Appendices for "Do Foreign Firm Betas Change During Cross-listing?"

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Abstract

These appendices discuss four main aspects of the analysis in the paper. First, Appendix A describes the data. Second, Appendix B compares the break-date results to liberalization date findings in the literature. Third, Appendix C reports results broken down by geographical reason. And finally, Appendix D explains in detail the Monte Carlo experiments reported in Section 3 of the paper.

On-line Appendices

Appendix A: Data Description

The data for the individual company stock returns were collected and cross-checked from the websites of the NYSE and NASDAQ and three ADR custodian depositaries: JP Morgan, Citibank, and Bank of New York. Using these sources, I selected all companies that were trading on NYSE and NASDAQ in July 2004. For non-Canadian companies, the data were collected in the following steps. In the first step, a data set of all foreign companies with stocks listed on the New York Stock Exchange 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. In the second step, the company stock returns in the home market and market values for the full available history were collected from Datastream.Canadian companies trade directly on US exchanges without ADR registration. As such, these companies are not listed on custodian bank ADR directories. Instead, I used the Canadian companies on the U.S. exchanges from Doidge, Karolyi, and Stulz (2004,2005).[1]

I then extracted the weekly Total Return Index series for each company from January 1970 to October 2009. Companies with less than 60 observations were excluded. For each of these companies, I compiled the Data Stream market return index from their home market. Table 1 in the text reports these countries. To calculate excess returns, the weekly T-bill rate from Ken French's data set was subtracted from each stock return.

Appendix B: Comparison on Market Index Returns to Bekaert-Harvey-Lumsdaine

In Table 3 and Figure 3a of the text, I report break-tests of country market indices against the US market index returns. Similarly, Bekaert, Harvey, and Lumsdaine (2002) BHL estimate break

[1] I thank Andrew Karolyi for providing these names and mneumonics for the Canadian companies.

tests for market return indices. However, the purpose of the BHL study is to date endogenous liberalization break dates in aggregate macro-level time series. As such their focus is different from the analysis in this paper. Nevertheless, I examined the relationship between the two sets of studies as a robustness check.

Table A.1 summarizes the break dates estimates from the BHL study in the first two columns. BHL consider both a break in the mean in column A and a break in all the parameters in column B. Since the question addressed by BHL concerns liberalization, they study emerging markets exclusively. On the other hand, in this paper I examine emerging markets only to the extent that they have stocks listed in the US. As a result, the set of countries we have in common with BHL is a smaller set of 14 countries.

Another difference between our studies is that BHL has a different sample period. While Bekaert and Harvey (2000) report that the samples differ by country, the maximum possible sample period for any country is from January 1976 to December 1995. By contrast, my inclusion of countries depends upon whether a company from the home country is represented on the US exchange. The third column summarizes the maximum number of overlapping years in the two studies. These range from 1.5 for Brazil to 23 years for Mexico and Venezuela.

The break date estimates using the sup(F) tests are reported in the last six columns for the case where the minimum subsample partition allowed is 15% and 5% of the sample, respectively. Several interesting features arise from the comparison. First, and least surprisingly, for the countries where there is little overlap in sample periods, the estimated breakdates with the sup(F) tests occur later than the BHL estimates. For example, the median BHL estimates for breaks in Argentina and Brazil occur in the mid to late 1980s, though these estimates are not significant. On the other hand, using the later sample, I find strong evidence of breaks in 1999 and 2002, closer to the Argentine and Brazilian crises periods. Second, for some countries where BHL found strong evidence of breaks before our sample, I do not find evidence of later breaks. For example, BHL estimate break dates for the Philippines and Indonesia in 1987 and 1991, respectively, but with my later samples, I find no evidence of further breaks. Third, to allow for the possibility that the minimum subsample restriction is binding for some of our countries with shorter samples, I also estimate the model allowing for a shorter restriction of 5% of the sample. For Brazil, Chile, Turkey, and Taiwan, I do indeed find evidence of finer sample partitions. Finally, for some countries when we have a similar sample period, our estimated break dates are relatively close. For example, for Venezuela, both BHL and our estimates suggest a break in the early 1990s.

Overall, while our sample periods and independent variables differ from BHL, our qualitative results are similar where they overlap.

0.1 Appendix C: Beta Estimates by Geographic Area

Table 6 reports summary statistics of the distribution of betas for market-weighted and equally-weighted portfolios of countries and companies. In this appendix, I show these same results decomposed into Emerging Markets and Developed Markets as well as continents.

Table A.2 reports the statistics for the country level betas. Panel A shows the 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 and correlations with the US to rise over time can be seen in both portfolios. Panel B details the breakdown of portfolios by regions. In every case, the beta means and correlations increase between periods 1 and 2. In some cases, there is a reversion to a lower beta in the third period but these are based upon sample sizes of two or even one country.

Table A.3 provides the same information for company level betas on their home markets. Panel A demonstrates that the pattern noted in Table 6 is robust across companies coming from emerging and developed markets. Moreover, the correlation between the returns and the home market appears to be relatively stable over the subperiods. Panel B further breaks the information down into geographic regions, conveying some interesting distinctions across these areas. Generally, the companies from Asia and the Middle East & Africa tend to have lower betas with their home markets at around 0.3, while the companies from other areas have betas on their home markets closer to one.Insert for companies

By contrast, Table A.4 reports the US market beta statistics for portfolios decomposed into geographic area. For all of the geographic areas, the market-weighted betas of company returns against the US increase between the first and last period. Furthermore, the mean correlation of these stock returns with the US market increases as well, even for companies from developed countries. For example, the correlation between European cross-listed stocks and the US is on-average just 0.16 in period 1, but increases to 0.24 in period 2, 0.27 in period 3 and finally 0.34 in period 4.

Overall, these results suggest that the relationships found in the text hold for more disaggregated portfolios. The beta of foreign markets on the US has increased towards one and the correlations have also trended upward.

Appendix D: Minimum Variance Portfolio Model

In the text, I reported on Monte Carlo analysis that provided a robustness check on the estimated parameters. This analysis, depicted in Figure 4b, suggested that international diversification is diminishing, consistent with the literature.[2] In this appendix, I describe the details behind this analysis For this analysis, 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.

[2] See, for instance, Christoffersen et al (2012) and Liu (forthcoming).

Under the assumptions of i.i.d., an investor who minimizes the variance of expected returns will choose to hold the minimum variance portfolio given by equation:[3]

$$\omega_t = \frac{V_t^{-1}\iota}{\iota' V_t^{-1}\iota} \tag{A1}$$

where V is the conditional variance-covariance matrix of returns, ι is a vector of ones, and t subscripts refer to the information set at time t. I next describe the calculations for the moments in the three asset portfolio described in the text. I also analyzed a two asset portfolio menu in which investors could only choose the U.S. market and a market-weighted portfolio of foreign cross-listed stocks. The conclusion that the parameter estimates reported in the text provide diminishing international diversification was similar.

0.1.1 Portfolio Construction

For the three asset model, the investor chooses between the US market, a market-weighted portfolio of foreign stocks traded in the US, and the portfolio of foreign market indices, and with returns defined, respectively, as $\left[r_t^u, r_t^F, r_t^L\right]$. In this case, the return vector is given by:

$$\mathbf{r}_t^p \equiv \left[r_t^u, r_t^F, r_t^L\right] = \left[r_t^u, \mathbf{Z}_t'\mathbf{r}_t^i, \mathbf{X}_t'\mathbf{r}_t^\ell\right] \tag{A2'}$$

Where $\mathbf{r}_t^i$ is an $N \times 1$ vector of the cross-listed foreign company returns at time t, $\mathbf{Z}_t$ is an $N \times 1$ vector of the shares of market weights of the foreign stocks as a proportion of the market weight of all the foreign stocks in the portfolio at time t., $\mathbf{r}_t^\ell$ is an $L \times 1$ vector of foreign market returns at time t, and $\mathbf{X}_t$ is an $L \times 1$ vector of the market weights of the foreign market indices as a proportion of the total set of foreign market indices with home companies listed in the US.

[3] See, for example, Campbell, Lo, and MacKinlay (1997) for a derivation.

Then the variance of the three-asset version of the model can be written:

$$V_t = \begin{bmatrix} \sigma_U^2 & \sigma_U^2 \mathbf{Z}_t' \mathbf{b}_t^U & \sigma_U^2 \mathbf{X}_t' \widehat{\boldsymbol{\beta}}_t^L \\ \sigma_U^2 \mathbf{Z}_t' \mathbf{b}_t^U & \sigma_U^2 \mathbf{Z}_t' \mathbf{b}_t^u \mathbf{b}_t^{u\prime} \mathbf{Z}_t + \left(\mathbf{Z}_t \cdot \widetilde{\boldsymbol{\beta}}_t^L\right)' \ \Gamma_t \ \left(\mathbf{Z}_t \cdot \widetilde{\boldsymbol{\beta}}_t^L\right) + \mathbf{Z}_t' \ \Omega_t \ \mathbf{Z}_t & \sigma_U^2 \mathbf{Z}_t' \mathbf{b}_t^u \widehat{\boldsymbol{\beta}}_t^{L\prime} \mathbf{X}_t + \left(\mathbf{Z}_t \cdot \widetilde{\boldsymbol{\beta}}_t^\ell\right) {}' \widehat{\widetilde{\Gamma}}_t \mathbf{X}_t \\ \sigma_U^2 \mathbf{X}_t' \widehat{\boldsymbol{\beta}}_t^L & \sigma_U^2 \mathbf{Z}_t' \mathbf{b}_t^u \widehat{\boldsymbol{\beta}}_t^{L\prime} \mathbf{X}_t + \left(\mathbf{Z}_t \cdot \widetilde{\boldsymbol{\beta}}_t^\ell\right) {}' \widehat{\widetilde{\Gamma}}_t \mathbf{X}_t & \sigma_U^2 \mathbf{X}_t{}' \ \widehat{\boldsymbol{\beta}}_t^L \widehat{\boldsymbol{\beta}}_t^L \ {}'\mathbf{X}_t + X_t' \ \widehat{\Gamma}_t X_t \end{bmatrix}$$

Where $\mathbf{b}_t^U$ is the $N \times 1$ parameter vector with typical element $b_t^{i\ell}$ and $\boldsymbol{\beta}_t^L$ is the $N \times 1$ parameter vector of country market loadings, $\widetilde{\boldsymbol{\beta}}_t^L$, and where $\cdot$ in the operation $\mathbf{Z}_t \cdot \widetilde{\boldsymbol{\beta}}_t^L$ indicates element by element multiplication. Also, this variance-covariance matrix depends upon the $L \times L$ variance-covariance matrix of country residuals $\widehat{\Gamma}_t \equiv E_t\left(\mathbf{u}_t \mathbf{u}_t'\right)$ where $\mathbf{u}_t$ is the $L \times 1$ vector of residuals to each company's home market regression on the US market and the $N \times L$ covariance matrix of country residuals $\widetilde{\Gamma}_t \equiv E_t\left(\widetilde{\mathbf{u}}_t \mathbf{u}_t'\right)$and the $L \times 1$ vector of country betas, $\widetilde{\boldsymbol{\beta}}_t^\ell$.. Furthermore, the company residual variance-covariance matrix is given by: $\Omega_t = E_t\left(\mathbf{e}_t \mathbf{e}_t'\right)$= for $\mathbf{e}_t$ the vector of company return residuals, with typical element, $e_{\tau,t}^{i\ell}$. Similarly, the country residual variance-covariance matrix arrayed by each firm's home country is given by the $L \times L$ matrix: $\widetilde{\Gamma}_t \equiv E_t\left(\mathbf{u}_t \mathbf{u}_t'\right)$ where $\mathbf{u}_t$ is the $L \times 1$ vector of residuals to each company's home market regression on the US market .

In estimating the parameters and variances of the model, I did not assume homoskedasticity of the residuals. However, for the portfolio model, I assume that the agent assume variances will be constant over the next year. Moroever, the model treats the portfolio variance as changing over time in response to the evolution of the parameters δ and weights Z. Note that in the off-diagonal terms in (A6), I have used the fact that: $E_t\left(\mathbf{u}_t r_t^u\right) = 0$ by construction.

I then calculate this variance-covariance matrix each year using the new parameter estimates and residuals to construct the portfolios using the minimum variance portfolio allocation equation (A1).

0.1.2 Residual Estimates and Results

Figure 4a in the text plots the parameter estimates used to determine the portfolio allocation assuming investors have access to the foreign company investments as soon as they are listed in local markets. As noted above, changes in the US returns affect foreign companies according to their factor loadings: $b^{iu} \equiv \beta^{i\ell}\beta^{\ell} + \beta^{iu}$ where β^{iu} is the beta of each foreign company on its local market, β^{ℓ} is the beta of the home market return on the US market, and β^{iu} is the beta of the foreign company on the US market. Figure A1 depicts the residual variance for both the foreign country market returns r^L and the foreign company returns r^F. The perceived residual variances for both portfolios increase sharply in the wake of the 1987 crash and then decline through the late 1990s.

The bottom panel of Figure A1 also demonstrates the trend toward inclusion of foreign markets and foreign stocks based solely on availability of those stocks in local markets. The proportion of foreign companies that is available in the US by 2004 become available in their local markets rather gradually. For the 1970s and 1980s, only about 20 to 30% of these stocks are included in the foreign company portfolio returns, r^F. However, in the 1990s, the dimension of this portfolio increases quickly so that by 2000, almost 100% of the foreign companies are included. The country representation of these stocks follows a more accelerated pace. By 1989, about 50% of the countries are represented by companies that are accessible in the US. But this proportion increases dramatically so that by 1995 almost 100% of the countries with listings by 2004 are included.

0.2 Alternative Specifications

In this appendix, I describe the effects of allowing for alternative specifications of the basic equations studied in the text. I consider these extensions along several dimensions: (1) more frequent changes; (2) industry risk; and (3) more gradual parameter shifts.

0.2.1 More frequent parameter changes

So far, I have allowed for breaks that partition subsamples into no less than 15% of the sample, according to the "trimming" parameter ε defined by Bai and Perron (2003a,b). As described earlier, I took this approach because finer partitions of the sample can potentially lead to finding too many breaks. Moreover, this minimum subsample was found to be most reliable in their Monte Carlo tests.

The recent financial crisis may create a problem with using a higher trimming parameter, ε, however. If stock returns become more correlated at the time of a crisis as argued by Longin and Solnik (2001), then the crisis may have generated a break in parameters nearer 2007. However, if 15% of the sample is 5 years as it would be for a series beginning in about 1980, the break would show up in the estimates around 2002. If so, our analysis would be biased toward earlier break date estimation and may therefore affect the portfolio allocation decisions described earlier.

To address this issue, I estimated all parameters and break dates assuming a finer trimming parameter of $\varepsilon = 5\%$ of the sample. Consistent with expectations based upon a finer trimming parameter, I found slightly more breaks with the last break date moving later than 2004.

To examine the implications of these estimates, I recalculated the portfolio analysis for the typical US investor. In general, the results are quite similar except that the shift toward higher betas occurs later in the 2000s. As a result, the variance reduction attainable from shorting foreign stocks occurs further into the financial crisis and the diversification gains are attenuated. However, the pattern of allocation into foreign stocks are very similar over time to those shown in Figure 4B. When the trimming parameter is 5% of the sample, the minimum variance investor tends to hold slightly less foreign company stocks than for the 15% case. For most of the period, the allocations do not imply much differentiation in variance reduction.

Overall, the evidence here suggest that the results are robust to allowing for more frequent breaks. While the dating of the breaks at the end of the sample must be viewed with caution, the overall implications for pattern of variance reduction are similar.

0.2.2 Industry risk factors

The analysis in the text focuses upon a two factor model of world and local effects. However, the estimated residual risk may be driven by omitted variables that could affect the shifts in parameters over time. In particular, Bekaert, Hodrick and Zhang (2009) have found that multiple factors are needed to explain international stock returns more generally. Also, Brooks and Del Negro (2005) and Carrieri, Errunza, and Sarkissian (2006) have shown that industry risks are important in explaining in international stock returns.

To examine the effects of industry risk, I augmented the foreign stock level relationship to include an industry factor captured by the return on a market-weighted portfolio of firms within the industry. I then tested this model for breaks using the industry portfolios for each of the foreign stocks through 2004 (not shown). I found that the pattern for the number of breaks is roughly the same as in the two factor model. Moreover, while the timing of breaks differ somewhat, the implications for diversification are similar to the base model. The residual variances differ between the two factor and three factor model during the early period before 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 the post 1988 sample.

Overall, therefore, the general qualitative results for our base two factor framework appear robust to the inclusion of industry effects.

0.2.3 Gradual parameter shifts

The analysis reported in the text estimates a model with discrete shifts in the parameters. The strongest evidence in breaks occurred at the country level and these breaks were used to condition possible foreign stock market breaks. 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 are more gradual, perhaps evolving over time until the changes are picked up by the filter as a shift.

Although the break-date approach in this paper can encompass more gradual changes, the portfolio allocation thought experiment treated the changes as discrete within a year window. This restriction raises the question of whether the timing of shifts will be shifted forward or later. To consider this possibility, I examined 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. I estimated this model for the country returns through 2004 for the local market model and found that the standard errors of the breaks were generally wider than the abrupt break model (not shown). However, most of the estimated breaks with the based model occur within the confidence interval of the gradual break model. The results suggest that a more gradual adjustment model would imply similar timing to our base model.

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Table A.1: Comparison of Emerging Market Break Points

Table compares the results from the text with those of Bekaert, Harvey, and Lumsdaine (2002) for the countries in common. The reported Bekaert, Harvey, and Lumsdaine (2002) results are from their Table 2 for A. Mean break and B. All parameter break. The sample period for BHL differs by country, but they report the maximum sample period in Bekaert and Harvey (2000), Table II. *,**,*** indicate significance levels of 10%, 5%, and 1%, respectively. # note that the ending date for all countries is October 2009.

	BHL Median Estimates : Max Sample Period Jan-76 to Dec-95		Sup(F) Break-Point Estimates:						
	A. Mean break	B. All parameters break	Sample Start Date[#] *Maximum Overlap in Years*	Min Subsample: ε=15%			Min Subsample: ε=5%		
Country	*Median*	*Median*		*Break 1*	*Break 2*	*Break 3*	*Break 1*	*Break 2*	*Break 3*
Argentina	Jun-85	Jul-89	Aug-93 *2.4*	Jan-99***			Jan-99**		
Brazil	Sep-83	Sep-83	Jul–94 *1.5*	Oct-02***			Oct-02***	Dec-08**	
Chile	Jul-80**	Nov-79***	Jul-89 *6.4*	Jan-94***	Mar-03***	Jan-99*	Jan-91***	Mar-03***	
Colombia	Apr-94	Feb-92**	Mar-92 *3.8*	Oct-03***			Oct-03***		
Greece	Nov-85*	Aug-90*	Jan-90 *6.0*	Feb-06***			Feb-06***		
India	Apr-92	Jun-90	Jan-90 *6.0*	Apr-00***			Apr-00***		
Indonesia	Nov-91**	Nov-91**	Jan-90 *6.0*						
Korea	Apr-89	Apr-89	Sep-87 *8.3*	Sep-97***			Sep-97***		
Mexico	Jan-83	Oct-87***	Jan-73 *23.0*	Nov-04***			Nov-04***		
Philippines	Aug-87***	Aug-87***	Jan-90 *6.0*						
Portugal	Feb-88***	Jan-88***	Jun-94 *1.6*	Nov-05***			Nov-05***		
Taiwan	Jun-89	Jun-89	Jan-90 *6.0*	Sep-01***			May-90***	Jun-91***	Sep-01**
Turkey	Aug-90	Aug-90	Aug-93 *2.4*	Oct-00***			Oct-00***	Feb-02**	Mar-03**
Venezuela	Feb-92	Feb-92**	Jan-73 *23*	Feb-94*	Sep-98*		Dec-90***		

Table A.2 Foreign Market Beta Summary Statistics

Estimate means, standard error means, and cross-sectional standard deviations for various market portfolios in the regression: $r_t^\ell = \alpha^\ell + \beta^\ell r_t^u + u_t^\ell$ where r_t^ℓ is the excess return of country ℓ's equity return, r_t^u 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	**Estimate**	**Period 1** ($\tau = 1$)	**Period 2** ($\tau = 2$)	**Period 3** ($\tau = 3$)	**Period 4** ($\tau = 4$)
Panel A: Market Weighted Developed Vs. Emerging					
	β^ℓ Mean	0.325	0.785	0.903	1.138
Market	Std Err Mean	0.041	0.044	0.035	0.037
Weighted	$Corr(r^\ell, r^u)$	0.195	0.361	0.474	0.479
	β^ℓ St Dev	0.171	0.272	0.167	0.000
	No. of Obs	21	21	5	1
	β^ℓ Mean	0.453	0.928	0.657	0.807
Equally	Std Err Mean	0.074	0.085	0.064	0.057
Weighted	$Corr(r^\ell, r^u)$	0.208	0.309	0.223	0.384

Table A.2 Foreign Market Beta Summary Statistics (cont.)

Portfolio	**Estimate**	**Period 1** ($\tau = 1$)	**Period 2** ($\tau = 2$)	**Period 3** ($\tau = 3$)	**Period 4** ($\tau = 4$)
Panel B: Market Weighted by Region					
Asia	β^ℓ Mean	0.230	0.505	0.258	n/a
	Std Err Mean	0.063	0.045	0.055	n/a
	$Corr(r^\ell, r^u)$	0.104	0.285	0.127	n/a
	β^ℓ St Dev	0.267	0.221	0.000	n/a
	No. of Obs	11	6	1	n/a
Europe	β^ℓ Mean	0.380	0.894	1.028	n/a
	Std Err Mean	0.036	0.047	0.041	n/a
	$Corr(r^\ell, r^u)$	0.247	0.393	0.503	n/a
	β^ℓ St Dev	0.174	0.294	0.052	n/a
	No. of Obs	18	18	4	n/a
Middle East & Africa	β^ℓ Mean	0.334	0.788	1.119	n/a
	Std Err Mean	0.065	0.082	0.073	n/a
	$Corr(r^\ell, r^u)$	0.174	0.220	0.323	n/a
	β^ℓ St Dev	0.245	0.422	0.000	n/a
	No. of Obs	3	2	1	n/a
North America	β^ℓ Mean	0.607	0.975	0.693	1.138
	Std Err Mean	0.043	0.051	0.025	0.037
	$Corr(r^\ell, r^u)$	0.239	0.323	0.424	0.479
	β^ℓ St Dev	0.178	0.284	0.000	0.000
	No. of Obs	2	2	1	1
Oceania	β^ℓ Mean	0.399	1.107	n/a	n/a
	Std Err Mean	0.032	0.058	n/a	n/a
	$Corr(r^\ell, r^u)$	0.260	0.388	n/a	n/a
	β^ℓ St Dev	0.047	0.211	n/a	n/a
	No. of Obs	2	2	n/a	n/a
South America	β^ℓ Mean	0.578	1.166	0.377	0.807
	Std Err Mean	0.087	0.083	0.060	0.057
	$Corr(r^\ell, r^u)$	0.203	0.404	0.176	0.384
	β^ℓ St Dev	0.412	0.509	0.160	0.000
	No. of Obs	6	5	2	1

Table A.3 Foreign Company Local Beta Estimates

Local market beta $\left(\beta^{i\ell}\right)$ estimate means, standard error means, and cross-sectional standard deviations for various market portfolios in the two equation system regressions: (i) $r_t^\ell = \alpha^\ell + \beta^\ell r_t^u + u_t^\ell$; and (ii) $r_t^{i\ell} = \alpha^{i\ell} + \beta^{i\ell} r_t^\ell + \beta^{iu} r_t^u + e_t^{i\ell}$ where r_t^ℓ,r_t^u, and $r_t^{i\ell}$ are the excess returns of the local market, US market, and firm i from country ℓ, respectively, and where $\left\{\alpha^\ell, \beta^\ell, \alpha^{i\ell}, \beta^{i\ell}, \beta^{iu}\right\}$ are parameters for country ℓ and firm i.

Portfolio	**Estimate**	**Period 1**[a] ($\tau = 1$)	**Period 2** ($\tau = 2$)	**Period 3** ($\tau = 3$)	**Period 4** ($\tau = 4$)
Panel A: Market Weighted Developed Vs. Emerging					
Market Weighted	$\beta^{i\ell}$ Mean	0.697	0.781	0.892	0.934
	Std Err Mean	0.123	0.143	0.095	0.082
	$Corr(r^\ell, r^u)$	0.236	0.191	0.214	0.238
	$\beta^{i\ell}$ St Dev	0.515	0.637	0.612	0.491
	No. of Obs	386	303	165	37
Equally Weighted	$\beta^{i\ell}$ Mean	0.334	0.471	0.648	0.554
	Std Err Mean	0.079	0.091	0.087	0.076
	$Corr(r^\ell, r^u)$	0.110	0.134	0.195	0.174
	$\beta^{i\ell}$ St Dev	0.533	0.677	0.534	0.389
	No. of Obs	166	119	53	15

Table A.3 Foreign Company Local Beta Estimates (cont.)

Portfolio	Estimate	Period 1 ($\tau = 1$)	Period 2 ($\tau = 2$)	Period 3 ($\tau = 3$)	Period 4 ($\tau = 4$)
Panel B: Market Weighted by Region					
Asia	$\beta^{i\ell}$ Mean	0.260	0.315	0.366	0.843
	Std Err Mean	0.076	0.081	0.074	0.054
	$Corr(r^\ell, r^u)$	0.072	0.076	0.117	0.313
	$\beta^{i\ell}$ St Dev	0.544	0.774	0.586	0.534
	No. of Obs	94	63	30	8
Europe	β^{ℓ} Mean	0.734	0.850	0.948	0.966
	Std Err Mean	0.134	0.160	0.098	0.085
	$Corr(r^\ell, r^u)$	0.261	0.209	0.218	0.233
	$\beta^{i\ell}$ St Dev	0.518	0.643	0.624	0.559
	No. of Obs	217	173	92	23
Middle East & Africa	$\beta^{i\ell}$ Mean	0.316	0.214	0.052	n/a
	Std Err Mean	0.084	0.077	0.096	n/a
	$Corr(r^\ell, r^u)$	0.094	0.097	0.012	n/a
	$\beta^{i\ell}$ St Dev	0.499	0.599	0.435	n/a
	No. of Obs	19	14	5	n/a
North America	$\beta^{i\ell}$ Mean	0.813	0.689	1.164	0.607
	Std Err Mean	0.142	0.146	0.128	0.110
	$Corr(r^\ell, r^u)$	0.165	0.112	0.233	0.135
	$\beta^{i\ell}$ St Dev	0.529	0.670	0.705	0.434
	No. of Obs	145	107	50	9
Oceania	$\beta^{i\ell}$ Mean	0.939	0.912	0.813	0.941
	Std Err Mean	0.059	0.067	0.060	0.057
	$Corr(r^\ell, r^u)$	0.347	0.287	0.306	0.260
	$\beta^{i\ell}$ St Dev	0.333	0.503	0.270	0.066
	No. of Obs	21	17	12	2
South America	$\beta^{i\ell}$ Mean	0.970	0.937	1.062	0.788
	Std Err Mean	0.070	0.075	0.078	0.086
	$Corr(r^\ell, r^u)$	0.375	0.309	0.329	0.232
	$\beta^{i\ell}$ St Dev	0.412	0.406	0.290	0.262
	No. of Obs	68	57	33	10

[a] "Periods" are defined as intervals over which the company-specific parameter vector is stable. Thus, they do not correspond to the same time periods for all companies.

Table A.4 Foreign Company US Beta Estimates

US market beta $\left(\beta^{iu}\right)$ estimate means, standard error means, and cross-sectional standard deviations for various market portfolios in the two equation system regressions: (i) $r_t^\ell = \alpha^\ell + \beta^\ell r_t^u + u_t^\ell$; and (ii) $r_t^{i\ell} = \alpha^{i\ell} + \beta^{i\ell} r_t^\ell + \beta^{iu} r_t^u + e_t^{i\ell}$ where r_t^ℓ,r_t^u, and $r_t^{i\ell}$ are the excess returns of the local market, US market, and firm i from country ℓ, respectively, and where $\left\{\alpha^\ell, \beta^\ell, \alpha^{i\ell}, \beta^{i\ell}, \beta^{iu}\right\}$ are parameters for country ℓ and firm i.

Portfolio	**Estimate**	**Period 1**[a] ($\tau = 1$)	**Period 2** ($\tau = 2$)	**Period 3** ($\tau = 3$)	**Period 4** ($\tau = 4$)
Panel A: Market Weighted Developed Vs. Emerging					
Market Weighted	β^{iu} Mean	0.432	0.776	0.842	1.003
	Std Err Mean	0.125	0.128	0.075	0.064
	$Corr(r^i, r^u)$	0.152	0.222	0.257	0.319
	β^{iu} St Dev	0.527	0.645	0.541	0.551
	No. of Obs	386	303	165	37
Equally Weighted	β^{iu} Mean	0.624	0.979	1.133	0.752
	Std Err Mean	0.148	0.125	0.115	0.093
	$Corr(r^i, r^u)$	0.181	0.250	0.274	0.199
	β^{iu} St Dev	0.589	0.770	0.565	0.554
	No. of Obs	166	119	53	15

Table A.4 Foreign Company US Beta Estimates (cont.)

Portfolio	Estimate	Period 1 ($\tau = 1$)	Period 2 ($\tau = 2$)	Period 3 ($\tau = 3$)	Period 4 ($\tau = 4$)
Panel B: Market Weighted by Region					
Asia	β^{iu} Mean	0.355	0.608	0.646	0.579
	Std Err Mean	0.105	0.098	0.084	0.059
	$Corr(r^i, r^u)$	0.131	0.169	0.176	0.192
	β^{iu} St Dev	0.577	0.498	0.574	0.411
	No. of Obs	94	63	30	8
Europe	β^{iu} Mean	0.445	0.827	0.870	1.035
	Std Err Mean	0.137	0.141	0.074	0.063
	$Corr(r^i, r^u)$	0.163	0.242	0.270	0.343
	β^{iu} St Dev	0.539	0.601	0.573	0.587
	No. of Obs	217	173	92	23
Middle East & Africa	β^{iu} Mean	0.732	0.452	0.866	n/a
	Std Err Mean	0.182	0.118	0.131	n/a
	$Corr(r^i, r^u)$	0.141	0.143	0.182	n/a
	β^{iu} St Dev	0.653	0.716	0.293	n/a
	No. of Obs	19	14	5	n/a
North America	β^{iu} Mean	0.717	0.898	0.986	1.157
	Std Err Mean	0.120	0.109	0.099	0.088
	$Corr(r^i, r^u)$	0.190	0.207	0.269	0.258
	β^{iu} St Dev	0.536	0.810	0.555	0.580
	No. of Obs	145	107	50	9
Oceania	β^{iu} Mean	0.316	0.682	0.793	1.048
	Std Err Mean	0.065	0.070	0.061	0.057
	$Corr(r^i, r^u)$	0.094	0.192	0.252	0.288
	β^{iu} St Dev	0.257	0.721	0.361	0.086
	No. of Obs	21	17	12	2
South America	β^{iu} Mean	0.779	0.992	1.192	0.920
	Std Err Mean	0.132	0.112	0.090	0.093
	$Corr(r^i, r^u)$	0.164	0.221	0.315	0.248
	β^{iu} St Dev	0.512	0.688	0.538	0.563
	No. of Obs	68	57	33	10