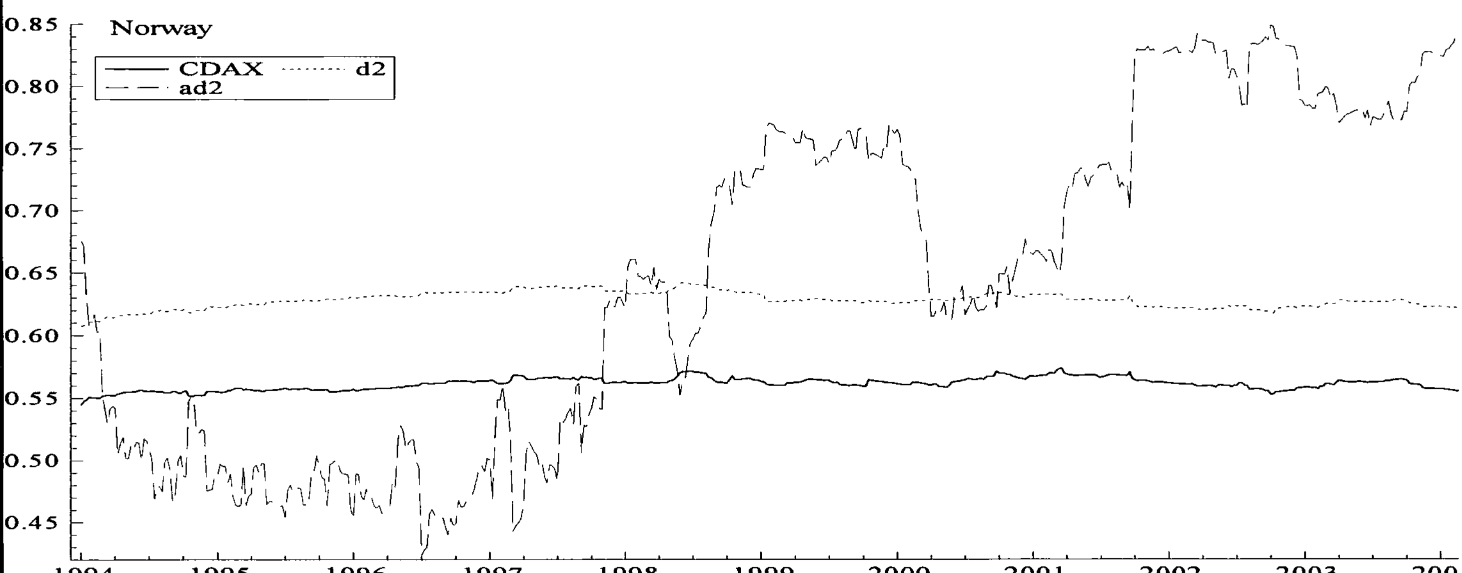
2001
2002
2003
2004


Norway
CDAX
d2
ad2
0.85
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0.45
1994
1995
1996
1997
1998
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2000
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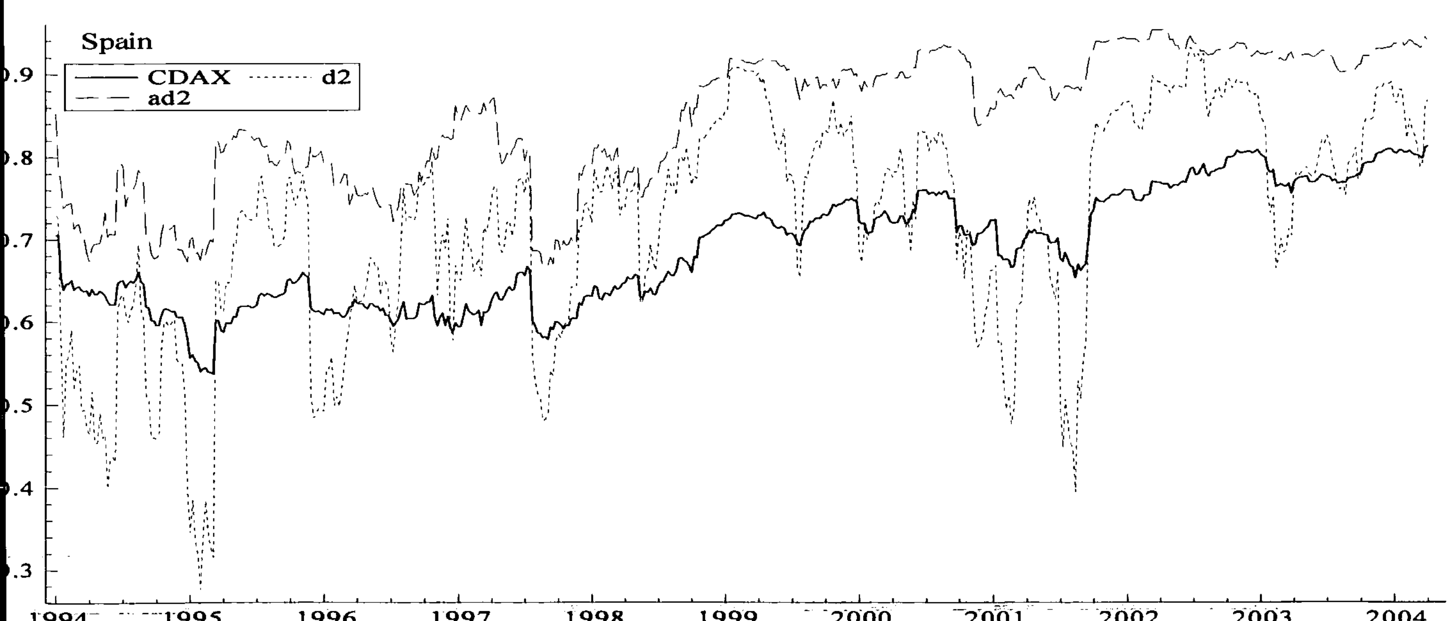
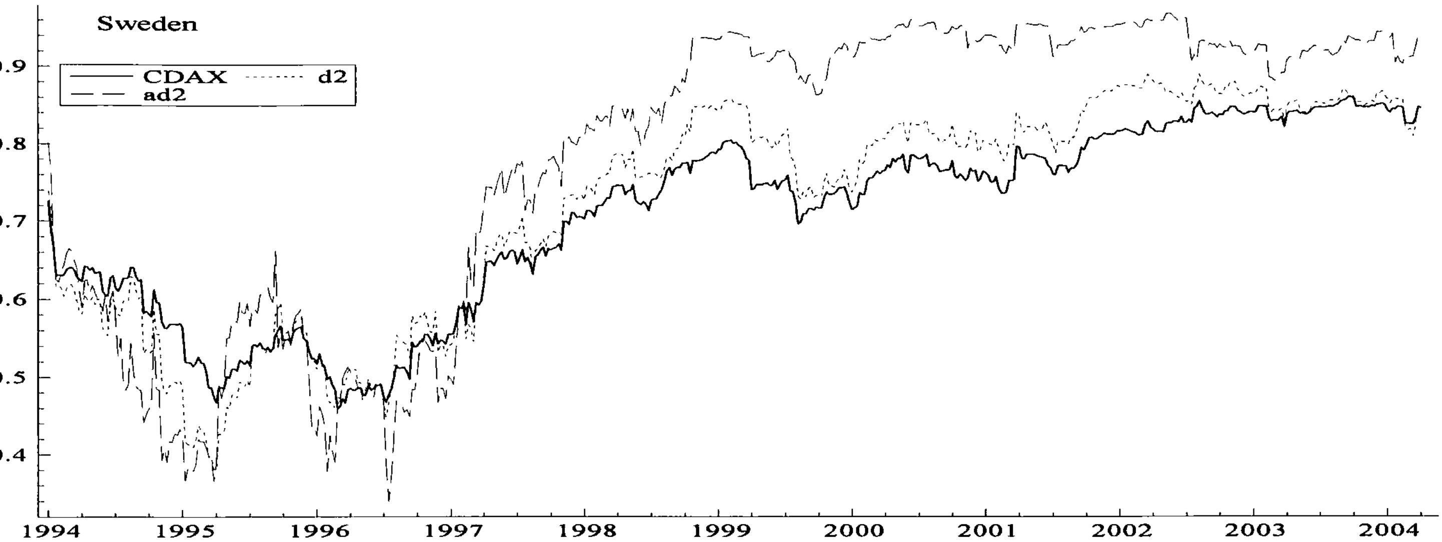
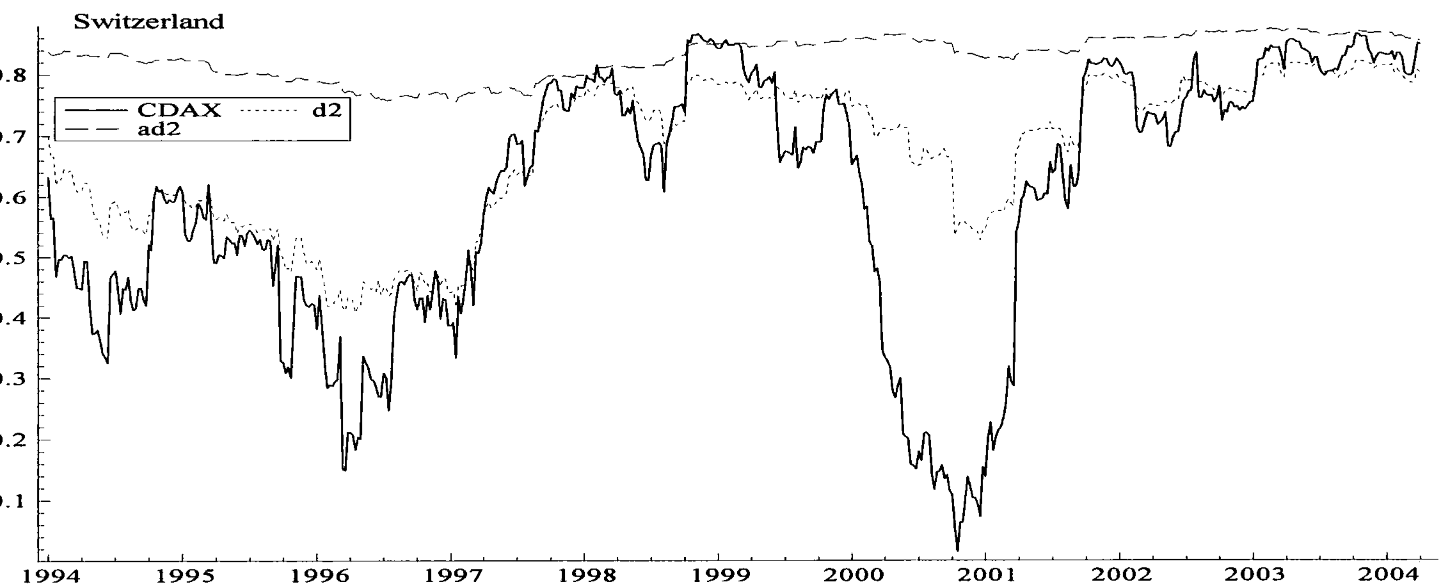
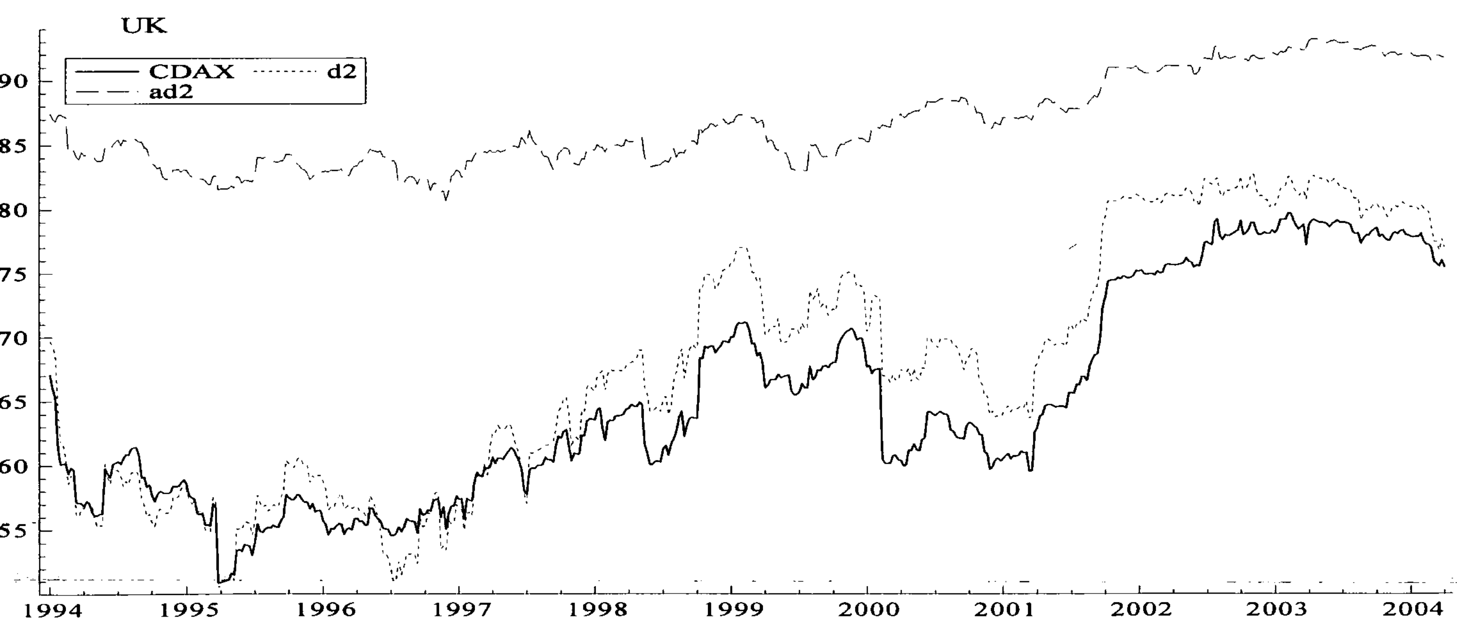
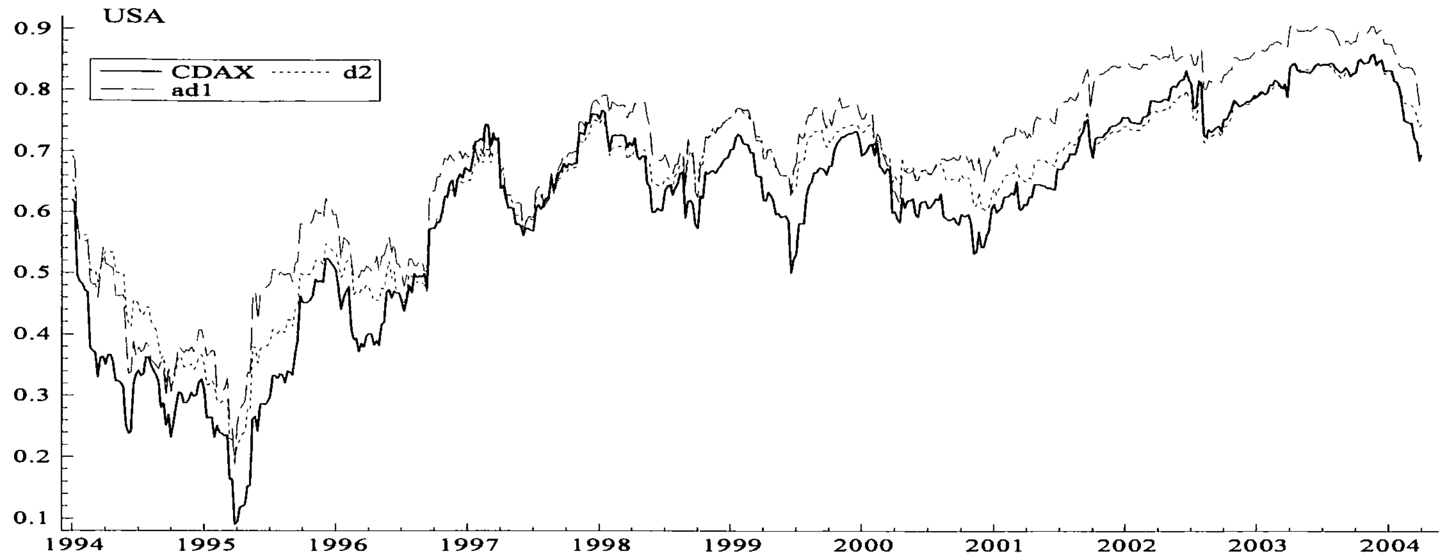
2002
2003

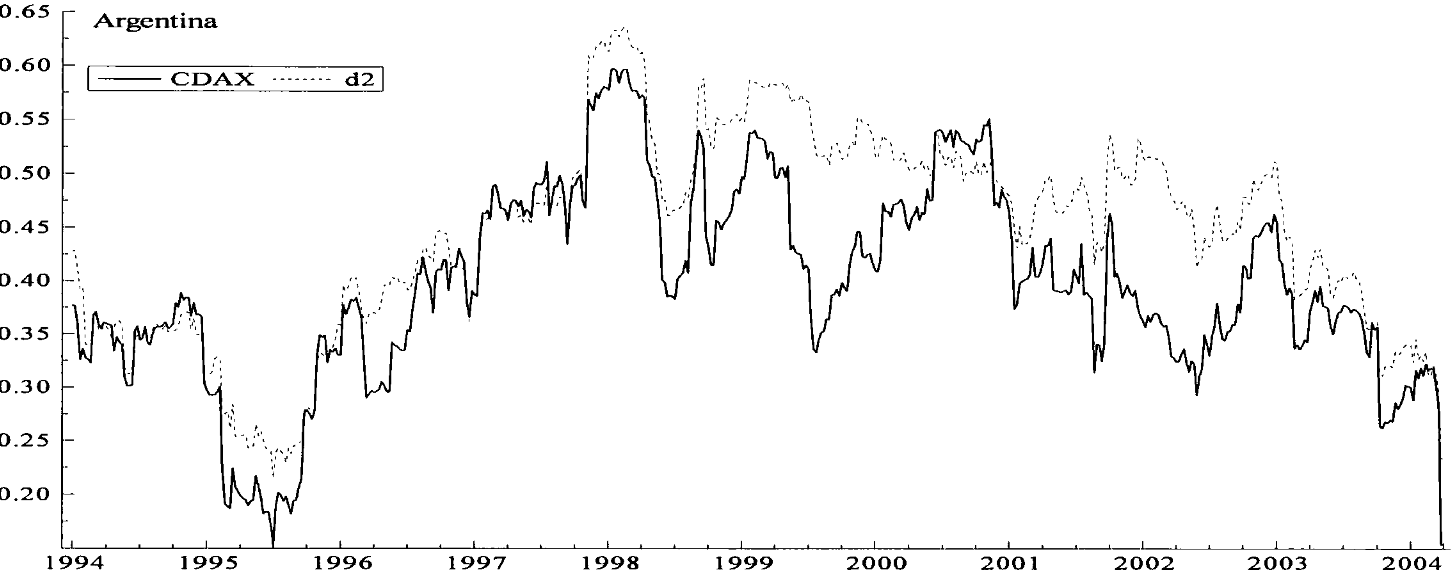

Spain
CDAX
d2
ad2
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

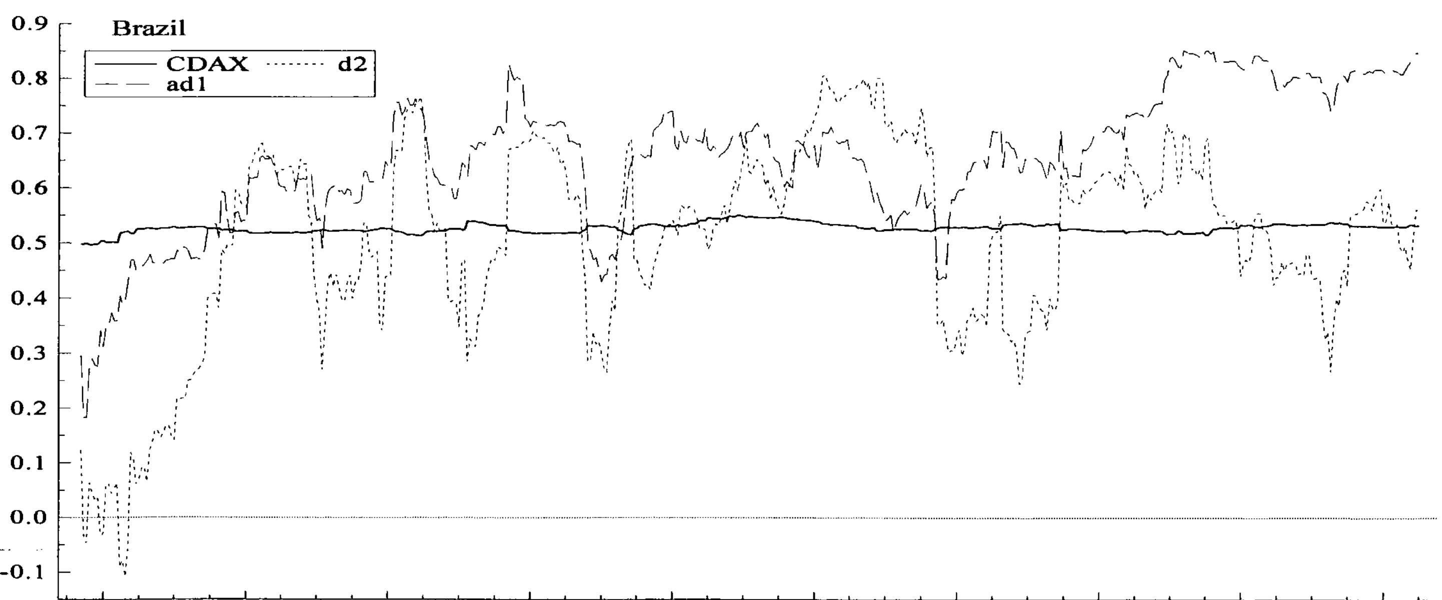

Sweden
CDAX
d2
ad2
.9
.8
.7
.6
.5
.4
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

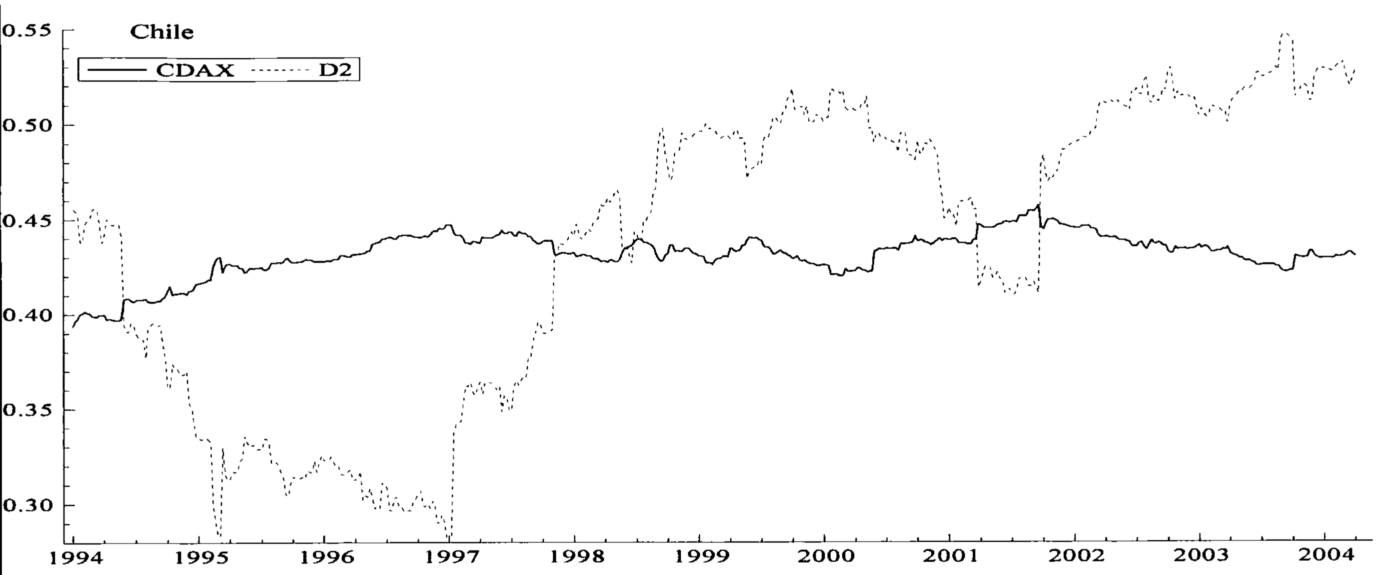

Switzerland
CDAX
d2
ad2
.8
.7
.6
.5
.4
.3
.2
.1
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

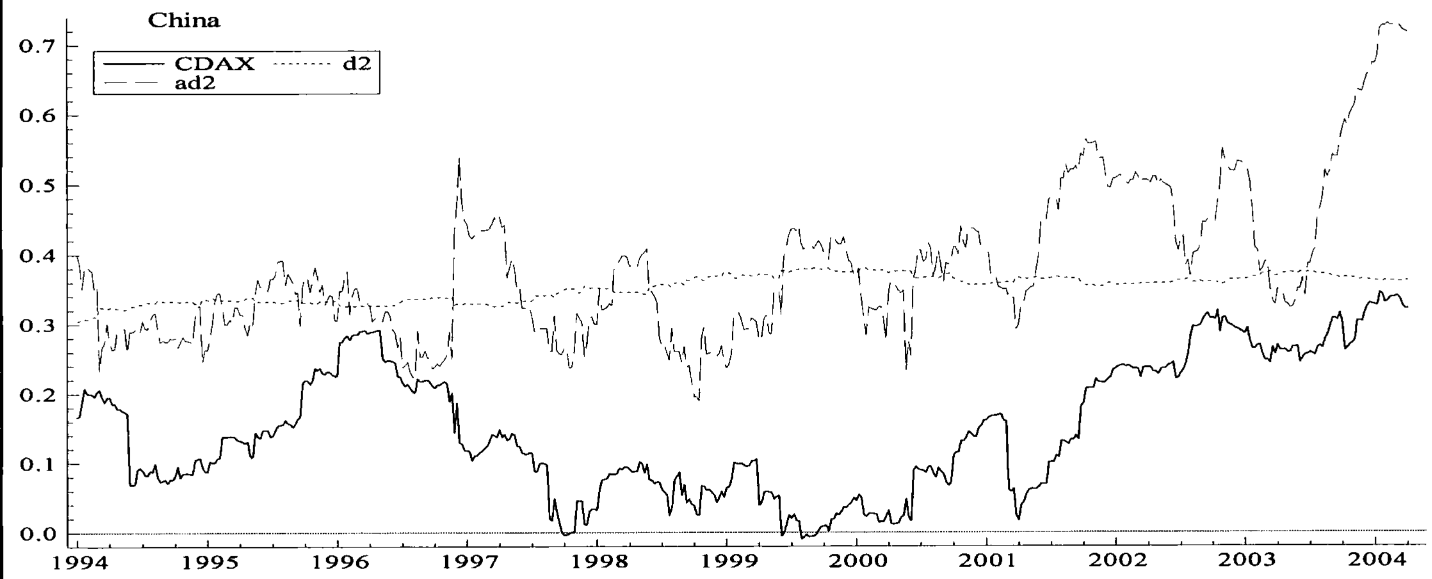

UK
CDAX
d2
ad2
90
85
80
75
70
65
60
55
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

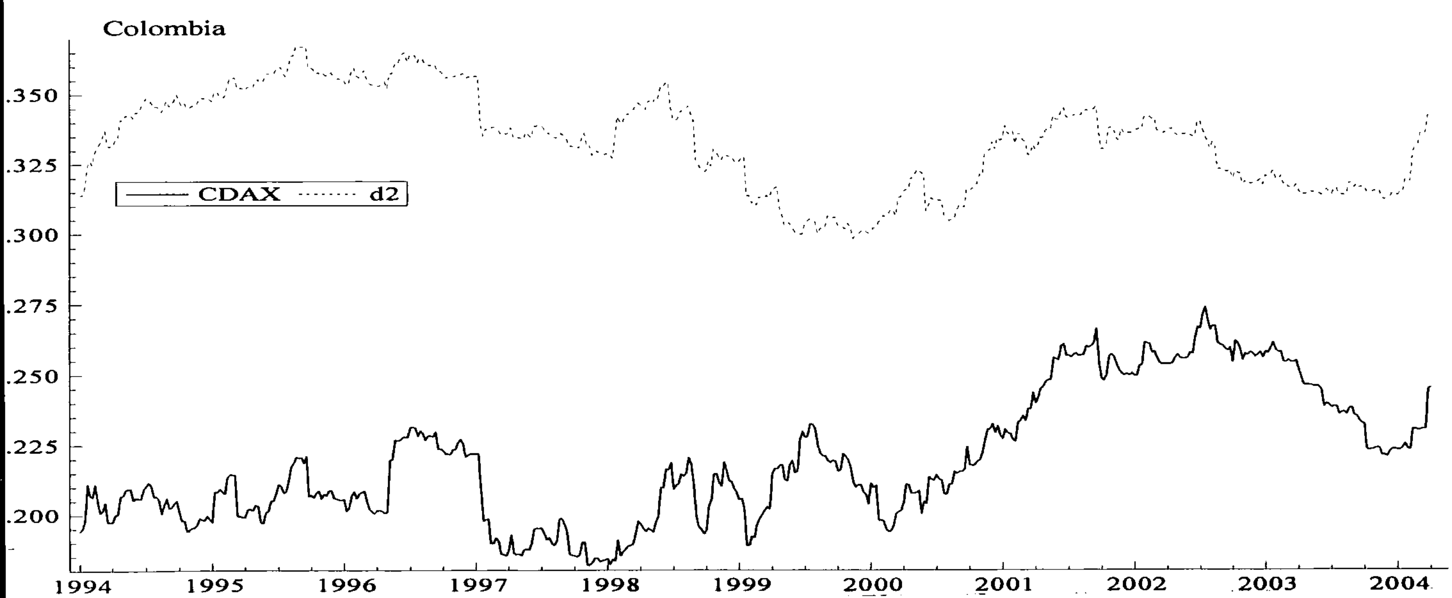

USA
CDAX
d2
ad1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

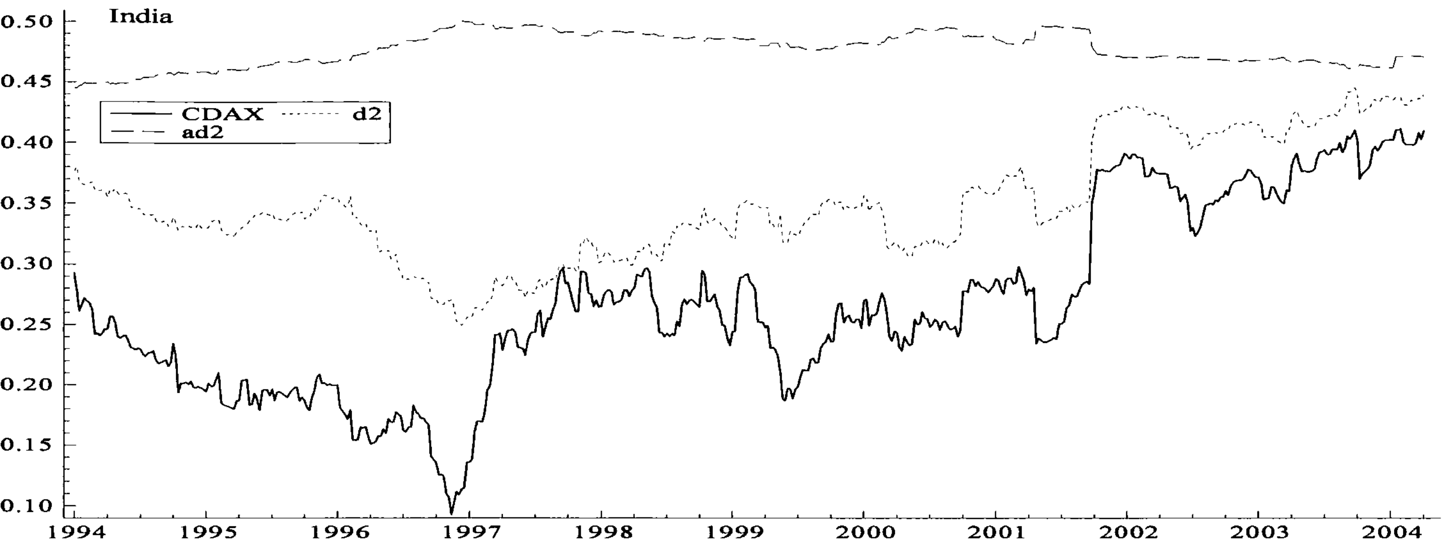

Argentina
CDAX
d2
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

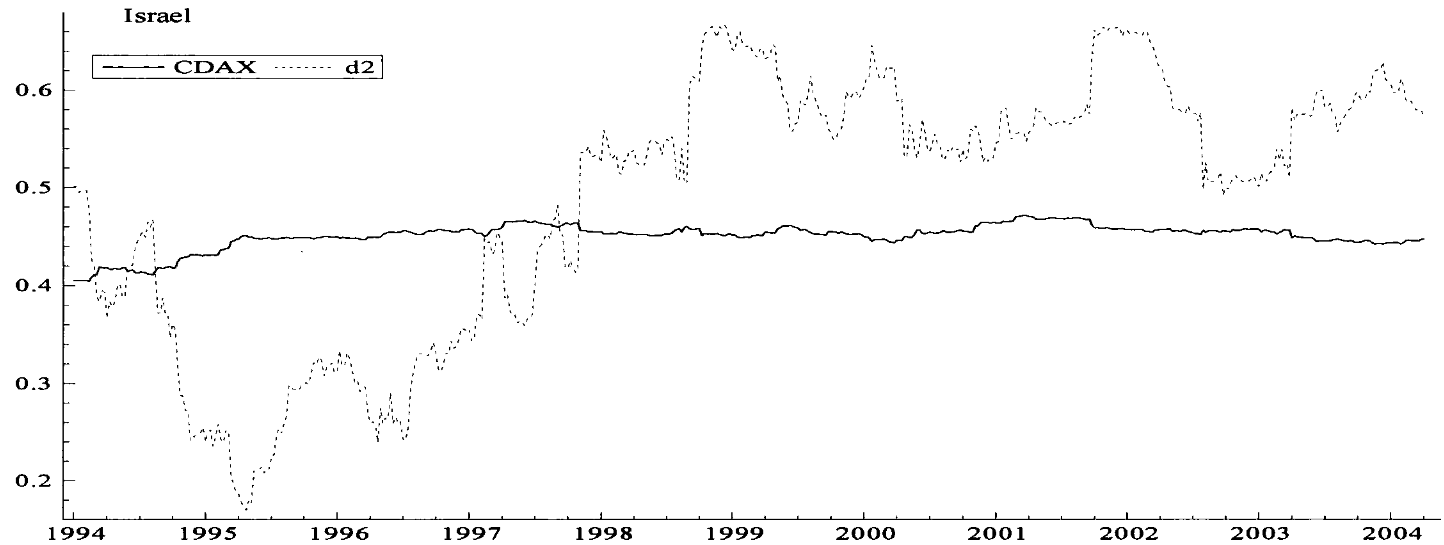

Brazil
CDAX
d2
ad1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

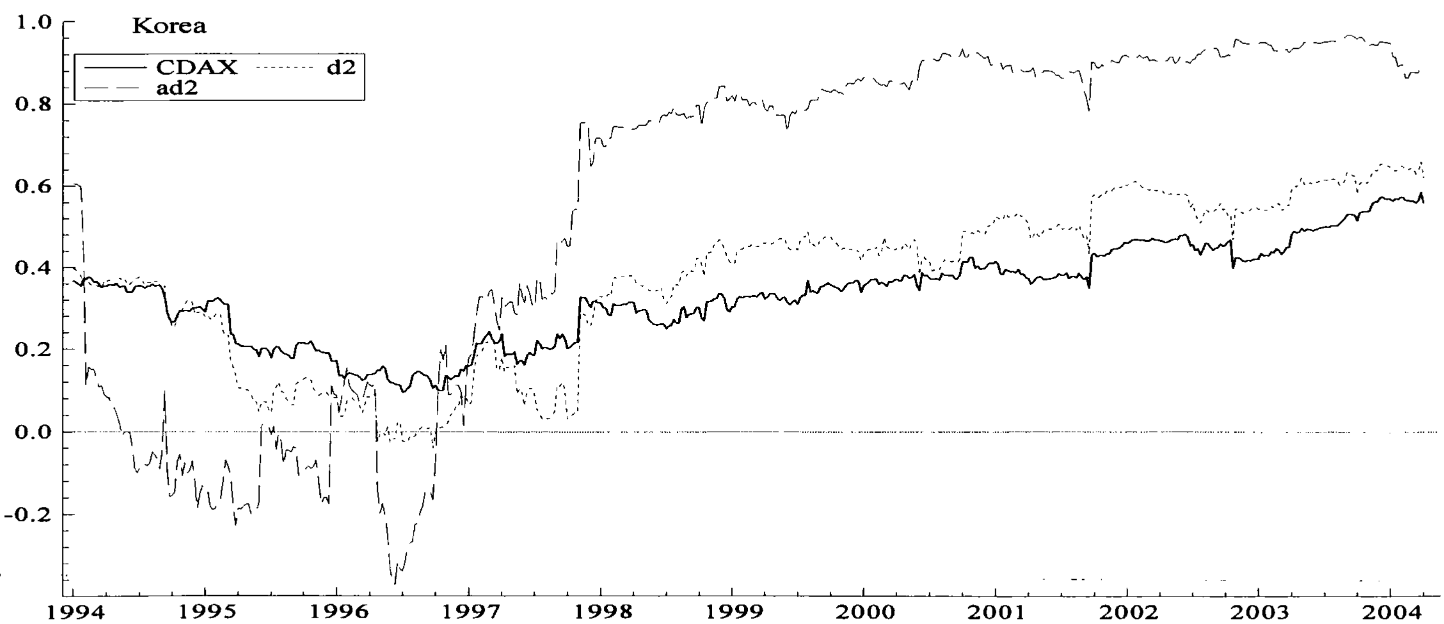

Chile
CDAX
D2
0.55
0.50
0.45
0.40
0.35
0.30
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

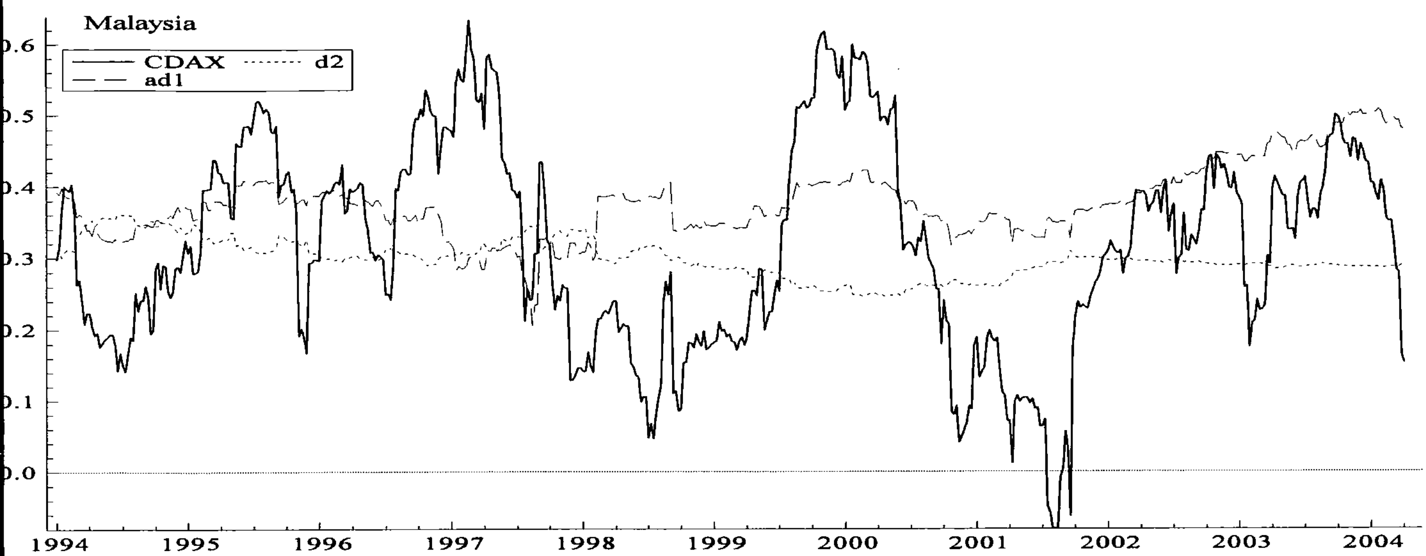

China
CDAX
d2
ad2
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

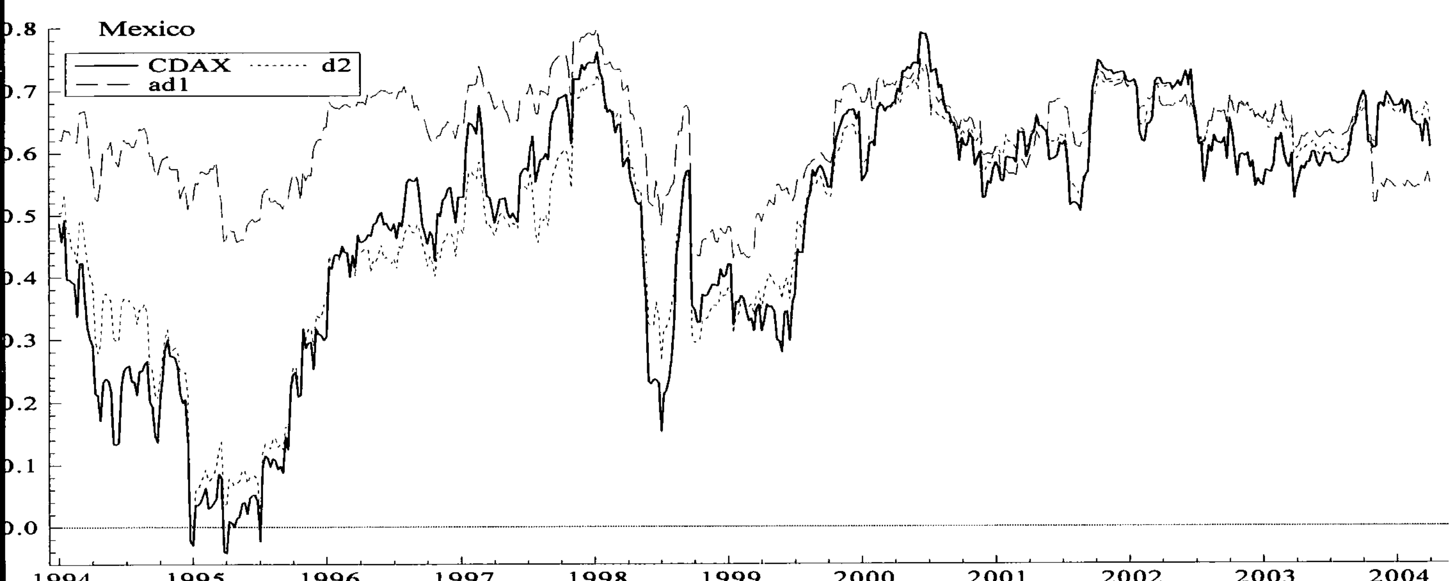

Colombia
CDAX
d2
.350
.325
.300
.275
.250
.225
.200
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

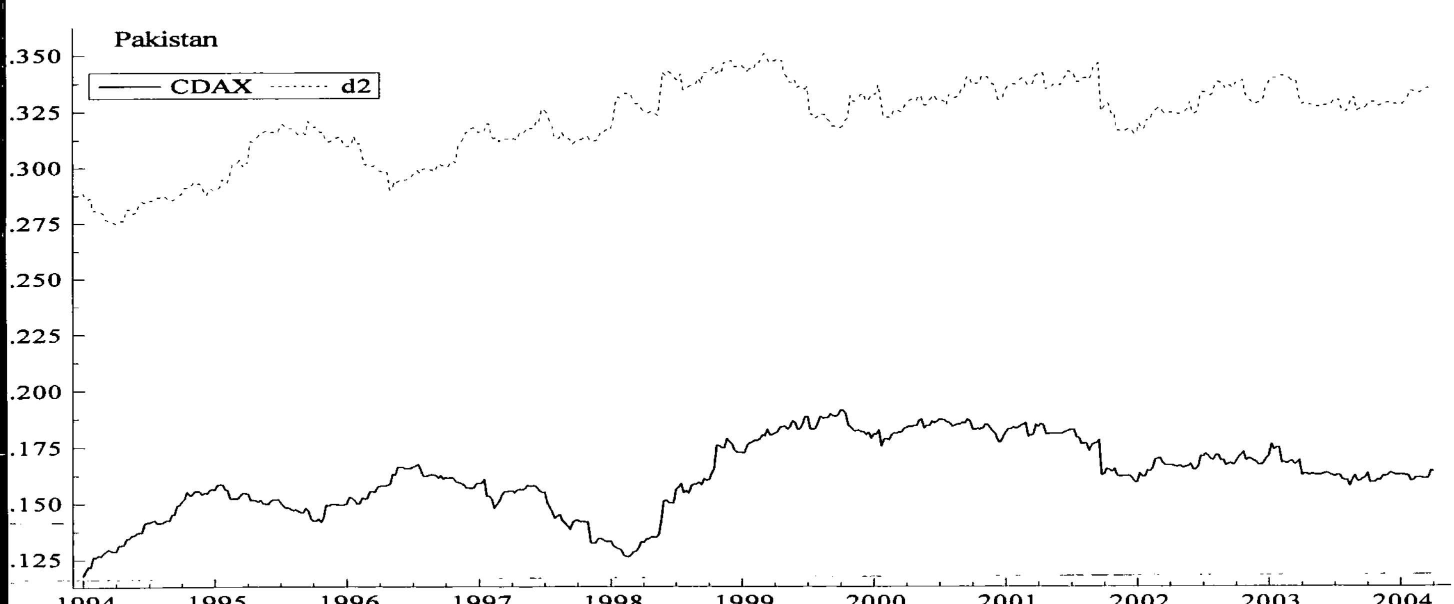

India
CDAX
d2
ad2
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004

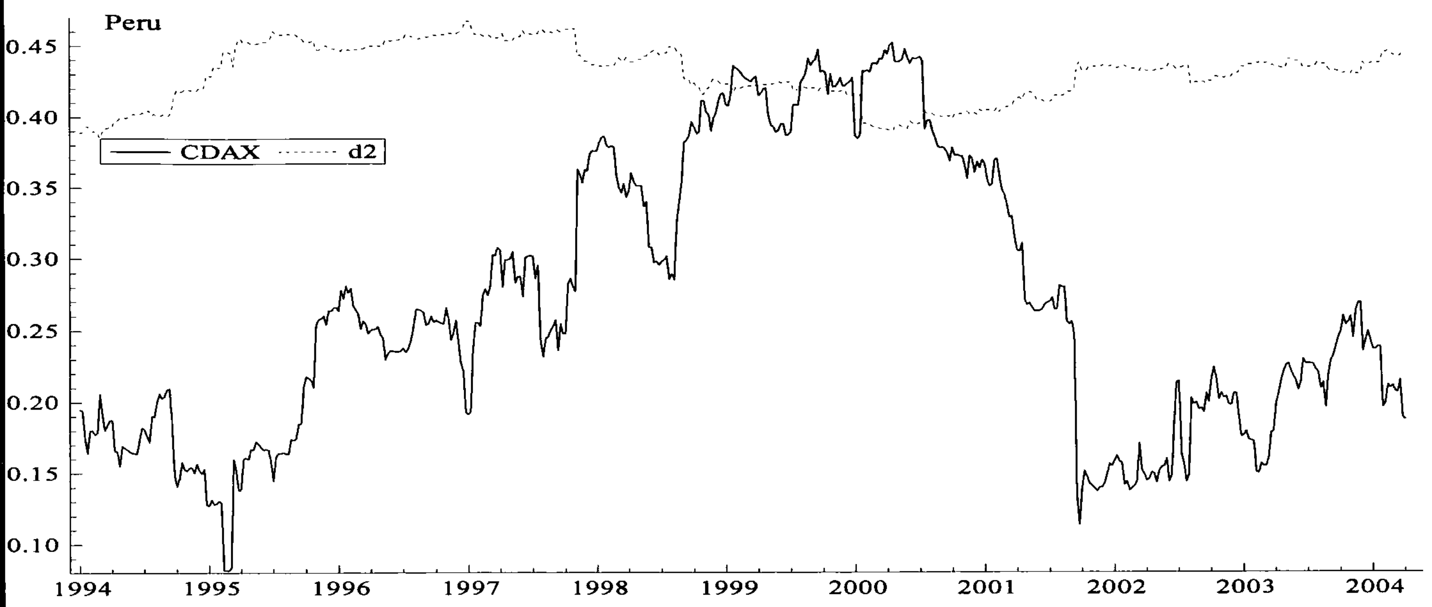

Israel
CDAX
d2
0.6
0.5
0.4
0.3
0.2
1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004

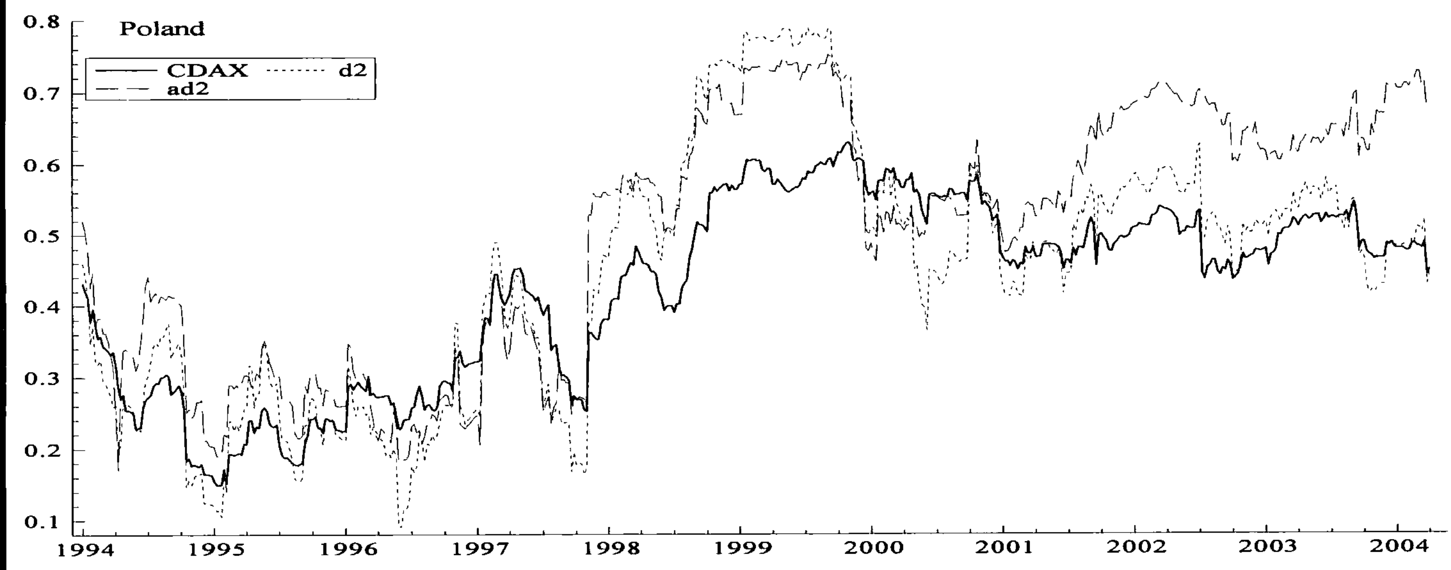

Korea
CDAX
d2
ad2
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004


Malaysia
CDAX
d2
ad1
1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004

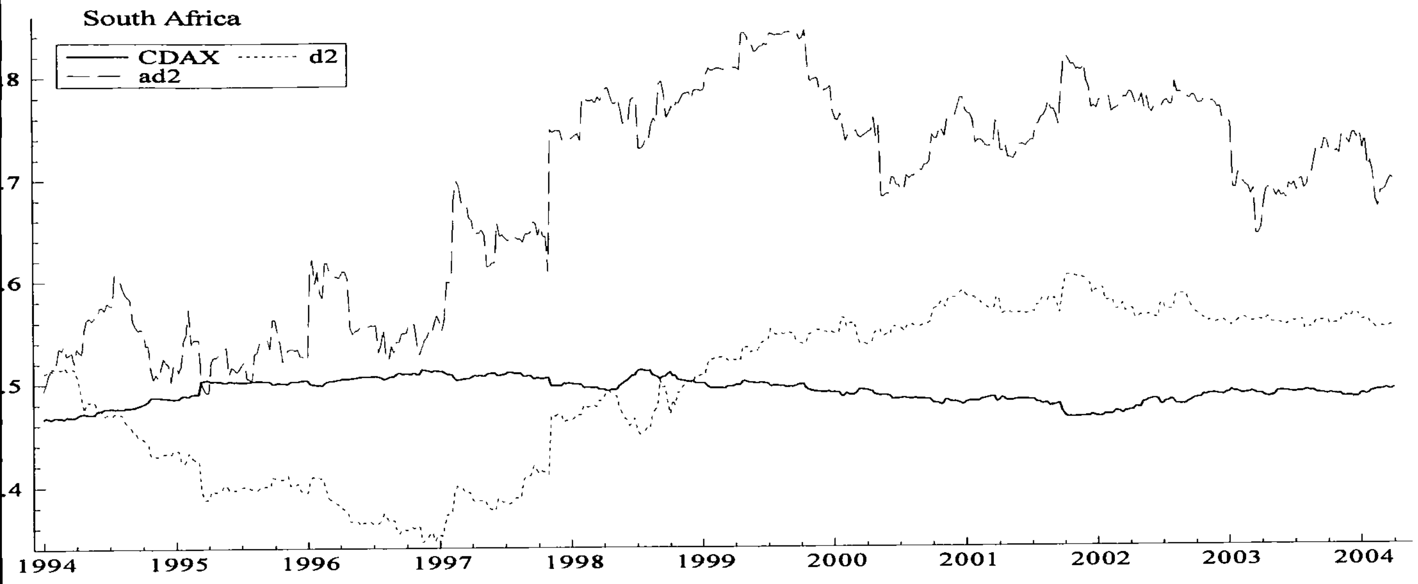

Mexico
CDAX
d2
ad1
1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004


Pakistan
CDAX
d2
1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004

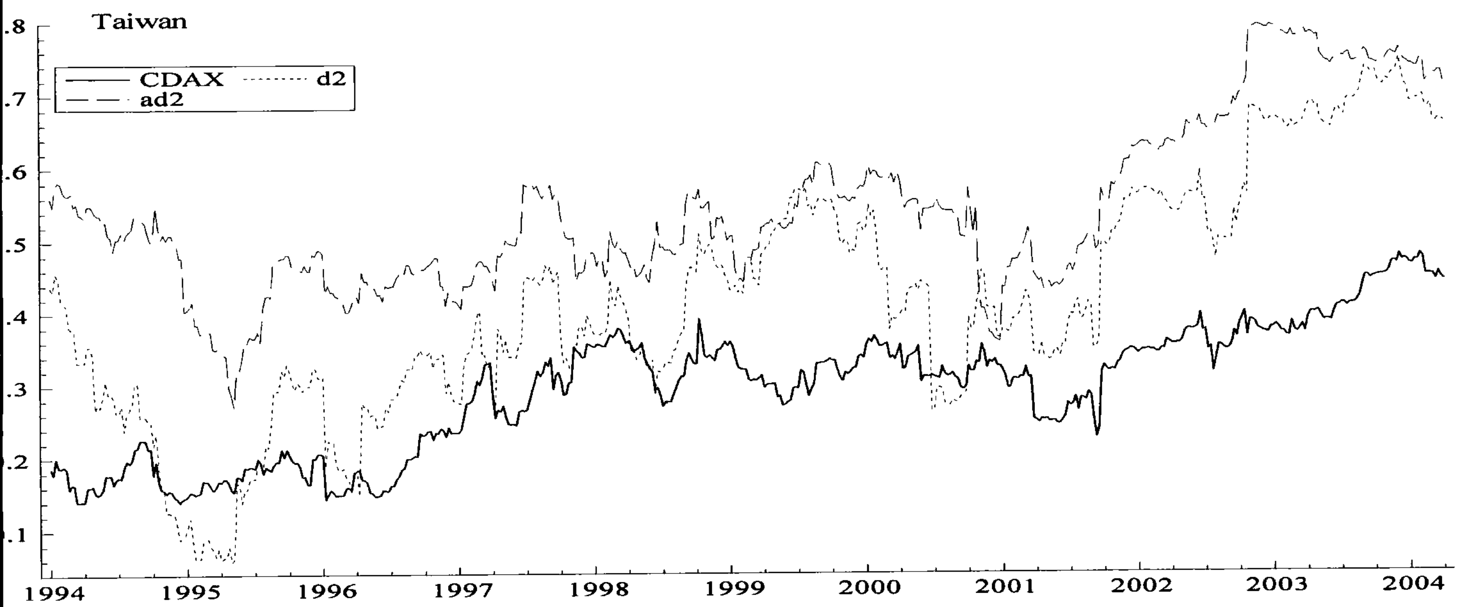

Peru
CDAX
d2
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004


Poland
CDAX
d2
ad2
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

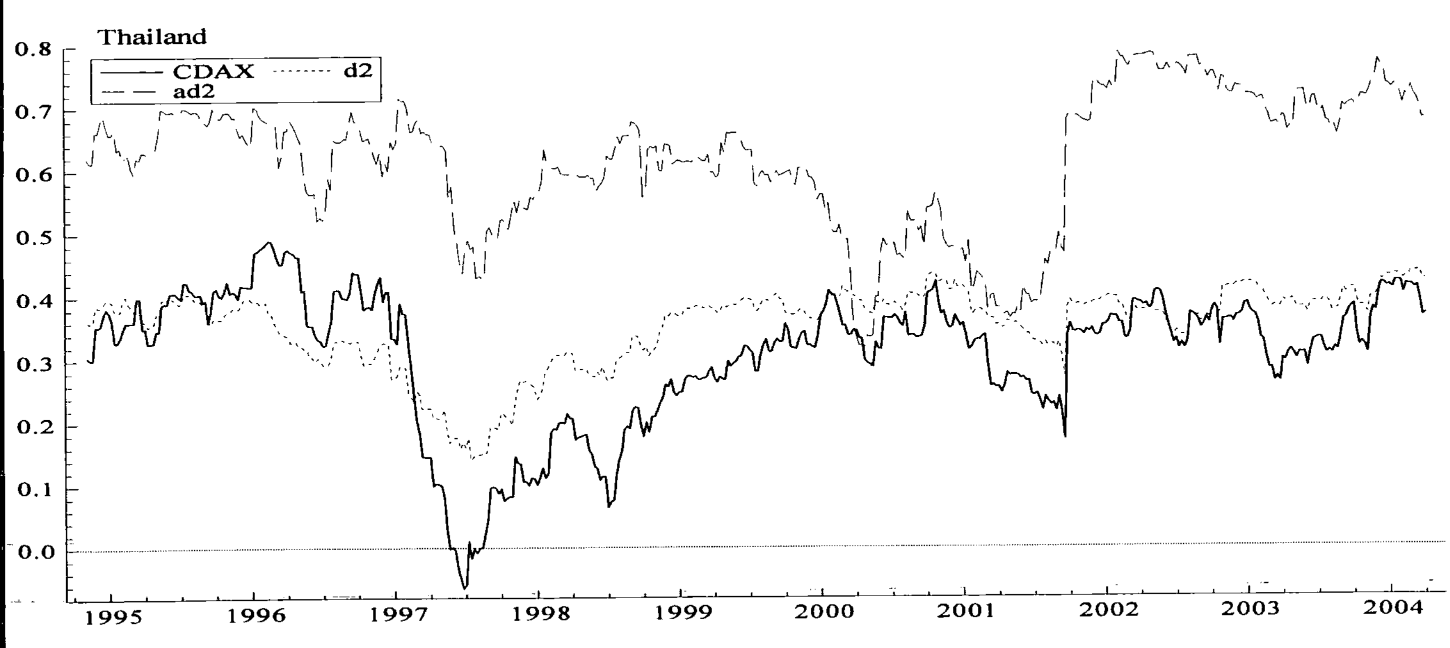

Russia
CDAX
d2
ad2
0.8
0.7
0.6
0.5
0.4
0.3
1998
1999
2000
2001
2002
2003
2004



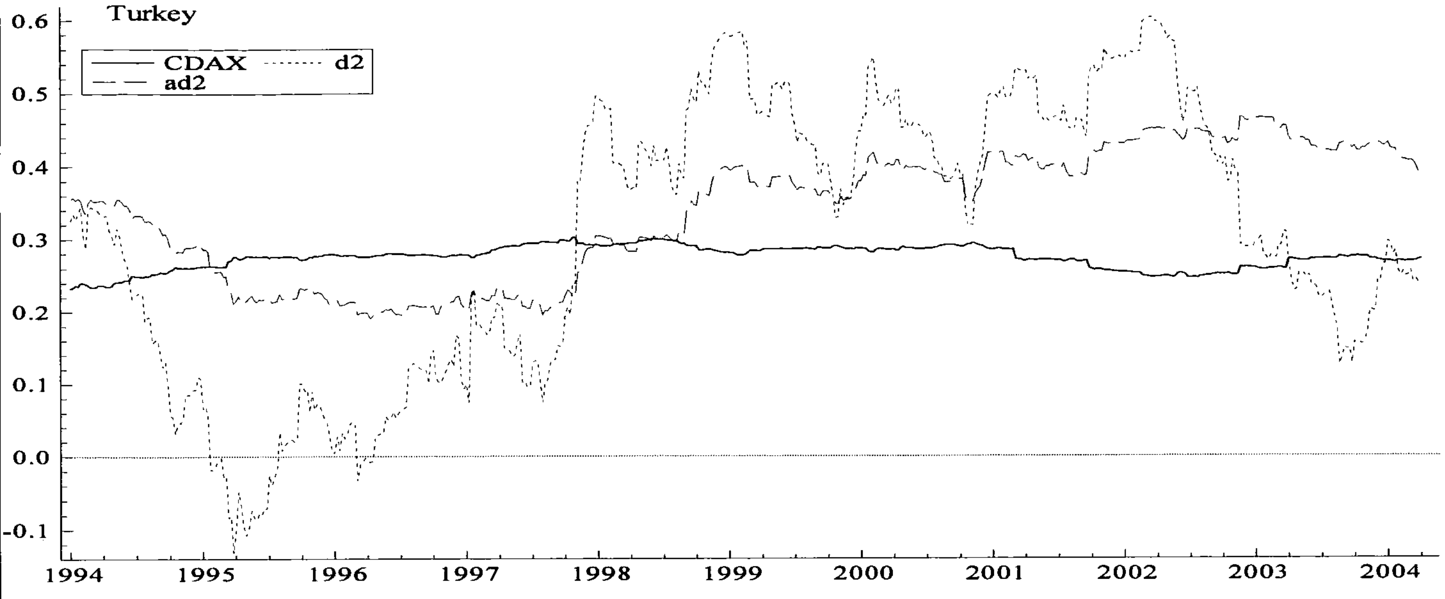
South Africa
CDAX
d2
ad2
.8
.7
.6
.5
.4
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

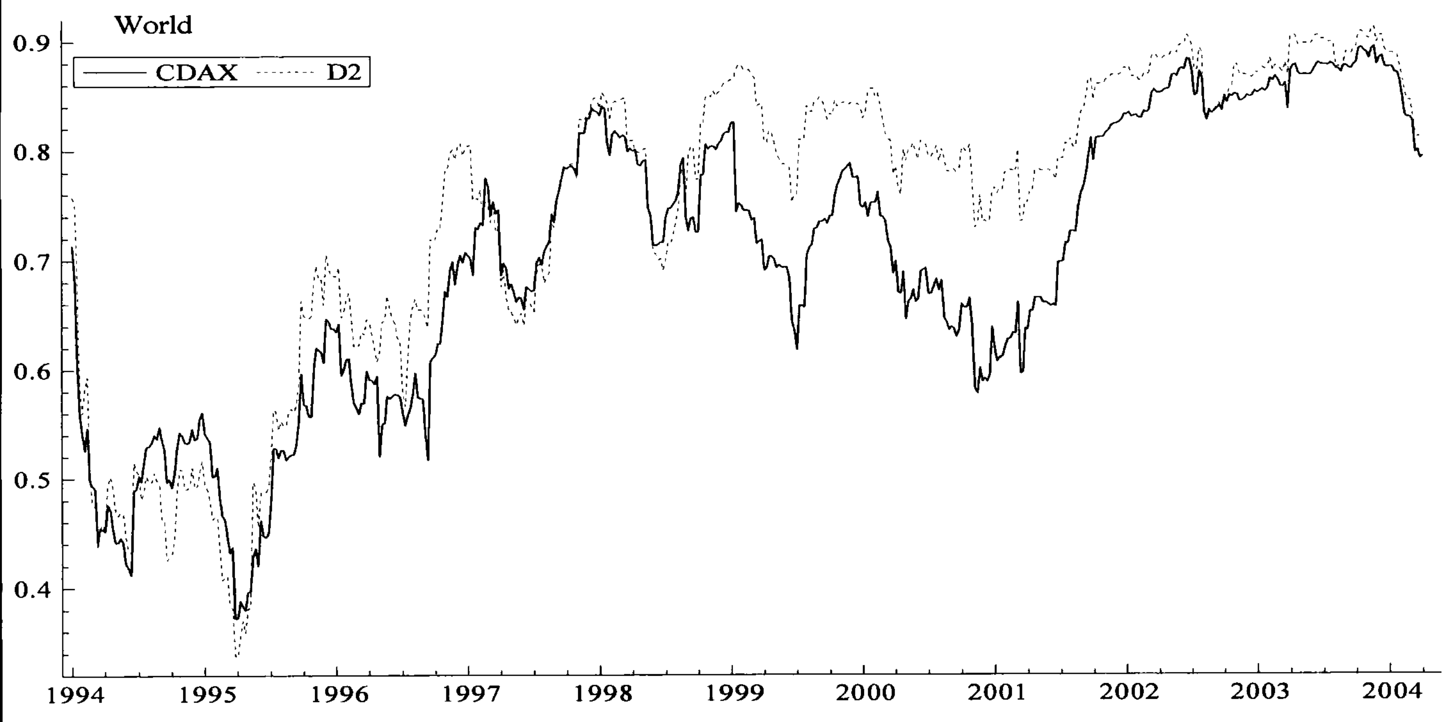


Taiwan
CDAX
d2
ad2
.8
.7
.6
.5
.4
.3
.2
.1
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

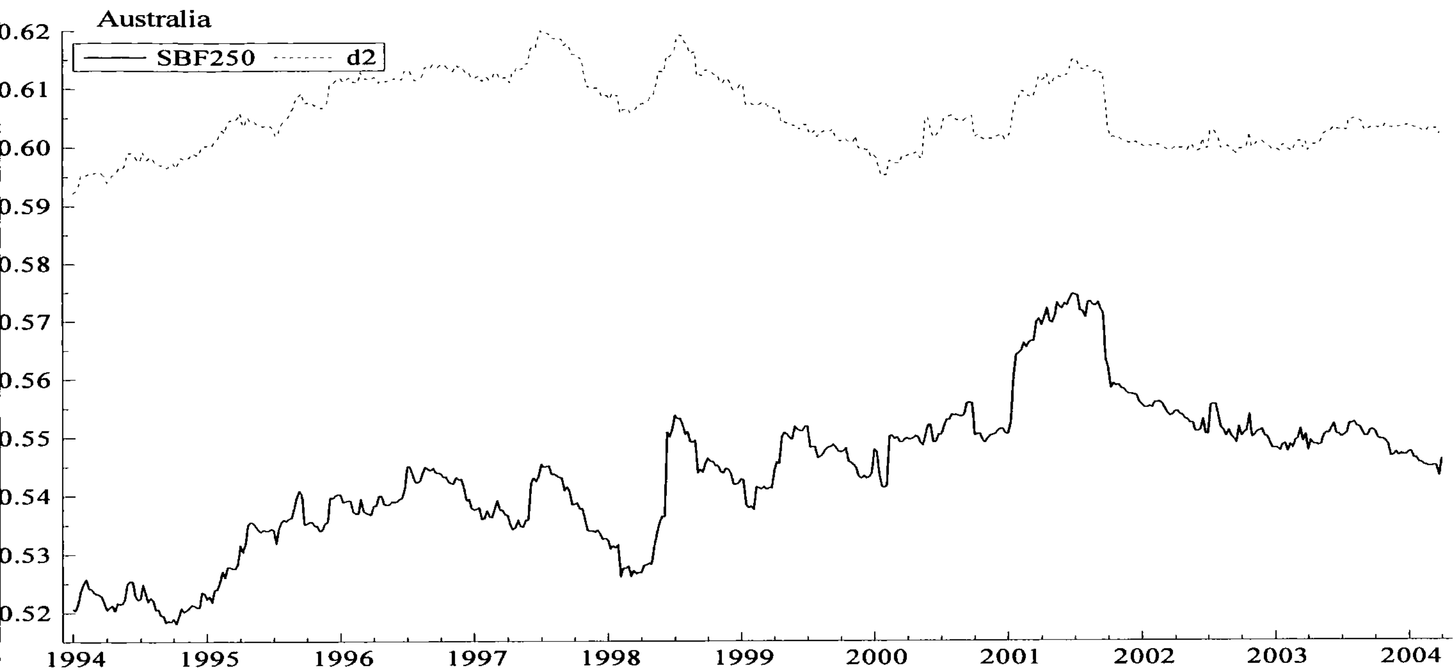


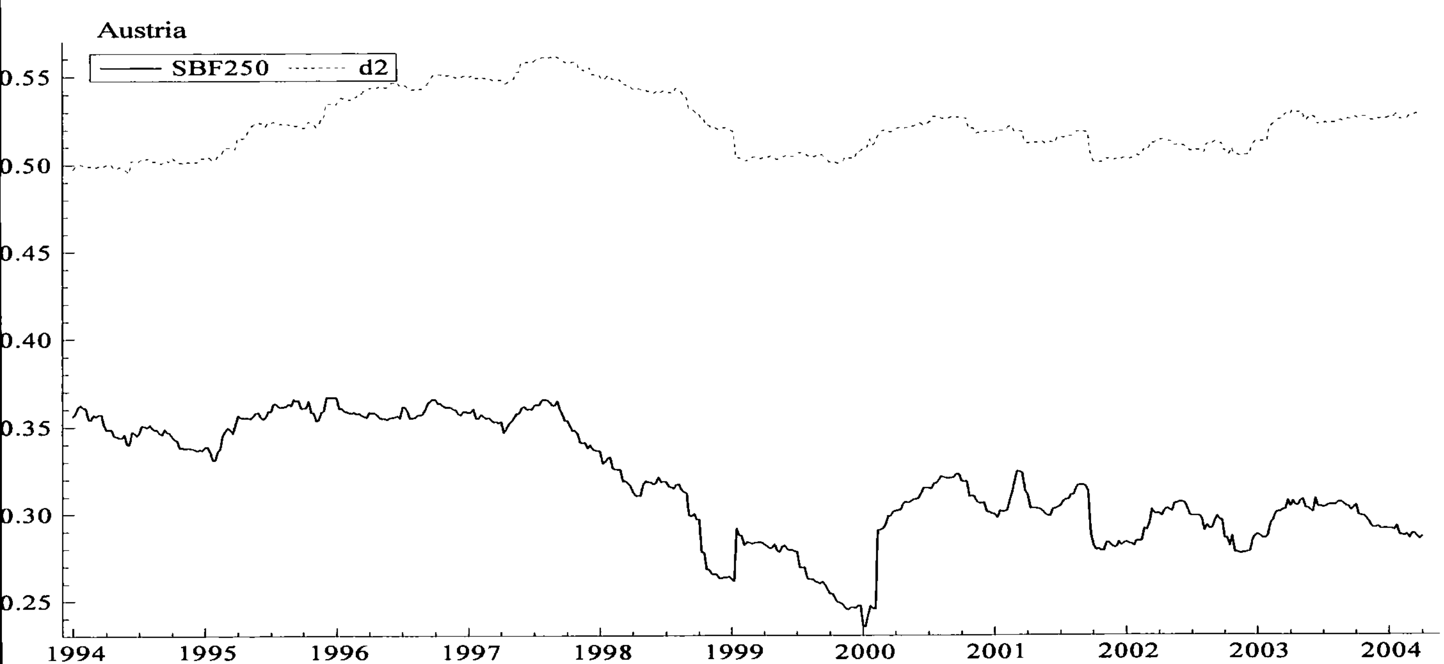
Thailand
CDAX
d2
ad2
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

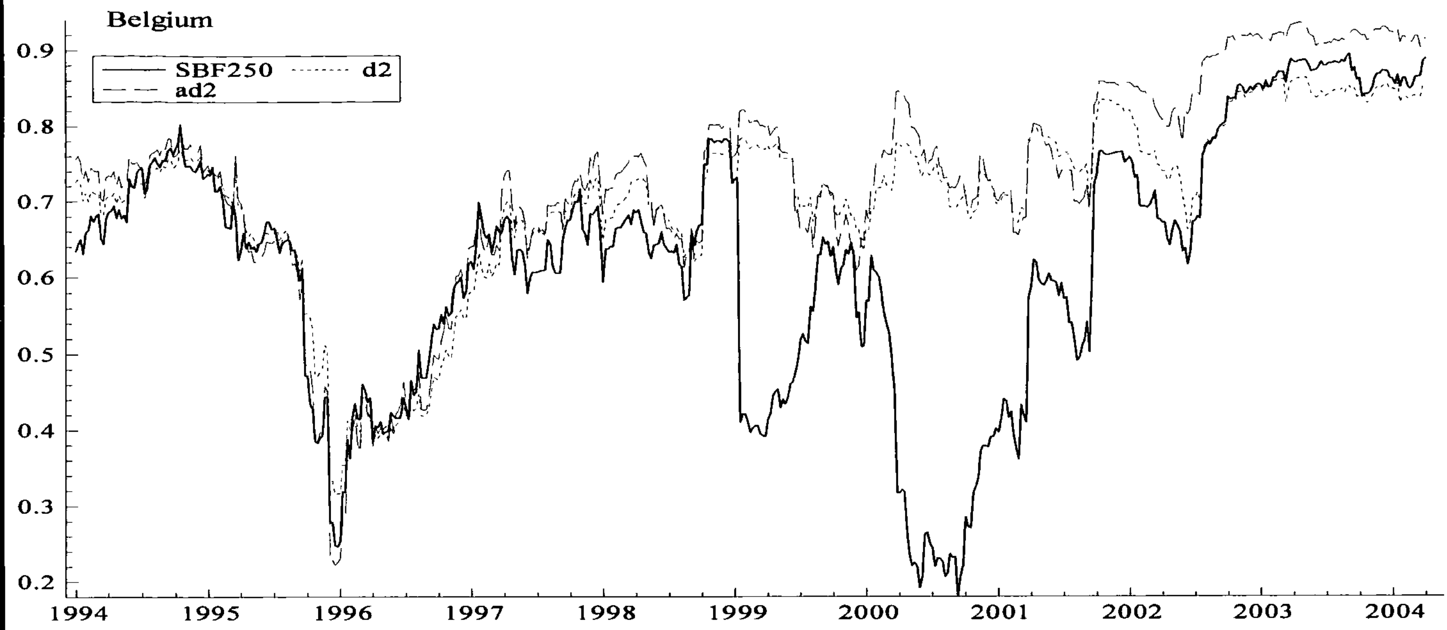

Turkey
CDAX
d2
ad2
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

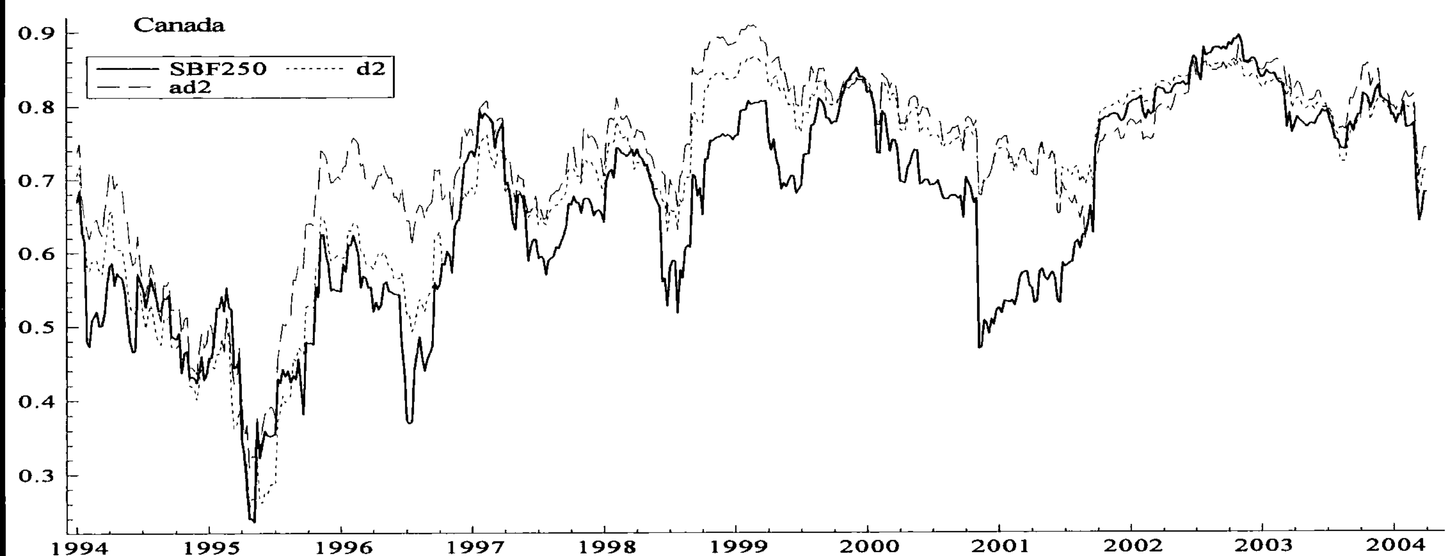

World
CDAX
D2
0.9
0.8
0.7
0.6
0.5
0.4
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

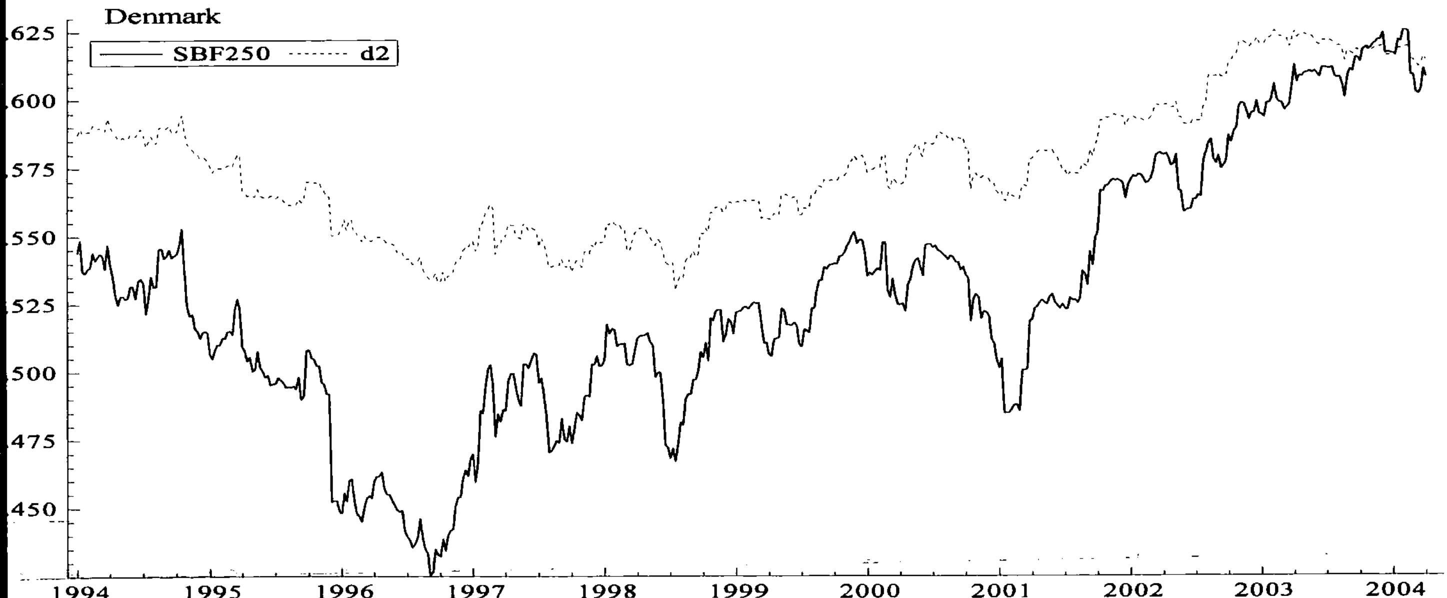
Appendix C5(c): **Dynamic Conditional Correlations (DCC)** between foreign market indices and various diversification portfolios based on French traded assets. 'SBF-250' is the correlation between the foreign index and the French SBF-250 Index.

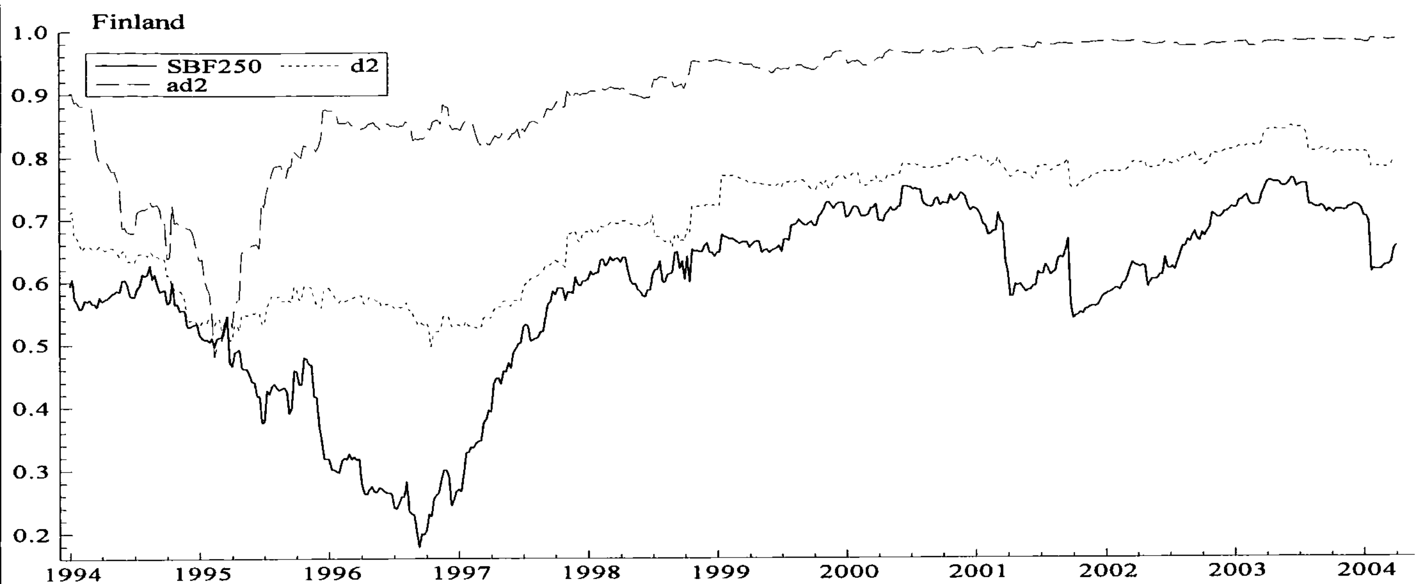


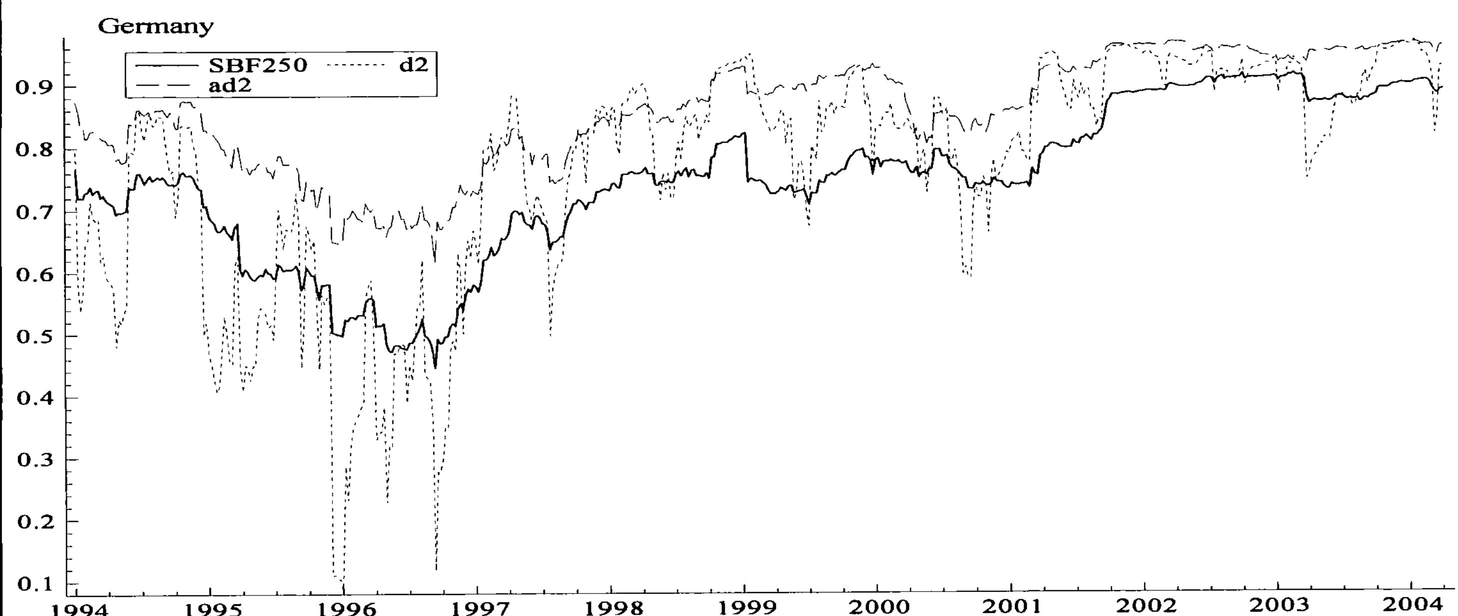


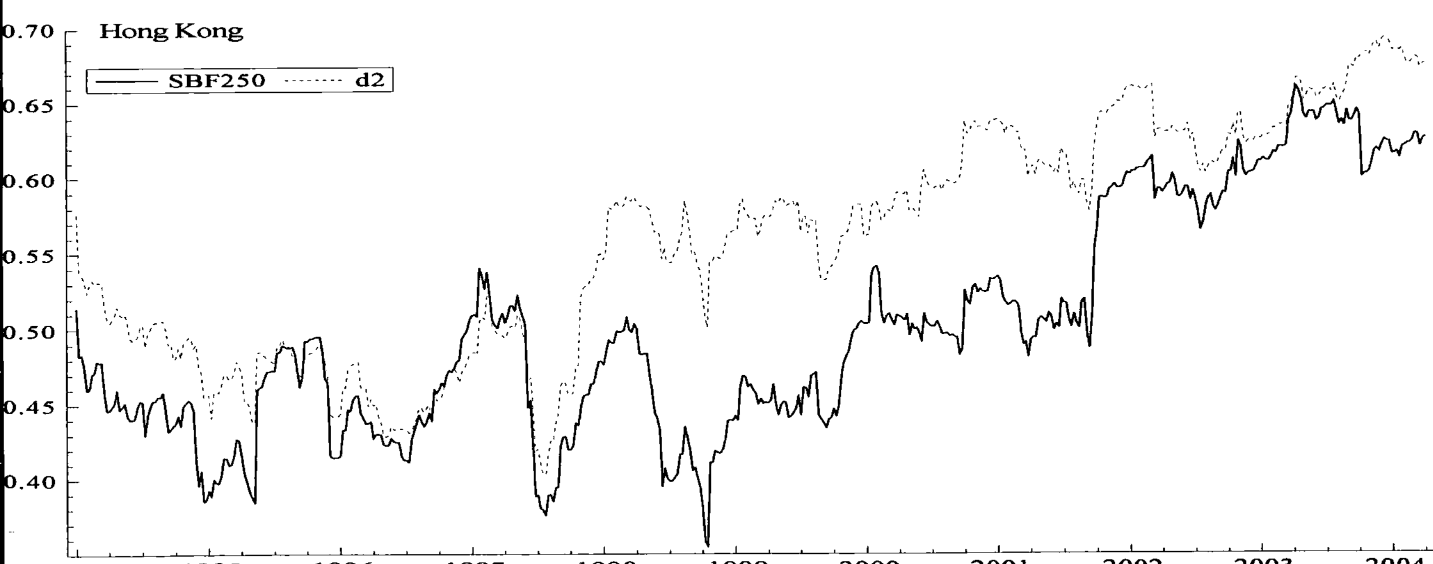

Belgium
SBF250
d2
ad2
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004

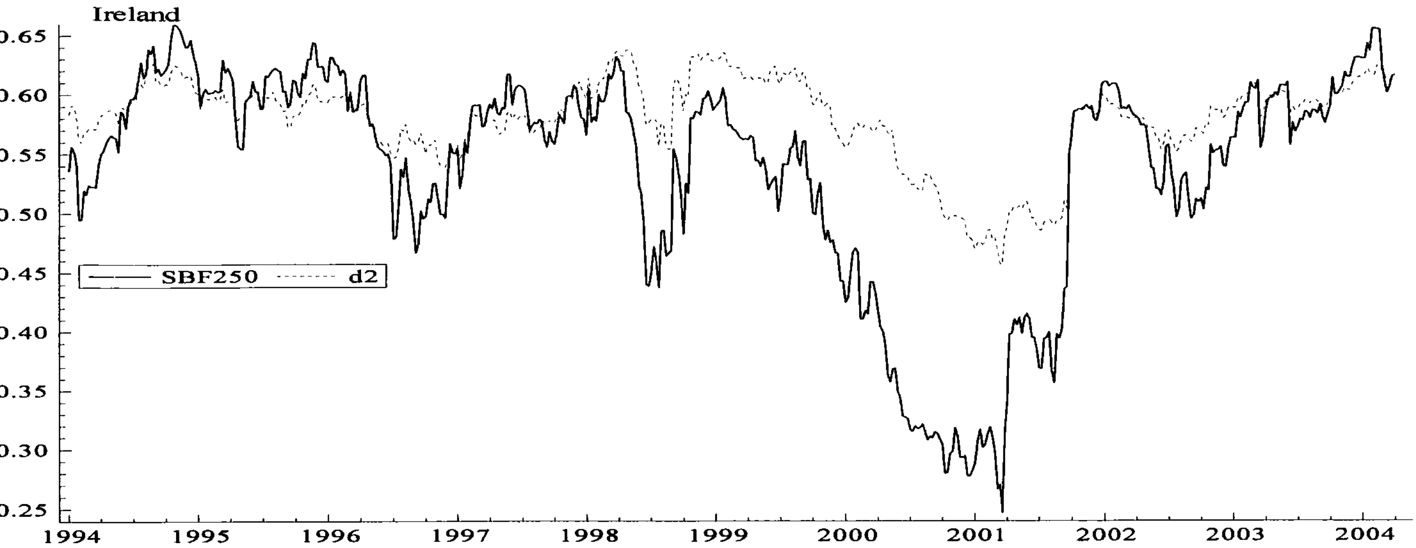

Canada
SBF250
d2
ad2
0.9
0.8
0.7
0.6
0.5
0.4
0.3
1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004


Denmark
SBF250
d2
.625
.600
.575
.550
.525
.500
.475
.450
1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004

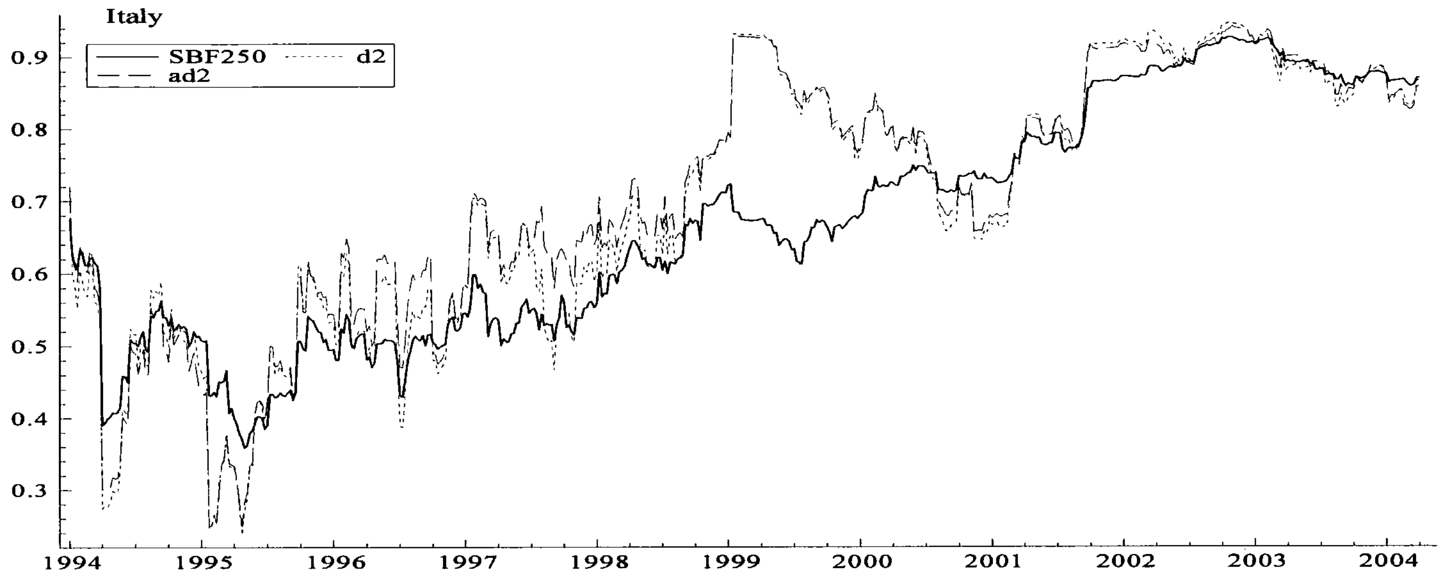

Finland
SBF250
d2
ad2
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004


Germany
SBF250
d2
ad2
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

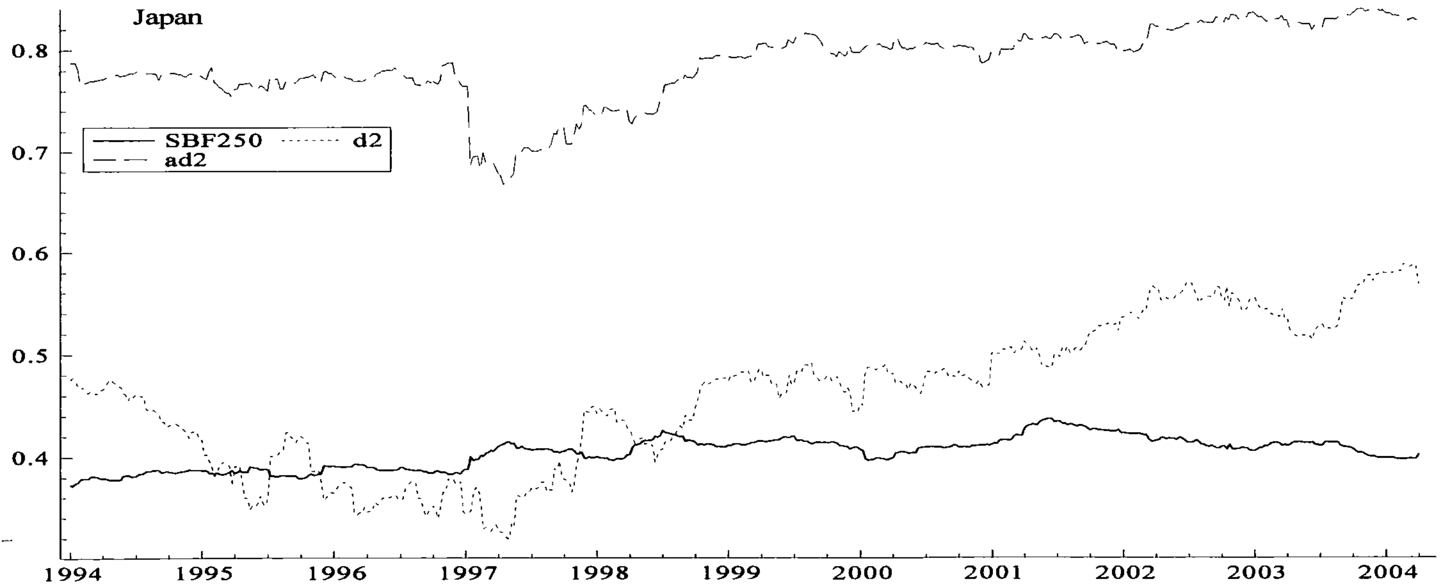

Hong Kong
SBF250
d2
0.70
0.65
0.60
0.55
0.50
0.45
0.40
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004



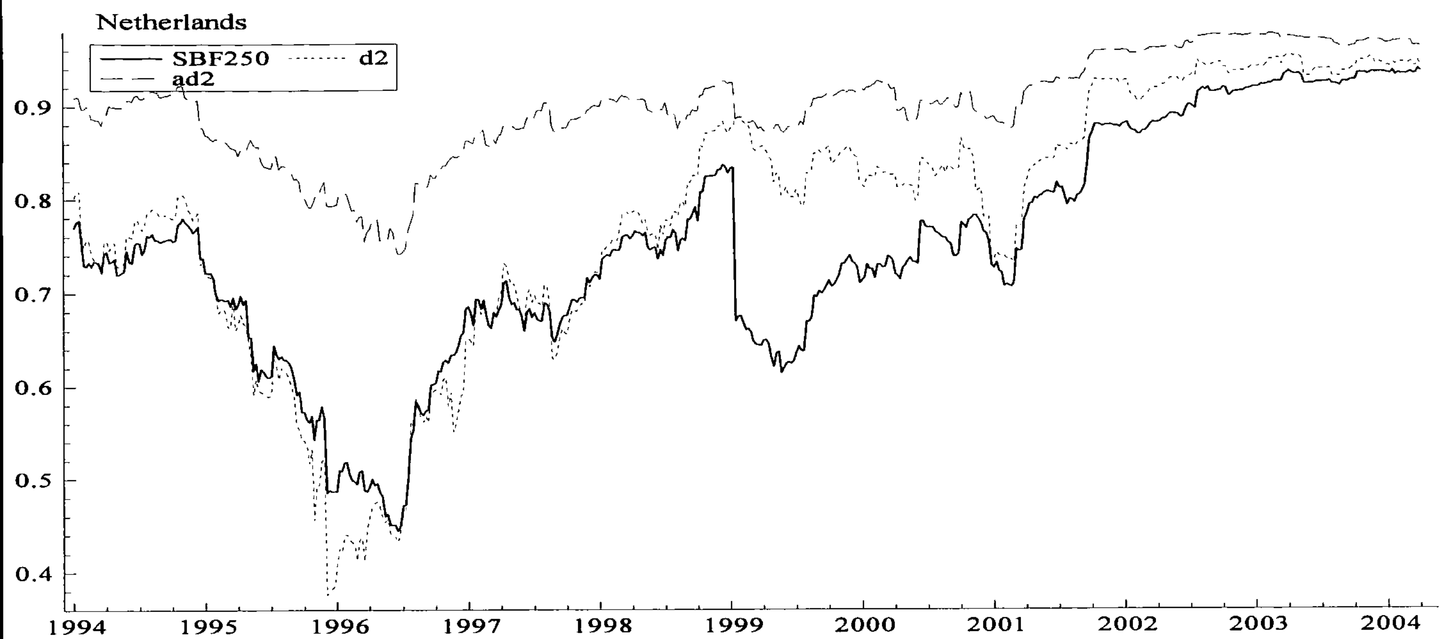
Ireland
SBF250
d2

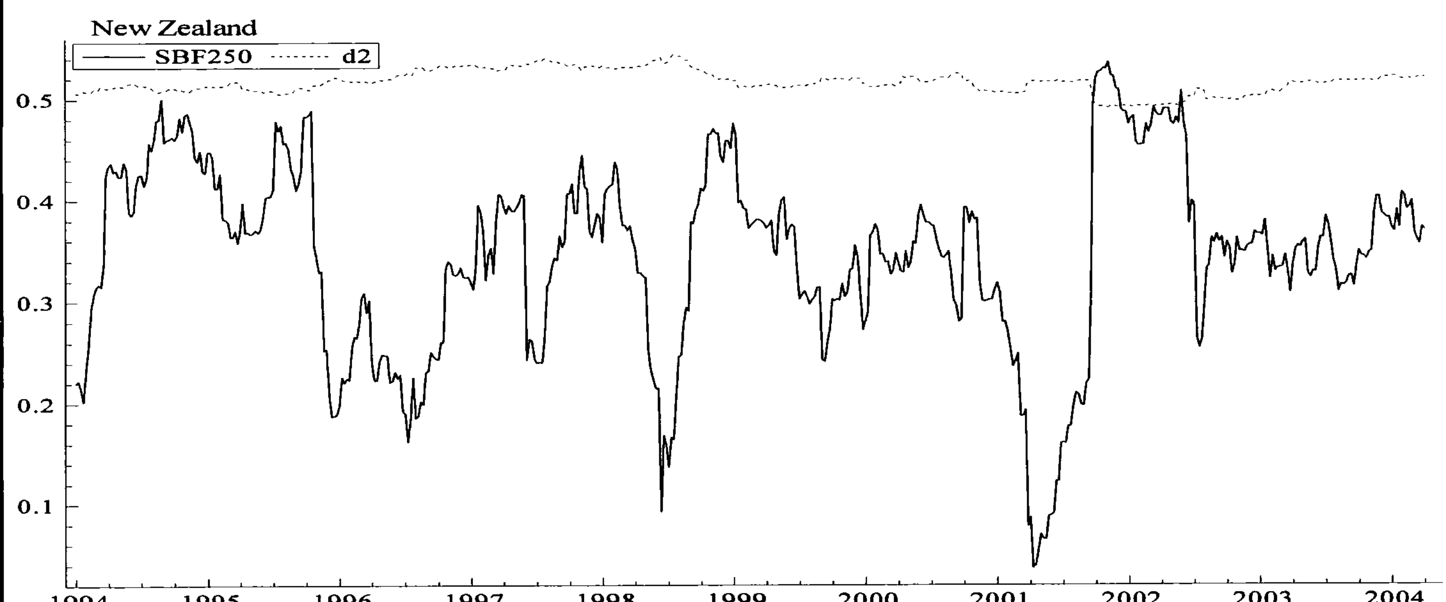


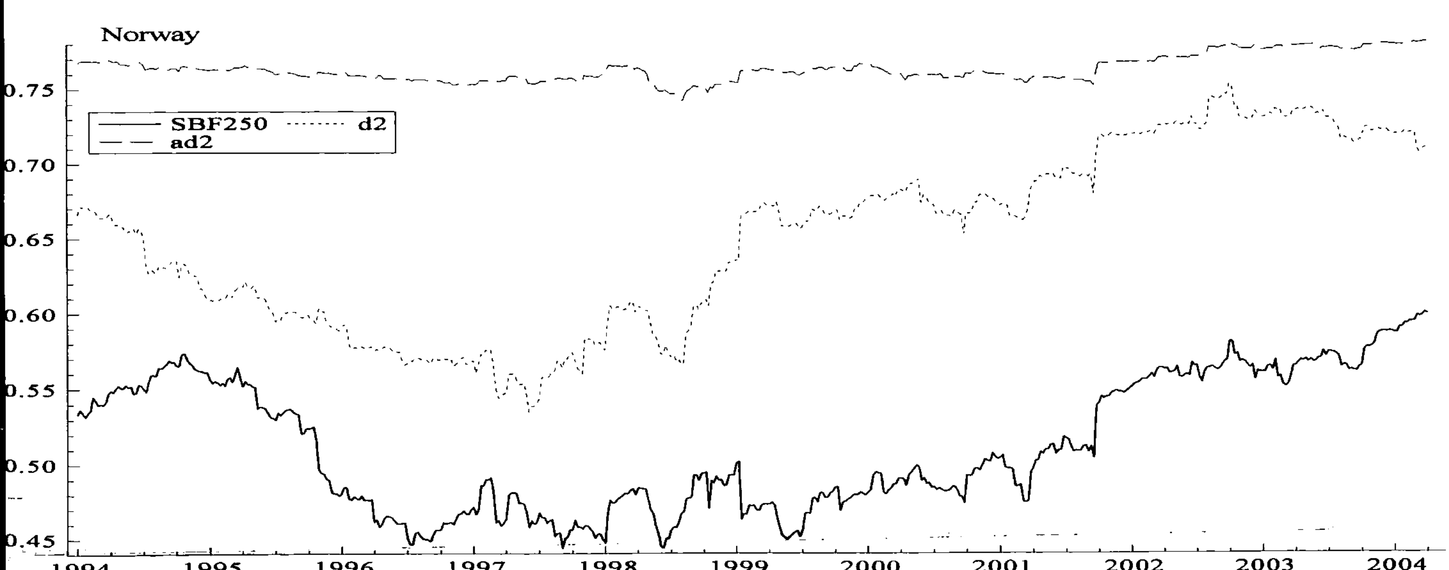
Italy
SBF250
d2
ad2

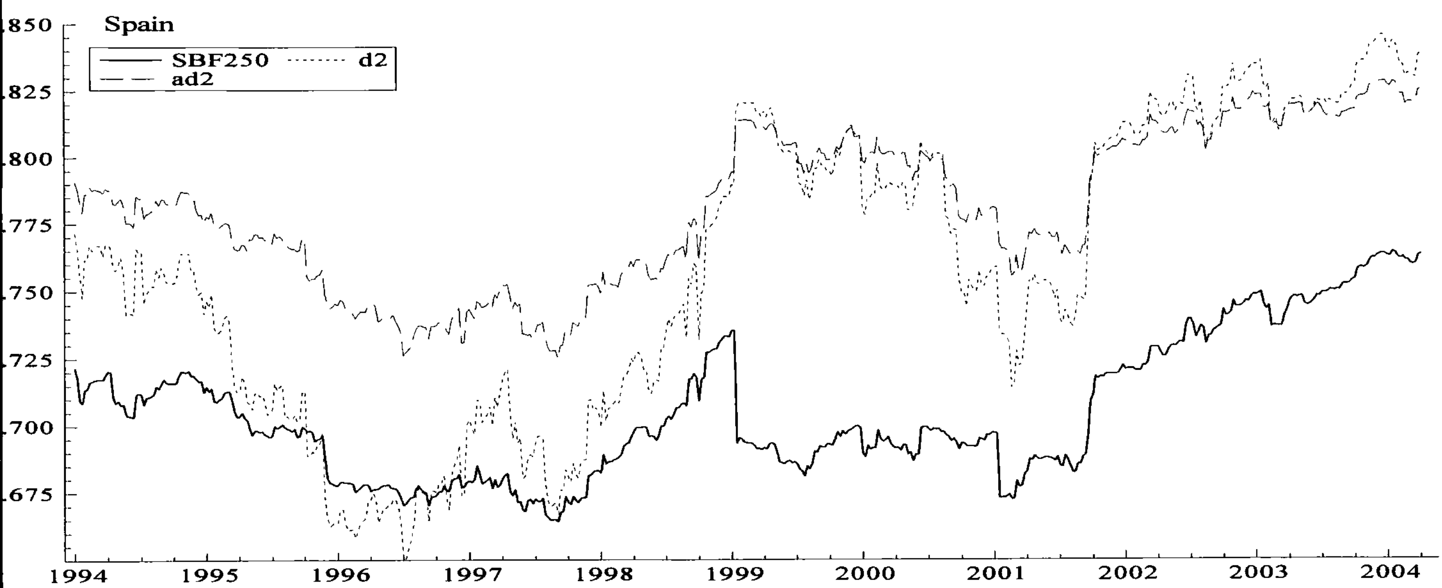


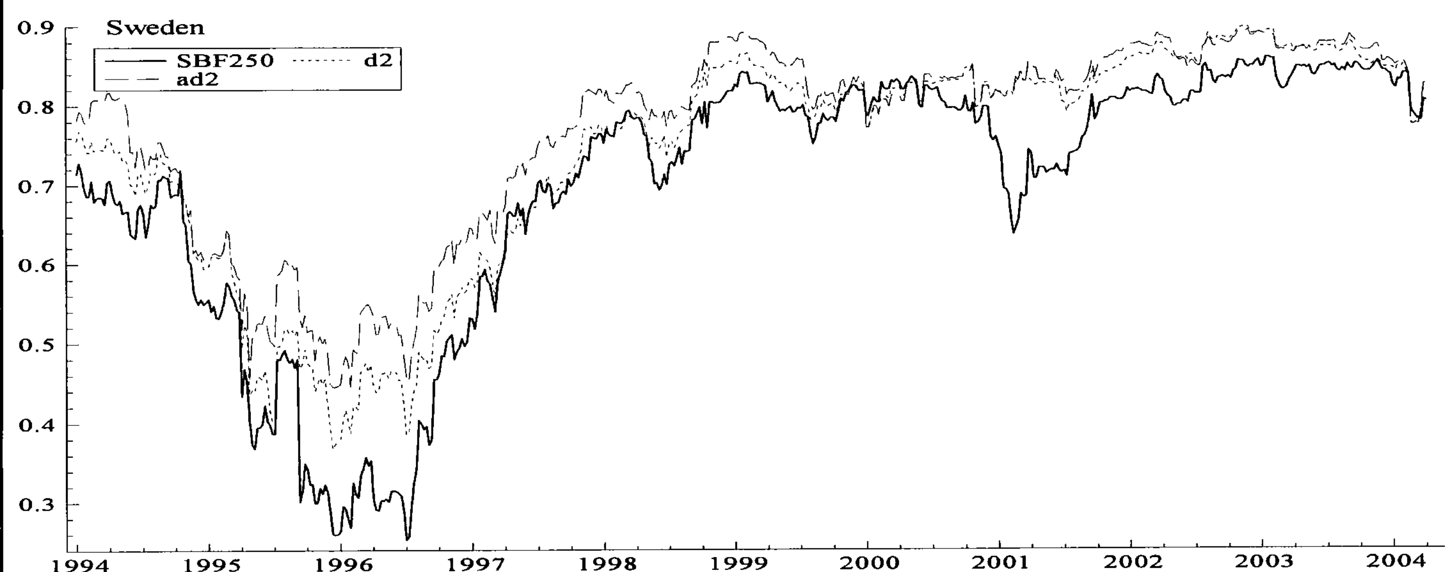
Japan
SBF250
d2
ad2

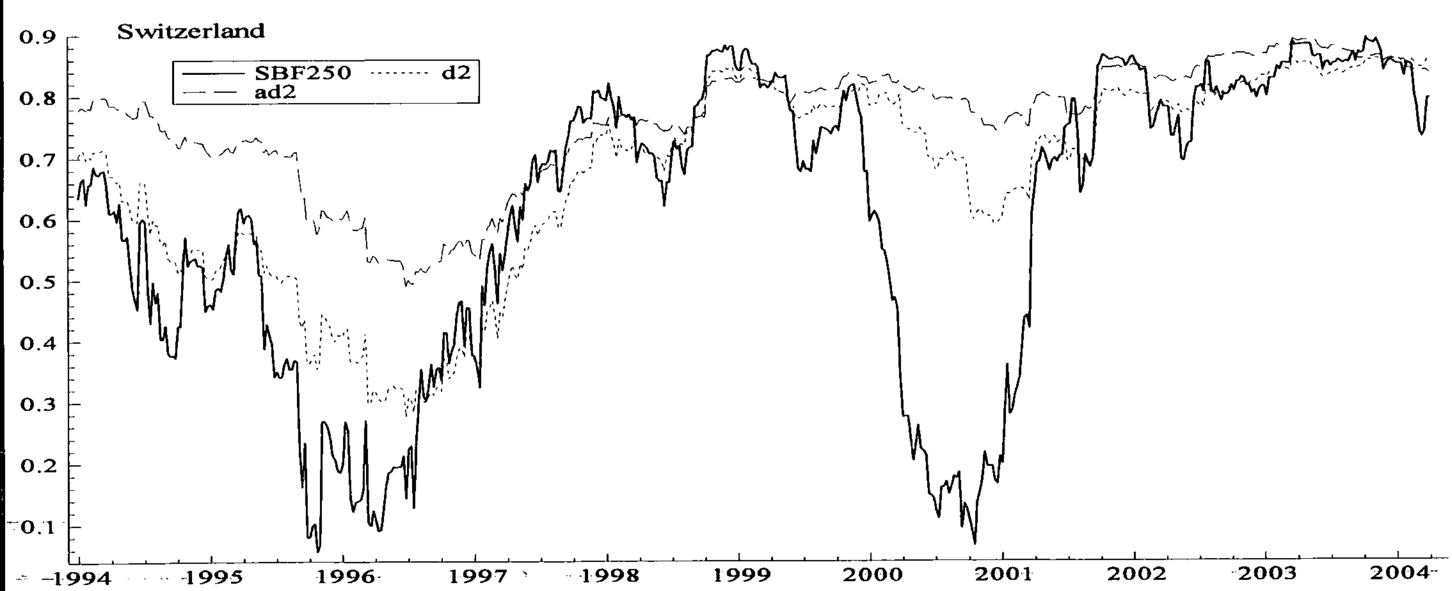

Netherlands
SBF250
d2
ad2
0.9
0.8
0.7
0.6
0.5
0.4
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

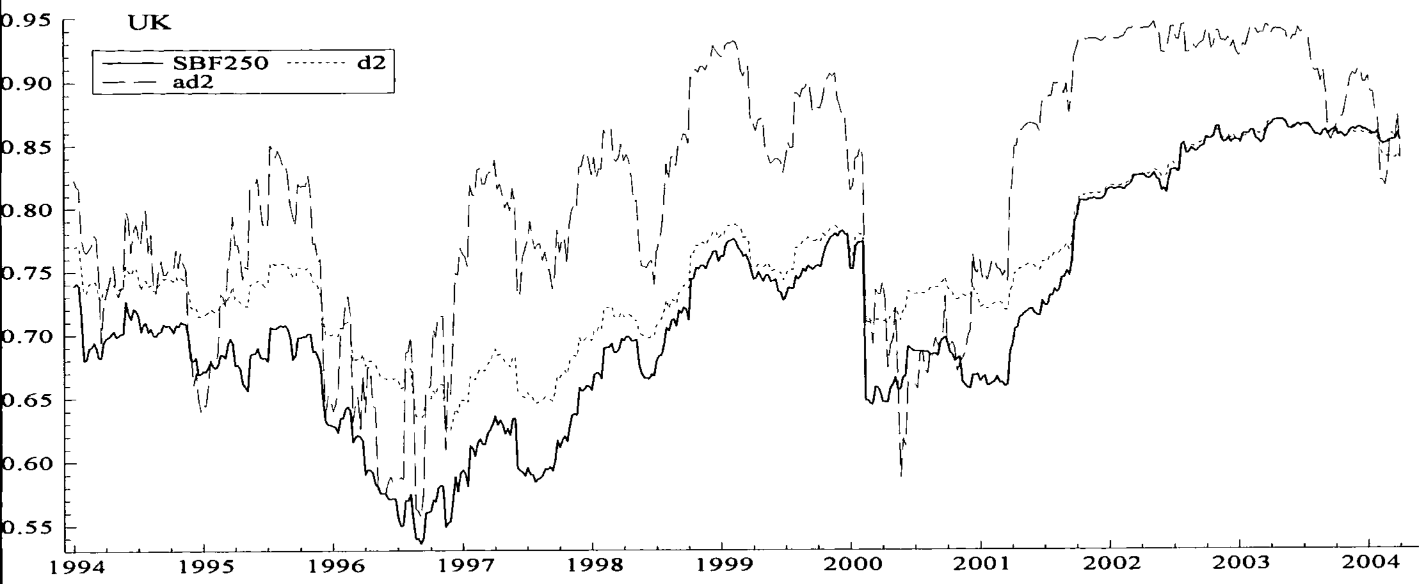

New Zealand
SBF250
d2
0.5
0.4
0.3
0.2
0.1
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

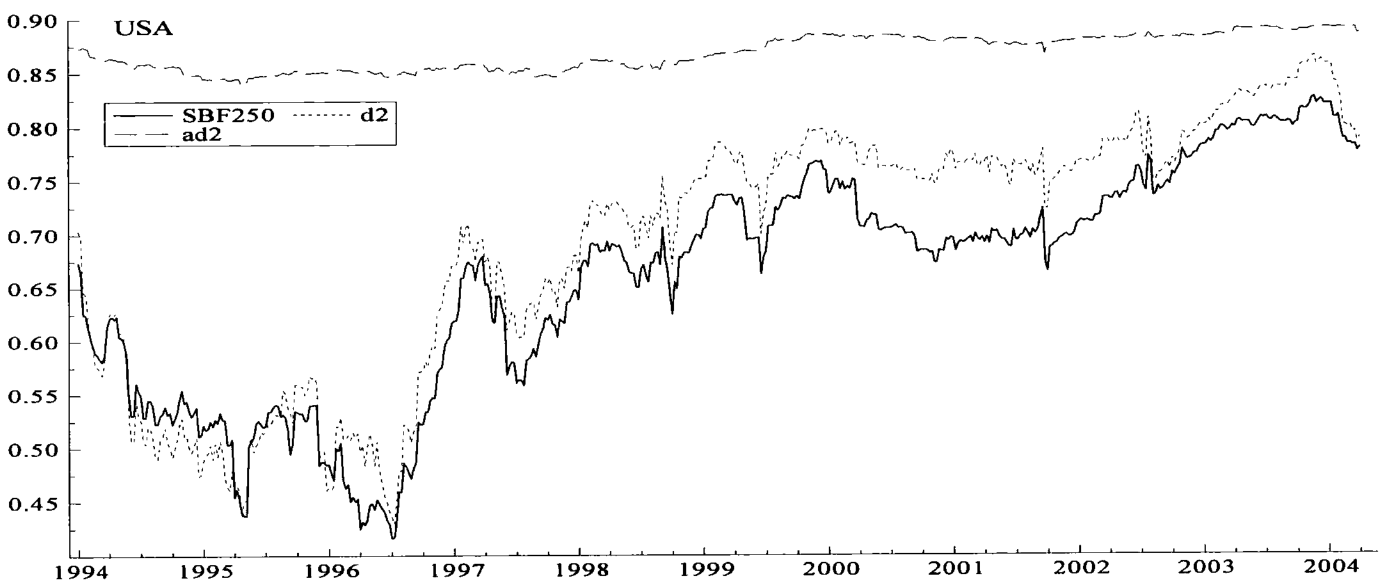

Norway
SBF250
d2
ad2
0.75
0.70
0.65
0.60
0.55
0.50
0.45
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004

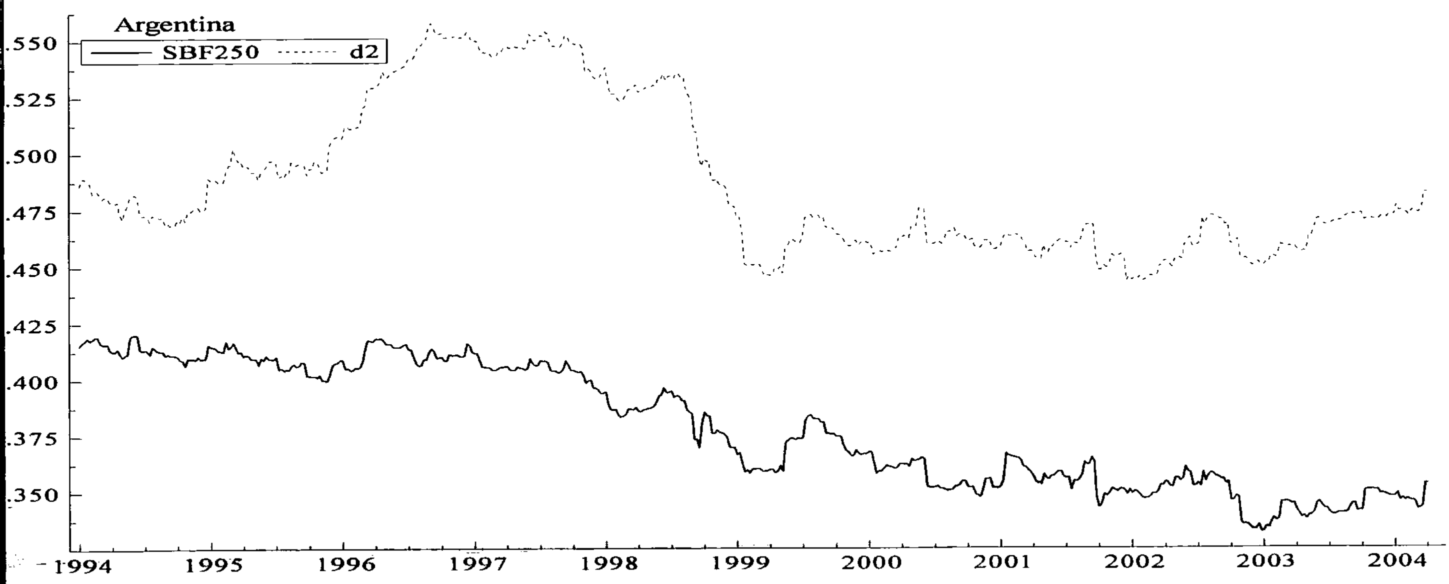

Spain
SBF250
d2
ad2
.850
.825
.800
.775
.750
.725
.700
.675
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004


Sweden
SBF250
d2
ad2
0.9
0.8
0.7
0.6
0.5
0.4
0.3
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004


Switzerland
SBF250
d2
ad2
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004


UK
SBF250
d2
ad2
0.95
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0.55
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004


USA
SBF250
d2
ad2
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0.45
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004


Argentina
SBF250
d2
.550
.525
.500
.475
.450
.425
.400
.375
.350
1994
1995
1996
1997
1998
1999
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2001
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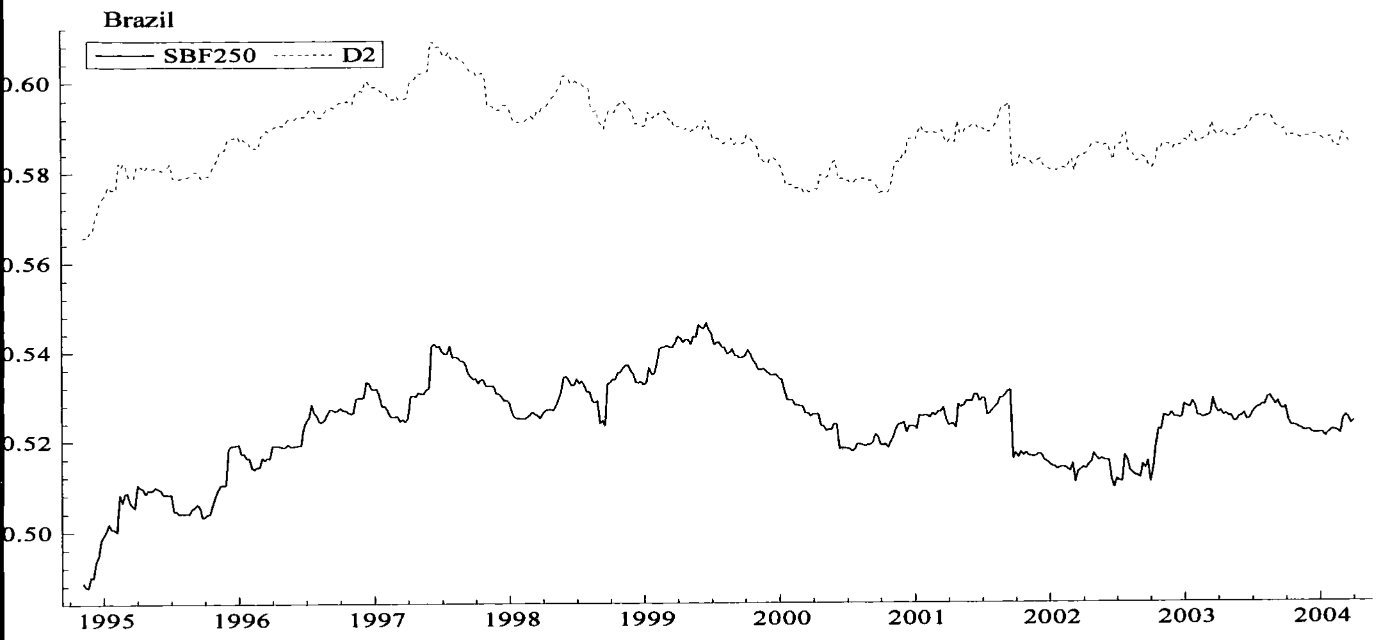
2003
2004


Brazil
SBF250
D2
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0.58
0.56
0.54
0.52
0.50
1995
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1997
1998
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2001
2002
2003
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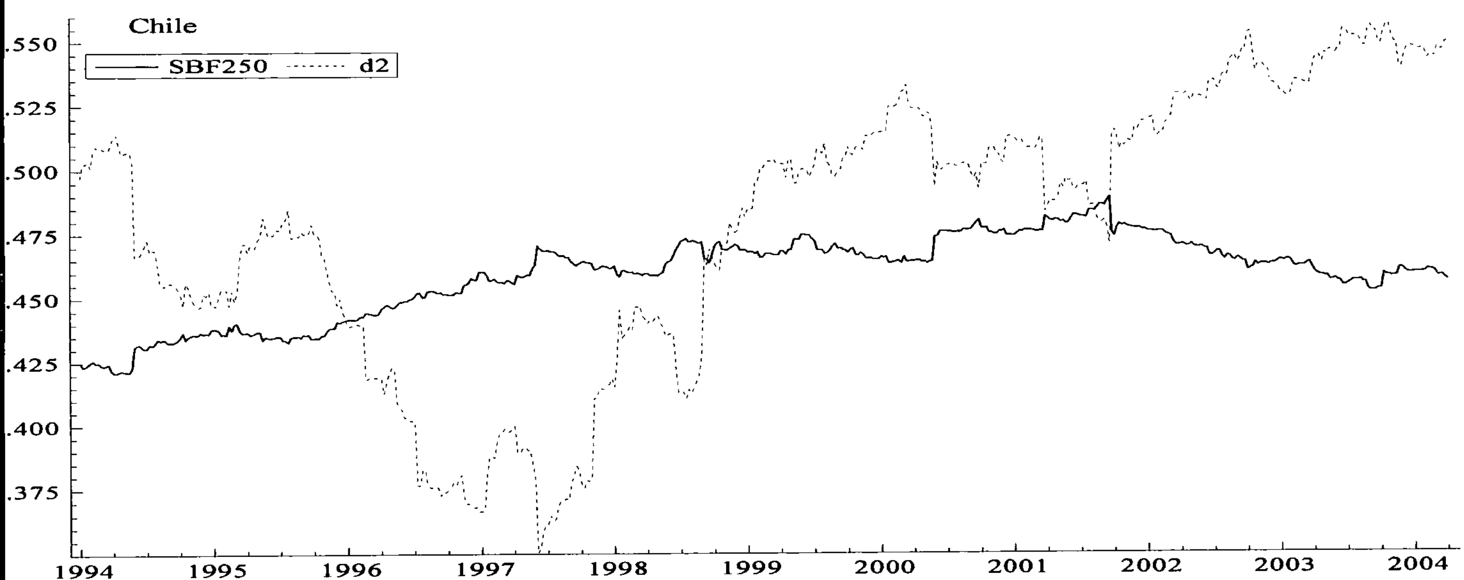
Chile
SBF250
d2
.550
.525
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.450
.425
.400
.375
1994
1995
1996
1997
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1999
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2001
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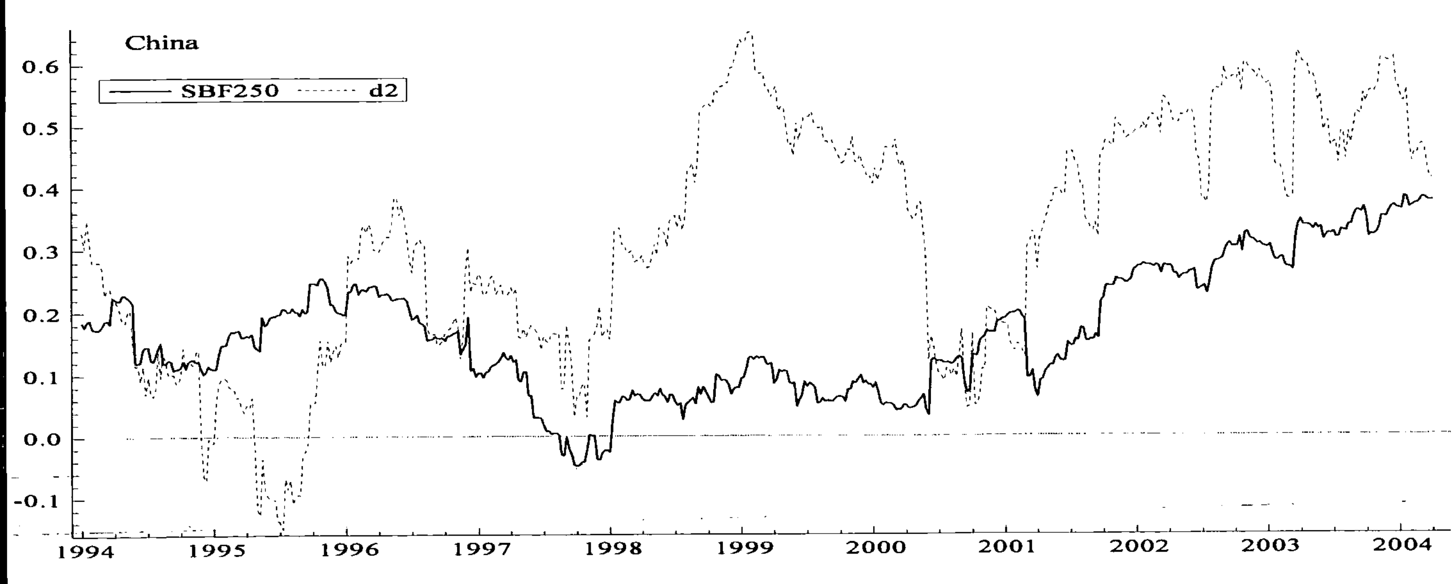
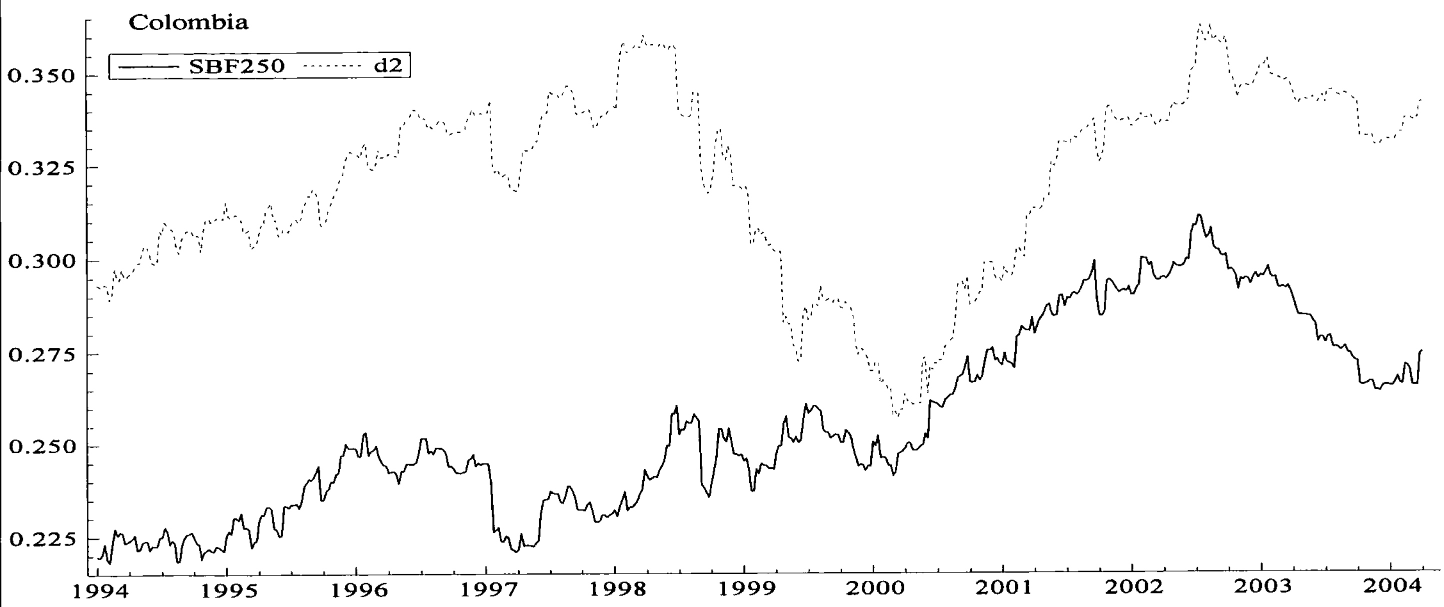
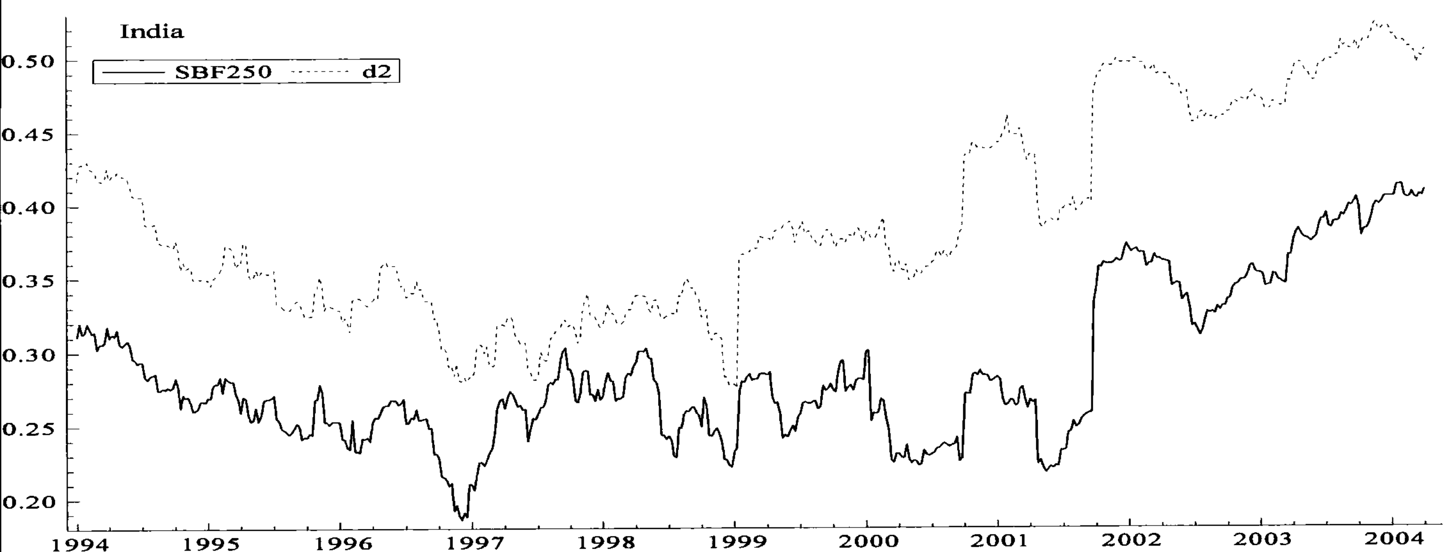
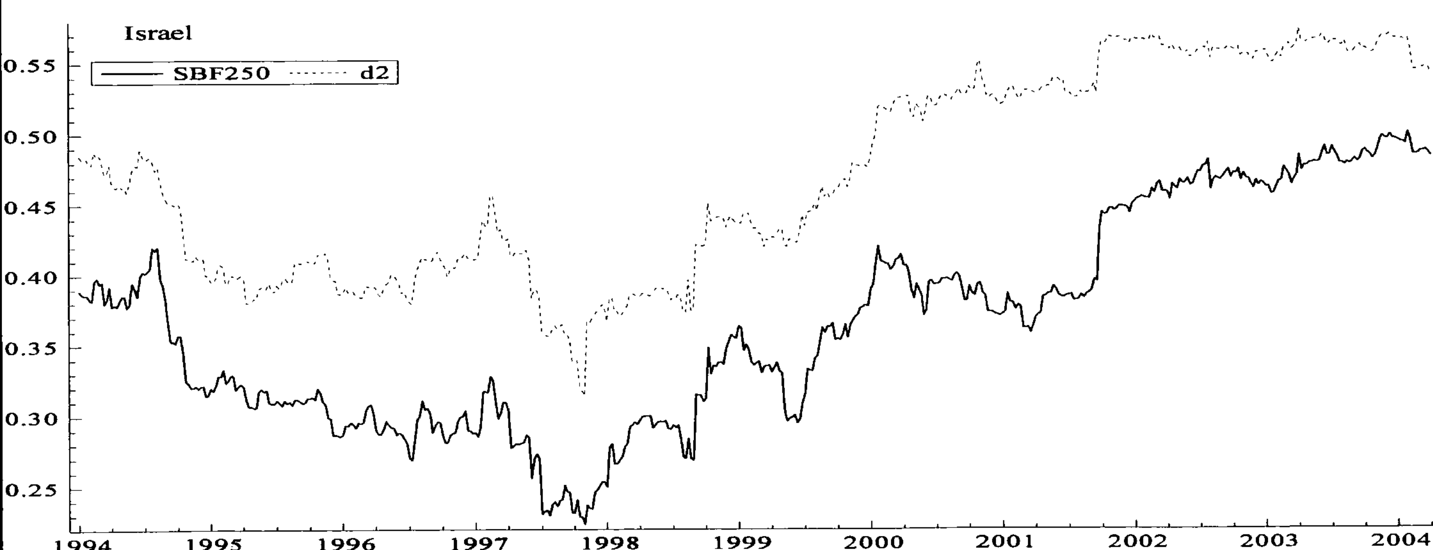

China
SBF250
d2
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004


Colombia
SBF250
d2
0.350
0.325
0.300
0.275
0.250
0.225
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004


India
SBF250
d2
0.50
0.45
0.40
0.35
0.30
0.25
0.20
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004


Israel
SBF250
d2
0.55
0.50
0.45
0.40
0.35
0.30
0.25
1994
1995
1996
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1999
2000
2001
2002
2003
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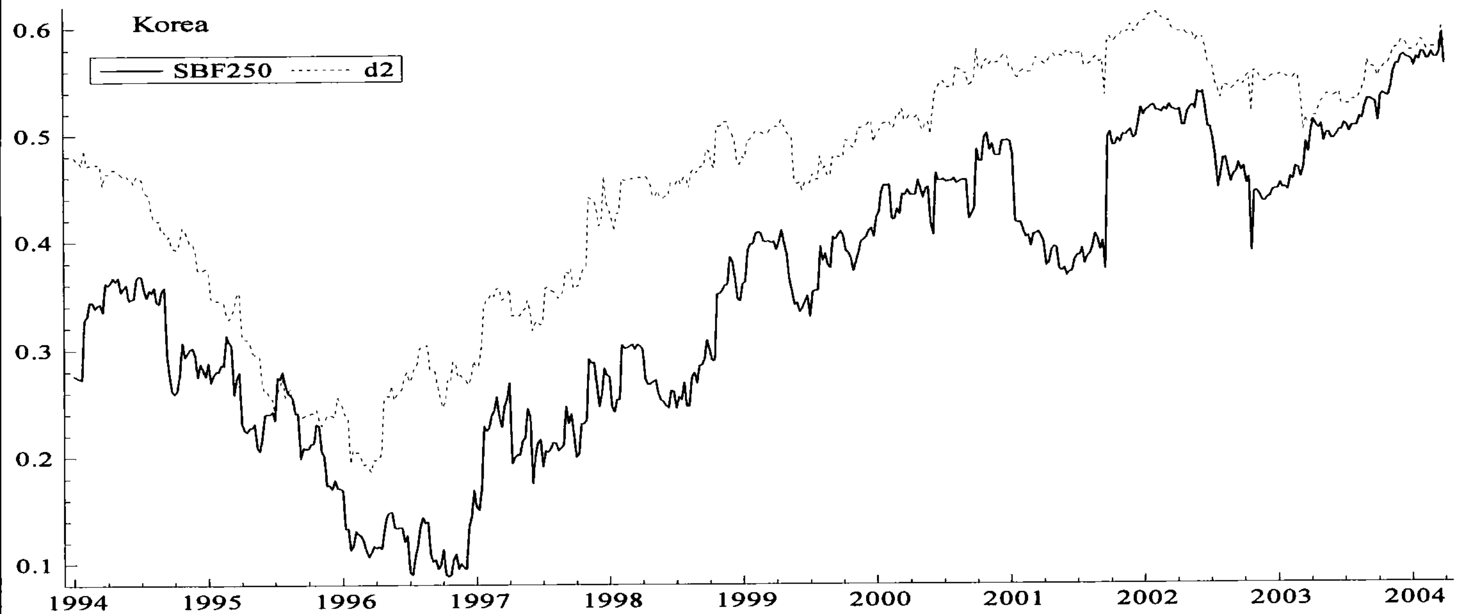
Korea
SBF250
d2
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0.3
0.2
0.1
1994
1995
1996
1997
1998
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2001
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2003
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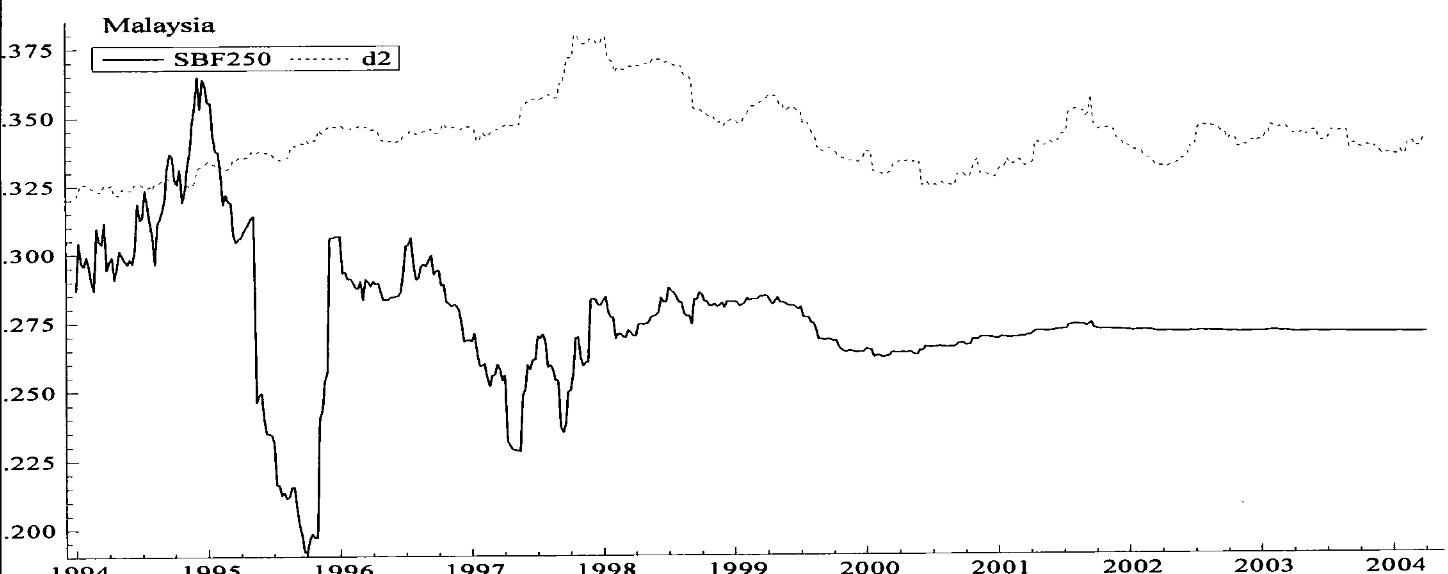
Malaysia
SBF250
d2
.375
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.325
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.275
.250
.225
.200
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
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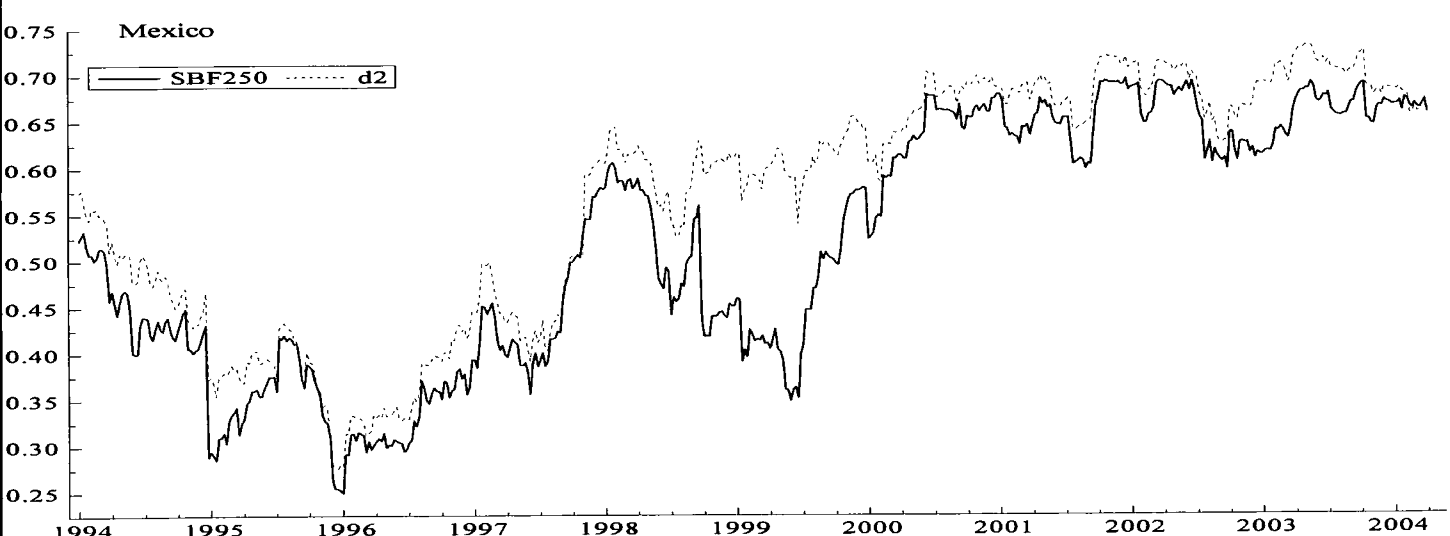
Mexico
SBF250
d2
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
1994
1995
1996
1997
1998
1999
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2001
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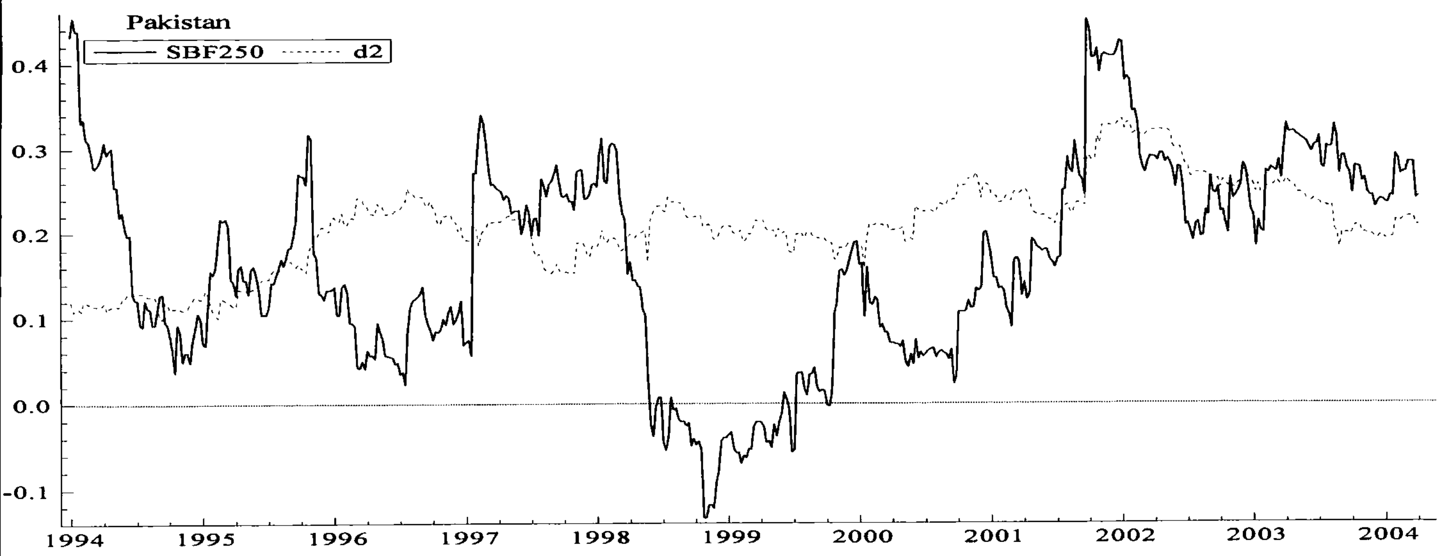
Pakistan
SBF250
d2
0.4
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0.1
0.0
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1994
1995
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2001
2002
2003
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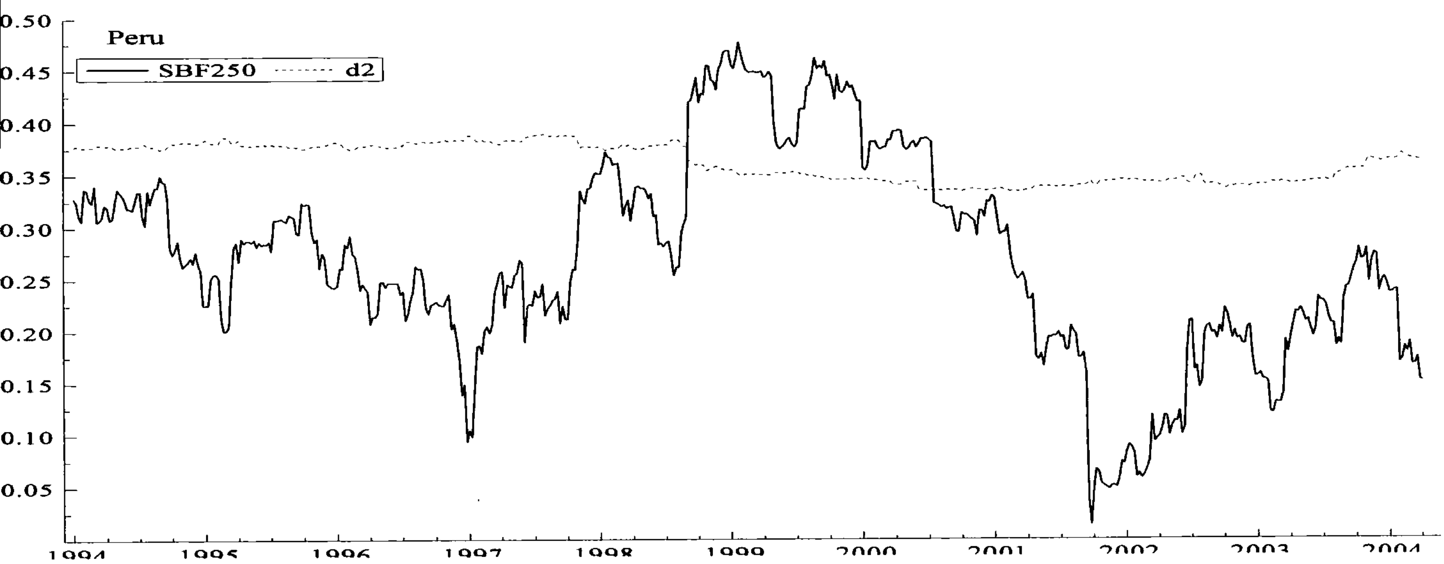
Peru
SBF250
d2
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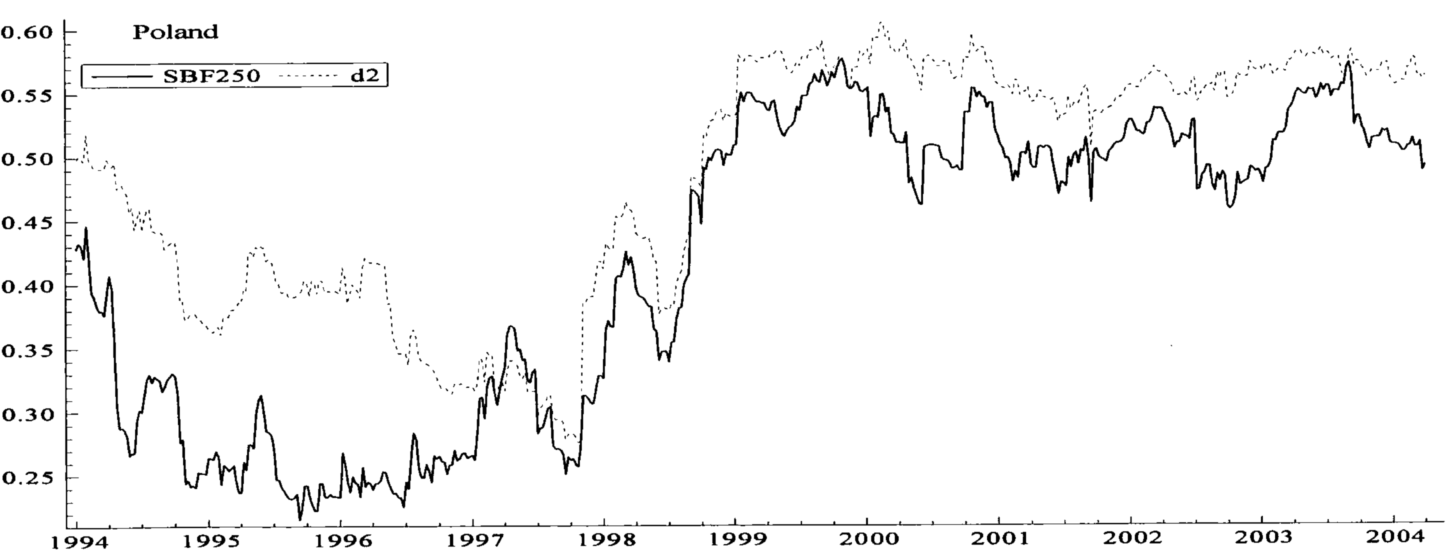
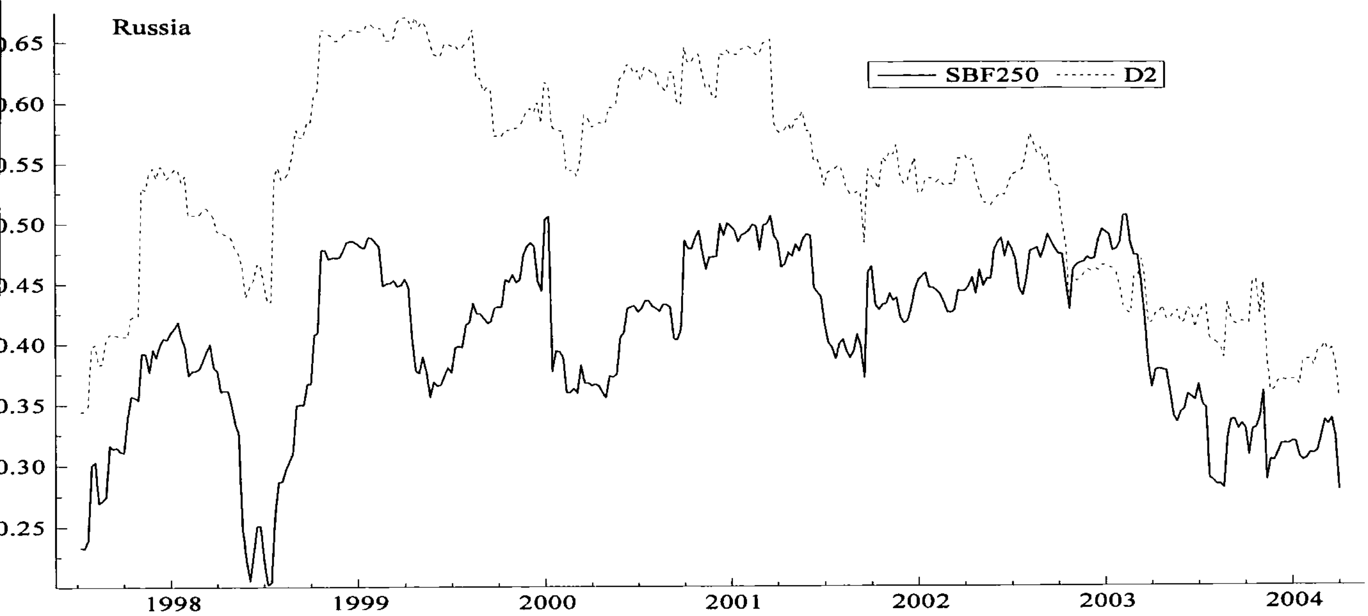
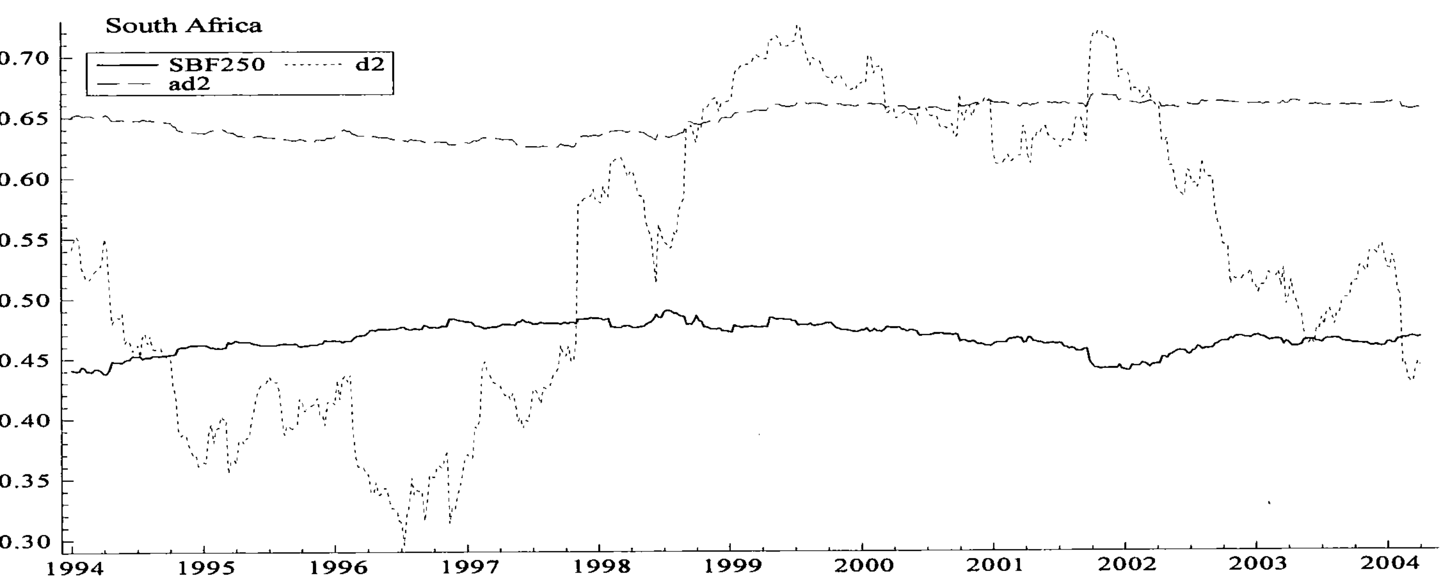
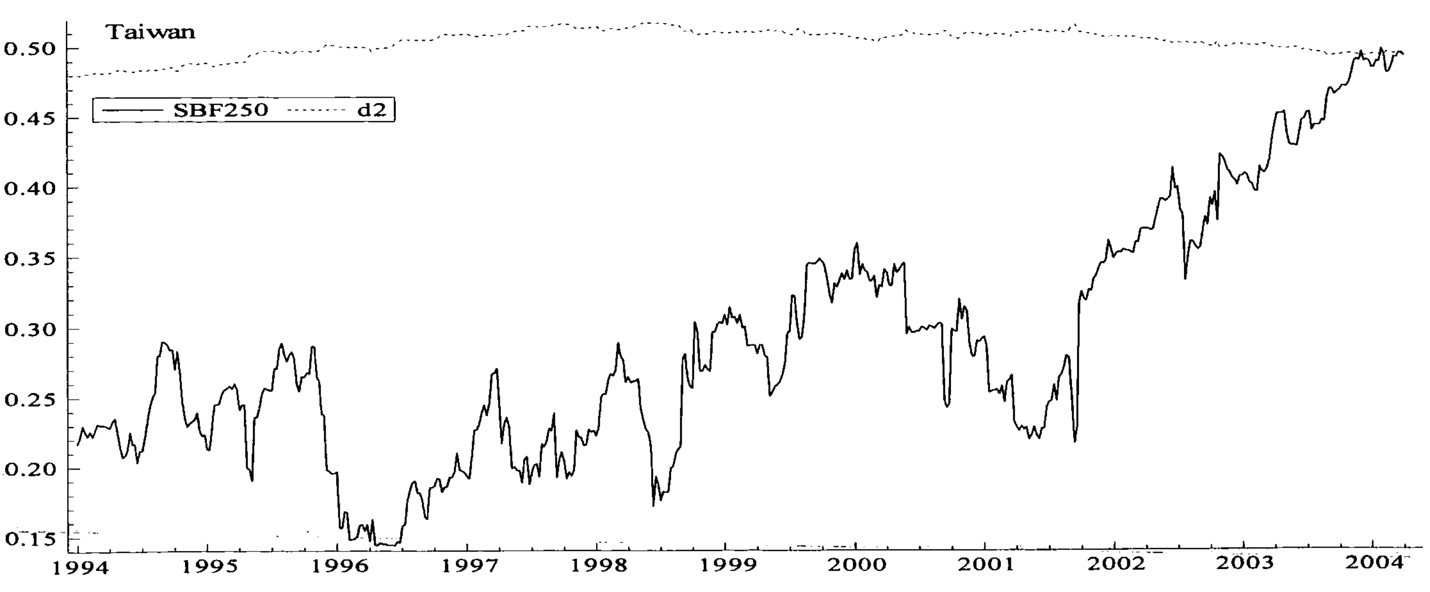
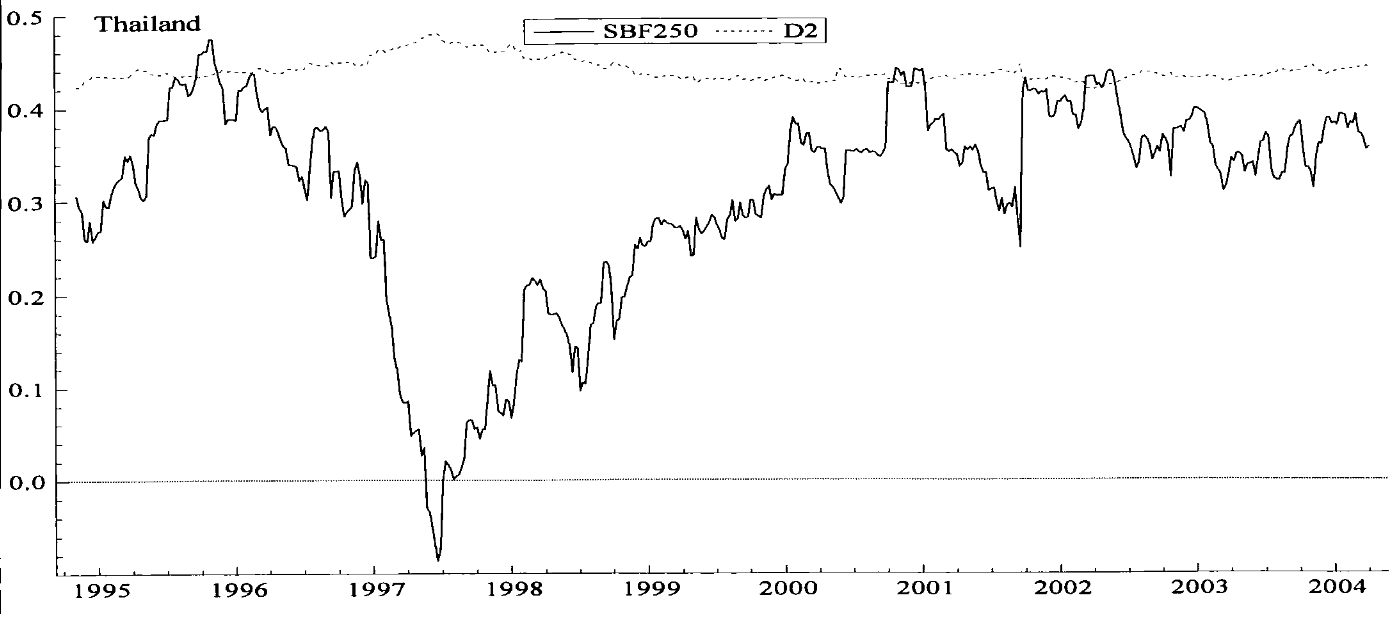
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05

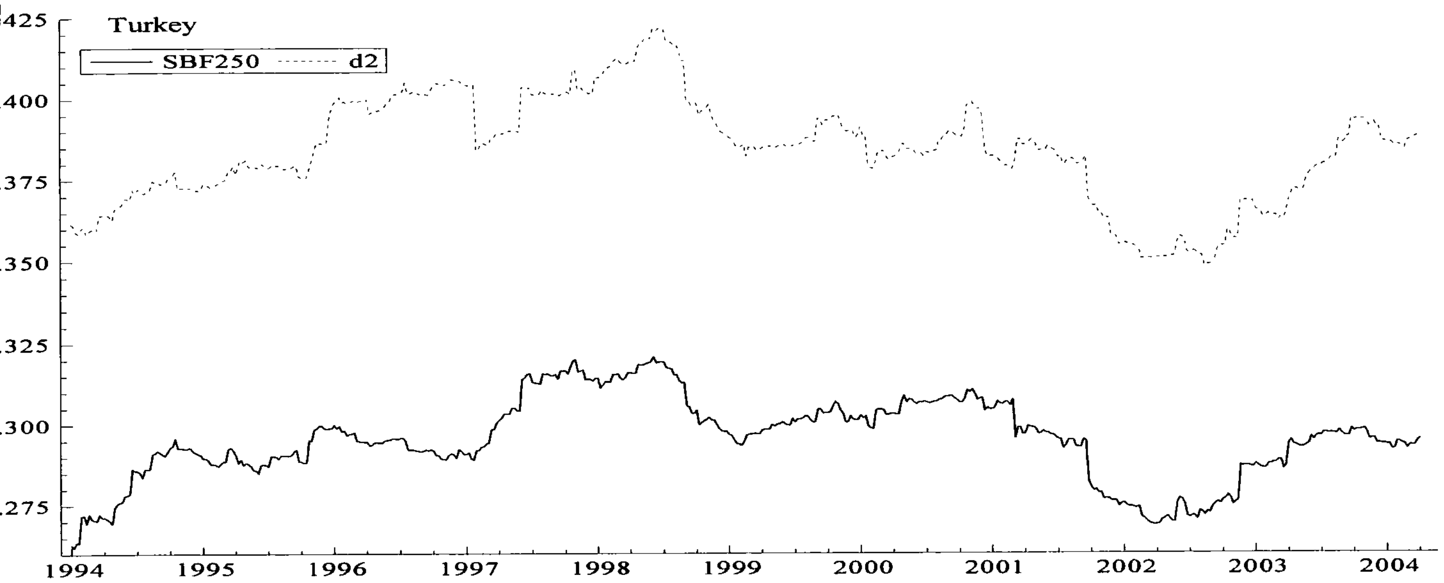

Poland
SBF250
d2
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004


Russia
SBF250
D2
1998
1999
2000
2001
2002
2003
2004


South Africa
SBF250
d2
ad2
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004


Taiwan
SBF250
d2
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004


Thailand
SBF250
D2
0.5
0.4
0.3
0.2
0.1
0.0
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004


Turkey
SBF250
d2
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.375
.350
.325
.300
.275
1994
1995
1996
1997
1998
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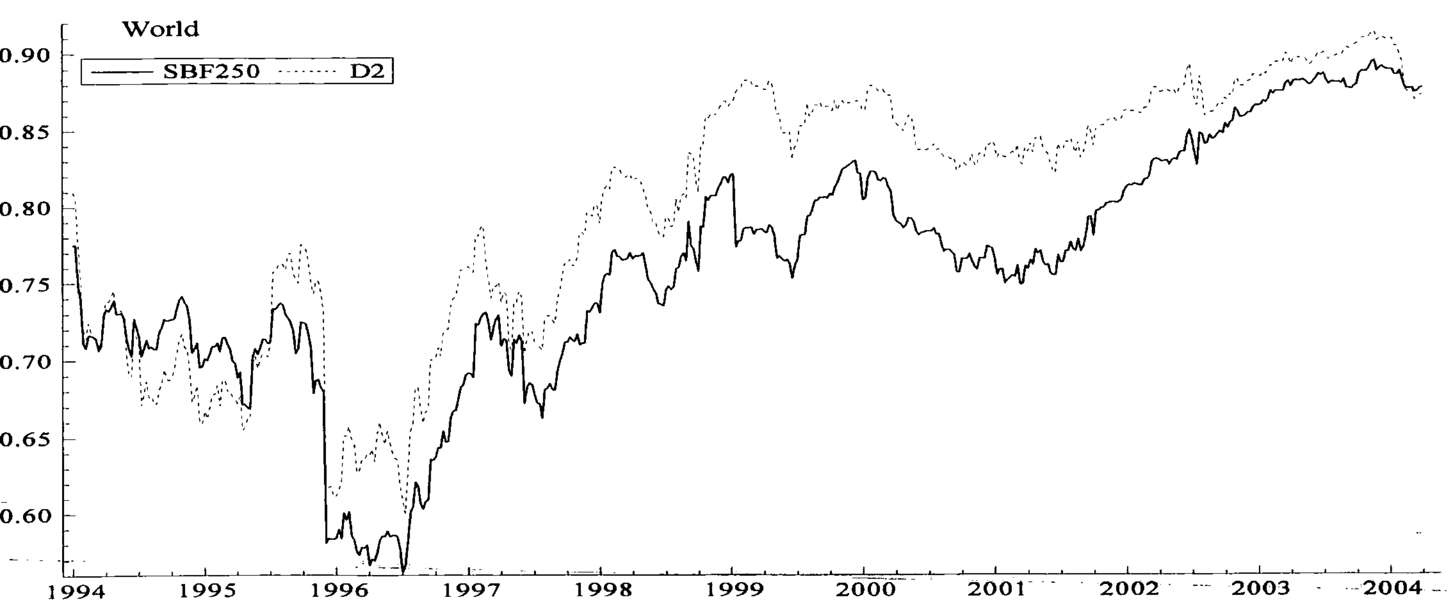
2000
2001
2002
2003
2004


World
SBF250
D2
0.90
0.85
0.80
0.75
0.70
0.65
0.60
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004