"Is the International Diversification Potential Diminishing for Foreign Equity Inside the US?

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ABSTRACT

One of the most enduring puzzles in international macroeconomics and finance is so-called "home bias"; i.e., the tendency for investors to disproportionately weight their asset portfolios towards domestic securities and thereby forego gains to international diversification. Errunza *et al* (1999) argue that domestic US investors need not go to foreign markets to obtain international diversification. Rather, they can implement home-based foreign diversification using foreign stocks and other foreign risks in the US. At the same time, the betas of foreign stocks cross-listed in the US increase in the US after the cross-listing, as documented in the literature surveyed by Karolyi (2006). In this paper, I ask what the changing asset pricing characteristics of foreign stocks in the US imply about the potential for home-based international diversification. For this purpose, I extend the break-date estimation approach of Bai and Perron (1998) to consider potentially changing covariances over time. I then calculate minimum variance portfolios for using a portfolio of foreign equity in the US as well as the home markets of these foreign companies. I find that the overall risk minimization improvement properties of foreign equity in the US have declined over the past two decades. At the same time, however, the foreign company stocks have generally provided comparable risk reduction as their home market indices consistent with home-based diversification.

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One of the most enduring puzzles in international macroeconomics and finance is the tendency for investors to disproportionately weight their asset portfolios towards domestic securities and thereby forego gains to international diversification. The puzzle in international macroeconomics has focused upon the tendency for consumers to be underinsured against aggregate shocks that could otherwise have been hedged by holding foreign assets.[1] In the financial economics literature, the puzzle has been based upon the observation that investor portfolios hold less foreign securities than implied by predictions of standard mean-variance optimization principles.[2] In both the macroeconomics and financial economics frameworks, the underlying source of diversification arises from the relatively low correlation in asset returns across countries.[3]

A number of explanations have been proposed to explain this phenomenon, including the transactions costs of acquiring and/or holding foreign assets. The transactions may be in the form of outright brokerage type costs or more subtle information costs.[4] On the other hand, Errunza *et* al (1999) have argued that transactions costs cannot be very high for stocks of foreign companies that trade in the United States on exchanges since they are not substantially more expensive to acquire than domestic stocks. Also, the foreign stocks traded on the New York Stock Exchange (NYSE) must go through the same disclosure requirements as domestic companies, including provision of the US-based accounting and financial statements. It therefore seems less likely that the information costs are significantly higher for these stocks.[5] Interestingly, Errunza *et al* (1999) find that domestically traded stocks can span the risks of foreign markets. They dub this effect “home-made diversification.” Since domestic investors need not go to foreign capital markets to diversify internationally.[6]

This international “home-made” diversification depends critically on sustained low correlations between the cross-listed foreign stock returns and the US stock market. However, there are at least two reasons to doubt the stability of this relationship over time. First, a number of studies have found that foreign stocks become more correlated and/or have higher betas with the US market after cross-listing.[7] Second, foreign stocks have a strong country risk component.[8] The growing impression in recent years, however, is that the returns from international stock markets have become more correlated over time due to a general integration of markets. If

[1] See for example Backus, Kehoe and Kydland (1991), Baxter and Crucini (1995), Cole and Obstfeld (1991), Stockman and Tesar (1995), and Pesenti and van Wincoop (2002).
[2] See for example the frameworks in French and Poterba (1991) and Pastor (2000).
[3] Lewis (1999) describes the relationship between these two approaches in the context of domestic investor’s diversification into foreign assets.
[4] On information costs, see Gehrig (1993).
[5] While not the focus of this paper, one could alternatively argue that some of these stocks may be less liquid and company news could arrive during times of the day when US market is not open. Karolyi (2006) discusses literature that analyzes the potential for market liquidity to affect cross-listing decisions. By contrast, Tesar and Werner (1995) show that the aggregate turnover of foreign stocks is higher than domestic stocks, suggesting that the transactions costs for purchasing and selling foreign stocks are not higher than domestic stocks.
[6] Errunza *et al* (1999) also tested whether portfolios of multinational firms span the foreign markets, finding that the hypothesis cannot be rejected.
[7] See Foerster and Karolyi (1999) and the references in Karolyi (2006).
[8] Heston and Roewenhorst (1994) showed that country effects were more important than industry effects. Bekaert, Hodrick and Zang (2005) re-examine this relationship using a more general approach, showing that while industry factors appeared more important than country factors for a while, this phenomenon was short-lived and appears to have disappeared.

true, the country risk factor in foreign cross-listed stocks would become more correlated with the US market, further reducing diversification potentials. These two relationships raise the question: Does the international diversification potential in foreign cross-listed stocks remain in this new integrated financial environment?

This paper re-examines the cross-listed stock pricing relationships and asks what the potentially changing nature of these relationships says about diversifying with home-made international diversification. Since foreign stocks depend strongly upon their own local markets, I begin by examining the diversification relationship for US investors from the foreign market indices in the home countries of the cross-listed companies. Next, I study the set of foreign companies traded in the United States themselves. For both sets of foreign returns, I allow for the possibility that the relationship between US and foreign markets have changed over time. I then analyze the effects of potential asset pricing changes in stock market indices and cross-listed firms to consider the implications for minimizing portfolio variance.

An extensive literature has analyzed international asset pricing relationships, including the possibility that those relationships have changed over time. Therefore, it is important to note how this paper relates to this literature. Papers investigating the potential for changing asset pricing relationships have generally followed one of two different approaches.

The first general approach puts structure on the dynamic process for parameters.[9] While the effects of time-varying parameters on returns have a long history in the literature, recent studies have examined more directly the impact of time-varying correlations on portfolio choice. In particular, Longin and Solnik (2001) demonstrate the importance of extreme crises events on measures of bivariate correlations of pairs of country stock returns. They note that stock markets co-movement during crises tends to limit the potential for diversification. Ang and Bekaert (2002) develop a regime switching model to determine how much of this changing bivariate structure would affect the optimal allocations to foreign stocks, finding the change in allocations are relatively small. Similar to this line of studies, I find below that periods of shifts in covariances are also associated with periods of increased volatility in markets and that these periods imply relatively little gain from foreign asset allocation.

The second general approach is to consider asset return breaks around given event dates. For example, Karolyi (2006) surveys the voluminous literature that has studied the effects on foreign stock returns following the event of cross-listing in different markets. Event analysis of emerging stock market indices has also been the focus of capital market liberalization studies as surveyed in Henry (2006).[10] Similar to these studies, I focus below upon breaks around dates for foreign stocks that have undergone significant changes such as cross-listing, home market liberalization, or both.

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[9] For example, Bekaert and Harvey (1995) and Baele (2005) estimate a time-varying Markov switching process in international equity return relationships.

[10] Some of the studies that examine the effects of specific event dates such as market liberalizations, foreign speculators, or equity cross-listings include Bekaert and Harvey (1997,2000), Bekaert, Harvey and Lumbsdaine (2002), Foerster and Karolyi (1999), and Henry (2000), to name a few.

While this paper shares some similarities with these two literatures, its primary goal is different. My goal is to develop a picture of foreign stocks listed in the US to re-consider whether home-based diversification has changed over time. For the purpose of considering potential time variation in home-based diversification, I need an approach that will minimize the structure on the dynamic process of changing parameters. Like the event study literature, I focus exclusively on foreign cross-listed stocks and allow for parameters to be stable over time. Unlike that literature, however, I do not condition the breaks on event dates. By doing so, I estimate the process in a minimally parameterized manner which allows the resulting estimated processes either to be stable over time or to change over time as dictated by the data.

To achieve this goal, I estimate a standard factor model for each foreign cross-listed stock against the US market return and then test for shifts in the relationship. In practice, tests for structural breaks pick up both discrete shifts and gradually changing parameter movements.[11] To test for whether and when these parameter distribution shifts occur, I first use the endogenous break point estimation approach of Bai and Perron (1998) to generate the series of co-variation parameters over time. Later, I also estimate a variation on the model proposed by Bai and Perron (2003b) to consider more gradual changes.

To evaluate the economic significance of these parameter changes, I use the estimates to examine the implications for a simple portfolio decision model in which a US investor could choose between US and foreign portfolios. When restricted to holding foreign assets in the form of market indices, I find that the minimum variance allocation in foreign market indices actually increases over time. However, the minimum variance allocation into foreign stocks decreases when the investor is allowed to hold foreign stocks that are traded in the US. Also, the lowest variance attainable by diversifying into foreign portfolios has increased over time. These results suggest that the benefits to foreign diversification have declined to US investors.

In addition to examining foreign stocks in the US, the paper also makes two other contributions. First, while the estimation in Bai and Perron (1998) was developed for single equations, this paper applies the empirical analysis to multiple equations and provides a framework for examining the cross-section of the parameters.

Second, the paper provides a new test for the independence of the world market effect in a standard international factor model with the world market and local market factors.[12] Since local markets depend upon the world market, a shift in the relationship between foreign market indices would also confound the relationship between an individual foreign stock trading in the US and the US market. In this paper, I show that the two factor model can be written as a nested relationship between foreign stocks and the home market, and the home and foreign markets in turn. I propose a test for whether shifts in the relationship between foreign stocks and the US are a result of changes at the macro level or at the individual stock level.

[11] Stock (1994) describes the difficulties between testing for structural breaks versus parametric changes that would suggest non-stationarity. As Bai and Perron (2003a) show, the algorithm for the model to be estimated below can be extended to threshold switching models.
[12] See for example Ferson and Harvey (1993) and Dumas and Solnik (1995).

The paper proceeds as follows. Section 1 provides estimates for the home markets of foreign companies listed in the US market. Section 2 includes the foreign stocks in the United States in estimation. Section 3 examines the overall implications for the portfolio potential for foreign stocks inside and outside the US. Section 4 considers the potential for other explanations. Concluding remarks follow.

Section 1: Home Markets of Foreign Cross-Listed Stocks

Company level stocks have a strong relationship with their home market indices. The literature also suggests that the relationship between market indices has shifted over time, whether as a result of general integration or due to crisis periods. If so, the relationship between the cross-listed foreign firms and the US market may change as an indirect effect of more general macro-related shifts. To explore this possibility, I first begin the analysis by studying the relationship between the US market and the home markets of foreign stocks that are listed in the US. Indeed, in Section 2 below, I show that foreign stocks in the US would incorrectly appear to have breaks against the US market if these more general macro shifts are not appropriately incorporated into the empirical model.

1a. Empirical Framework and Motivation

I start with a standard factor pricing relationship used in the literature on international market returns:

$$r_t^{\ell} = \alpha^{\ell} + \beta^{\ell}{}' f_t^{\ell} + u_t^{\ell} \qquad (1)$$

Where r_t^{ℓ} is the nominal excess return on the equity market of country ℓ at date *t*, f_t^{ℓ} is a vector of factors at time *t* that affect the return on the equity market of country ℓ, β^{ℓ} is a vector of factor intensity parameters, α^{ℓ} is a constant parameter and u_t^{ℓ} is a residual. Since all the analysis below is based upon excess returns, I will simply call them returns throughout. Also, while the basic pricing relationship may be constant, as specified in equation (1), I will consider more general versions of the model, including time-variation in the parameters. These more general versions all have constant parameters as a special case.

The pricing relationship in (1) can be motivated in various ways. From a general equilibrium viewpoint, when markets are complete, f_t^{ℓ} is a scalar latent variable proportional to the stochastic discount rate.[13] Alternatively, f_t^{ℓ} may represent a common component across countries, but also include additional hedge factors arising from local risks. For example, if real returns differ across countries due to deviations from purchasing power parity, $\beta^{\ell}{}' f^{\ell}$ can represent the pricing to reflect the risk premia on portfolios that bear this risk, in addition to the common pricing component across countries.[14]

A benchmark model that has often been used to examine international equity market index returns especially in the context of the gains to international diversification is:[15]

[13] See for example the discussion in Bekaert and Hodrick (1992).
[14] Adler and Dumas (1983) developed the classic model on this relationship. Dumas and Solnik (1995) and Vassalou (2000) provide some empirical evidence showing that real PPP deviations are priced in the international market.
[15] See for example, Obstfeld (1994) and Henry (2003).

$$r_t^{\ell} = \alpha^{\ell} + \beta^{\ell}\ r_t^{w} + u_t^{\ell} \tag{2}$$

The model is a single factor model where the benchmark depends on r^w_t, the return on a global world equity portfolio. I use this framework to examine the potential portfolio allocation changes in equity market indices in this section. Clearly, there are more factors that are important for explaining international stock returns as has recently been analyzed by Bekaert, Hodrick, and Zhang (2005). Therefore, in the following sections, I also report results for model that includes both local market and industry effects.

This investigation is motivated by at least three common perceptions about international equity markets. One, global markets have become more interconnected over time. Two, international pricing relationships have often experienced shifting patterns in their co-movements due to crises and political changes. And three, the pricing relationship between emerging market country returns and the world market returns often appear to change around the time of opening in markets.[16]

While specific events may herald a significant change in these asset pricing relationships between countries, a more gradual integration process may also achieve the same effect. Therefore, my goal is to minimize the structure on whether and how the factor loadings change. By doing so, I allow the estimates to capture the cross-section and time-series variation in international asset pricing relationships without preconditioning on liberalization events or any presumption about whether international markets have become more integrated.

For this purpose, I follow three steps. First, I test for breaks in the relationship between local equity market returns and the world market. Second, for equity returns in the countries that reject the hypothesis of no breaks, I implement the approach derived by Bai and Perron (1998, 2003a) to estimate the break points in the relationship and provide confidence intervals for the breakpoints for each country. Third, I use the parameter estimates to form hypothetical minimum variance portfolios to see how the changes in asset pricing relationships would affect international allocation.

1b. Econometric Analysis

The estimator developed by Bai and Perron (1998) considers a single equation time series regression equation with a given number of breaks in the parameters and describes how the number of breaks can be consistently estimated. Bai and Perron (2003a,b) further examine the finite sample properties of these estimators. I first describe the basic B-P framework before explaining below how I extend this analysis to allow for multiple equations.

Single-Equation Estimation: To examine potential breaks in the basic asset pricing relationship in equation (2), I follow B-P in allowing for the possibility of a maximum number of breaks in the parameters, defined as m. Below, a series of tests are conducted to determine a conservative number for the maximum number of breaks before using the estimation approach.

[16] For an early paper examining equity market liberalization, see Bonser-Neal, et al (1990). More recently, Henry (2000) and Chari and Henry (2004) have studied the effect of market liberalization on market indices. Bekaert, Harvey and Lumsdaine (2002) use the joint behavior of international returns in order to date implicit liberalization from integration.

I begin by describing the estimation for a specific country. The details of the analysis are relegated to the appendix. Using the standard world CAPM and allowing for possible parameter shifts, the returns for country ℓ are:

$$r_t^{\ell} = \alpha_\tau^{\ell} + \beta_\tau^{\ell}\, r_t^{w} + u_{\tau,t}^{\ell}, \qquad \text{for } \tau = 1, \ldots, m+1; \qquad t = 1, \ldots, T \tag{3}$$

where time is defined over a set of time subintervals T_τ for $\tau = 1, \ldots, m+1$. Without loss of generality, the time intervals are arrayed so that:

$$t = \{1, \ldots, T_1, T_{1+1, \ldots,} T_2, T_{2+1, \ldots,} T_3, \ldots, T_{m, \ldots,} T\} \tag{4}$$

for $T_0 = 0$ and $T_{m+1} = T$. Note that the constant parameter model in (2) is a special case of (3) where $m \neq 0$.

To economize on notation for developing the estimator to be used below, I subsume the country index ℓ and rewrite the general factor model in (1) as:

$$r_t = \delta' f_t + u_t \tag{1'}$$

where r_t is the asset return series, u_t is the residual, and δ is the parameter vector $\delta = \{\alpha , \beta \}'$ and where f_t is rewritten to include a constant as the first factor. Using this notation together with the model in (3) and (4) implies that:

$$r_t = \delta_\tau' f_t + u_t \tag{5}$$

where δ_τ is a fixed parameter vector for each period τ, $\tau = 1, \ldots, m+1$ on the on the intervals implied by T_i.

Bai and Perron (1998) show that unknown breakpoints can be estimated consistently by minimizing over the sum of squared residuals for all possible partitions of the data into m+1 different intervals. In other words, T_1, T_2, …., T_m can be consistently estimated by solving the following minimization:

$$\left\{\hat{T}_1, \hat{T}_2, \ldots, \hat{T}_m\right\} = \underset{T_1, T_2, \ldots, T_m}{\arg\min} \left[\sum_{\tau=1}^{m+1} \left(\sum_{t \in \{T_{(\tau-1)}+1, \ldots, T_\tau\}} [r_t - \delta_\tau' f_t]^2 \right) \right] \tag{6}$$

Bai and Perron (1998) also derive the limiting distribution of these break point estimates providing confidence intervals on the breakpoint estimates.

While the estimation of the break dates requires minimizing the sum of squared residuals for *all* possible m partitions of the data, Bai and Perron (2003b) show that the estimator can have poor properties when the minimal length of the partition becomes too small. The reason is intuitively clear --- finer partitions of the intervals will imply fewer observations and, therefore, less precise estimates. BP propose constraining the minimal length of a segment for calculating the sum of squares in the argmin calculation in (6). This minimal length is defined as a proportion of the total sample size so that the percentage "trimming" constraint ε is used to construct a minimal length of a segment: $h = \varepsilon T$. Bai and Perron (2003b) show that the size of this trimming factor depends upon the number of maximum breaks, m, and derive critical values based upon this statistic. Bai and Perron (2003a) report on Monte Carlo simulations of the finite sample properties of this distribution for various tests in terms of a "trimming parameter" $\varepsilon = h/T$. They find that the accuracy of the tests depend upon this trimming parameter, a point I return to below.

Multi-Equation Estimation: The Bai-Perron estimator described above was developed for an individual time series. Since my goal is to develop a cross-sectional as well as time-series picture of the covariation pattern in foreign relative to domestic returns, I extend this framework to multiple equations.

Specifically, I examine the effects of each country index separately to build up a set for each return of: (a) number of breaks; (b) break date estimates and their associated confidence intervals; and (c) parameters per subperiod interval. Later I will use this panel of estimates to demonstrate the implications for this distribution of returns on international portfolio choice.

I first test for the number of breaks, m^ℓ, for each country market index. I then estimate the set of break dates: $(\hat{T}_1^\ell, \hat{T}_2^\ell, \ldots, \hat{T}_{m^\ell}^\ell)$ and δ_τ $\forall$ $\tau = 1, \ldots, m^\ell+1$. In other words, rewriting equation (3) as a set of equation over countries ℓ implies:

$$r_t^\ell = \alpha_\tau^\ell + \beta_\tau^\ell r_t^w + u_{\tau,t}^\ell, \qquad \text{for } \ell = 1, \ldots, L, \quad \tau = 1, \ldots, m^\ell+1 \qquad (3')$$

Note that the number of parameter shifts, m, differ by country ℓ and include m=0; i.e., no breaks. Moreover, no restrictions are placed on the variance of the residual, $u_{\tau,t}^\ell$, over subperiods. Indeed, the variance will generally change over subperiods, T_τ, and across countries, ℓ. In the empirical estimates below, the standard errors are also corrected for a general conditional heteroskedasticity as in White (1980) and Andrews (1991).

1c. Country-Level Data

The goal of this paper is to look at the effects of potential changes in foreign asset pricing relationships relative to the US market. I take the approach from a US perspective for two main reasons. First, a great deal of research has focused upon diversification from the point of view of a US investor, including some of the earliest research on home bias. It therefore seems natural to focus upon this benchmark case. Second, the US market has the biggest market cap of any country in standard world indexes. While I will use the US market as the measure of the "world" index below, estimation using the Morgan Stanley World Index gives qualitatively similar results.

For data analysis on the country indices, I use the Morgan Stanley Capitalization Weighted indices for major countries.[17] To compare these market indices with foreign stocks in the United States, I examine only the foreign countries with foreign stocks on the New York Stock Exchange in 2004. This partition yields the 40 foreign countries listed in Appendix Table 1. Weekly returns are constructed for each of these indices reconverted into US dollars from 1970, or the earliest available, until April 2004. The returns are transformed into excess returns by subtracting the weekly T-bill rate obtained from Ken French's website from the stock

[17] The index includes reinvested dividends converted into US dollars.

returns. As explained above, the US market was used to proxy for the "world" index. This equity market series was taken to be the S&P 500. More information about these series is provided in Appendix 1.

1d. Break Tests

Table 1 provides evidence for breaks in the asset pricing relationship in equation (3). I first test the null hypothesis of "no breaks" for each country's equation. Bai and Perron (2003a) describe the properties of various break tests against different alternatives. Since the limiting distribution of these tests depends upon the proportion of the minimal subinterval, measured by ε, I calculate the test statistics based upon two different constraints on this parameter. Panel A constrains ε to be no smaller than 15% while Panel B allows ε as small as 5%. These two panels of Table 1 report summary evidence for the proportion of countries rejecting the break tests at marginal significance level (MSL) of 10%, 5%, and 2.5%.

Bai and Perron (2003a) report Monte Carlo results suggesting that break tests based upon supF tests have the most robust properties. The first three columns report the proportion of countries that reject the hypothesis of no break against the alternative of one, two, and three breaks, alternatively. In a naturally occurring distribution with no breaks, the hypothesis of breaks should be rejected about the same percent as the test MSL. However, in Panel A, the proportion of countries that rejects no breaks relative to 1 break ranges from about 59% for 2.5% MSL to 69% for 10% MSL. This same test against the alternative of 3 breaks increases to 69% for 2.5% MSL to 82% for 10% MSL. Results for Panel B with a lower allowable proportion of minimum intervals show a similar pattern. Since the estimated proportion is considerably higher than the MSL, these results show that the break tests are rejected more often than would occur by chance.

While Bai and Perron advocate using the supF test with given numbers of breaks, they acknowledge that there are circumstances in which they might be deceptive. For example, for a regime switching model in which the parameters switch back to an initial regime, the test will underestimate the number of breaks. For this reason, they also suggest testing the hypothesis of no breaks against an unknown number of breaks. The last two columns of Panels A and B report the proportion of countries that rejected this hypothesis using the "double maximum" test,

$$\text{Max } F_T(M,q) = \max_{1\le m\le M}\left(\frac{\hat{T}_1}{T},\ldots,\frac{\hat{T}_m}{T};q\right)$$

The "UD Max" test is an equal weighted version while the "WD Max" test weights the individual tests such that the marginal p-values are equal across values of m. Again, the proportion of countries that reject the hypothesis of no break is significantly higher than the MSL and the pattern is similar when the minimum sample length is shortened to 5%. In the following results, I maintain the assumption that the minimum sample length is 15% since Bai and Perron find this value of ε produces better sample properties when the number of breaks are as high as three.

Panel C of Table 1 reports summary evidence for the sequential "supF test" given by marginal significance levels (MSL) of 10%, 5%, and 2.5%. In this test, a sequential procedure estimates each break one at a time, and estimation stops when the supF(τ+1|τ) test is no longer significant at the given marginal significance level. To identify m^ℓ, I begin the analysis by conducting sequential SupF tests for each country, allowing up to four subperiods.[18] The second column of Panel C reports the proportion of the countries that rejected the hypothesis of zero breaks. The last three columns of Panel C report the proportion of countries that show evidence of one break, two breaks and three breaks, respectively. Countries with one break make up the majority of the cases ranging from 69% at 10% MSL to 78% at 2.5% MSL. On the other hand, the number of countries with evidence of 3 breaks is quite small at only 4 to 7%. This evidence suggests that assuming the number of breaks to be less than four is not overly restrictive.

1e. Breakpoint Statistics

Given the number of breaks by country, I estimate the break date equations for each country return series. Defining $\hat{m}_\ell$ as the estimated number of parameter breaks for country ℓ, the result is a set of $\hat{m}_\ell$ break date estimates for ℓ = 1, …, L given by

$$(\hat{T}_1^\ell, \hat{T}_2^\ell, ..., \hat{T}_{\hat{m}_\ell}^\ell) \tag{7a}$$

and parameter estimates for each interval τ = 1, …, $\hat{m}_\ell$ +1 for country ℓ given by

$$\{\hat{\alpha}_\tau^\ell, \hat{\beta}_\tau^\ell, \hat{u}_\tau^\ell\} \tag{7b}$$

Where the residual is normally distributed with possibly differing variance across intervals,

$$u_{\tau,t}^\ell \sim N(0, \sigma_\tau^{\ell 2}) \tag{7c}$$

Thus, I estimate a set of parameters by subperiod along with break points and confidence intervals around each estimate of the breakpoint and parameters. I chose $\varepsilon = .15$ as a conservative constraint on the minimal sample length.[19]

Panel D of Table 1 reports the mean and standard deviation of the break point estimates T_1 and T_2 across the countries.[20] Under "Full Sample by Break," I give the mean and standard deviation for all first and second breaks. As the evidence shows, the mean of the first break is in November 1992 while the mean of the second break is November 1997. When the breaks are grouped by single break versus double break countries, the evidence looks similar. The countries that appear to shift parameters only once are on average centered on May 1993 while the countries with evidence of two breaks have their first break centered at March 1991. Overall, the mean breaks occur in the early and late 1990s.

The standard errors around the break dates give a sense of how tightly the break dates are estimated. Panel D of Table 1 also reports the mean of the standard error of the break point estimates across countries. The standard error means range from 5 months for the second break estimates to 12 months for the first break estimate when all

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[18] As will be shown below, the country returns show little evidence of more than two breaks anyway, so this seems like a fairly conservative assumption for the maximum number of breaks, m.

[19] In Monte Carlo simulations, Bai and Perron find that the maximal value of m for $\varepsilon = 0.15$ is 5. Since m is 4 or less in all the analysis in this paper, this appears relatively conservative.

[20] There were insufficient data points to estimate the mean and standard deviation for the third break point.

first breaks are grouped together. To get a better picture of the break-points, Figure1a plots the break-point estimates for each year by country along with its 95% standard error bounds for the 5% marginal significance case. As the figure shows, most of the countries have only one break but a few have two break points. For example, Belgium experiences a break relative to the US in the late 1970s and then again in the late 1990s. The figure also shows that many of the breaks in the Latin American and Asian country returns occur in the late 1990s, roughly consistent with the Asian criisis.

One way to look at how many breaks occur in different periods is to depict the frequency of breaks in five year intervals. Figure 1b shows the frequency of breaks by the number of countries with break points decomposed into the first break, second break and total. Figure 1c shows the same information plotted by the percentage of total breaks over the period. As the figure clearly demonstrates, most of the country breaks occur in the late 1990s.

1f. Parameter Estimates

While the results above show evidence that the relationship between US and foreign equity markets shifted over time, they do not indicate how those relationships have changed. These changes can be seen in the parameter estimates themselves. Table 2 reports descriptive statistics for the set of estimates of the beta parameter in (7b) for the MSL of 5%[21]. These statistics are reported for different groupings of portfolios and across pseudo-periods between breaks. Note that these pseudo-subperiods are not actual time periods. Rather, they correspond to a thought experiment in which the countries with no breaks have parameters δ_1^ℓ for the whole period, countries with one break create a new subperiod with estimates δ_2^ℓ at the same time, etc. This hypothetical period decomposition allows me to examine the properties of the parameter distribution within breaks. Below I report the effects of parameters aligned over time by year as well.

More precisely, the pseudo-periods are formed by allocating the estimates for each country into the maximum number of periods. In other words, defining this maximum as

$$\hat{m} \equiv \underset{\ell=1,..,L}{Max}\{\widehat{m}^1,...,\widehat{m}^L\},$$

the parameter estimates by pseudo-periods are given by:

$$\delta^\ell = \{\delta_1^\ell, \delta_2^\ell, ..., \delta_{m+1}^\ell\} \qquad \text{for } \ell = 1, \ldots, \text{L} \qquad (8)$$

$$\text{Where } \delta_\tau^\ell = \delta_\tau^\ell \qquad \text{if } \tau \le \widehat{m}_\ell + 1$$

$$= \delta_{\widehat{m}_\ell}^\ell \qquad \text{if } \tau > \widehat{m}_\ell + 1$$

This assignment creates coefficient estimates for each country ℓ over each of the m+1 pseudo- subperiods. Since we estimate the maximum number of breaks for any country to be 2, the number of pseudo-periods is 3.

[21]For the MSLs of 2.5% and 10% the estimates are virtually identical.

Table 2 reports the breakdown by pseudo period and by market portfolio.[22] Panel A shows the Market Weighted Portfolios by totals and broken down by quartile from bottom to top.[23] The mean size of beta rises from 0.386 to 0.588, which could be interpreted as a general increase in covariation between local markets and the US market. The break-down by market value quartile portfolios shows a similar relationship in all but the lowest (1st) Quartile. Panel A also reports the mean of the standard errors across countries to be about 0.05. The table also reports the cross-sectional standard deviation of the market weighted betas at around 0.003 for the total portfolio and about 0.05 for the quartiles.

Panel B shows similar results for a market-weighted breakdown of developed countries versus emerging markets. While the mean of the standard errors is higher for emerging markets, the general tendency for mean beta to rise over time can be seen in both portfolios.

Panel C details the breakdown of portfolios by region. The general tendency for country portfolio betas to increase over time can be seen in all regions except for Latin America and Oceania.

To see whether these estimates are sensitive to the choice of marginal significance level, Figure 2 depicts the mean of betas and their standard deviation for three different levels. As the figure shows, the parameter estimates are virtually identical across MSLs. Figure A1 in the appendix shows the same relationship for alphas.

1g. Parameters over time

The results in Table 2 and Figure 2 are based upon pseudo-periods in which the parameters are treated as though they coincide with distinct periods. But since breaks occur at different times for each country, they do not correspond to changes in calendar time.

To consider how the parameters change over time, I next take each return's estimated parameter vector and array them over time to form a time series of the parameters. That is, I form the set of parameter vectors for each country and time period:

$$\hat{\delta}^{\ell}(t) = \{\hat{\delta}_1^{\ell}(1), \hat{\delta}_1^{\ell}(2), ..., \hat{\delta}_1^{\ell}(\hat{\mathrm{T}}_1^{\ell}), \hat{\delta}_2^{\ell}(\hat{\mathrm{T}}_1^{\ell}+1), ..., \hat{\delta}_{m^{\ell}}^{\ell}(\hat{\mathrm{T}}_{\mathrm{m}^{\ell}}^{\ell}), ..., \hat{\delta}_{m^{\ell}}^{\ell}(\mathrm{T})\} \quad \forall\ \ell = 1, ..., \mathrm{L};\ \mathrm{t} = 1, ..., \mathrm{T} \qquad (9)$$

Below, I consider the foreign portfolio distribution from the point of view of a US investor at a yearly basis. For this purpose, I examine a subset of the parameter vectors in equation (9), by taking the estimates at the end of each year.

I report the plot of the time series and cross section of these estimates in Figures 3 below. Figure 3a reports the estimates of $\beta^{\ell}(t)$ for an MSL of 5%. As the cross-section indicates, the betas of local markets on the US market tended to increase over time, particularly in the late 1990s. Figure 3b reports the same results for an MSL of 10% with almost the same results as for MSL of 5%. The exception is that there are more breaks with a higher MSL so that some of the emerging markets register negative betas in the late 1990s after the Asian

[22] Since there is little evidence for 3 breaks, the results for Period 4 are virtually identical to Period 3 and are therefore not reported.

[23] To ensure the countries remain in the same portfolios over time in this table, the market weights are taken at April 2004 values. Below, I examine a time-varying market weight of portfolios in which weights are updated annually.

crisis. In what follows, I will use the parameter results for MSL 5%, although the overall results are robust to choices of MSL 2.5% and MSL 10%.

1h. Break Point Confidence Intervals

The estimation provides confidence intervals for breaks dates. Thus for each of the estimates of break points in (7a) $(\hat{T}_1^{\ell}, \hat{T}_2^{\ell}, ..., \hat{T}_{m^{\ell}}^{\ell}), \forall L$, I estimate 90% and 95% confidence intervals around the break points. This provides upper and lower bounds for which the break points occur with 90% or 95% probability. Defining L(Break) as the number of countries with evidence of breaks, this estimation gives a set of $\sum_{\ell=1}^{L(Break)} \hat{m}^{\ell}$ upper confidence interval bounds and lower confidence interval bounds. Figure 4a depicts the total proportion of countries with upper bounds and lower bounds of breaks in a given year. As the figure shows, lower bounds for breaks appear in three main groups: the late 1970s to early 1980s; the early 1990s; and following the Asian crisis of 1997. A finer break-down of the confidence intervals is given in Figure 4b where the proportions are decomposed into countries with evidence of one break versus countries with two breaks. As this figure suggests, countries with two breaks generally have the second one either during the 1991 to 1994 period or else the late 1990s.

1i. Economic Significance: Foreign Portfolio Choice

Up to this point, I have explored the data from a statistical viewpoint to look at the changing picture of a standard international asset pricing relationship. I now begin to look at the economic significance of these changes for minimizing variance. For this purpose, I ask how a US investor would allocate his portfolio between domestic and foreign equity markets to achieve a minimum variance portfolio. I focus on the minimum variance portfolio for two main reasons. First, variance reduction has been the focus of much of the international home bias puzzle literature, including studies in which the mean of returns may be equal.[24] As such, the gains from reducing variance may provide a lower bound on gains including improvements in mean returns. Second, studies examining optimal portfolio choice based upon mean estimates have found that portfolio allocations will respond to the market that has been doing well, but will not necessarily reflect expected future returns.[25] Moreover, optimally constructed portfolio allocations are sensitive to differences in imprecisely estimated mean returns. Nevertheless, the analysis described below was also conducted to produce tangency portfolios for a US investor, yielding qualitatively similar results (not shown).[26]

The minimum variance optimization gives a portfolio allocation based upon the distribution of returns from the portfolio as r_t^p :

$$r_t^p = \sum\nolimits_{k=1}^{K} \omega_t^k r_t^k \tag{10}$$

[24] See for example Cole and Obstfeld (1991) and the discussion in Lewis (2000).
[25] This point is made in Black and Litterman (1992), among others.
[26] Some of these results are reported in Lewis (2006).

where K is the number of assets and where ω_t^k is the portfolio weight from asset k. Under the assumption that returns are exogenous and iid, a standard assumption for CAPM versions of equation (1), it is well-known that the weights on the minimum variance portfolio are given by:[27]

$$\omega_t^{MinVar} = \left(\frac{V^{-1}\iota}{\iota' V^{-1}\iota} \right) \tag{11}$$

where $\boldsymbol{\omega}_t$ is the K x 1 vector of optimal portfolio shares, ι is a K dimensional vector of ones, and V is the variance-covariance matrix of returns.

To focus upon the relationship between the US and foreign markets, I form a market-weighted portfolio of the foreign markets, $r_t^F = \sum_{\ell=1}^{L} x_t^\ell r_t^\ell$, and use the US return as the other portfolio. Then, using the mapping from parameter estimates to time series in equation (9), the variance-covariance matrix of returns V is computed for each year. I next use these estimates to calculate the minimum variance portfolio in equation (11). Note that by calculating the portfolio in this way, I am assuming that the agents believe that the variance-covariance matrix will be stable over the following year. Nevertheless, I also incorporate the agent uncertainty in estimates of the variance-covariance matrix by conducting a Monte-Carlo experiment in which agents view the parameters as draws from a distribution given by the estimated parameters. Appendix 2 details these computations.

Figure 5 reports the foreign portfolio allocation implied by the parameter estimates for the minimum variance portfolio. The figure shows the allocation into foreign stocks over time along with the confidence interval arising from the standard error of the portfolio of β^ℓ. The figure shows that the optimal holding of the portfolio increases modestly from 60% in 1973 to 70% by 2003. More dramatically, the allocation dips down from 1974 to 1987, but then follows a generally increasing trend since 1987.

This result may seem surprising given that the estimates of beta suggested that the covariance of the US with the rest of the world should be increasing over time. Focusing on this relationship would lead to the conclusion that allocation into foreign markets should decrease, not increase. To explore this relationship more closely, I report the portfolio beta in Figure 6a. The beta of the foreign returns does indeed increase. Figure 6b shows the resulting components in the foreign return variance and the covariance of foreign returns to US returns. The green line shows that the covariance of the foreign and US returns increase over the time period, albeit slowly. At the same time, the residual non-diversifiable variance in foreign returns declines fairly quickly. Since 1987, this standard deviation has declined dramatically, from about 5 basis points per week to 2 basis points per week. As a result, allocation into foreign stocks becomes more desirable even though the covariance has also increased.

The estimates show that the covariance of the US market with the rest of the world has increased over time. This result would suggest that the optimal allocation into foreign markets should decline. By contrast, a

[27] For example, the solution to the minimum variance and the tangency portfolio described below are given in Campbell, Lo, and MacKinlay (1996), Chapter 5.

model of foreign portfolio allocation based upon the estimates shows an increase in optimal portfolio diversification into foreign stocks. The reason is that even though the covariance between markets has declined, the residual idiosyncratic risk in foreign markets has declined.

Section 2: Foreign Stocks in US Markets

While the integration of international markets has coincided with higher covariation between markets, it has also provided better ways to hedge foreign idiosyncratic risk. That is, the hedge properties of foreign stocks relative to domestic stocks have declined but the non-diversifiable component of risk in foreign markets has also declined. Based upon the parameter estimates above, the net effect of these two opposing forces is that the diversification potential of foreign markets increases.

The inability for diminishing diversification to provide an explanation for home bias suggests a re-consideration of more conventional explanations such as transaction costs and information costs. Since the early 1990s, a growing number of foreign stocks have begun to trade in the United States. These foreign stocks trade on US exchanges with the same transactions costs as do domestic stocks. On the NYSE, the companies must go through the same disclosure requirements as US companies. These requirements include SEC registration and financial reporting according to US GAAP accounting standards. Errunza *et al* (1999) emphasized the importance of domestically traded foreign risks as a potential way to circumvent transaction costs while reaping the same foreign portfolio diversification. They found that domestically traded securities span the foreign market indices.

If the asset pricing characteristics of foreign market indices can be substituted by using domestically-traded assets, then the implications for home bias in light of the results above become even more dramatic. Domestically traded assets can be acquired at comparable transactions costs and, yet, financial integration has on net improved the portfolio diversification from holding foreign stocks.

To examine whether these results hold up in light of the shifts in asset pricing relationships found above, I reconsider the asset pricing relationships of domestically traded foreign stocks. Some researchers have found that the behavior of foreign stocks change when they are listed in the United States in that their betas with respect to the US market get closer to one.[28] If so, the shift in betas could result from a change in the relationship between the local market index and the US market as found above, or it could be due to a foreign company-specific shift in its relationship to the US market.[29] The implications for the diversification potential of domestically-traded foreign stocks depend critically on this distinction, however. If the shift is general to the entire foreign market, then the individual foreign stocks are replicating the foreign market behavior found above. On the other hand, if the shift is specific to the company, then the foreign stocks trading in the US market may represent a somewhat different asset class than the rest of their local market.

[28] See for example, Foerster and Karolyi (1999) who examine the impact upon local and world betas of foreign stocks after cross-listing in the US.
[29] Lewis and Darbha (2004) examine the time of changes in the betas and compare them to listing dates finding that the change in betas generally occurs after the listing date.

To examine these relationships, I first look at the empirical asset pricing relationships in foreign firm equities that traded in the United States as of 2004. That is, I ask whether the presence of foreign stocks in the US would change the desirability of investing in the foreign markets. As before, the decision is made from the point of view of a US investor, but here I allow the investor to also allocate the portfolio into domestically traded foreign stocks.

(2a) Data on Foreign Companies

In order to examine the diversification potential of foreign companies in the US, I collected the available time series for local market returns on all foreign companies listed on the NYSE in May 2004. By doing so, my analysis focuses upon the foreign companies that end up being listed in the US. This approach allows me to consider the portfolio decision of a US investor who wishes to consider only domestically available foreign stocks.[30]

Foreign stocks trade on a variety of exchanges in the US, including the over the counter market (OTC) and institutional investor-only markets (RADR, 144A). In this paper, I restrict the analysis to foreign stocks on the public exchanges for two main reasons. First, my goal in this paper is to consider diversification and, indirectly, home bias, from the viewpoint of a representative small US investor. I therefore exclude foreign stocks that are only available to large institutional investors. Second, OTC stocks do not require the same level of disclosure requirements as do domestic and foreign stocks on the public exchanges. As such, domestic investors may consider these foreign stocks to have higher costs associated with acquiring information.

Exchange-traded foreign companies in the US primarily trade on the NYSE and NASDAQ.[31] I exclude NASDAQ stocks since recent research suggests that the "Tech Bubble" of the late 1999s may have made the sources of risk in foreign stocks difficult to interpret.[32] In this study, I use weekly stock returns in foreign markets for parent non-US companies that have stocks trading on the New York Stock Exchange. The time period is from January 1970 or the earliest date of availability to May 2004. All return series are measured in US dollars.

The data for this paper were collected in the following steps for non-Canadian companies. Step (1) A data set of all foreign companies with stocks listed on the New York Stock Exchange in the US were obtained from the Bank of New York, the primary custodian bank for ADRs in this country. This set was cross-checked with listings from the NYSE itself and JP Morgan, another ADR custodian bank. All together there were 351 ADRs for 337

[30] An alternative would be to examine all available stocks in the US in each year and incorporate the possibility of de-listing. I leave this analysis for future research.

[31] Currently, two foreign companies also trade on the AMEX.

[32] See the discussion on the sources of risk in Carrieri, Errunza, and Sarkissian (2006), Brooks and Del Negro (2005), and Bekaert, Hodrick, and Zhang (2005). In 2004, the market value of foreign stocks on the NYSE and NASDAQ together comprised 98% of the total market value across public exchanges. At the 2000 peak of NASDAQ, the foreign companies hit a max of 27% of this total. Thus, the companies listed on NYSE comprise most of the foreign market cap in the US.

parent companies across 41 foreign countries. Step (2) For each of these companies, stock returns in the home market and market values for full available history were collected from Datastream.[33]

Canadian companies trade directly on US exchanges without ADR registration. As such, these companies are not listed on custodian bank ADR directories. Andrew Karolyi kindly provided the hand-collected names and identifying mneumonic codes for the Canadian companies listed in the US.[34] Appendix Table A2 lists the total set of companies on the NYSE and their home countries.

(2b) Empirical Framework and Motivation

Examining the individual stock returns requires an extension of the standard factor model in (1). For each individual foreign company *i,* the returns are determined by a factor model:

$$r_t^{i\ell} = \alpha^{i\ell} + \beta^{i\ell\prime} f_t^{\ell} + e_t^{i\ell} \qquad i = 1, \ldots, N; \;\; \ell = 1, \ldots, L \qquad (12)$$

where $r^{i\ell}_t$ is the return on company *i* which is located in country ℓ. These returns depend upon a set of factors that affect companies in country ℓ. A standard model often used to characterize company returns internationally is one in which $f^{\ell}_t = \{r^{\ell}_t, r^{w}_t\}$. According to this approach, the domestic market captures local risk factors that are not measured in the world return. Thus, the model would be written as:

$$r_t^{i\ell} = \alpha^{i\ell} + \beta^{i\ell} r_t^{\ell} + \beta^{iw} r_t^{w} + e_t^{i\ell} \qquad (12')$$

However, as we have noted above, the joint distribution of $\left\{r_t^{\ell}, r_t^{w}\right\}$ has been unstable over the sample period. If local stocks have a stable relationship with their local market over time but the local markets experience shifts against the US markets, the local stocks will appear to have an unstable relationship with the US market. This instability would just be a reflection of the overall local market relationship with the US noted above. These country level breaks will then contaminate estimates about the relationship between foreign stocks trading in the US and their relationship with the US market.

This relationship can be seen by substituting the shifting country return process r^{ℓ}_t from (3') into the company return in (12'). This implies:

$$\begin{aligned} r_t^{i\ell} &= \alpha^{i\ell} + \beta^{i\ell}[\alpha_\tau^{\ell} + \beta_\tau^{\ell} r_t^{w} + u_{\tau,t}^{\ell}] + \beta^{iw} r_t^{w} + e_t^{i\ell} \\ &= a_t^{i\ell} + b_t^{i\ell} r_t^{w} + \varepsilon_t^{i\ell} \end{aligned} \qquad (13)$$

Where

$$a_t^{i\ell} \equiv \alpha^{i\ell} + \beta^{i\ell}\alpha_\tau^{\ell}$$

$$b_t^{i\ell} \equiv \beta^{i\ell} \beta_\tau^{\ell} + \beta^{iw}$$

$$\varepsilon_t^{i\ell} \equiv \beta^{i\ell} u_{\tau,t}^{\ell} + e_t^{i\ell}$$

33 I also collected the price in the US. Since this price moved very closely with the local return through arbitrage, I focus upon the longer local market series.

34 These data were used in Doidge, Karolyi, and Stulz (2004,2005).

And where, as above, τ indexes the subinterval in which foreign market indices are stable against the US market return. Equation (13) shows that even if the factor loadings of the foreign stocks on the local and world market, $\alpha^{i\ell}$ and $\beta^{i\ell}$ are not time-varying, an estimate of the parameters in a regression of foreign stocks on the world market would be. This results from the shifting factor loadings of the local market on the world, α_τ^ℓ and β_τ^ℓ.

At the same time, there may be different reasons for the relationship between foreign stocks and the US market to change relative to the overall local market. Using event studies, a vast literature on international cross-listings has found that a company's cost of capital tends to fall after cross-listing. Moreover, the betas of the foreign stock increase against the US.[35] Others such as Baruch and Saar (forthcoming) have argued that the decision to list on an exchange arises from the perception that the company is more similar to other stocks on a given exchange. Therefore, if there are shifts in individual foreign stock returns as a result of listing in the US market, it is not clear whether these shifts would occur before or after the cross-listing.

To maintain the agnostic approach taken above, I begin by asking whether foreign stocks listed on US exchanges have a stable relationship with the US market once accounting for breaks against their local markets. Defining $\delta_\tau^{i\ell} \equiv \widehat{\delta}^{i\ell}$ the estimated parameter using date from the interval of time, given by $t = (T_{\tau-1}, T_\tau)$, note that equation (13) can be written as a set of restrictions on the foreign stock return factor pricing equations:

$$r_t^{i\ell} = \alpha_\tau^{i\ell} + \beta_\tau^{i\ell}\alpha_\tau^\ell + (\beta_\tau^{i\ell}\beta_\tau^\ell + \beta_\tau^{iw}) r_t^w + \beta_\tau^{i\ell} u_{\tau,t}^\ell + e_t^{i\ell} \tag{13'}$$

where for all τ ≠ q, τ= 1, …, m^ℓ, the restrictions are:

$$\alpha_\tau^{i\ell} = \alpha_q^{i\ell} \tag{13a}$$

$$\beta_\tau^{i\ell} = \beta_q^{i\ell} \tag{13b}$$

$$\beta_\tau^{iw} = \beta_q^{iw} \tag{13c}$$

In other words, once conditioning on the world market return breaks, the firm specific parameters should be time invariant.

I therefore begin by estimating (13') and testing restrictions (13a) and (13b) for each foreign stock using a Wald test. Since some studies have focused upon ADRs alone and thereby excluded Canadian stocks, Table 3 reports the results for the non-Canadian firms. Panel A gives a summary of the number and proportion of firms that come from countries with No Breaks (m=0), One Break (m=1), and Two Breaks (m=2), respectively. Roughly 40% of the firms come from countries that did not show evidence of a change in asset pricing relationships with the US. Another 42% come from countries with one break, while only 18% of the firms come from countries that show evidence of two breaks.

Table 3 Panel B reports the results of testing zero restrictions on the stock level world parameters, broken down by country breaks and combined in the last column under "All." 40% of the foreign stocks reject the joint restriction that: $\alpha^{i\ell} = 0 = \beta^{i\ell}$. However, when the restrictions are decomposed into the parameters separately,

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[35] See for example, Foerster and Karolyi (1999). Karolyi (2006) surveys the literature on international cross-listings.

only about 5% of the stocks reject the hypothesis that $\alpha^{i\ell} = 0$ at the 5% MSL, which is comparable to the number that one would reject in a random sample. This proportion falls even lower to 3% when the tests are conditioned on the breaks from the home country: $\text{Ho}: \alpha^{i\ell} = 0$. These results show that there is no evidence of excess returns of foreign companies in the US once conditioned on local market returns.

The results for β^{iw} are mixed. If this parameter equals zero then the foreign stock depends upon the US market only through the effect of the local market on the US: $\beta^{i\ell}\beta^{\ell}_{\tau}$. About 45% of the foreign stocks in the US reject the hypothesis that the direct coefficient of the foreign stock on the US is different from zero. Therefore, most of the company parameters do not reject this restriction.

Table 3 Panel C reports the proportion of firms that reject the restrictions given in (13a-c). The first column reports the proportion rejecting the hypothesis given in (13a) that alphas are constant over time. Since very few stocks had evidence that these parameters were different from zero, it is not surprisingly that only about 6% of the stocks rejected this hypothesis. Tests for constancy of $\beta^{i\ell}$ and β^{iw} reject more often at 16% and 13%, respectively. I will further analyze these companies below.

A generic problem in detecting breaks is making sure there are sufficient observations in the time series to test for the number of breaks. Table 3 Panel D gives summary information about the number of cross-sectional and time series numbers of observations for the foreign companies. The first entry in each cell gives the summary statistics for all but the Canadian companies, while the second entry gives the summary for all the foreign companies. The cross-sectional number of firms is 363 and these break down into the number of breaks in the home company as described above. The table also reports summary statistics for the number of time series observations per firm. These range from a minimum of 62 to a maximum of 1670 observations. The mean and median of number of time series observations are 800 and 634, respectively, for all of the foreign companies. Generally, the number of observations of individual stocks is fewer than their home country indices, leading to the question of whether there are enough observations within each country subperiod to have sufficient information for the tests in Panel C. To examine this issue, the right hand columns report the number of observations decomposed by the subperiods implied by the shifts in local markets against the world. The minimum ranges from 62 for stocks for pseudo-subperiod 1 to 266 for stocks during pseudo-subperiod 3. Similarly, the median number of observations per company range from 406 for $\tau = 1$ to 266 for $\tau = 3.$. Finally, the last row gives information about the total number of observations as approximately 580,000 for the total sample, 335,000 for stocks from subperiod 1, 128,000 for stocks from subperiod 2, and 17,632 for stocks from subperiod 3. The number of observations when Canadian companies are excluded is smaller, yet remains large. These results therefore suggest there should be sufficient observations to detect shifts in parameters across home country subperiods.

Given the evidence for parameter instability across these subperiods for about 40% of the foreign stocks, I next examine the behavior of returns for these individual stocks more closely. For each of these companies, I estimate the following nested model:

$$r_t^{i\ell} = \alpha_\varsigma^{i\ell} + \beta_\varsigma^{i\ell}\, r_t^\ell + \beta_\varsigma^{iw}\, r_t^w + e_{\varsigma,t}^{i\ell}, \qquad \text{for } i = 1, ..., N;\ \varsigma = 1, ..., n^i + 1 \tag{14}$$

$$r_t^\ell = \alpha_\tau^\ell + \beta_\tau^\ell\, r_t^w + u_{\tau,t}^\ell, \qquad \text{for } \ell = 1, \ldots, L,\ \ \tau = 1, \ldots, m^\ell + 1 \tag{3'}$$

Equation (14) takes the two-factor international stock equation given in (13) but allows for the possibility of shifts in the company level returns that differ from the home country shifts estimated earlier and repeated here as (3'). Note that the number of breaks and their implied subperiods may differ for the country and firm returns. In other words, for the returns of firm i in country ℓ, the estimates suggest that $\tau \neq \zeta$, $n^i \neq m^\ell$ and furthermore the breakdates of the firm may differ from the country returns.

Although the intervals should be specified as dependent upon the firm I, I subsume the firm superscripts on the time intervals κ without loss of generality. The mapping analogous to equation (4) is then:

$t \in \{\kappa_{(\zeta-1)}+1, \ldots, \kappa_\zeta\}$ for $\kappa_\zeta \in \{\kappa_1, \kappa_2, \ldots, \kappa_n\}$

where the estimates of κ_ζ are:

$$\{\hat{\kappa}_1, \hat{\kappa}_2, ..., \hat{\kappa}_{n^i}\} = \underset{\kappa_1, \kappa_2, ..., \kappa_{n^i}}{\arg\min} \left[\sum_{\varsigma=1}^{n^i+1} \left(\sum_{t \in \{\kappa_{(\varsigma-1)}+1, ..., \kappa_\varsigma\}} [r_t^{i\ell} - \delta_\varsigma^{i}\,'\mathrm{f}_t^\ell]^2 \right) \right] \tag{15}$$

And $\kappa_o = 0, \kappa_{n^i+1} = T$. The equations in (15) contain both local home country returns and US market returns. In turn, these variables are jointly unstable as documented above. Therefore, I condition the firm level estimation in (15) on these macro breaks as described next.

2c. Company Break Tests Statistics

The cross-subinterval tests above found evidence for company-specific return instability. In order to estimate the subperiods of relative stability in equation (15), I first test for the number of breaks in the equity pricing relationship, as above. Note that equation (3') describes the relationship between the elements in the factor vector $f_t^\ell = \{r_t^\ell, r_t^w\}$ Constraining the factor process by the estimates, I first test for the number of breaks in each company returns, n^i, for the set of companies, i = 1, …, N.

Results for the break date estimates are given in Table 4. At an MSL of 10%, 164 companies reject the hypothesis of no breaks, with the numbers declining to 111 companies at an MSL of 2.5%. Most of the foreign firms only reject the hypothesis that there is not more than one break. Only one firm rejects the hypothesis at 2 or more breaks at the 5% MSL.

The table also reports the mean of the break-point estimate and of the standard errors of the estimates. The statistics for the break points are provided by marginal significance level of the number of breaks. The first break has a mean in 1996, the second break in 1998 to 1999. There are insufficient numbers of firms with three breaks to make inferences.

There are greater differences when the companies are sorted into whether they show evidence of single, double, or triple breaks. The single break companies have a mean break in 1997. The double break companies generally show a first shift in the early 1990s with a second mean shift in 1999. The triple break companies display a similar pattern but with an early break in the late 1970s and early 1980s. The mean of the standard error of these estimates range from four to nine months.

Figure 7A gives a plot of the breakdates of the foreign companies, arrayed by home country. The first break in the relationship between individual company returns against the US and on the home market is by Kubota, a Japanese firm in 1977, while the last break is by Cunoc, a Hong Kong firm. Figure 7B gives a plot of the number of initial breaks, second breaks and total breaks, while Figure 7C shows the same information as a proportion of the companies that show instability. Clearly, most of the companies show instability during the late 1990s and early 2000s.

While the predominance of changes appears in the latter part of the sample, it should be emphasized that most of the companies do not show any evidence of instability. At the peak period, only 60 companies demonstrated a first or second break, out of a total of 363 companies or about 16% of the total possible companies.

2e. Parameter Estimates

The evidence above suggests instability in the asset pricing relationships, but it does not tell us about the pattern in the parameter relationships. For this purpose, Tables 5 and 6 report cross-sectional estimates of the local market betas $\beta^{i\ell}$ and the US market beta β^{ℓ}, respectively, for various portfolios of foreign stocks, grouped into the 4 break pseudo-periods described above.

Local Market Betas: Table 5, Panel A shows the results for the coefficient of the *i*-th stock return on the local stock market return, $\beta^{i\ell}$. The first three rows provide summary statistics for a market-weighted portfolio while the second set of rows do the same for an equally-weighted portfolio. In all cases, the mean of the local beta is quite close to one. The mean of the standard error as well as the standard deviation of beta is quite small for the market-weighted portfolio, although the equally weighted portfolio shows a great deal more variation. The rest of the panel shows the results broken down into quartile portfolios. The mean of the top quartile is very close to one, while the bottom quartile is lower at around .83 for the first subperiod. The top quartile has quite small standard error means at less than 0.09, while the bottom quarter shows greater standard error means, but still less than 0.14. The pattern suggests that the betas of the individual stocks on the local markets are quite close to 1 and these relationships have not changed much over time.

Panel B shows the same statistics grouped into regional portfolios. While the means are very close to one for Europe and Oceania, the means are somewhat lower for Africa & the Middle East and, for the first subperiod, Latin America and Asia. These results suggest that there may be differences for emerging versus developed markets.

Panel C addresses this possibility where the results are reported for market weighted portfolios. The mean of the local beta for emerging markets is closer to 0.85 for the first sub-period but increases to close to one for the subsequent periods. In all of the sub-cases considered, the betas are relatively close to one and do not decrease over time. This suggests that companies that list in the US move closely with their local markets. Despite general shifts in international markets, the co-variation of the foreign stocks with their own country indices has not changed much over time.

US Market Betas: Table 6 shows the same statistics for the cross-section of betas on the US market. The means are all quite close to zero. This result is consistent with the zero restriction hypothesis tests in Table 3 that found approximately 60% of the stocks could not reject the hypothesis that these estimates are equal to zero.

Most estimates in the literature find that direct estimates of foreign cross-listed stocks on the US market are significantly greater than zero. It is therefore important to note that the estimates here are the *conditional* direct effects of the stocks on the US market. To see this point, note that the standard coefficient of foreign stocks on the US market return in equation (13) is comprised of three different parameters: $b^{iw} \equiv (\beta^{i\ell}\beta^{\ell}+\beta^{iw})$ where b^{iw} is the composite coefficient. In this way, $\beta^{i\ell}$ can be seen as the standard CAPM beta of foreign stock returns on their local market return while β^{ℓ} is the world CAPM beta of the local market on the US market. As the country level estimates in Table 2 suggest, β^{ℓ} are significantly positive and the market weighted estimates range from about 0.4 to 0.6. Table 5 reports that estimates of the stock level betas on their own markets, $\beta^{i\ell}$, are also generally significantly positive and quite close to one. The product of these two betas, $\beta^{i\ell}\beta^{\ell}$, then measures the implied effect of the foreign stocks on the US market that would be implied by standard CAPM relationships. As such, the parameter β^{iw} can be viewed as the marginal relationship between foreign stocks and the US market that is not implied by these standard relationships. Not surprisingly, therefore, this direct effect is equal to zero in many cases.

In Panel A of Table 6, the mean of the parameter estimate for the market weighted portfolio increases from 0.06 in Periods 1 and 2 to 0.08 in Periods 3 and 4. When this result is broken into quartile-based portfolios, no overall relationship emerges. These differences combined with the fact that developed country firms have more market weight than the emerging markets suggest that there may be differences across regions. Panel B of Table 6 shows the break-down into regional portfolios. Indeed, Europe, Asia and Oceania show a trend toward increasing betas on the US market, while the Latin American and the Africa/Middle East portfolios show the opposite trend.

Since Asia and Europe include some emerging market countries, Panel C breaks the firms into developed versus emerging market portfolios. Both portfolios show a general decrease in mean between the first pseudo-subperiod to the later subperiods.

In summary, the marginal effect of foreign stocks on the US market once conditioned on foreign markets is small and close to zero. Moreover, when broken into market-weighted developed and emerging market portfolios, these marginal effects become smaller over time. This result may suggest that the foreign stocks listed in the US have become more integrated with the US market over time.

(2g) Foreign Portfolio Allocation

The analysis above describes how the parameters have changed over time, but does not give a sense of the economic significance of the relationships. For this purpose, I use a similar mean-variance optimization model as I did in the country indices above but now allow the investors to hold a portfolio of foreign stocks in the United States. The investor has a choice of combinations arising from three different portfolios: (a) the domestic market; (b) a capitalization weighted average of foreign market indices; and (c) a capitalization weighted average of foreign markets listed in the United States with excess returns given by:

$$r_t^S = \sum_{i=1}^{N} z_t^i r_t^{i,\ell} \tag{15}$$

where z_t^i is the market cap weight from company *i* in the total portfolio of foreign companies listed on the NYSE. The tangency portfolio weights of the domestic market, portfolio of foreign markets, and portfolio of foreign stocks listed in the domestic market are given by equation (11), repeated here for convenience:

$$\boldsymbol{\omega}_t = V_t^{-1} E(\mathbf{r}_t) / \iota' V_t^{-1} E(\mathbf{r}_t) \tag{11}$$

where now $\mathbf{r_t} \equiv \left[r_t^s, r_t^F, r_t^w \right]'$ so the optimal portfolio is given by (11) and:

$$E(\mathbf{r}_t) = \left[\quad \alpha_\varsigma^{i\ell} + \beta_\varsigma^{iw} E(r_t^w),\ \alpha_\tau^{\ell} + \beta_\tau^{\ell} E(r_t^w),\ E(r_t^w) \quad \right] \tag{16}$$

$$V_t = E_t\left[\quad (\mathbf{r}_t - E_t\, \mathbf{r}_t)\, (\mathbf{r}_t - E_t\, \mathbf{r}_t)' \quad \right]$$

Figure 8 shows the effects of the parameter estimates on the allocation in both the foreign markets and the US listed foreign stocks. The figures depict the allocation into foreign stocks over time in two different portfolios: the foreign markets and the domestically-listed foreign stocks. In order to get a sense of the variability of these allocations, I used Monte Carlo simulations to obtain 95% confidence intervals as follows.

First, the parameters: β^{ℓ}, $\beta^{i\ell}$, β^{iw} were drawn using the variance-covariance matrix from their estimated joint distribution in each year. Second, these estimates together with their standard errors were used to calculate the tangency portfolio for that run of the distribution. Third, after 10,000 generations of the tangency portfolio, the 95% confidence intervals were generated for each year. Lastly, first three steps were followed for each subsequent year up until 2004.

Figure 8 depicts the minimum variance portfolio estimates. Up until about 1994, the results support the notion that there is under-investment in foreign assets. For most of this period, the diversification benefits suggest that the US investor should be holding from 50% to 80% of his portfolio in foreign assets. During 1992, the estimates even suggest that the domestic investor should short the domestic market and go long a combination of foreign markets and foreign stocks listed in the US. After 1994, this relationship changes dramatically. By the end of the sample, the parameter estimates indicate that only about 20% of the US investor's portfolio should be held in foreign assets in order to achieve the minimum variance portfolio.

Figure 8 also shows the optimal relationship between holdings in foreign stocks in the US and foreign stocks in foreign market indices. From 1974 to 1987, foreign stocks in the US outperform the diversification of the foreign markets. The optimal holdings of the foreign stocks range around 40% of the portfolio while optimal holdings of foreign market indices range around 25%. This relationship reverses during 1987 to 1990, but after 1994, the optimal holdings of foreign markets and foreign stocks in the US are approximately the same at around 10%.

When comparing the three asset results in Figure 8 with the two asset framework in Figure 5, the results are strikingly different. As shown in Figure 5 when the only source of foreign diversification is to hold the foreign market indices, the optimal allocation into foreign stocks increases over time. As we saw above, even though the correlation across markets increased, the allocation into foreign markets increased because of the decline in residual risk in the foreign portfolio. By contrast, when the investment set is expanded to include a portfolio of foreign stocks listed in the US, the optimal allocation into total foreign assets declines. I investigate the sources of this difference in the next section.

3. Foreign Stocks Inside the US and Their Home Markets

The portfolio allocations described above are just an alternative way to view the distribution of the parameter estimates. I now take a closer look at this distribution over time and across stocks.

(3a) Parameters Behind the Decisions

To understand the parameters that determine these patterns, Figures 9 show the parameters and standard errors for the market weighted portfolios of foreign market indices and foreign companies that are listed in the US. Figure 9a shows that the estimate of the foreign market on the US, β^{ℓ}, is relatively stable over time, consistent with the country beta estimates in Figure 6a. On the other hand, the estimate of the coefficient of the foreign stocks with their own markets, $\beta^{i,\ell}$, has increased from 1982, peaking at above 1 in 2001. At the same time, the beta of the stocks with the world market, $\beta^{i,w}$, varied near zero. The aggregate measure of the relationship between foreign stocks and the US market, $\mathrm{b}^{\mathrm{iw}} \equiv (\beta^{\mathrm{i}\ell}\beta^{\ell}+\beta^{\mathrm{iw}})$, shows some variation, but generally rises faster than the local country on the US market due to the increase in $\beta^{\mathrm{i}\ell}$.

These parameters together with the variance estimates of the components generate the portfolio combinations. Appendix 2 shows that the return variances are given by:

$$Cov(r_t^s, r_t^f) = \sigma_w^2 \mathbf{Z}_t\,'\mathbf{b}_t^w \boldsymbol{\beta}_t^{\ell}\,'\mathbf{X}_t + \mathbf{Z}_t\,'\boldsymbol{\beta}_t^i \mathbf{U}_t \mathbf{X}_t$$

$$Cov(r_t^s, r_t^w) = \sigma_w^2 \mathbf{Z}_t\,'\mathbf{b}_t^w$$

$$Cov(r_t^f, r_t^w) = \sigma_w^2 \mathbf{X}_t\,'\boldsymbol{\beta}_t^{\ell}$$

Where $\mathbf{U}_t \equiv E_t(\mathbf{u}_t\mathbf{u}_t')$ for $\mathbf{u}_t \equiv [\mathrm{u}_\mathrm{t}^1, \ldots, \mathrm{u}_\mathrm{t}^\mathrm{L}]'$, the cross-country variance-covariance matrix; $\sigma_w^2 \equiv E(u_t^{w2})$; $\mathbf{Z}_\mathbf{t}$ and $\mathbf{X}_t$ are, respectively, the N x 1 vector of the market weights of the foreign stocks in the foreign stock portfolio and the Lx1 vector of market weights in the foreign stocks in the US at time t; and where $\mathbf{b}_t^w, \boldsymbol{\beta}_t^\ell$ are the vectors of portfolio parameters with typical element, $\mathrm{b}_t^{iw}, \beta_t^\ell$.

The covariances are depicted in Figure 9b. The covariance between foreign markets and the US market return move quite closely with the covariance between foreign stocks in the US and the US market return. This is not surprising since these covariances are both driven by similar movements in coefficients and changes in market values. By contrast the covariance between foreign markets and the foreign stocks in the US has increased dramatically since 1994 when they were actually negative. Note that part of the changes in covariances between the two terms may arise from changes in the cross-country variance-covariance matrix U.

To examine these relationships, Figure 9c shows the time varying pattern of variance estimates of these portfolios. Appendix 2 shows that the variance of the foreign portfolio is given by:

$$Var(r_t^F) = \sigma_w^2 \mathbf{X}_t' \boldsymbol{\beta}_t^\ell \boldsymbol{\beta}_t^\ell{}' \mathbf{X}_t + \mathbf{X}_t' \mathbf{U}_t \mathbf{X}_t$$

The variance of the foreign portfolio return, r_t^f, depends upon two terms. The first term evolves according to variation in market weights of the foreign market indices, X, and the risk-loading of the country indices on the world market, $\boldsymbol{\beta}_t^\ell$. This term captures the variation in the foreign return arising from its dependence on the world return. The second term measures the effects of return variation from comovements in returns across countries. In a standard CAPM framework, this effect would represent the idiosyncratic risk that would be minimized in large portfolios.

Figure 9c shows the evolution of this estimate over time. The foreign portfolio variance shows a marked increase following the 1987 stock market crash, but then generally declines afterward with a slight elevation in the early 1990s. The figure also shows the contribution to this variance from the residual covariance among countries, $\mathbf{X}_t' \mathbf{U}_t \mathbf{X}_t$. As the figure shows, the residual variance in this country portfolio comprises a majority of the overall variance in the beginning in 1974. After 1987, though, the contribution of this residual variance to the overall variance declines until about half by 2004.

Similarly, the variance of the foreign stocks in the US is:

$$Var(r_t^s) = \sigma_w^2 \mathbf{Z}_t' \mathbf{b}_t^w \mathbf{b}_t^w{}' \mathbf{Z}_t + \mathbf{Z}_t' \boldsymbol{\beta}_t^i \mathbf{U}_t \boldsymbol{\beta}_t^i{}' \mathbf{Z}_t + \mathbf{Z}_t' \Omega_t \mathbf{Z}_t$$

The first two terms on the right hand side mirror the components found in the variance of foreign market indices. That is, the first and second terms capture the risk arising from dependence of these stocks on the US market and the residual world comovement captured by U_t. By contrast, the last component, $\mathbf{Z}_t' \Omega_t \mathbf{Z}_t$, is the residual variation in foreign stocks after the effects of variation in US market and foreign market risks have been taken out.

Figure 9c shows this measure over time. The residual variance is small for most of the period except for the period from 1987 to 1992. By the end of the sample, the contribution of this term to overall variance is essentially zero. The overall variance of the foreign stocks in the US follows the movement of the foreign market, but with more exaggerated swings.

(3b) Interpreting the Portfolio Allocation

The patterns in the variance estimates make the portfolio allocations in Figure 8 transparent. Following 1987, the residual risk increases for foreign stocks both inside and outside the US. As a result, the US investor would choose to hold more domestic stocks and less foreign stocks, particularly those that are listed in the US. However, from 1990 onward, the variance of the foreign stocks decline. Since there is a negative covariance between foreign stocks inside and outside the US from 1991 to 1994, the US investor gets an extra diversification boost from holding onto both types of foreign stocks and even shorts the domestic stock market in 1992. Subsequently, the covariance between the two portfolios of foreign stocks increase and the US investor cannot achieve the same diversification benefit.

One way to see this relationship is to examine the attainable minimum variance portfolio over time. This is depicted in Figure10a along with the St Dev of holding the US portfolio alone. Another view at the same relationship is given in Figure 10b which shows the percentage reduction in standard deviation at the minimum variance point for the US investor. This is given by: [StDev(US Return) – StDev(MinVar)]/StDev(US Return). The figure compares the minimum variance point for portfolios using market indices from Section 1 with the portfolio results using both sets of foreign stocks from Section 2.

Figure 10b shows that the diversification gains decline between 1974 and 2004 for both sets of stocks. However, there is a sharp increase in risk reduction in the early 1990s reaching about 35% of the underlying risk based upon the total foreign stock portfolios. This results because the covariance between the two sets of foreign stocks becomes negative at the same time that the variance of foreign stocks declines as Figure 9 shows. By the mid-1990s, this pattern reverses as the two sets of portfolios become much more highly correlated.

The minimum variance portfolio with foreign stocks indices alone follow a similar pattern, but without the upswing in diversification benefit in 1992. Foreign stocks become less risky, but there is not a set of foreign assets with low correlation such as the foreign stocks inside the US to allow the hedge component. On the other hand, the diversification potential does not drop off as dramatically as when US listed foreign stocks can be held. Rather, it rises slightly and stays at about 15%.

This difference underlies the significantly different sizes of foreign portfolio holdings in the two cases. When there is only one source of holding foreign assets, Figure 3 showed that the general decline in residual risk in the foreign portfolio makes the US investor put more weight in the foreign portfolio over time. However, when there are two sources of foreign investment, the attractiveness of this investment depends critically on the co-movement between these two portfolios. As long as the correlation is small and negative, the US investor would like to hold both portfolios. On the other hand, if the correlation increases over time, as it did after 1994, allocation of portfolio into one of the portfolios will increase risk in the foreign portfolio allocation overall, thereby increasing the allocation at home.

(3b) "Home-Based Foreign Diversification"

The results above show that the risk reduction properties of foreign assets have declined over time. This relationship is especially pronounced when foreign stocks inside and outside the US are part of the investment opportunity set. Errunza et al (1999) have proposed using "Home Grown" foreign assets as a substitute for investing directly in foreign equity markets. Indeed, the results above suggest that the foreign equities that trade in the US move very closely with their local markets. Therefore, I now consider the two asset allocation model as in Section 1 but substitute foreign stocks listed in the US for the portfolio of foreign markets. That is, I consider an investor choosing an allocation in two possible assets with return vector: $\mathbf{r_t} \equiv \left[r_t^s, r_t^w\right]'$ where the processes are the same as estimated above.

Figures 11 report the results of repeating the portfolio simulations excluding the foreign market allocation. Comparing these results to the counterparts using foreign indices only in Figures 5 demonstrates a similar pattern, but with much greater time variation. For example, the pronounced increase in variance in foreign stock inside the US following the crash of 1987 creates a more significant decline in foreign allocation. Similarly, there is more variation in the estimates in the late 1990s and early 2000s, and the standard errors show much greater sampling error. The mean allocation at the end of the sample is roughly the same as the beginning and is comparable to the allocation in Figure 5a at the end of the sample. However, the sampling error shows that the allocation could be as low as 0.3 or as high as 0.9.

Returning to the variance reduction properties of these portfolios, Figure 10b shows that during the period following 1994 through 2003, a portfolio of foreign stocks outside the US, using foreign market indices, dominates a portfolio of foreign stocks inside the US, using cross-listed stocks. By 2003, however, the diversification properties are essentially the same for both portfolios.

Overall, then, the foreign stocks listed within the US have similar diversification patterns as foreign markets indices particularly following 1994. The primary differences between the foreign stocks inside and outside the US are two-fold. First, the portfolio of foreign cross-listed stocks in the US has a greater residual risk than the portfolio of foreign market indices. Second, the sampling uncertainty for the beta coefficients from the cross-listed stocks is greater than that of the foreign market portfolio. As a result, the confidence intervals around the appropriate allocation into a portfolio of cross-listed stocks are many times larger than those of the portfolio of foreign market indices.

Section 4. Other Effects on Foreign Market Characteristics over Time

The analysis in this paper so far has focused upon a two factor model of world and local effects with discrete breaks in the parameters. However, recent research has found that other factors may be important in explaining international stock returns. For example, Bekaert, Hodrick and Zhang (2005) find that multiple factors are needed to explain international stock returns and Brooks and Del Negro (2005) and Carrieri, Errunza, and

Sarkissian (2006) find evidence of the importance of industry risks in international stock returns. If omitted variables are important in explaining the shifts above, then the residual risk may be capturing these effects. Also, shifts in parameters may change gradually over time in response to liberalizations and integration in markets. Therefore, I re-examine the foreign market return relationships below introducing alternatively industry effects and a version of the model suggested by Bai and Perron (2003a) to examine gradual rather than discrete shifts.

4a. The Effects of Industry Risk

To examine the effects of industry risk, I augment the foreign stock level equation in (14) to include an additional factor r_t^d the return on industry d, for firm i from home country ℓ and industry d:.

$$r_t^{i\ell d} = \alpha_{\varsigma}^{i\ell} + \beta_{\varsigma}^{i\ell}\, r_t^{\ell} + \beta_{\varsigma}^{iw}\, r_t^{w} + \beta_{\varsigma}^{id}\, r_t^{d} + e_{\varsigma,t}^{i\ell n}, \qquad \text{for } i = 1, ..., N;\ \varsigma = 1,..., n^i + 1 \quad (17)$$

If the industry factor can explain the results above, then the inclusion of the factor should lead to differences in the evidence of breaks and the implied portfolio residuals. To investigate this possibility, I tested equation (17) for breaks using the industry portfolios for each of the foreign stocks from Data Stream. The appendix reports the industries represented in the sample.

In Panel A, Table 7 reports in the results of the break tests and compares then to the results using the two factor model reported previously. The proportion of companies rejecting the hypothesis of no breaks falls slightly from 59% in the two factor model to 53% in the three factor model with industry. However, similar to the two factor model, most of the companies suggest evidence of only one break. Moreover, the percentage of companies that find evidence of breaks well exceeds the marginal significance level of the test at 5%.

While the pattern for the number of breaks is roughly the same as in the two factor model, the three factor model may imply different dates at which the breaks occurred. Panel B investigates this possibility by repeating the statistics for the break dates for the two factor model previously reported in Table 4. For all three values of the MSL, the breaks occur at roughly the same periods. The means of first breaks are clustered around mid 1995 to early 1996, while second and third breaks tend to happen around 1997. When the means are taken over stocks conditioned on the number of breaks, the similarities are even more striking. For single break companies, the mean break dates for both the two and three factor models are all in 1997 and are well within a standard error of each other. Another point of similarities is in the mean of standard errors, although the three factor model tends to have a slightly smaller mean standard error of months.

The evidence in Table 7 suggests that the *timing* of shifts in the basic asset pricing attributes of foreign stocks in the US found above are not strongly affected by inclusion of an industry factor. These results do not say anything about the *magnitude* of the shifts on asset pricing attributes, however. In particular, the decomposition of portfolio effects above illustrated the importance of the foreign stock residual variance in the allocation decision. If industry effects are important omitted variables in the two factor model, the residual variance may be driven by changes in this effect thereby driving the results found above.

To analyze this possibility, I examine the model in equation (17) including an industry factor. As before, each return is estimated separately, allowing for differences in numbers of breaks and break estimates. From these estimates, I calculate the residuals and then finally construct the evolution of residual variance.

Figure 12 depicts the residual variance of the foreign stock portfolio including industry effects. For comparison purposes, it also plots the original residual variance based upon only world and local effects. Both estimates show a similar pattern with a sharp spike in the 1988 to 1992 period and decline thereafter. The variances differ the most during the early period. The model with the industry effects has less variation and a lower residual variance level until 1988. However, after this point, the estimates are virtually identical for the rest of the sample. As a result, the implied portfolio allocation in foreign stocks is essentially unchanged for post 1988.

Overall, therefore, the general qualitative results found for foreign stocks in the US based upon a local and world factor model appear robust to the inclusion of industry effects.

4b. The Effects of Gradual Parameter Shifts

The analysis in this paper has focused upon a model with discrete shifts in the parameters. The strongest evidence in breaks occurred at the country level. To keep with the standard factor model approach, I have nested the model within a framework that implied abrupt parameter shifts. On the other hand, it seems likely that at least some of the changes were more gradual, perhaps evolving over time until the changes are picked up by the filter as a discrete shift. While these changes can still be parameterized as a discrete shift, it raises the question of whether the timing of shifts will be shifted forward or later.

For this purpose, I examine a variation of the model proposed by Bai and Perron (2003a) in which the parameters are fixed yet the left hand side variable is auto-correlated. Applying this strategy to the local market model in equation (1) implies:

$$r_t^{\ell} = \alpha^{\ell} + \beta^{\ell}{}' f_t^{\ell} + u_t^{\ell} \qquad (1')$$

where $u_t^{\ell} = \rho_{\tau}^{\ell} r_t^{\ell} + \tilde{u}_t^{\ell}$. Thus, only the autocorrelation parameter of returns is assumed to shift, but not the other parameters.

Figure 13 depicts the estimates of break dates for the countries assuming this gradual parameter shift along with their 90% confidence intervals. The standard errors of the breaks are generally wider than the abrupt break model in Figure 1. Figure 13 also plots the breaks for the abrupt break model. Most of the breaks with the abrupt break model occur within the confidence interval of the gradual break model. The estimated break dates for the abrupt break model were outside of the gradual break model for only six countries.

Of course, a full factor model that includes all possible factors would not have an autocorrelation term. Therefore, this analysis should be interpreted with caution. Nevertheless, it suggests that a more gradual adjustment model would have similar timing to the more discrete change model analyzed above.

5. Conclusion

In this paper, I have looked at the data on foreign returns from a US investor's point of view to consider the impact of changing covariances among international returns on the opportunities for diversification. I examined the foreign markets first to consider the usual argument that domestic residents hold a suboptimally low portfolio allocation in foreign stock indices. I found that the covariances among country stock markets have indeed shifted over time for a majority of the countries. However, in contrast to the common perception that markets have become more integrated over time, the covariance between foreign markets and the US market have increased only slightly from the beginning to the end over the last twenty years. Moreover the standard deviation of the foreign portfolio has declined over this time.

To consider the economic significance of these parameter changes, I looked at a simple portfolio decision model in which a US investor could choose between US and foreign market portfolios. I found that the minimum variance allocation in foreign markets has actually increased over time. This may seem counter-intuitive given that the higher degree of integration increases the correlation across markets. On the other hand, the falling variance of foreign portfolios increases the allocation into foreign markets. Overall, this second effect dominates the integration effect so that allocation into foreign markets remains high.

These results work against a resolution to the home bias puzzle due to greater integration. I therefore looked at whether foreign stocks that list in the United States can explain the lack of foreign investment. Errunza *et al* (1999) have argued that these stocks can explain the lack of investment in foreign markets directly. I extended the model from above to examine the behavior of foreign stocks listed in the United States. Perhaps surprisingly, I found that the estimates of covariation with the US market have increased over time, even after conditioning on the general increase in covariation between US and foreign markets.

Using these parameter estimates to evaluate a simple three-asset model, I found that while the allocation in the foreign *markets* do not decline much over time, the allocation into US listed foreign *stocks* do decline, particularly in the 1990s. These results suggest that the diversification properties of domestic-listed foreign stocks are inferior to investing in foreign markets directly. I then evaluated the two asset model using the cross-listed foreign stocks instead of foreign market indices. I found that the mean of allocation into foreign stocks does not decline over time, but the confidence intervals increase substantially.

A more important determinant of economic importance is whether these allocations in fact can reduce the variability of the portfolio. For this purpose, I compared the risk reduction from three possible foreign portfolios – foreign market indices, foreign cross-listed stocks, and both groups. Here I found that the greatest gains in diversification improvement since 1994 have been in foreign market indices over foreign cross-listed stocks or a combination of both groups. Of course, these results are just a way to demonstrate the effects of the parameters. An unconstrained efficient portfolio decision based upon the universe of foreign stocks would undoubtedly allow a larger reduction in risk. Nevertheless, the analysis here points to some general trends in the foreign portfolio diversification potentials. These trends could be summarized with the following results. First, international equity markets have become more highly correlated. Second, foreign stocks inside the US have come more correlated with the US over time. As a consequence of these trends, the attainable diversification from foreign diversification is declining whether the investor holds foreign stocks inside or outside the US.

Table 1

Summary Statistics on Break Tests

Panels A and B report the proportion of foreign country returns rejecting the hypothesis that there are less than one, two, three and unknown breaks in the regression: $r_t^{\ell} = \alpha^{\ell} + \beta^{\ell} r_t^{w} + u_{\ell,t}$ where r_t^{ℓ} is the excess return of country ℓ's equity return, r_t^{w} is the excess return of the US market. Panel C gives the results of the sequential Sup(F) test. Panel D reports the means of the estimated break dates and their associated standard errors based upon the Bai-Perron (1998) estimator.

Panel A: Proportion of Countries Rejecting Tests of No Breaks – Min Break = 15% of Sample					
MSL[a]	Sup F test of No Break vs:			Tests of No Break vs Unknown Number of Breaks	
	m=1	m=2	m=3	UD Max	WD Max
10%	0.692	0.769	0.821	0.769	0.821
5%	0.641	0.744	0.795	0.769	0.744
2.5%	0.590	0.692	0.692	0.615	0.692
Panel B: Proportion of Countries Rejecting Tests of No Breaks – Min Break = 5% of Sample					
MSL	Sup F test of No Break vs:			Tests of No Break vs Unknown Number of Breaks	
	m=1	m=2	m=3	UD Max	WD Max
10%	0.769	0.692	0.821	0.846	0.872
5%	0.667	0.667	0.769	0.744	0.821
2.5%	0.667	0.564	0.667	0.718	0.718

Panel C: Distribution of Break Categories Using Sequential Test				
MSL	*Proportion of Total Countries*[b] *Rejecting Ho: No Breaks*	**Proportional # of Breaks**[c]		
		1 Break	*2 Breaks*	*3 Breaks*
10%	0.722	0.692	0.231	0.077
5%	0.639	0.739	0.261	0.043
2.5%	0.639	0.783	0.217	0.043

Panel D: Summary Statistics of Country Break Estimates					
Statistic	**Full Sample by Break**		**Single Break Only**	**Double Break Only**	
	Break 1	**Break 2**	**Break**	**Break 1**	**Break 2**
Mean Break (reported as "year.month")	1992.11	1997.11	1993.05	1991.03	1997.11
Mean StErr (in months)	*10*	*5*	*12*	*6*	*5*

[a] Marginal significance levels for the test of no structural break and the sequential sup(F) test described in Bai and Perron (1998).
[b] Ratio of the number of countries that reject the test of no structural break over the total number of countries.
[c] Proportion of countries that reject the sequential test of a given number of breaks plus one over the number of countries that reject the supF test of no structural break.
[d] Estimates based upon 5% MSL case. (Results for 2.5% and 10% are almost identical.)

Table 2

World Market Beta Summary Statistics by Portfolios

Estimate means, standard error means, and cross-sectional standard deviations for various market portfolios in the regression: $r^{\ell}_{t} = \alpha^{\ell} + \beta^{\ell} r^{w}_{t} + u_{\ell,t}$ where r^{ℓ}_{t} is the excess return of country ℓ's equity return, r^{w}_{t} is the excess return of the US market. "Periods" are defined as the interval over which a parameter is stable and do not correspond to the same time periods for all countries.

Portfolio	β^{ℓ} Estimate	Period 1 ($\tau = 1$)	Period 2 ($\tau = 2$)	Period 3 ($\tau = 3$)
Panel A: Market Weighted Total and by Quartile[a]				
Market Weighted	**Mean**	**0.386**	**0.572**	**0.588**
	Std Err Mean	*0.050*	*0.050*	*0.048*
	Std Dev Beta	0.003	0.003	0.003
1st Quartile	**Mean**	**0.400**	**0.486**	**0.327**
	Std Err Mean	*0.045*	*0.039*	*0.037*
	Std Dev Beta	0.034	0.042	0.028
2nd Quartile	**Mean**	**0.368**	**0.583**	**0.561**
	Std Err Mean	*0.044*	*0.051*	*0.051*
	Std Dev Beta	0.052	0.037	0.039
3rd Quartile	**Mean**	**0.436**	**0.735**	**0.694**
	Std Err Mean	*0.083*	*0.088*	*0.076*
	Std Dev Beta	0.037	0.044	0.038
Top Quart	**Mean**	**0.400**	**0.568**	**0.606**
	Std Err Mean	*0.062*	*0.056*	*0.056*
	Std Dev Beta	0.043	0.046	0.044
Panel B: Market Weighted Developed Vs. Emerging				
Market Weighted Developed	Mean	**0.372**	**0.533**	**0.574**
	Std Err Mean	*0.040*	*0.041*	*0.041*
	Std Dev Beta	0.031	0.037	0.038
Market Weighted Emerging	Mean	**0.458**	**0.761**	**0.655**
	Std Err Mean	*0.104*	*0.093*	*0.085*
	Std Dev Beta	0.012	0.021	0.016

Panel C: Market Weighted by Region				
Equally Weighted	**Mean**	**0.362**	**0.589**	**0.532**
	Std Err Mean	*0.092*	*0.078*	*0.071*
	Std Dev Beta	0.003	0.003	0.003
Europe	**Mean**	**0.328**	**0.605**	**0.581**
	Std Err Mean	*0.057*	*0.058*	*0.049*
	Std Dev Beta	0.024	0.027	0.028
Asia	**Mean**	**0.386**	**0.586**	**0.521**
	Std Err Mean	*0.093*	*0.096*	*0.095*
	Std Dev Beta	0.020	0.299	0.299
Oceania	**Mean**	**0.435**	**0.317**	**0.317**
	Std Err Mean	*0.043*	*0.053*	*0.053*
	Std Dev Beta	0.112	0.116	0.116
Latin America	**Mean**	**0.533**	**0.626**	**0.459**
	Std Err Mean	0.149	0.100	0.087
	Std Dev Beta	0.004	0.009	0.004
Africa & Middle East	**Mean**	**0.064**	**0.733**	**0.733**
	Std Err Mean	*0.172*	*0.088*	*0.088*
	Std Dev Beta	0.003	0.003	0.003

[a] Market weights based upon dollar-value market capitalizations in April 2004

Table 3

Summary Statistics of Foreign Market Breaks and Restrictions on Foreign Firm Pricing

Panel A reports the proportion of foreign stocks listed in the US that come from home countries with markets showing evidence in Table 1 of no breaks, one break or two breaks and total. Panel B reports the proportion of the firms that reject the hypothesis that the parameter estimates equal zero for the two equation system:

$$r_t^{\ell} = \alpha_\tau^{\ell} + \beta_\tau^{\ell} r_t^{w} + u_{t,\tau}^{\ell},$$
$$r_t^{i\ell} = \alpha^{i\ell} + \beta^{i\ell}\alpha_\tau^{\ell} + (\beta^{iw} + \beta^{i\ell}\beta_\tau^{\ell}) r_t^{w} + \beta^{i\ell} u_{t,\tau}^{\ell} + e_t^{i\ell}$$

for $\ell = 1, \ldots, L$, the total number of countries, and $\tau = 1, \ldots, m+1$ where m is the total number of possible breaks, 4. The first equation is the same market equity excess return regression reported in Tables 1 and 2. The second equation is given by $r_t^{i\ell}$, the excess return of firm *i* from home country ℓ, on a two factor model of the local market excess return and the US market return substituting the local market return in the first equation into this two factor model. Panel C reports the proportion of stocks in each category that reject the hypothesis that the parameters are constant across home country subperiods. Panel D reports the mean, median, minimum, and maximum number of observations for the company and country pair regressions.

Panel A: Firms Decomposed by Country Break Category				
Statistic	**No Breaks m=0**	**One Break m=1**	**Two Breaks m=2**	**All**
Proportion of Firms	0.402	0.415	0.183	1.000
No of Firms	*130*	*134*	*59*	*324*

Panel B. Proportion of Firms rejecting Zero Parameter Restrictions				
Null Hypothesis	**No Breaks**	**One Break**	**Two Breaks**	**All**
Ho: $\alpha^{i\ell}=0$; $\beta^{iw}=0$	0.399	0.459	0.200	0.401
$\text{Ho}: \alpha^{i\ell} = 0$	0.040	0.092	0.000	0.054
Ho: $\beta^{iw}=0$	0.457	0.495	0.267	0.452
$\text{Ho}: I(T_\tau)\alpha^{i\ell} = 0$	0.058	0.050	0.007	0.032
Ho:$I(T_\tau)\beta^{iw} = 0$	0.669	0.928	0.210	0.420

Table 3 (continued)

Panel C: Proportion of Firms rejecting Constant Parameters across Country Breaks				
Null Hypothesis	$\delta^{i\ell} \equiv \alpha^{i\ell}$	$\delta^{i\ell} \equiv \beta^{i\ell}$	$\delta^{i\ell} \equiv \beta^{iw}$	$\delta^{i\ell} \equiv \{\alpha^{i\ell}, \beta^{i\ell}, \beta^{iw}\}$
Ho: $I(T_j)\delta^{i\ell} = I(T_k)\delta^{i\ell}$, $j \neq k, \forall j,k$	0.060	0.163	0.132	0.397

Panel D: Number of Firm Stock Observations ***First Entry = Total Excluding Canadian firms, Second Entry = Full Total***					
Category	**Statistic**	**Total**	**By Subperiods in Local Market Stock Return**		
			τ=1	*τ=2*	*τ=3*
No of Firms per Time *(Cross-Section)*	Count	312 *363*	291 *304*	139 *190*	30 *30*
No of Observations in subinterval per Firm *(Time Series)*	Mean	772 800	576 558	461 586	294 294
	Median	564 634	406 388	361 505	266 266
	Min	62 62	62 62	75 75	266 266
	Max	1625 1670	1625 1625	1255 1437	346 346
Total No. of Firm,Country Observations *(Time Series and Cross Section)*	Count	481,792 580,478	167,640 339,208	128,046 222,652	17,632 17,632

Table 4
Means and Standard Errors of Estimated Break Dates of Foreign Company Returns

The individual foreign company stock breaks are estimated with the two equation system:

$$r_t^\ell = \alpha_\tau^\ell + \beta_\tau^\ell \, r_t^w + u_{\tau,t}^\ell; \qquad \text{for } \tau = 1, ..., m^\ell;\ \ell = 1, ..., L;$$

$$r_t^{i\ell} = \alpha_\varsigma^{i\ell} + \beta_\varsigma^{i\ell} \, r_t^\ell + \beta_\varsigma^{iw} \, r_t^w + e_{\varsigma,t}^{i\ell}, \qquad \text{for } \varsigma = 1, ..., m^i;\ i = 1, ..., N;$$

where L is the total number of countries, 41, and N is the total number of foreign stocks, 363. The first equation is the same market equity excess return regression reported in Tables 1 and 2. The second equation is given by $r_t^{i\ell}$, the excess return of firm *i* from home country ℓ, on a two factor model of the local market excess return and the US market return.

MSL	Statistic	Full Sample by Break[a]			Single Break Only[b]	Double Break Only[c]		Triple Break Only[d]		
		Break 1	Break 2	Break 3	Break	Break 1	Break 2	Break 1	Break 2	Break 3
10%	Mean Break (reported as "year.month")	1996.02	1999.12	1998.05	1997.03	1993.03	1999.11	1984.01	1989.00	1998.05
	Mean StErr[e] (in months)	*8.0*	*4.7*	*7.1*	*8.3*	*7.0*	*4.8*	*6.8*	*4.4*	*7.1*
	No. of Stocks	164	35	4	129	31		4		
5%	Mean Break (reported as "year.month")	1996.06	1998.11	1998.08	1997.05	1992.06	1999.06	1978.11	1985.09	1998.08
	Mean StErr (in months)	*6.8*	*4.8*	*4.2*	*7.0*	*5.7*	*4.6*	*8.2*	*8.6*	*4.2*
	No. of Stocks	134	23	1	111	22		1		
2.5%	Mean Break (reported as "year.month")	1996.07	1999.12	NA	1997.02	1991.12	1999.12	NA	NA	NA
	Mean StErr (in months)	*5.7*	*4.7*	*NA*	*5.8*	*5.0*	*4.7*	*NA*	*NA*	*NA*
	No. of Stocks	111	13	0	98	13		0		

[a]Averages based upon combining all break estimates.
[b] Conditional averages based only upon company stocks with one break.
[c] Conditional averages based only upon company stocks with two breaks.
[d] Conditional averages based only upon company stocks with three breaks.
[e]Average of the estimated standard error around the break date.

Table 5
Foreign Company Local Beta Estimates

Local market beta ($\beta^{i\ell}$) estimate means, standard error means, and cross-sectional standard deviations for various market portfolios in the two equation system regressions:

$$r_t^{\ell} = \alpha^{\ell} + \beta^{\ell} r_t^{w} + u_{\ell,t}$$

$$r_t^{i\ell} = \alpha^{i\ell} + \beta^{i\ell}\, r_t^{\ell} + \beta^{iw}\, r_t^{w} + e_t^{i\ell}$$

Where r_t^{ℓ} is the excess return of country ℓ's equity return, r_t^{w} is the excess return of the US market, $r_t^{i\ell}$ is the excess equity return of company *i* from country ℓ, and where $\{\alpha^{\ell}, \beta^{\ell}\}$ is the parameter vector for country ℓ and where $\{\alpha^{i\ell}, \beta^{i\ell}, \beta^{iw}\}$ is the parameter vector for company *i*. "Periods" are defined as the interval over which the company-specific parameter vector is stable and do not correspond to the same time periods for all companies.

Panel A: Market-Weighted Portfolios

Portfolio	$\beta^{i\ell}$ Estimate	Period 1 (ς = 1)	Period 2 (ς = 2)	Period 3 (ς = 3)	Period 4 (ς = 4)
Market Weighted	**Mean**	1.000	0.998	1.043	1.035
	Std Err Mean	*0.082*	*0.093*	*0.094*	*0.093*
	Std Dev Beta	0.001	0.001	0.001	0.001
Equally Weighted	**Mean**	0.899	1.043	1.071	1.062
	Std Err Mean	*0.103*	*0.117*	*0.120*	*0.121*
	Std Dev Beta	0.422	0.471	0.505	0.493
Bottom Quartile	**Mean**	0.834	0.985	1.013	1.002
	Std Err Mean	*0.125*	*0.138*	*0.139*	*0.140*
	Std Dev Beta	0.003	0.004	0.003	0.003
2nd Quartile	**Mean**	0.870	1.130	1.147	1.149
	Std Err Mean	*0.119*	*0.135*	*0.141*	*0.142*
	Std Dev Beta	0.002	0.003	0.003	0.003
3rd Quartile	**Mean**	0.880	0.975	1.000	0.991
	Std Err Mean	*0.098*	*0.102*	*0.106*	*0.106*
	Std Dev Beta	0.003	0.003	0.004	0.004
Top Quart	**Mean**	1.031	0.996	1.046	1.037
	Std Err Mean	*0.077*	*0.089*	*0.089*	*0.088*
	Std Dev Beta	0.001	0.002	0.002	0.002

Panel B: Geographic Portfolios					
Portfolio Equally Weighted	**$\beta^{i\ell}$ Estimate**	**Period 1** (ς = 1)	**Period 2** (ς = 2)	**Period 3** (ς = 3)	**Period 4** (ς = 4)
Europe	**Mean**	0.912	1.028	1.065	1.062
	Std Err Mean	*0.101*	*0.123*	*0.127*	*0.127*
	Std Dev Beta	0.391	0.532	0.596	0.588
	No of Obs	*150*	*150*	*150*	*150*
Asia	**Mean**	0.816	0.967	0.983	0.939
	Std Err Mean	*0.101*	*0.100*	*0.099*	*0.098*
	Std Dev Beta	0.510	0.540	0.542	0.487
	No of Obs	*62*	*62*	*62*	*62*
Oceania	**Mean**	0.946	1.032	1.077	1.091
	Std Err Mean	*0.080*	*0.090*	*0.091*	*0.092*
	Std Dev Beta	0.288	0.371	0.243	0.233
	No of Obs	*12*	*12*	*12*	*12*
Latin America	**Mean**	0.841	1.029	1.037	1.038
	Std Err Mean	*0.101*	*0.113*	*0.118*	*0.120*
	Std Dev Beta	0.495	0.427	0.429	0.436
	No of Obs	*89*	*89*	*89*	*89*
Africa & Middle East	**Mean**	0.666	0.706	0.798	0.798
	Std Err Mean	*0.077*	*0.074*	*0.072*	*0.072*
	Std Dev Beta	0.467	0.496	0.601	0.601
	No of Obs	*9*	*9*	*9*	*9*

Panel C: Developed and Emerging Market Portfolios					
Portfolio	**$\beta^{i\ell}$ Estimate**	**Period 1** (ς = 1)	**Period 2** (ς = 2)	**Period 3** (ς = 3)	**Period 4** (ς = 4)
Developed Markets	Mean	0.906	0.946	0.920	0.918
	Std Err Mean	*0.072*	*0.082*	*0.083*	*0.083*
	Std Dev Beta	0.001	0.001	0.001	0.001
Emerging Markets	Mean	0.874	1.072	1.029	1.029
	Std Err Mean	*0.087*	*0.095*	*0.093*	*0.093*
	Std Dev Beta	0.004	0.014	0.009	0.009

Table 6

Foreign Company World Beta Estimates

US market beta (β^{iw}) estimate means, standard error means, and cross-sectional standard deviations for various market portfolios in the two equation system regressions:

$$r_t^{\ell} = \alpha^{\ell} + \beta^{\ell} r_t^{w} + u_{\ell,t}$$

$$r_t^{i\ell} = \alpha^{i\ell} + \beta^{i\ell} r_t^{\ell} + \beta^{iw} r_t^{w} + e_t^{i\ell}$$

Where r_t^{ℓ} is the excess return of country ℓ's equity return, r_t^{w} is the excess return of the US market, $r_t^{i\ell}$ is the excess equity return of company *i* from country ℓ, and where $\{\alpha^{\ell}, \beta^{\ell}\}$ is the parameter vector for country ℓ and where $\{\alpha^{i\ell}, \beta^{i\ell}, \beta^{iw}\}$ is the parameter vector for company *i*. "Periods" are defined as the interval over which the company-specific parameter vector is stable and do not correspond to the same time periods for all companies.

Panel A: Market-Weighted Portfolios

Portfolio	β^{iw} Estimate	Period 1 ($\varsigma = 1$)	Period 2 ($\varsigma = 2$)	Period 3 ($\varsigma = 3$)	Period 4 ($\varsigma = 4$)
Market Weighted	**Mean**	0.061	0.060	0.081	0.082
	Std Err Mean	*0.002*	*0.003*	*0.002*	*0.003*
	Std Dev Beta	0.061	0.003	0.003	0.003
Equally Weighted	**Mean**	0.07	0.05	0.06	0.06
	Std Err Mean	*0.140*	*0.071*	*0.075*	*0.074*
	Std Dev Beta	0.29	0.33	0.34	0.35
Bottom Quartile	**Mean**	0.097	0.070	0.046	0.046
	Std Err Mean	*<0.001*	*<0.001*	*<0.001*	*<0.001*
	Std Dev Beta	<0.001	0.001	0.001	0.001
2nd Quartile	**Mean**	*<0.001*	0.052	0.070	0.070
	Std Err Mean	<0.001	<0.001	0.001	0.001
	Std Dev: MW	0.002	*0.002*	*0.002*	*0.002*
3rd Quartile	**Mean**	0.051	0.043	0.103	0.103
	Std Err Mean	*<0.001*	*<0.001*	*<0.001*	*<0.001*
	Std Dev Beta	*0.001*	0.002	0.001	0.001
Top Quart	**Mean**	0.045	0.010	0.007	0.016
	Std Err Mean	*<0.001*	*<0.001*	*<0.001*	*<0.001*
	Std Dev Beta	0.001	0.001	0.001	0.001

Panel B: Geographic Equally Weighted Portfolios					
Portfolio	β^{iw} **Estimate**	**Period 1** (ς = 1)	**Period 2** (ς = 2)	**Period 3** (ς = 3)	**Period 4** (ς = 4)
Europe	**Mean**	0.029	0.037	0.055	0.061
	Std Err Mean	*0.110*	*0.137*	*0.136*	*0.136*
	Std Dev Beta	0.267	0.368	0.371	0.378
	No of Firms	*148*	148	148	148
Asia	**Mean**	0.192	0.087	0.123	0.123
	Std Err Mean	*0.188*	*0.154*	*0.154*	*0.154*
	Std Dev Beta	0.317	0.279	0.317	0.317
	No of Obs	56	56	56	56
Oceania	**Mean**	0.037	0.087	0.066	0.066
	Std Err Mean	*0.090*	*0.092*	*0.092*	*0.092*
	Std Dev Beta	0.278	0.293	0.298	0.298
	No of Obs	*12*	*12*	*12*	*12*
Latin America	**Mean**	0.079	0.052	0.059	0.059
	Std Err Mean	*0.201*	*0.177*	*0.170*	*0.171*
	Std Dev Beta	0.289	*0.290*	*0.290*	*0.290*
	No of Obs	*88*	*88*	*88*	*88*
Africa & Middle East	**Mean**	-0.085	*-0.190*	*-0.383*	*-0.383*
	Std Err Mean	*0.110*	*0.128*	*0.128*	*0.128*
	Std Dev Beta	0.311	0.420	0.336	0.336
	No of Obs	*7*	*7*	*7*	*7*

Panel C: Developed and Emerging Market Weighted Portfolios					
Portfolio	β^{iw} **Estimate**	**Period 1** ($\varsigma = 1$)	**Period 2** ($\varsigma = 2$)	**Period 3** ($\varsigma = 3$)	**Period 4** ($\varsigma = 4$)
Market Weighted Developed	Mean	0.044	0.018	0.024	0.031
	Std Err Mean	*0.086*	*0.100*	*0.098*	*0.098*
	Std Dev Beta	0.002	0.002	0.002	0.002
Market Weighted Emerging	Mean	0.068	0.005	0.024	0.024
	Std Err Mean	*0.157*	*0.140*	*0.129*	*0.130*
	Std Dev Beta	0.003	0.004	0.004	0.004

Table 7

Panel A reports proportions of foreign company returns rejecting the hypothesis of none and less than one, two, and three breaks in the parameters for the regressions of one of the models:

$$r_t^{i\ell} = \alpha^{i\ell} + \beta^{i\ell}\, r_t^{\ell} + \beta^{iw}\, r_t^{w} + e_t^{i\ell} \qquad \text{Two Factor Model}$$

$$r_t^{i\ell d} = \alpha^{i\ell} + \beta^{i\ell}\, r_t^{\ell} + \beta^{iw}\, r_t^{w} + \beta^{id}\, r_t^{d} + e_t^{i\ell n} \qquad \text{Three Factor Model}$$

Given local market returns follows the relationship: $r_t^{\ell} = \alpha_{\tau}^{\ell} + \beta_{\tau}^{\ell}\, r_t^{w} + u_{\tau,t}^{\ell}$, for $\tau = 1, \ldots, m^{\ell}+1$

And where r^{ℓ}_t is the excess return of country ℓ's equity return, r^{w}_t is the excess return of the US market, and r_t^{d} is the excess return on industry d. Panel B reports the means of the estimated break dates and their associated standard errors based upon the Bai-Perron (1998) estimator estimated for each of the country return regressions.

Panel A: Distribution of Break Categories for Two and Three Factor Model

Model	*Proportion of Total Companies** Rejecting Ho: No Breaks*	**Proportional # of Breaks†**		
		1 Break	*2 Breaks*	*3 Breaks*
Two Factor	59.1%	38.2%	2.5%	0.3%
Three Factor	53.1%	41.4%	4.3%	1.1%

* Percent of the companies that reject the supF test of no structural break at the 5% MSL.
† Percent of the companies that reject the sequential test of a given number of breaks plus one at the 5% MSL

Table 7 (continued)

Panel B: Sample Statistics for Break Date Estimates in Three Factor Model											
MSL	**Statistic**	**Full Sample by Break**‡			**Single Break Only**§	**Double Break Only****		**Triple Break Only**††			
		Break 1	**Break 2**	**Break 3**	**Break**	**Break 1**	**Break 2**	**Break 1**	**Break 2**	**Break 3**
10%	Mean Break (reported as "year.month")	1995.06	1997.04	1999.01	1997.06	1991.09	1998.08	1988.01	1992.08	1999.01
	Mean StErr‡‡ *(in months)*	*5.7*	*3.7*	*5.1*	5.9	*5.6*	3.9	*4.1*	*3.2*	*5.1*
	No. of Stocks	163	49	11	114	38		11		

‡ Averages based upon combining all break estimates.
§ Conditional averages based only upon company stocks with one break.
** Conditional averages based only upon company stocks with two breaks.
†† Conditional averages based only upon company stocks with three breaks.
‡‡ Average of the estimated standard error around the break date.

5%	Mean Break (reported as "year.month")	1995.06	1996.12	1999.10	1997.07	1990.01	1997.10	1988.12	1993.01	1999.10
	Mean StErr (in months)	*5.2*	*4.1*	*4.3*	*5.3*	*5.4*	*4.3*	*3.8*	*3.0*	*4.3*
	No. of Stocks	144	39	7	105	32		7		
2.5%	Mean Break (reported as "year.month")	1995.03	1996.06	1999.05	1997.07	1989.02	1997.05	1987.08	1991.11	1999.05
	Mean StErr (in months)	*5.2*	*4.3*	*4.8*	*5.2*	5.5	*4.5*	*3.6*	*3.2*	*4.8*
	No. of Stocks	127	34	6	93	28		6		

Figure 1A: Break Point Estimates by Country

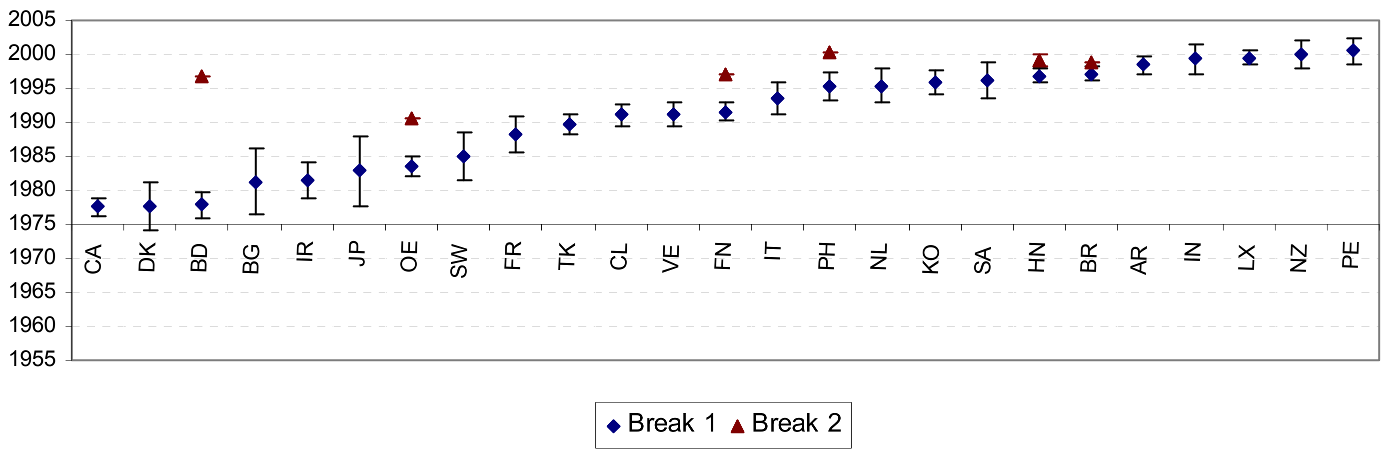


Figure 1b: Frequency of Country Breaks

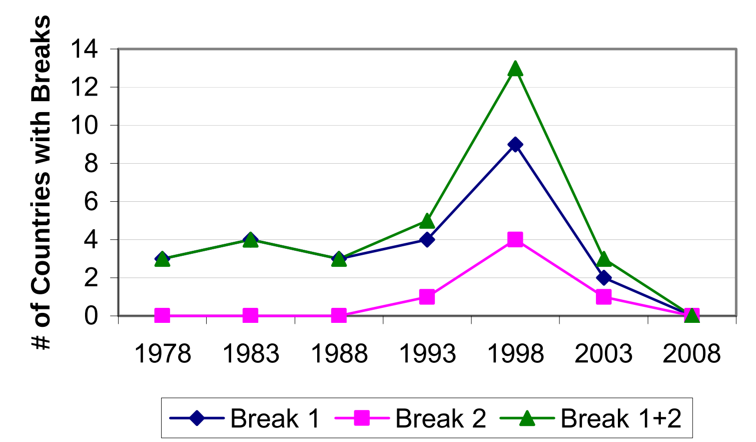
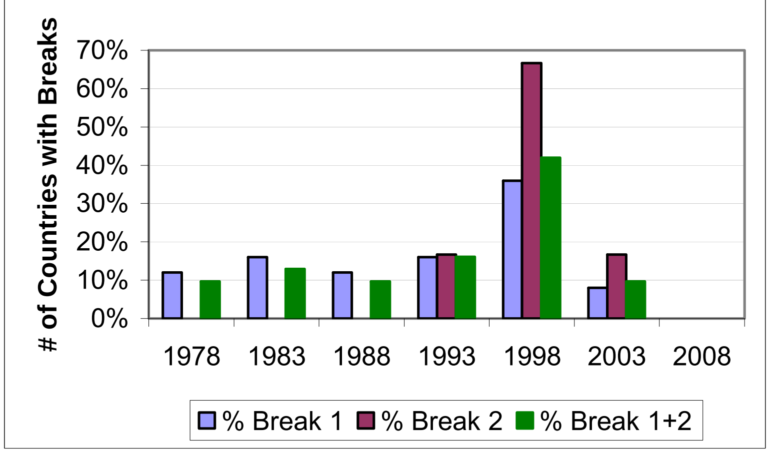


Figure 1c: Proportion of Country Breaks



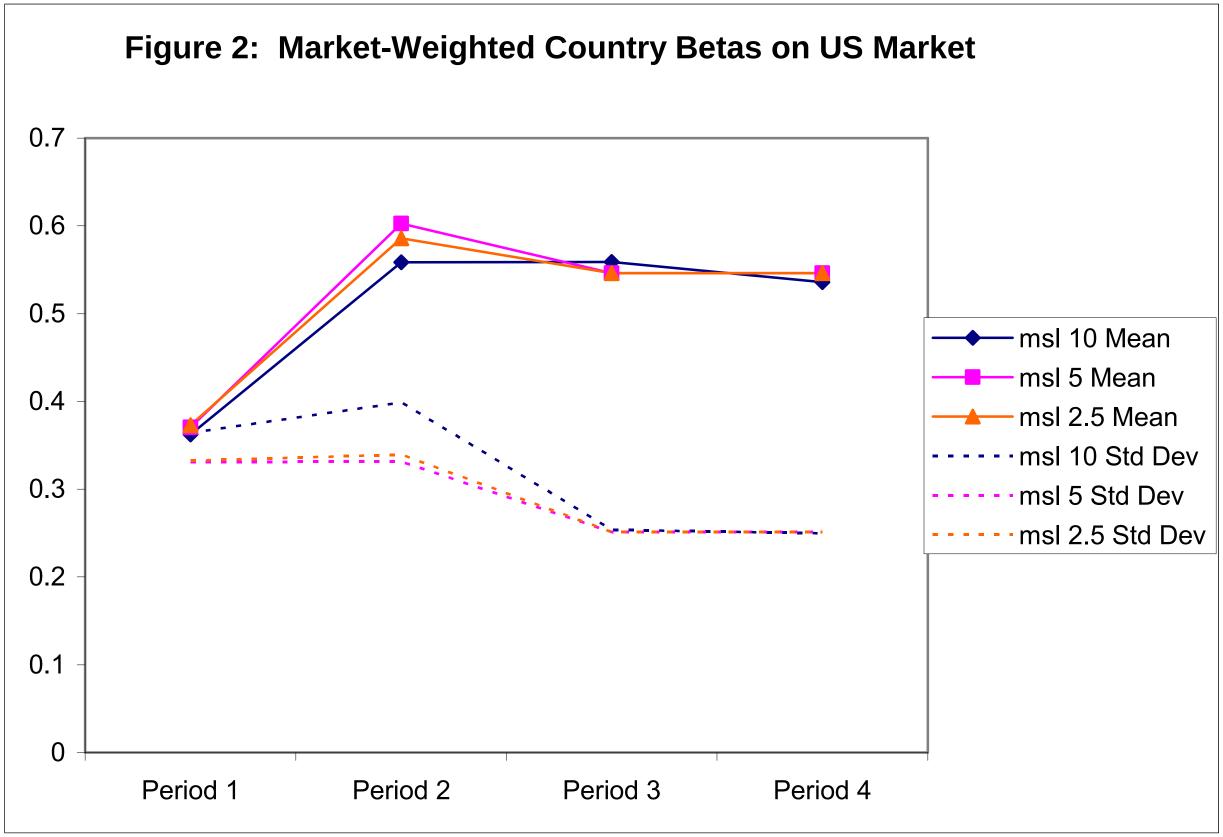


Figure 2: Market-Weighted Country Betas on US Market
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Period 1
Period 2
Period 3
Period 4
msl 10 Mean
msl 5 Mean
msl 2.5 Mean
msl 10 Std Dev
msl 5 Std Dev
msl 2.5 Std Dev

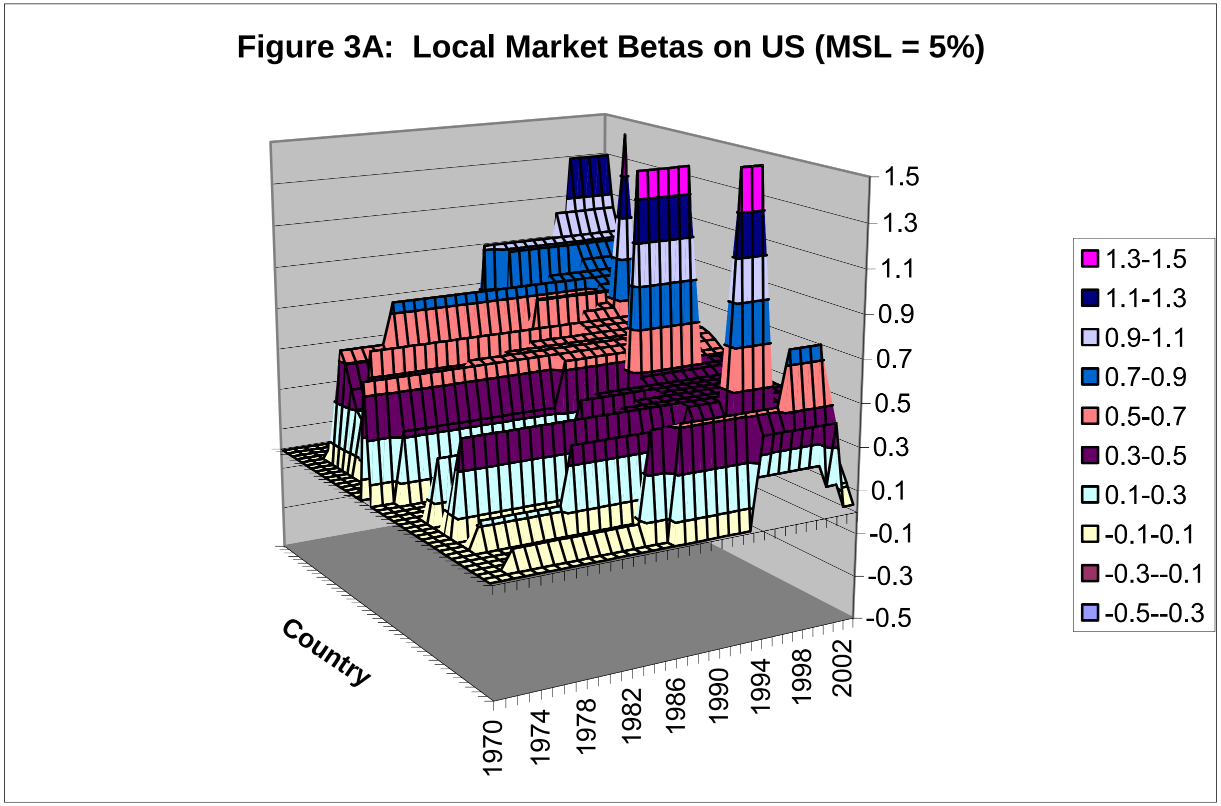
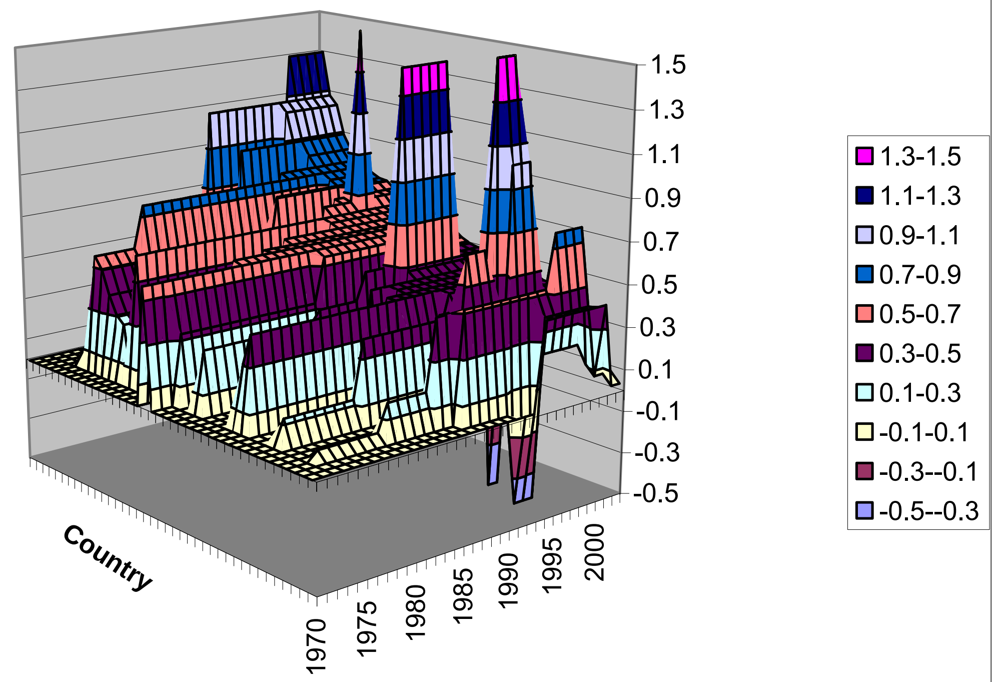


Figure 3A: Local Market Betas on US (MSL = 5%)
1.5
1.3
1.1
0.9
0.7
0.5
0.3
0.1
-0.1
-0.3
-0.5
Country
1970
1974
1978
1982
1986
1990
1994
1998
2002
1.3-1.5
1.1-1.3
0.9-1.1
0.7-0.9
0.5-0.7
0.3-0.5
0.1-0.3
-0.1-0.1
-0.3--0.1
-0.5--0.3

Figure 3B: Local Market Betas on US (MSL 10%)



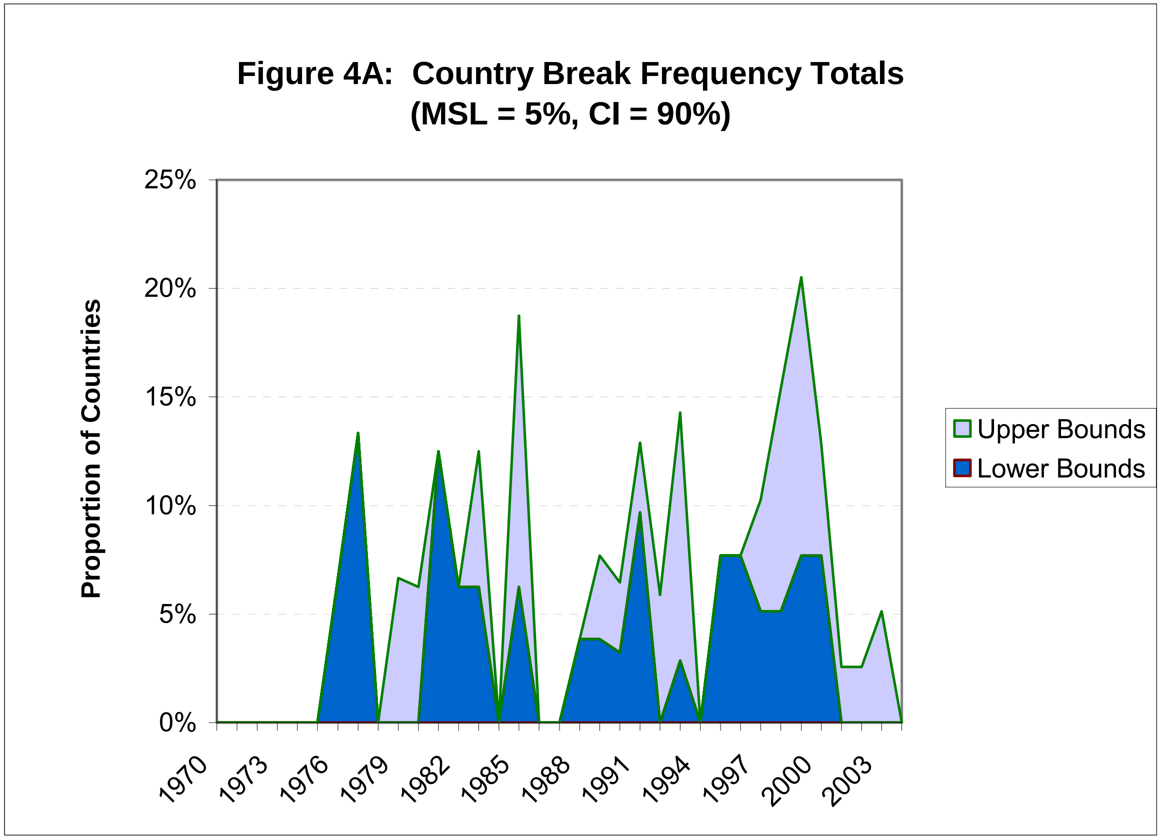


Figure 4A: Country Break Frequency Totals
(MSL = 5%, CI = 90%)
Proportion of Countries
25%
20%
15%
10%
5%
0%
1970
1973
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
Upper Bounds
Lower Bounds

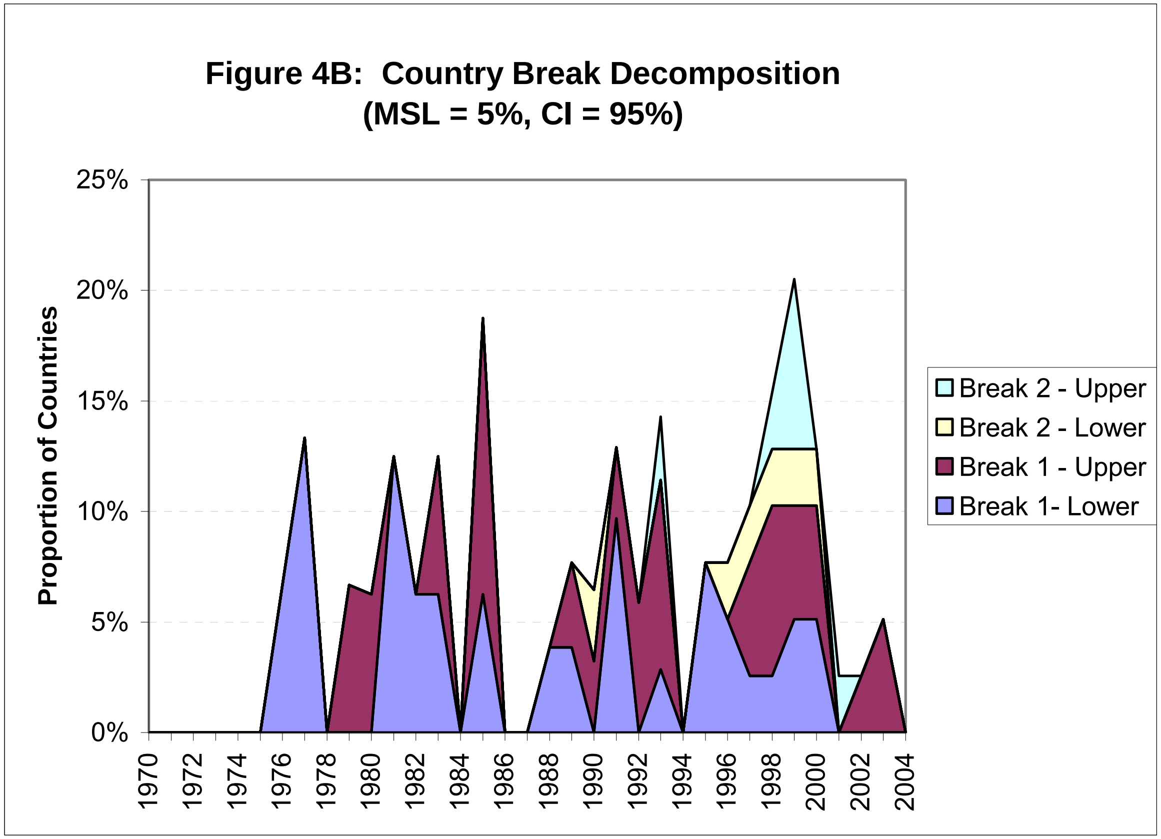


Figure 4B: Country Break Decomposition
(MSL = 5%, CI = 95%)
Proportion of Countries
25%
20%
15%
10%
5%
0%
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
Break 2 - Upper
Break 2 - Lower
Break 1 - Upper
Break 1- Lower

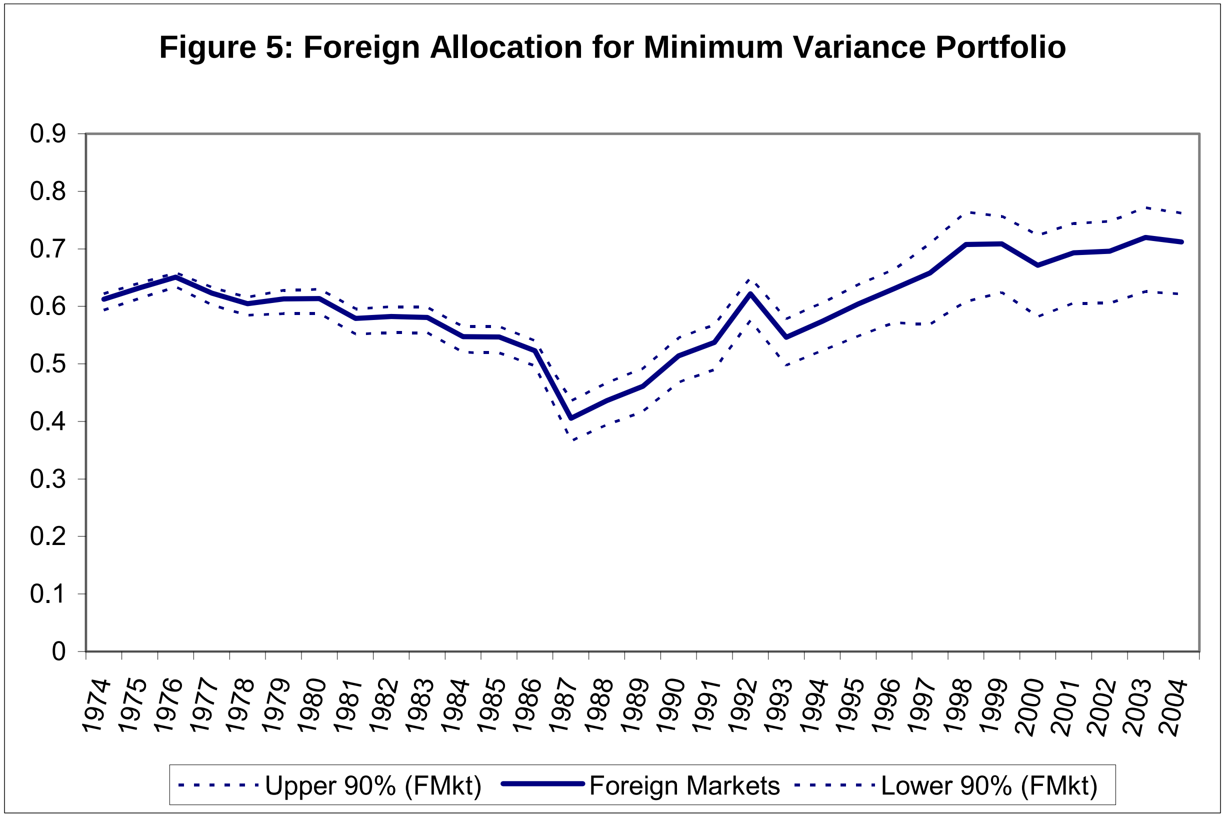


Figure 5: Foreign Allocation for Minimum Variance Portfolio
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
Upper 90% (FMkt)
Foreign Markets
Lower 90% (FMkt)

Figure 6A: Parameters over time

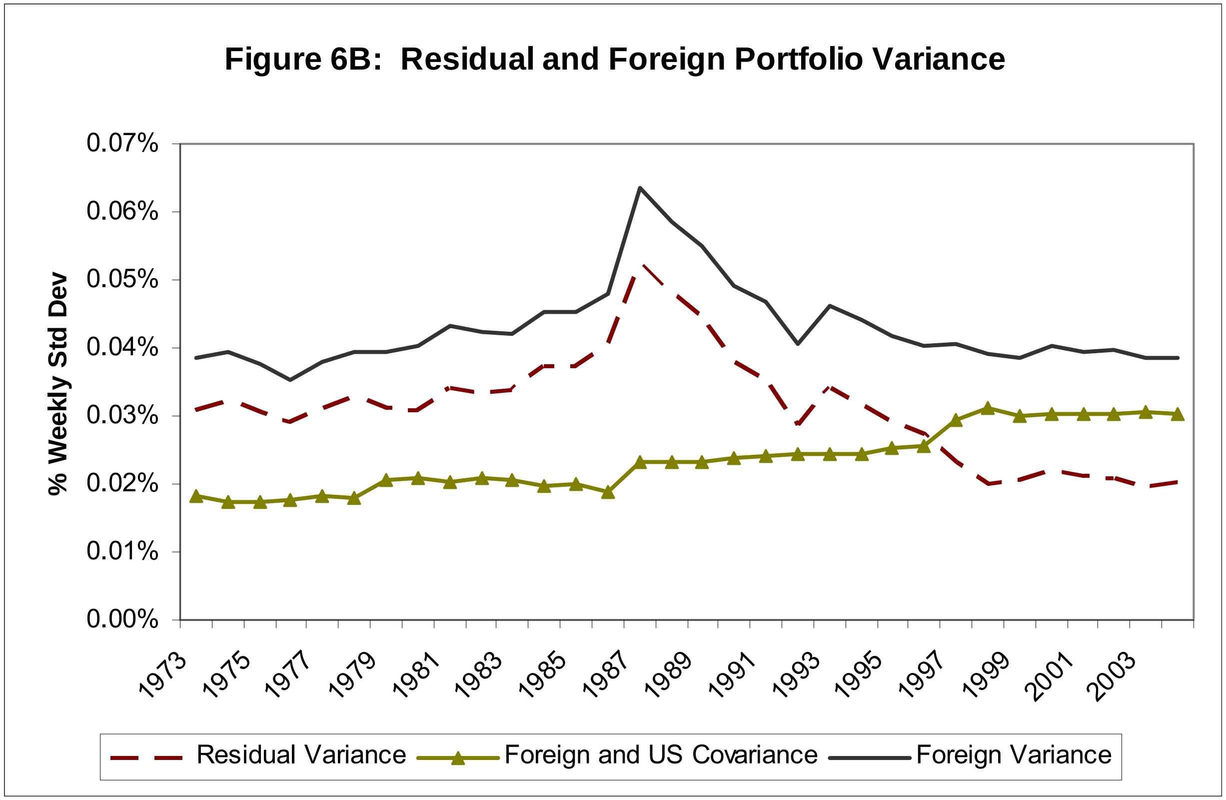
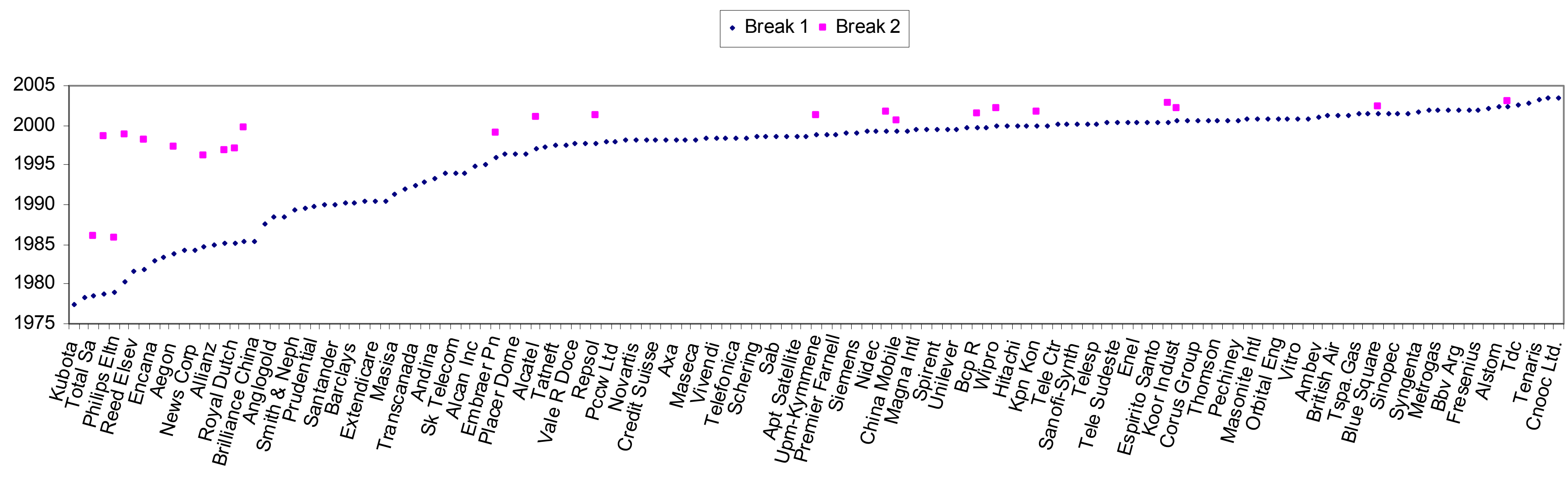


Figure 6B: Residual and Foreign Portfolio Variance
% Weekly Std Dev
0.07%
0.06%
0.05%
0.04%
0.03%
0.02%
0.01%
0.00%
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
Residual Variance
Foreign and US Covariance
Foreign Variance

Figure 7A: Break Point Estimates by Company



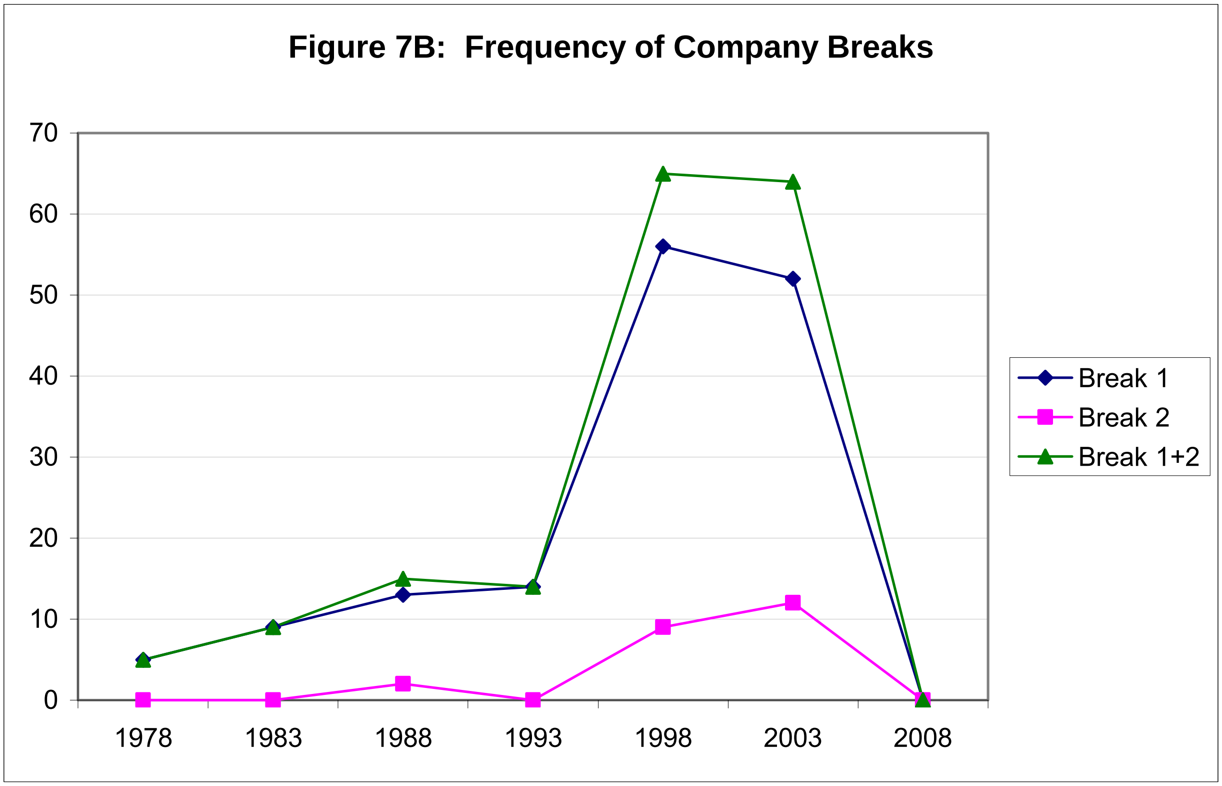


Figure 7B: Frequency of Company Breaks
70
60
50
40
30
20
10
0
1978
1983
1988
1993
1998
2003
2008
Break 1
Break 2
Break 1+2

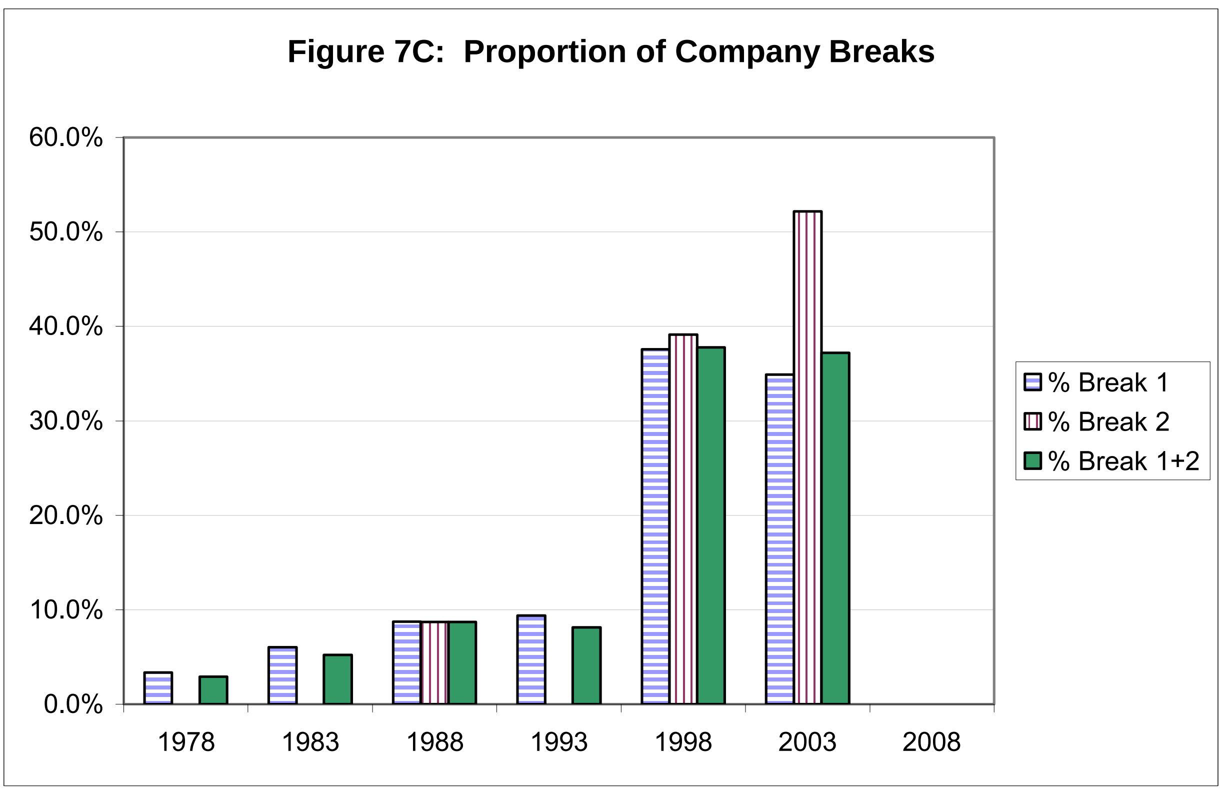


Figure 7C: Proportion of Company Breaks
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
1978
1983
1988
1993
1998
2003
2008
% Break 1
% Break 2
% Break 1+2

Figure 8: International Allocation-Minimum Variance Portfolio

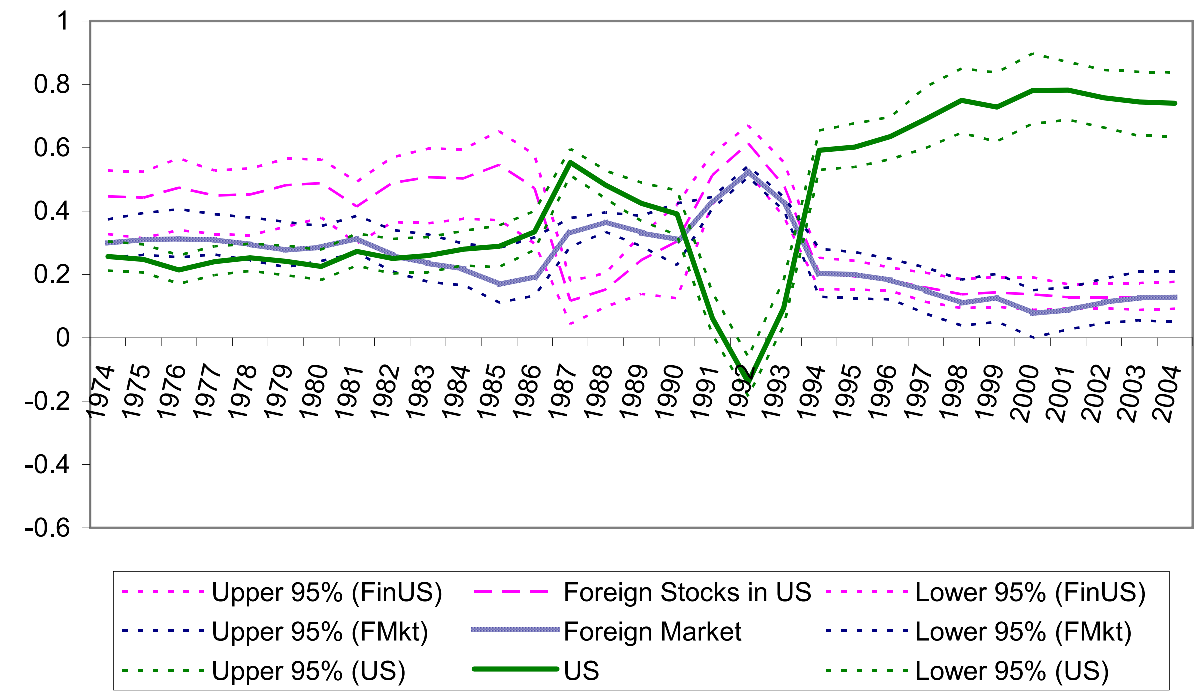


Figure 9a: Foreign Portfolio Parameters over Time

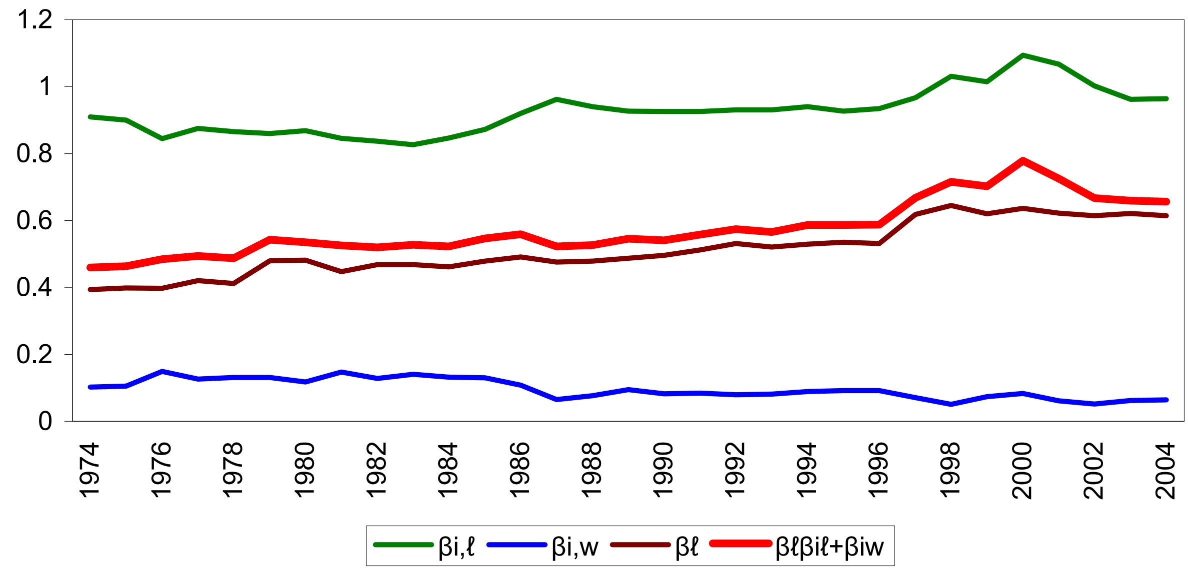
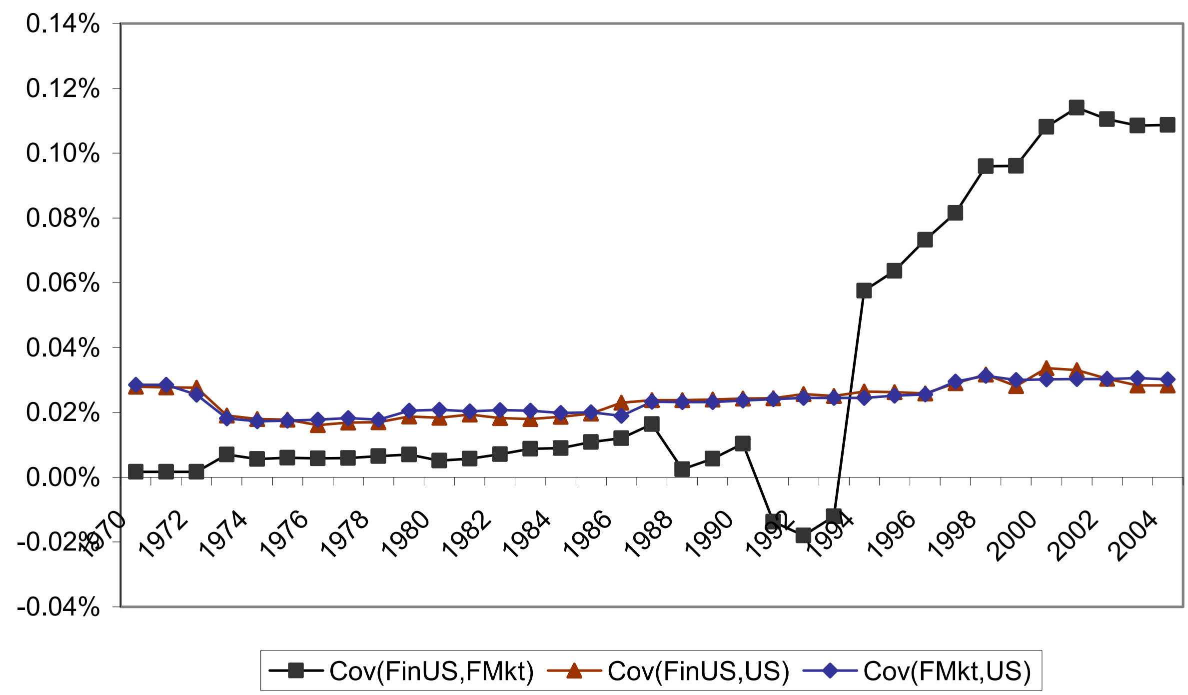


Figure 9b: Covariance Estimates Over Time



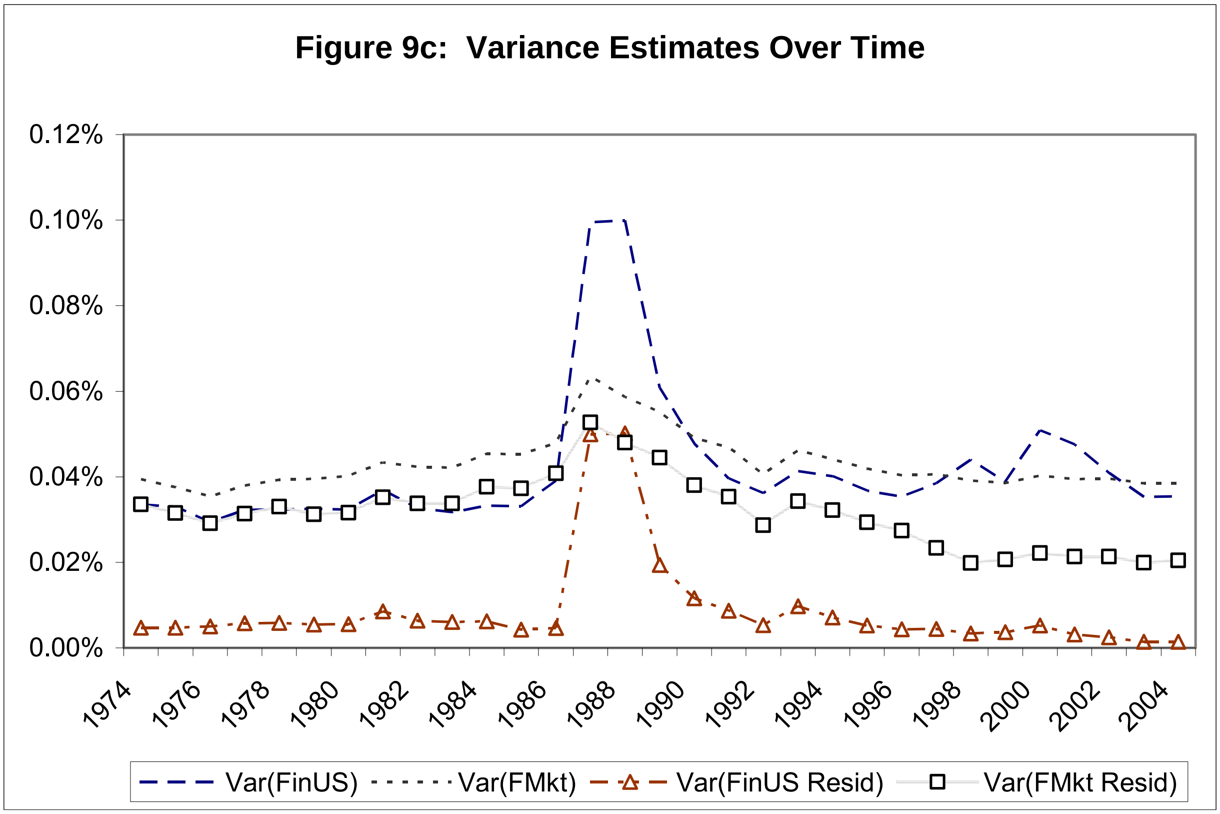


Figure 9c: Variance Estimates Over Time
0.12%
0.10%
0.08%
0.06%
0.04%
0.02%
0.00%
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
Var(FinUS)
Var(FMkt)
Var(FinUS Resid)
Var(FMkt Resid)

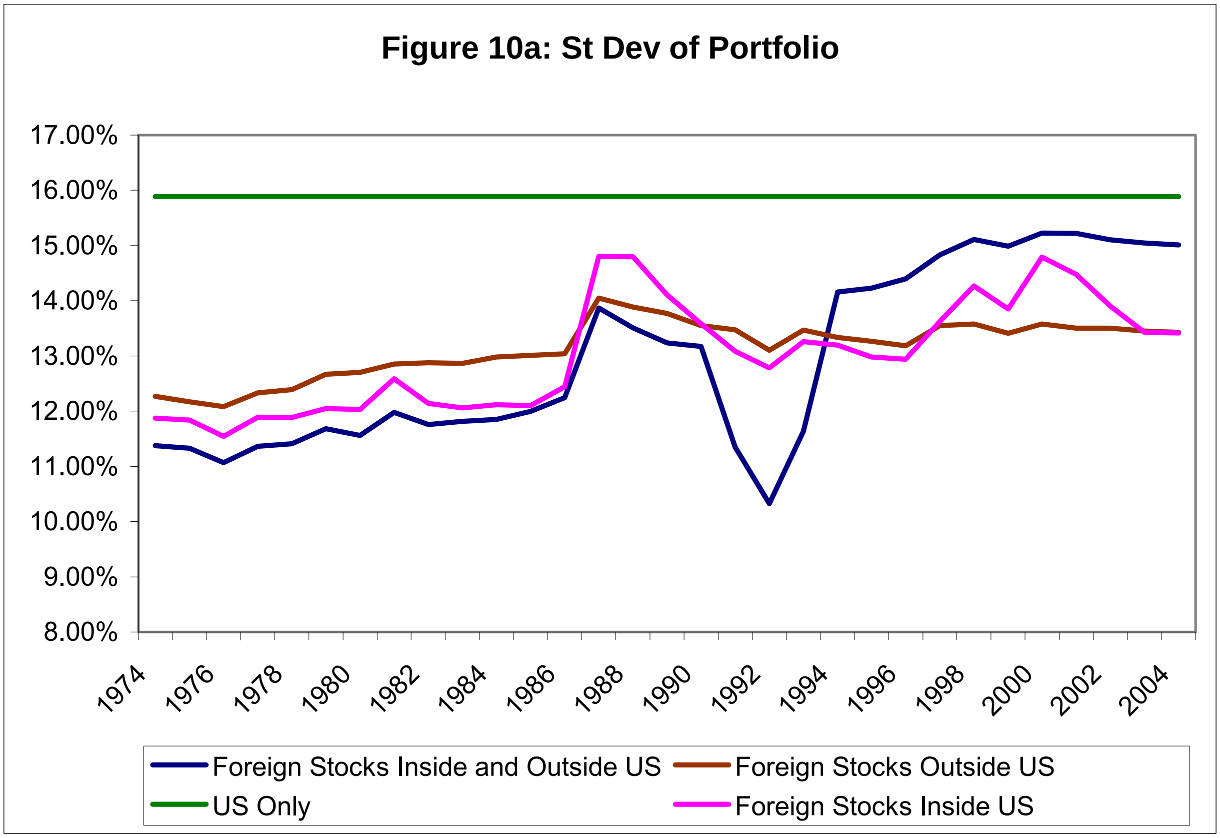


Figure 10a: St Dev of Portfolio
17.00%
16.00%
15.00%
14.00%
13.00%
12.00%
11.00%
10.00%
9.00%
8.00%
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
Foreign Stocks Inside and Outside US
Foreign Stocks Outside US
US Only
Foreign Stocks Inside US

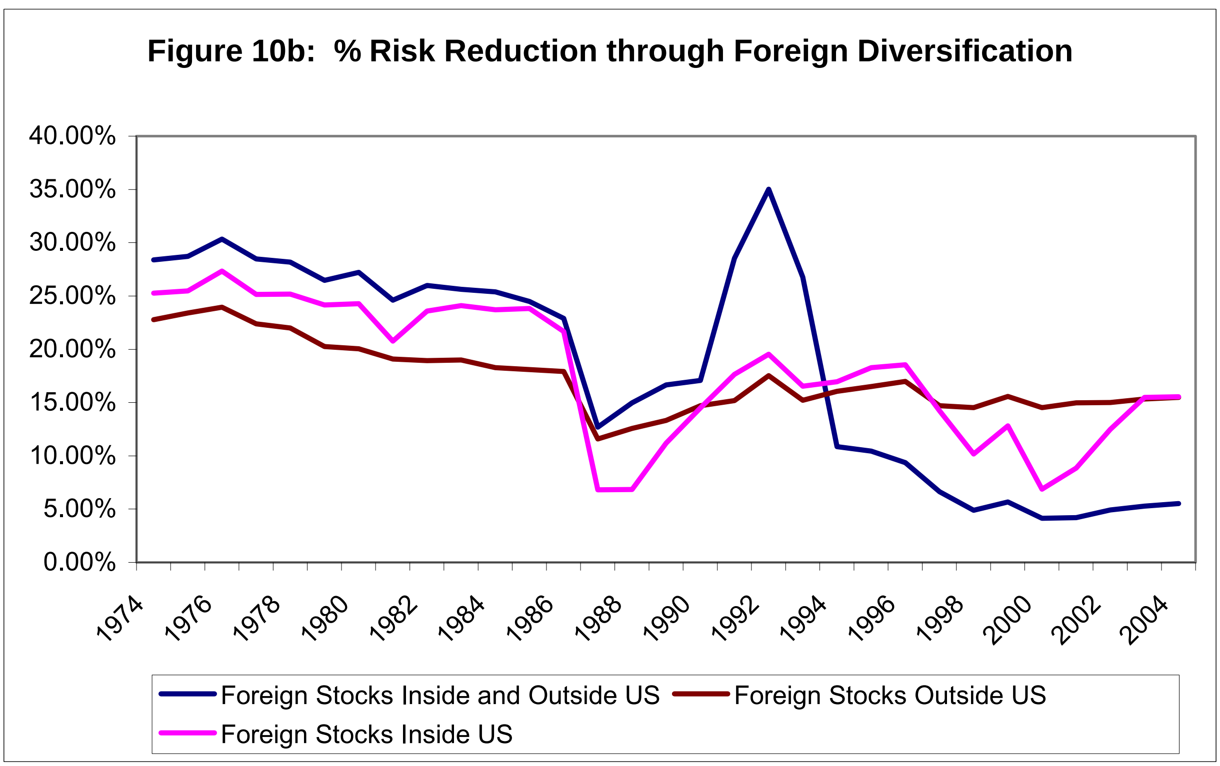


Figure 10b: % Risk Reduction through Foreign Diversification
40.00%
35.00%
30.00%
25.00%
20.00%
15.00%
10.00%
5.00%
0.00%
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
Foreign Stocks Inside and Outside US
Foreign Stocks Outside US
Foreign Stocks Inside US

Figure 11: Foreign Stocks in US - Minimum Variance Portfolio

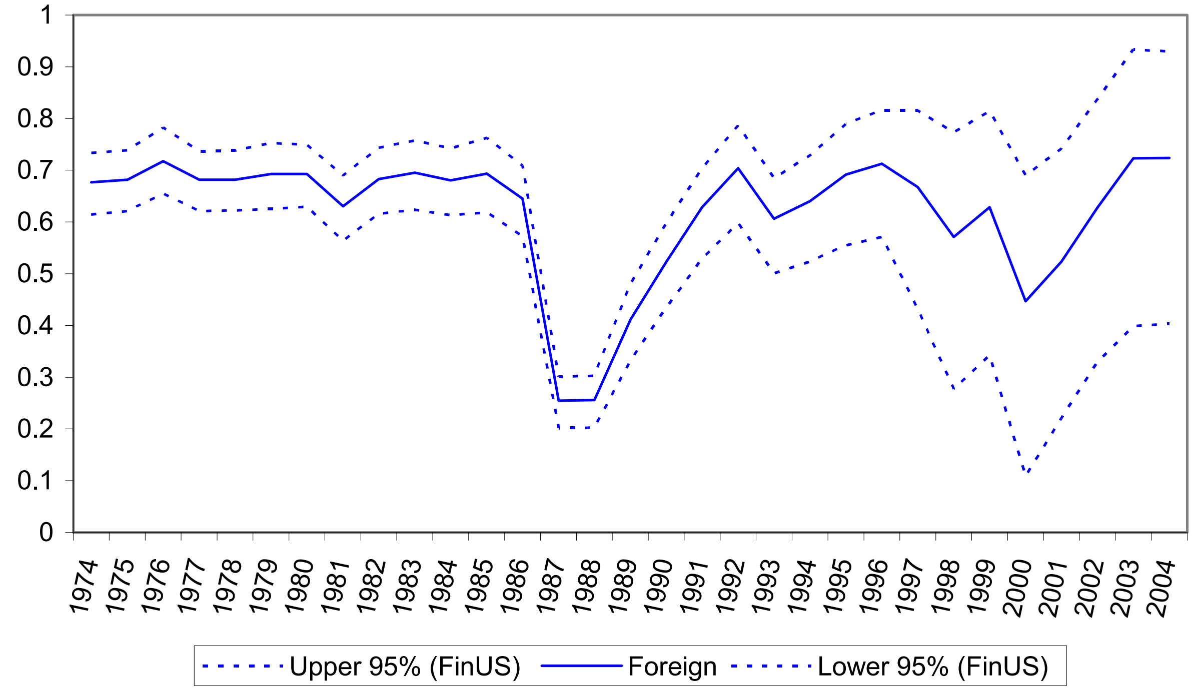


Figure 12: The effect of industry factor on residual variance

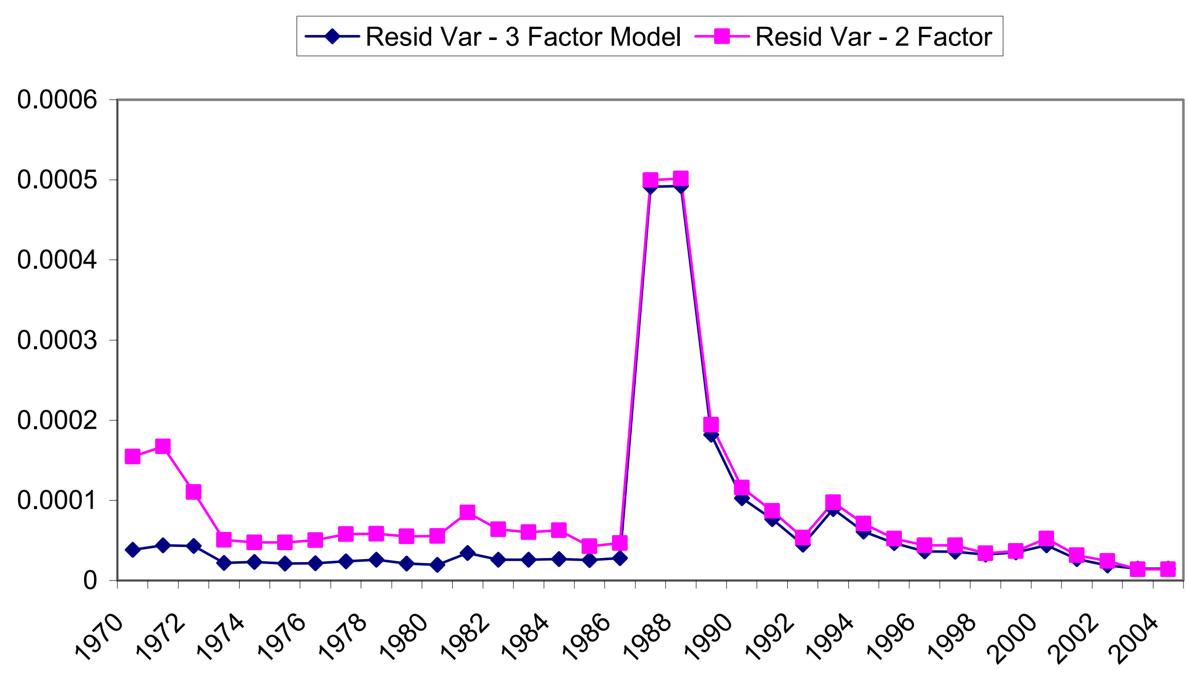
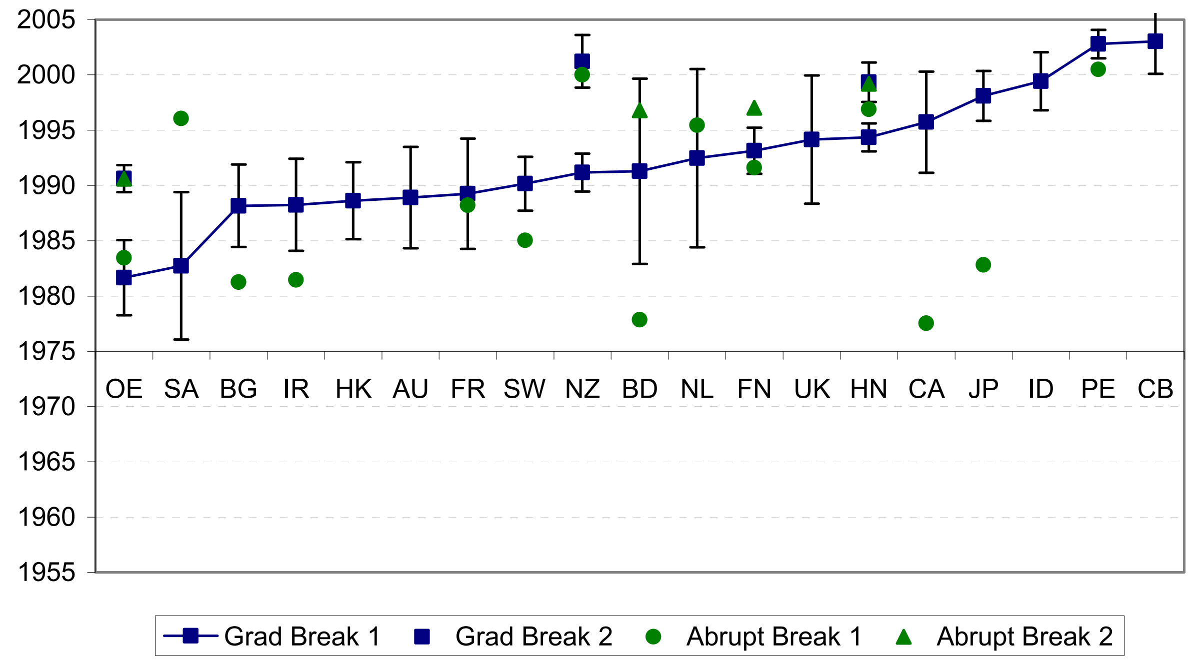


Figure 13: Gradual and Abrupt Breaks



Appendix 1: Data Description

The data on stock returns were compiled from Data stream for the market return index. The country indices are Morgan Stanley Capital Weighted Indices for the countries with foreign stocks listed in the United States. Appendix Table A1 reports these countries along with their mneumonics.

The data for the individual company stock returns were collected and cross-checked from the websites of the NYSE and three ADR custodian depositaries: JP Morgan, Citibank, and Bank of New York. For these companies, the stock return data were compiled from Data Stream. Appendix Table A2 reports these companies along with their primary country allocation.

Table A1: List of Foreign Countries

Country	*Mneumonic*	*Country*	*Mneumonic*
Argentina	AR	Israel	IS
Australia	AU	Italy	IT
Austria	OE	Japan	JP
Belgium	BG	Korea	KO
Brazil	BR	Luxembourg	LX
Canada	CA	Mexico	MX
Chile	CL	Netherlands	NL
China	CH	New Zealand	NZ
Columbia	CB	Norway	NW
Denmark	DK	Peru	PE
Finland	FN	Philipines	PH
France	FR	Portugal	PT
Germany	BD	Russia	RS
Ghana	GH	South Africa	SA
Greece	GR	Spain	ES
Hong Kong	HK	Switzerland	SW
Hungary	HN	Taiwan	TA
India	IN	Turkey	TK
Indonesia	ID	United Kingdom	UK
Ireland	IR	Venezuela	VE

Table A2: List of Foreign Companies

Company Name	*Country*	*Company Name*	*Country*
AUS.AND NZ.BANKING GP.	AU	BRASKEM PNA 1000	BR
BHP BILLITON	AU	BRASIL TELEC PN 1000	BR
COLES MYER	AU	PETROBRAS ON	BR
HARDIE JAMES	AU	PETROBRAS PN	BR
NATIONAL AUS.BANK	AU	VCP PN 1000	BR
NEWS CORP.PREF.	AU	CIA.SANMT.BASICO DE SP. (100	BR
NEWS CORPORATION	AU	SADIA S/A PN	BR
ORBITAL ENGINE CORP.	AU	TELE CTR OES PN 1000	BR
TELSTRA CORPORATION	AU	TELESP PN 1000	BR
WESTPAC BANKING	AU	BRASIL T PAR PN 1000	BR
ALUMINA	AU	TELE CELULAR SUL PN 1000	BR
WMC RESOURCES	AU	TELEMIG PART PN 1000	BR
BBVA BANCO FRANCES	AR	TELE NORTE PN 1000	BR
IRSA	AR	TELE LEST CL PN 1000	BR
METROGAS B	AR	TELE NORT CL PN 1000	BR
NORTEL INVERSORA PFD B	AR	TELE NORD CL PN 1000	BR
PEREZ COMPANC 'B'	AR	TELESP CL PA PN 1000	BR
TELF.DE ARGN.'B'	AR	TELE SUDESTE PN 1000	BR
TELECOM ARGN.'B'	AR	ULTRAPAR PN 1000	BR
TSPA.GAS DEL SUR B	AR	UNIBANCO UNITS (1 PN & 1 PNB	BR
YPF 'D'	AR	VALE R DOCE ON EJ	BR
AMERSHAM	UK	VALE R DOCE PNA EJ	BR
ALLIED IRISH BANKS	IR	BRIT.SKY BCAST.	UK
ALLIED DOMECQ	UK	BT GROUP	UK
AMVESCAP	UK	CABLE & WIRELESS	UK
ASTRAZENECA	UK	BANCOLOMBIA PFCL.	CB
DELHAIZE	BG	CADBURY SCHWEPPES	UK
BARCLAYS	UK	CELLTECH GROUP	UK
BRITISH AIRWAYS	UK	ANDINA 'B'	CL
BG GROUP	UK	ANDINA 'A'	CL
BRITISH ENERGY	UK	CTC 'A'	CL
BANK OF IRELAND	IR	CONCHATORO	CL
BHP BILLITON	UK	BANCO DE CHILE	CL
BUNZL	UK	CRISTALES	CL
BOC GROUP	UK	CERVEZAS	CL
BP	UK	D&S	CL
ARACRUZ PNB	BR	ENERSIS	CL
AMBEV ON 1000	BR	ENDESA	CL
AMBEV PN 1000	BR	LAN	CL
COPEL PNB 1000	BR	MASISA	CL
CMPH.BRASL.DISTB.PN 1000	BR	PROVIDA	CL
BRADESCO PN 1000	BR	QUINENCO	CL
PERDIGAO S/A PN	BR	BSANTANDER	CL
SID NACIONAL ON 1000	BR	SQM 'A'	CL
EMBRAER PN	BR	SQM 'B'	CL
EMBRATEL PAR PN 1000	BR	CORUS GROUP	UK
GERDAU PN	BR	ALTANA	BD
CEMIG PN 1000	BR	ALLIANZ	BD
BNC.ITAU HLDG.FINCA.PN 1000	BR	BASF	BD

Table A2: List of Foreign Companies (cont.)

Company Name	*Country*	*Company Name*	*Country*
BAYER	BD	GALLAHER GROUP	UK
DEUTSCHE TELEKOM	BD	GLAXOSMITHKLINE	UK
E ON	BD	ABN AMRO HOLDING	NL
EPCOS	BD	AEGON	NL
FRESENIUS MED.CARE	BD	AHOLD KON.	NL
FRESENIUS MED.CARE PREF.	BD	CHICAGO BRIDGE & IRON	NL
INFINEON TECHNOLOGIES	BD	REED ELSEVIER (AMS)	NL
PFEIFFER VACUUM TECH.	BD	ING GROEP CERTS.	NL
SAP	BD	ISPAT INTERNATIONAL	NL
SCHERING	BD	KLM	NL
SGL CARBON	BD	BUHRMANN	NL
SIEMENS	BD	KPN KON	NL
DIAGEO	UK	NEW SKIES SATTELITES	NL
NOVO NORDISK B	DK	PHILIPS ELTN.KON	NL
TDC	DK	ROYAL DUTCH PTL.	NL
ELAN	IR	TPG NV	NL
BBV ARGENTARIA	ES	UNILEVER CERTS.	NL
ENDESA	ES	MOOLEN (VAN DER)	NL
REPSOL YPF	ES	MATAV	HN
SANTANDER CTL.HISPANO	ES	HANSON	UK
TELEFONICA	ES	HSBC HDG. (ORD $0.50)	UK
TELEFONICA MOVILES	ES	BENETTON	IT
ENODIS	UK	DUCATI MOTOR HOLDING	IT
ALSTOM	FR	ENEL	IT
DANONE	FR	ENI	IT
ALCATEL	FR	FIAT	IT
EQUANT (PAR)	FR	FIAT PV	IT
VIVENDI UNIVERSAL	FR	FIAT RNC	IT
FRANCE TELECOM	FR	LUXOTTICA	IT
COMPAGNIE GL GEOPHYSIQUE	FR	SAN PAOLO IMI	IT
SUEZ	FR	TENARIS	IT
LAFARGE	FR	INDOSAT	ID
AXA	FR	TELKOM	ID
PECHINEY	FR	ICTL.HTLS.GP.	UK
PUBLICIS GROUPE	FR	IMPERIAL TOBACCO GP.	UK
RHODIA	FR	DR REDDYS LABS.	IN
AVENTIS	FR	HDFC BANK	IN
SCOR	FR	ICICI BANK	IN
SODEXHO ALLIANCE	FR	MAHANAGAR TEL.NIGAM	IN
STMICROELECTRONICS (PAR)	FR	SATYAM CMP.SVS.	IN
SANOFI-SYNTHELABO	FR	SILVERLINE TECHS.LTD.	IN
TOTAL SA	FR	VIDESH SANCHAR NIGAM	IN
TECHNIP	FR	WIPRO	IN
THOMSON	FR	INTERNATIONAL POWER	UK
VEOLIA ENVIRONNEMENT	FR	BLUE SQUARE ISR	IS
COCA-COLA HLC.BT.	GR	KOOR INDUSTRIES LTD	IS
NAT.BK.OF GREECE	GR	ADVANTEST	JP
OTE-HELLENIC TELC.	GR	CANON	JP
ASHANTI GOLDFIELDS	GH	HITACHI	JP

Table A2: List of Foreign Companies (cont.)

Company Name	*Country*	*Company Name*	*Country*
HONDA MOTOR	JP	BACHOCO UBL	MX
KONAMI	JP	CERAMIC ULD	MX
KUBOTA	JP	CEL 'V'	MX
MATSUSHITA ELEC.INDL.	JP	CEMEX CPO	MX
MITSUB.TOK.FINL.GP.	JP	COMERCI UBC	MX
NIDEC	JP	DESC 'C'	MX
NISSIN	JP	ELEKTRA	MX
NOMURA HDG.	JP	FEMSA.UBD	MX
NIPPON TELG. & TEL.	JP	CODUSA	MX
ORIX	JP	GRUMA 'B'	MX
PIONEER	JP	ICA	MX
SONY	JP	IMSA UBC	MX
TDK	JP	COCA-COLA FEMSA 'L'	MX
NTT DOCOMO INC	JP	SAVIA 'A'	MX
TOYOTA MOTOR	JP	TMM 'A'	MX
ALUM.CORP.OF CHINA 'H'	CH	MASECA 'B'	MX
APT SATELLITE HDG.	HK	RCENTRO 'A'	MX
ASIA SATELLITE TELECOM	HK	SAB	MX
SINOPEC BEJ YANHUA 'H'	CH	TLEVISA 'CPO'	MX
BRILLIANCE CHINA AUTV.HLDG.	HK	TELMEX 'L'	MX
CHINA EASTERN AIRL. 'H'	CH	TVAZTCA CPO	MX
SINOPEC CORP. 'H'	CH	VITRO 'A'	MX
CHINA MOBILE (HK) LTD.	HK	NORSK HYDRO	NW
CNOOC LTD.	HK	SMEDVIG A	NW
CHINA STHN.AIRL. 'H'	CH	SMEDVIG B	NW
CHINA TELECOM 'H'	CH	STATOIL	NW
GUANGSHEN RAILWAY 'H'	CH	NATIONAL GRID TRANSCO	UK
HUANENG PWR.INTL. 'H'	CH	HEAD NV	OE
JILIN CHEMICAL IND. 'H'	CH	TELEKOM AUSTRIA	OE
PETROCHINA CO. 'H'	CH	MMO2	UK
SINOPEC SHAI.PETROCHEM. 'H'	CH	BCP R	PT
PCCW LIMITED	HK	ELCTDAD.DE PORTL.	PT
CHINA UNICOM	HK	PT TELECOM SGPS	PT
YANZHOU COAL MINING 'H'	CH	BUENAVENTURA CAP	PE
KOREA ELECTRIC POWER	KO	TELF.DEL PERU 'B'	PE
KOOKMIN BK.	KO	PREMIER FARNELL	UK
KT CORPORATION	KO	PHILP.LONG DSN.TEL.	PH
POSCO	KO	PHILP.LONG DSN.TEL.	PH
SK TELECOM	KO	PRUDENTIAL	UK
LLOYDS TSB GP.	UK	PEARSON	UK
ESPIRITO SANTO	LX	ANGLOGOLD	SA
QUINSA PREF	LX	GOLD FIELDS	SA
STORA ENSO R	FN	HARMONY GOLD MINING	SA
METSO	FN	SAPPI	SA
NOKIA	FN	SASOL	SA
UPM-KYMMENE	FN	TELKOM	SA
MITCHELLS & BUTLERS	UK	REED ELSEVIER	UK
AMX 'L'	MX	RIO TINTO	UK
ASUR	MX	ROSTELECOM	RS

Table A2: List of Foreign Companies (cont.)

Company Name	***Country Mneumonic***	***Company Name***	***Country Mneumonic***
TATNEFT	RS	KINROSS GOLD CORPORATION	CA
VIMPELCOM	RS	ENERPLUS RESOURCES FUND	CA
ROYAL & SUN ALL.IN.	UK	CGI GROUP INC	CA
ABB LTD. R	SW	SHAW COMMUNICATIONS INC	CA
ADECCO R	SW	PRECISION DRILLING CORPORATION	CA
CENTERPULSE	SW	POTASH CORPORATION OF SASKATCHEWAN INC.	CA
CONVERIUM HOLDING R	SW	PETRO-CANADA	CA
CIBA SPLTY.CHEMS. R	SW	CAMECO CORPORATION	CA
CREDIT SUISSE R	SW	CHC HELICOPTER CORPORATION	CA
NOVARTIS R	SW	CANWEST GLOBAL COMMUNICATIONS CORP.	CA
SWISSCOM R	SW	PETROKAZAKHSTAN INCORPORATED (Hurricane)	CA
SERONO 'B'	SW	RITCHIE BROS AUCTIONEERS INC.	CA
SYNGENTA	SW	GILDAN ACTIVEWEAR INC.	CA
SHELL TRANSPORT & TRDG.	UK	NOVA CHEMICALS CORPORATION	CA
SMITH & NEPHEW	UK	CELESTICA INCORPORATED	CA
SPIRENT	UK	TELUS CORPORATION	CA
SCOTTISH POWER	UK	MASONITE INTERNATIONAL CORPORATION (Premdor)	CA
TURKCELL	TK	ROGERS COMMUNICATIONS INC	CA
TOMKINS	UK	TRANSALTA CORPORATION	CA
AU OPTRONICS	TA	MERIDIAN GOLD INC	CA
ADVD. SEMICON. ENGNR.	TA	CANADIAN NATIONAL RAILWAY COMPANY	CA
CHUNGHWA TELECOM	TA	ENBRIDGE INC	CA
TAIWAN SEMICON.MNFG.	TA	NORANDA INC	CA
UNITED MICRO ELTN.	TA	TRANSCANADA CORPORATION	CA
UNILEVER (UK)	UK	ABITIBI-CONSOLIDATED INC.	CA
UNITED UTILITIES	UK	DOMTAR INC.	CA
CANTV	VE	BCE INC	CA
VODAFONE GROUP	UK	ALCAN INC	CA
WOLSELEY	UK	PLACER DOME INC.	CA
FLETCHER CHAL.FOR.PREF.	NZ	NORTHGATE MINERALS CORPORATION	CA
FLETCH.CHAL.FORESTS	NZ	ENCANA CORPORATION	CA
ROYAL GROUP TECHNOLOGIES LIMITED	CA	IPSCO INC	CA
BIOVAIL CORPORATION	CA	NEXEN INC.	CA
CORUS ENTERTAINMENT INC	CA	FOUR SEASONS HOTELS INC	CA
SUNCOR ENERGY INCORPORATED	CA	NORTEL NETWORKS CORPORATION	CA
QUEBECOR WORLD INCORPORATED	CA	GOLDCORP INC.	CA
INTERTAPE POLYMER GROUP INCORPORATED	CA	TALISMAN ENERGY INC	CA
AGRIUM INCORPORATED	CA	BARRICK GOLD CORPORATION	CA

Table A2: List of Foreign Companies (cont.)

Company Name	***Country Mneumonic***
EXTENDICARE INC	CA
CANADIAN NATURAL RESOURCES LTD	CA
INCO	CA
ZARLINK SEMICONDUCTOR INC (Mitel)	CA
MAGNA INTERNATIONAL INC	CA
MDS INCORPORATED	CA
CANADIAN PACIFIC RAILWAY LIMITED	CA
FORDING CANADIAN COAL TRUST	CA
CP SHIPS LIMITED	CA
FAIRMONT HOTELS & RESORT INCORPORATED	CA
PENGROWTH ENERGY TRUST	CA

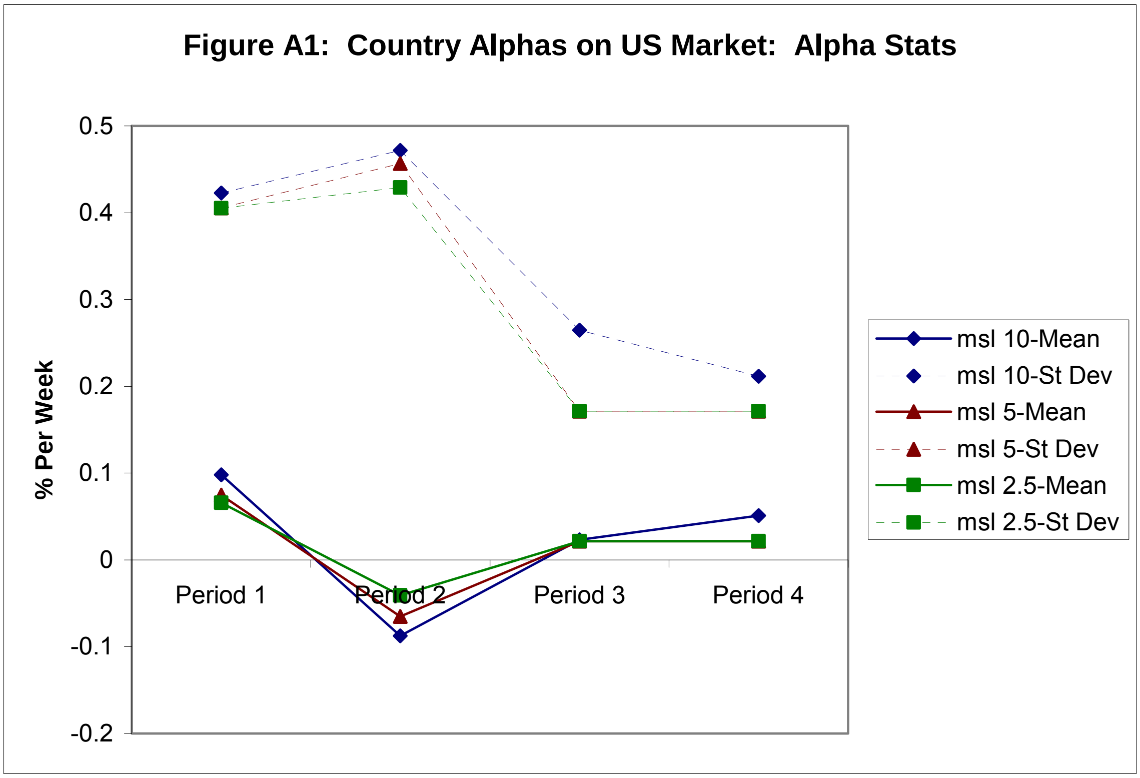


Figure A1: Country Alphas on US Market: Alpha Stats
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
% Per Week
Period 1
Period 2
Period 3
Period 4
msl 10-Mean
msl 10-St Dev
msl 5-Mean
msl 5-St Dev
msl 2.5-Mean
msl 2.5-St Dev

Appendix 2: Parameter Estimate - Implied Portfolio Model

The estimates of the model were used to evaluate the decision for a representative US investor who is deciding on how much to allocate into foreign stock portfolios.

Under the assumptions of i.i.d., an investor who maximizes expected returns subject to variance will choose to hold the tangency portfolio given by:

$$\varpi = V^{-1}E(\mathbf{r})/\iota' \, V^{-1}E(\mathbf{r})$$

where V is the variance-covariance matrix of returns and **r** is the column vector of portfolio returns.

Since I want to examine the pattern implied with parameters changing over time, I examine the conditional version given as:

$$\varpi_t = V_t^{-1}E_t(\mathbf{r}_{t+1})/\iota' \, V_t^{-1}E_t(\mathbf{r}_{t+1}) \qquad \text{(A1)}$$

Where *t* subscripts refer to the information set at time *t*. Thus, $E_t(\mathbf{r}_{t+1})$ is the conditional expectation at time *t* of the return vector realization at *t+1* and V_t is the variance-covariance matrix of returns. The minimum variance point for this set of portfolios is given by equation (11) in the text.

This appendix describes the details of construction of these moments in the following cases: (a) the two-asset model in Section 1, (b) the three asset model in Section 2, and (c) the Monte Carlo simulation that provides the confidence intervals for the model.

(a) *Two Asset Model*

For the two asset model, the investor chooses between a market-weighted portfolio of foreign market indices and the US market. In this case,

$$\mathbf{r}_t \equiv \left[r_t^F, r_t^w\right] \equiv \left[\mathbf{X}_t{}'\mathbf{r}_t^{\ell}, r_t^w\right] \qquad \text{(A2)}$$

Where $\mathbf{r}_t^{\ell}$ is an L x 1 vector of the foreign market index returns at time t, $\mathbf{X}_t$ is an L x 1 vector of the market weights of the stock market indices in the foreign market portfolio at time t. Note that the returns for each component of r^{ℓ}_t are given by the process in equation (3) of the text. This can be rewritten as:

$r^{\ell}_t = I(T_\tau)[\alpha^{\ell} + \beta^{\ell} r^w_t + u^{\ell}_{,t}]$, for $\ell = 1, \ldots, L$, $\tau = 1, \ldots, m+1$ (3)

where $I(T_\tau)$ is an indicator function that time is within a set of time intervals T_τ for $\tau = 1, \ldots, m+1$. For notational convenience, I hereafter redefine the parameter vector generally as: $\delta_t = \{\delta_\tau \mid t = I^{-1}(T_\tau); \tau = 1,\ldots,m+1\}$ (A3)

Thus, δ_t represents the mapping of the set of parameters within their time subsets T_τ into the time domain t.

Then the means and variances of the portfolio vector are given by:

$$E(\mathbf{r}_t) = [\mathbf{X}_t\,'(\boldsymbol{\alpha}^{\ell}_t + \boldsymbol{\beta}^{\ell}_t E(r^w_t)), E(r^w_t)]' \qquad \text{(A4)}$$

And

$$\mathbf{V}_t = \begin{pmatrix} \sigma^2_w \mathbf{X}_t\,'\boldsymbol{\beta}^{\ell}_t \boldsymbol{\beta}^{\ell}_t\,'\mathbf{X}_t + \mathbf{X}_t\,'\mathbf{U}_t\mathbf{X}_t & \sigma^2_w \mathbf{X}_t\,'\boldsymbol{\beta}^{\ell}_t \\ \sigma^2_w \mathbf{X}_t\,'\boldsymbol{\beta}^{\ell}_t & \sigma^2_w \end{pmatrix} \qquad \text{(A5)}$$

Where α^{ℓ}_t and β^{ℓ}_t are the L x 1 vectors of parameters α^{ℓ}_t and β^{ℓ}_t, respectively, for $\ell = 1, \ldots, L$; $\mathbf{U}_t \equiv E_t(\mathbf{u}_t\mathbf{u}_t\,')$ for $\mathbf{u}_t \equiv [u^1_t, \ldots, u^L_t]'$, the cross-country variance-covariance matrix; and $\sigma^2_w \equiv E(u^{w2}_t)$. The calibration model assumes that the residuals to the processes are conditionally homoskedastic in the time domain, though not in the cross-section. Therefore, the calibration model treats the portfolio variance as changing over time in response to the evolution of the parameters δ and X. However, these assumptions are not imposed on the estimation results described in the text. Note that in the off-diagonal terms in (A5), we have used the fact that: $E(\mathbf{u}_t u^w_t) = 0$ by construction in estimating equation (3).

I then use the estimates from the model for each year to calculate the means in (A4) and the variances in (A5) to form the tangency portfolio in (A1). The portfolios are created for each year at the end of the year for the following year for the minimum variance case where $E(r^w) = E(r^F)$. The results are plotted in Figure 5 in the text.

(b) ***Three Asset Model***

For the three asset model, the investor chooses between a market-weighted portfolio of foreign stocks traded in the US, the portfolio of foreign market indices, and the US market. In this case, I redefine the return vector to be:

$$\mathbf{r}_t \equiv \left[r_t^S, r_t^F, r_t^w \right] \equiv \left[\mathbf{Z_t}'\mathbf{r_t^i}, \mathbf{X}_t'\mathbf{r}_t^\ell, r_t^w \right] \qquad \text{(A2')}$$

Where $\mathbf{r}_t^i$ is an N x 1 vector of foreign stock returns for companies listed in the US at time t, $\mathbf{Z_t}$ is an N x 1 vector of the market weights of the foreign stocks in the foreign stock portfolio at time t.

Note that the returns for each component of $\mathrm{r}_t^{i,\ell}$ are given by the process in equation (14) of the text, rewritten here as:

$$\begin{aligned} \mathrm{r}_t^{i\ell} &= \Xi(\kappa_\varsigma)[\ \alpha_\varsigma^{i\ell} + \beta_\varsigma^{i\ell}\ \mathrm{r}_t^\ell\ + \beta_\varsigma^{iw}\ \mathrm{r}_t^{w} + \mathrm{e}_{\varsigma,t}^{i\ell}], \qquad \text{for } i = 1, ..., N;\ \varsigma = 1, ..., n^i + 1 \\ &= \mathrm{a}_t^{i\ell}\ + b_t^{i\ell}\mathrm{r}_t^{w}\ + \varepsilon_t^{i\ell} \end{aligned}$$

where

$$\begin{aligned} \mathrm{a}_t^{i\ell} &\equiv \alpha^{i\ell} + \beta^{i\ell}\alpha_\tau^\ell \\ b_t^{i\ell} &\equiv \beta^{i\ell}\ \beta_\tau^\ell + \beta^{iw} \\ \varepsilon_t^{i\ell} &\equiv \beta^{i\ell}\ \mathrm{u}_{\tau,t}^\ell\ +\ \mathrm{e}_t^{i\ell} \end{aligned}$$

And where $\Xi(\kappa_\varsigma)$ is an indicator function for the event that time t is within a set of time intervals κ_ς for ς = 1, …, n+1. I now redefine the parameter vector to map the set of parameter vectors in both time subsets T_τ and κ_ς into parameters at each date t. Thus, δ_t represents the mapping of parameters for countries within their time subsets T_τ into the time domain t and for stocks within their time subsets κ_ς.

Then the mean of the portfolio vector is given by:

$$E(\mathbf{r}_t) = [\mathbf{Z}_t'(\boldsymbol{\alpha}_t^i + \mathbf{b_t^w}E(r_t^w)), \mathbf{X}_t'(\boldsymbol{\alpha}_t^\ell + \boldsymbol{\beta}_t^\ell E(r_t^w)), E(r_t^w)]' \qquad \text{(A4')}$$

Where $\boldsymbol{\alpha}_t^i$ and $\mathbf{b}_t^w$ are the N x 1 vectors of parameters with typical component, $\mathrm{a}_t^{i\ell}$, and $b_t^{i\ell}$, respectively, for i = 1, …, N. Then the variance of the three-asset version of the model can be written:

$$
\mathbf{V}_t = \begin{pmatrix} \sigma_w^2 \mathbf{Z}_t\, '\mathbf{b}_t^w \mathbf{b}_t^w\, '\mathbf{Z}_t + \mathbf{Z}_t\, '\boldsymbol{\beta}_t^i \mathbf{U}_t \boldsymbol{\beta}_t^i\, '\mathbf{Z}_t + \mathbf{Z}_t\, '\Omega \mathbf{Z}_t & \sigma_w^2 \mathbf{Z}_t\, '\mathbf{b}_t^w \boldsymbol{\beta}_t^\ell\, '\mathbf{X}_t + \mathbf{Z}_t\, '\boldsymbol{\beta}_t^i \mathbf{U}_t \mathbf{X}_t & \sigma_w^2 \mathbf{Z}_t' \mathbf{b}_t^w \\ \sigma_w^2 \mathbf{Z}_t\, '\mathbf{b}_t^w \boldsymbol{\beta}_t^\ell\, '\mathbf{X}_t + \mathbf{Z}_t\, '\boldsymbol{\beta}_t^i \mathbf{U}_t \mathbf{X}_t & \sigma_w^2 \mathbf{X}_t\, '\boldsymbol{\beta}_t^\ell \boldsymbol{\beta}_t^\ell\, '\mathbf{X}_t + \mathbf{X}_t\, '\mathbf{U}_t \mathbf{X}_t & \sigma_w^2 \mathbf{X}_t\, '\boldsymbol{\beta}_t^\ell \\ \sigma_w^2 \mathbf{Z}_t\, '\mathbf{b}_t^w & \sigma_w^2 \mathbf{X}_t\, '\boldsymbol{\beta}_t^\ell & \sigma_w^2 \end{pmatrix}
$$

(A5')

Where $\Omega \equiv E(\mathbf{e_t e_t}')$ for $\mathbf{e}_t \equiv [\mathrm{e}_t^{1,\ell}, \ldots, \mathrm{e}_t^{N,\ell}]'$ and where I have used the fact that $E(\mathbf{e_t} r_t^w) = 0$ by construction in estimation of equation (14). Note that the lower right-hand corner submatrix of (A5') is the same as the covariance matrix in the two asset model given in (A5).

I then use the estimates from the model for each year to calculate the expected return vector in (A4') and the conditional variances in (A5') to form the tangency portfolio in (A1). The portfolios are created for each year at the end of the year for the following year. The results are plotted in Figures 8, 9 and 10 in the text.

(c) ***Monte Carlo Simulations to Generate Confidence Intervals***

To examine the confidence intervals of the calibration model, I used the model above together with the distributions of the parameters. In particular, I used the distribution from the joint distribution of the parameters given by the variation in the conditional mean vector in (A4') and in the conditional variance matrix in (A5'). The simulation is conducted for each year in the following steps:

<u>Step 1:</u> For each year, I form the market weights, $\mathbf{Z_t}$ and $\mathbf{X}_t$, and form the implied mean and variance-covariance matrix.

<u>Step 2:</u> I then use this mean and variance-covariance of the parameter estimates to generate a realization of the parameter vector: $\{\boldsymbol{\alpha}_t^i, \boldsymbol{\beta}_t^w, \alpha_t^{i,\ell}, \beta_t^{i,w}, \beta^{i\ell}{}_t\}$.

<u>Step 3:</u> Given these generated parameters, I reconstruct the conditional means and variances in (A4') and (A5') and then form the implied tangency portfolio.

<u>Step 4:</u> Steps 1 to 3 are repeated 10,000 times. The 5% and 95% ordinates from the frequency distribution are retrieved and saved.

These steps are repeated for each year from 1970 to 2004.

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