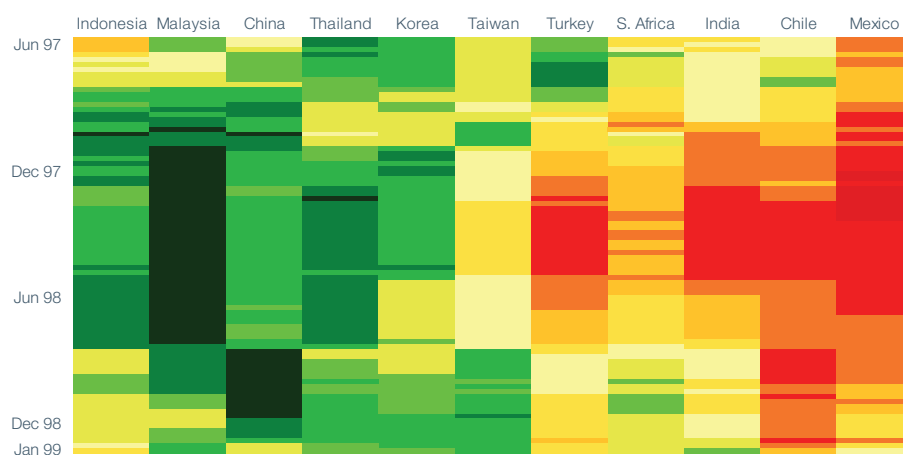


Country and Sector Contagion in Emerging Markets



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Over the past 20 years, globalization has induced financial market integration and, as a result, global equity markets have experienced increasing correlations. In this paper we explore the implications for investors with emerging market equity portfolios, in terms of both diversification and alpha opportunities.

Conventional wisdom from the 1990s (Heston and Rouwenhorst, 1994) suggests that country selection is more important than sector selection in international equity markets. In this paper, we explore whether this trend continues; and if so, to what extent.

We believe that the long-term trend towards globalization has played a part in this relationship. Consider the law of comparative advantage in economics (Torrens, 1815, and Riccardo, 1817), which holds that it is of mutual benefit for trading partners to specialize in those goods and services in which they have greatest comparative advantage.

Exhibit 1 illustrates the uninspiring trajectory that global trade has taken over the last 15 years.

If trade favors specialization, we can assume—in the absence of an empirical index measuring the degree of specialization—that increased trade has resulted in increased levels of specialization. A company with fewer barriers to entry, greater foreign direct invest-

ment (FDI), etc., is more likely to expand across borders than it is across sectors or industries. As such, as trade increases, we expect the distinction between countries to become relatively less meaningful than the distinction between sectors. Our paper begins by evaluating this relationship.

Investors in a high-risk asset class, however, ought to be most concerned with periods in which secular trends break down. As such, we also dedicate considerable time in this paper to periods of contagion—sharp spikes in volatility most acutely felt in the emerging markets, as cascading shocks increase correlations at the very time when low correlations would be most valuable. We investigate the relationship between countries and sectors in these periods, in both absolute and relative terms, as a means of better understanding the robustness of our hypothesis: that the gap in importance between country and sector is narrowing.

We examine a comprehensive sample of weekly emerging market country and sector returns, extracted from Russell Emerging Markets Indices from July 1996 to May 2009, a time span which includes both bull markets and periods of financial market contagion. We explore the relationship between the returns of 12 countries and 3 regional clusters, as well as 9 sectors, by estimating pairwise correlations and “equi-correlations” (average of pairwise correlations).¹ We calculate these correlations for both total returns, and “beta-neutral” returns (in which the market component of the returns has been extracted). By focusing on these two return measures we are able to draw conclusions for both country/sector diversification and individual security selection.

In “Emerging Markets: Portfolio Dispersion and Portfolio Concentration” (Lazard Investment Research, March 2010) we demonstrated the relevance of manager skill when the investment universe is disperse, and characterized emerging markets’ dispersion (cross-sectional standard deviation) from 1997–2009 (see Exhibit 2). Here we extend the themes of portfolio construc-

Exhibit 1
Global Trade

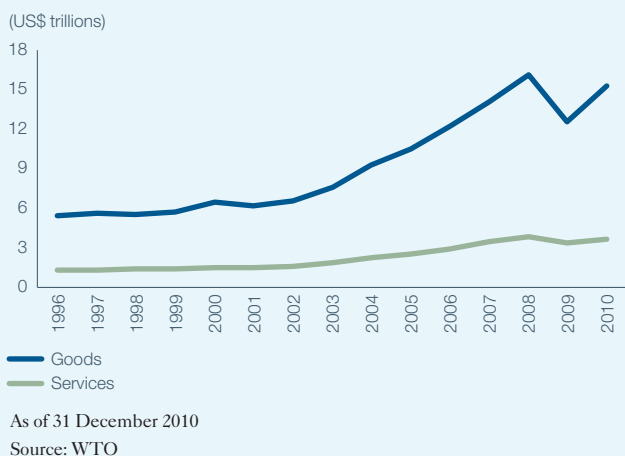
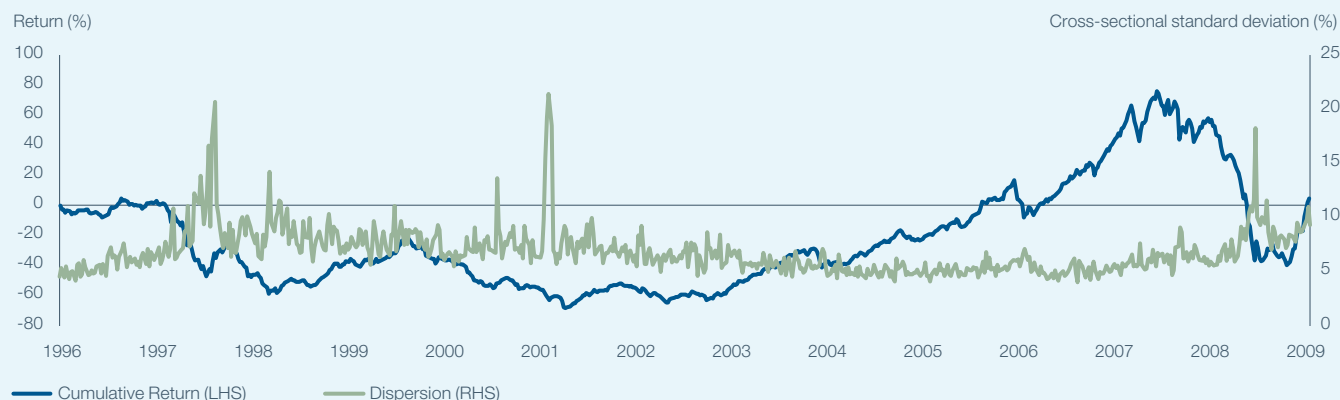


Exhibit 2
Cumulative Return and Dispersion in Emerging Markets



tion and active selection within emerging markets, with particular attention to country and sector selection during both positive and hostile market conditions.

All-country and All-sector Return Correlations

Total Return Correlations for Countries and Sectors

We first estimate correlations over time between equity return pairs across all country/clusters in the Russell Emerging Markets Index, using a moving average correlation measure.² We then calculate the “equi-correlation” measure, which is simply the average of all of these pairs of correlations for each week.³ Thus equi-correlation gives us some broad intuition about the extent of correlations between the various countries and clusters in the index, and how they change over time. We perform a similar set of calculations for the nine industry sectors within the index, to generate the time series of equi-correlations by sector.

Exhibit 3A depicts the country/cluster equi-correlations, those of the sectors, and the difference between them. Since we are particularly interested in contagion during “crisis” periods, we also highlight two significant periods of market crisis: the so-called

Asian Currency Crisis or Asian Contagion in the late 1990s, and the more recent Credit Crisis.

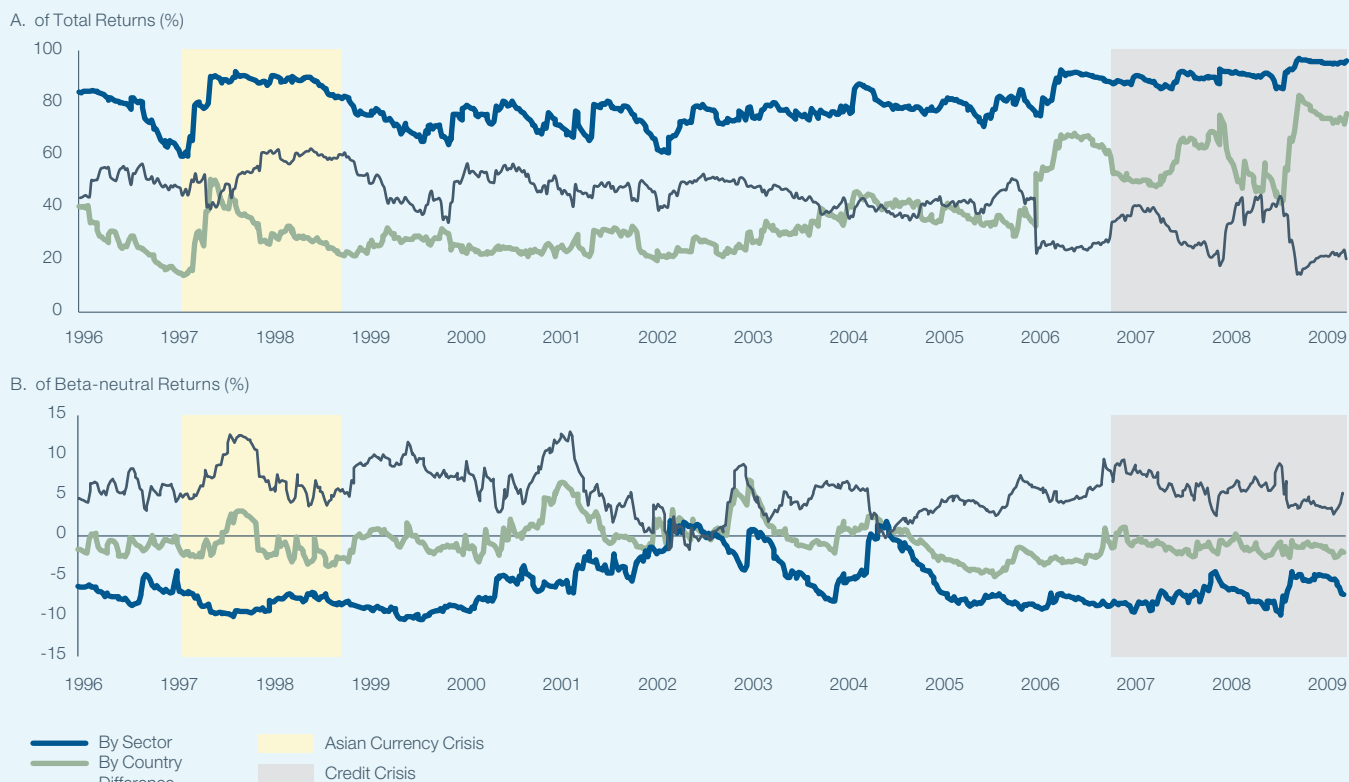
From Exhibit 3A, we see that average pairwise correlations—equi-correlations—between country returns are typically lower than those between sector returns, particularly during market crises. This confirms that country selection, in absolute terms, remains more important than sector selection, especially in periods of contagion. Investors will recognize this phenomenon from attribution literature as the “country” effect being more pronounced than the “sector” effect in the emerging markets.

However, we also observe that the difference in equi-correlations between countries and sectors appears to be narrowing over time (notwithstanding a period of widening during the recent Credit Crisis, when country correlations actually fell, but sector correlations did not). If this narrowing trend continues, country selection will become increasingly less important for diversification purposes.

Beta-neutral Return Correlations for Countries and Sectors

A continued narrowing of the spread between country correlations and sector correlations can have significant implications for portfolio management.

Exhibit 3
Equi-correlations by Country and Sector



As of 20 May 2009

Source: Lazard, Duke University, Russell Indices

Past performance is not a reliable indicator of future results.

For active investors with low emerging market beta, we are interested in exploring opportunities for alpha on a country versus sector basis. For this analysis, we extract the “beta-neutral” component of returns by carrying out a Capital Asset Pricing Model (CAPM) regression for each country. We use equal-weight average returns of all equities in the index as the “market” portfolio. The “error” component of these regressions is then the beta-neutral return⁴—intuitively, that part of the country or sector return that is not driven by emerging markets-wide effects.

Once we have the beta-neutral returns, we can then calculate their average pairwise correlations just as we did for total country and sector returns above. The average of all of these correlation pairs is the beta-neutral equi-correlation.

As we see in Exhibit 3B, the beta-neutral return correlations story looks a little different. We first observe that beta-neutral equi-correlations are far lower than total return equi-correlations, with levels close to zero or negative in many cases. This is not surprising—in fact, it is consistent with CAPM assumptions, and thus highlights the importance of the market component of returns in emerging markets. We also note that beta-neutral equi-correlations are lower for sectors than for countries—the opposite to our findings for total equi-correlations above. Thus, opportunities to find alpha in the emerging markets appear to be slightly better in sectors than in countries.

We also observe that there is no apparent trend over time, neither for the levels of country and sector equi-correlations, nor for the difference between the two. Nor does there appear to be any particular difference in the behavior of the beta-neutral equi-correlations during the two crisis periods we identified earlier. Thus correlations between beta-neutral returns have historically remained low and relatively stable, both over time and during financial crises.

Country-level and Sector-level Total Return Equi-correlations

While equi-correlations give us insight into average correlation levels across all countries (or all sectors), we note that, if some pairwise correlations are strongly negative, and some strongly positive, these may cancel each other out when calculating the average. To determine whether we are missing some country or sector-level effects in this way, we now look at equi-correlations on a country by country (and sector by sector) basis.

Total Return Correlations by Country

The equi-correlation for a given country is simply the average of that country’s pairwise correlations with every other country. Once again, we use a weighted moving average correlation measure to estimate correlations on a weekly basis.

Exhibits 4 and 5 show the country-level equi-correlations. For clarity, we divide the results into two graphs, the first of which shows Asian country equi-correlations; the second shows Latin American and all other country/cluster equi-correlations.⁵

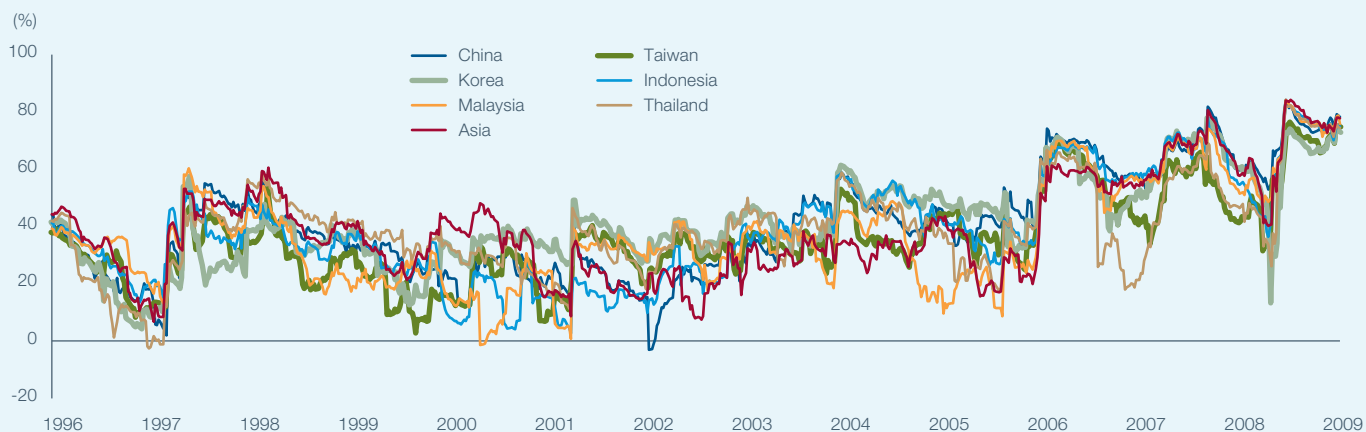
We note first that negative values are very rare. This indicates that the total equi-correlations in the previous section—the averages across all countries—are not “hiding” any large negative correlations between any pairs of countries that might have been lost in the averaging process. Thus, not surprisingly, we see that the country-level equi-correlations are showing similar trends to the overall equi-correlations: they are increasing over time in most countries.

Total Return Correlations by Sector

When we break down the equi-correlations by industry sector, as shown in Exhibit 6, we again get a similar message relative to the overall sector equi-correlations illustrated in Exhibit 3A. Sector

Exhibit 4

Average Pairwise Correlations between Each Country and All Other Emerging-market Countries: Asian Countries



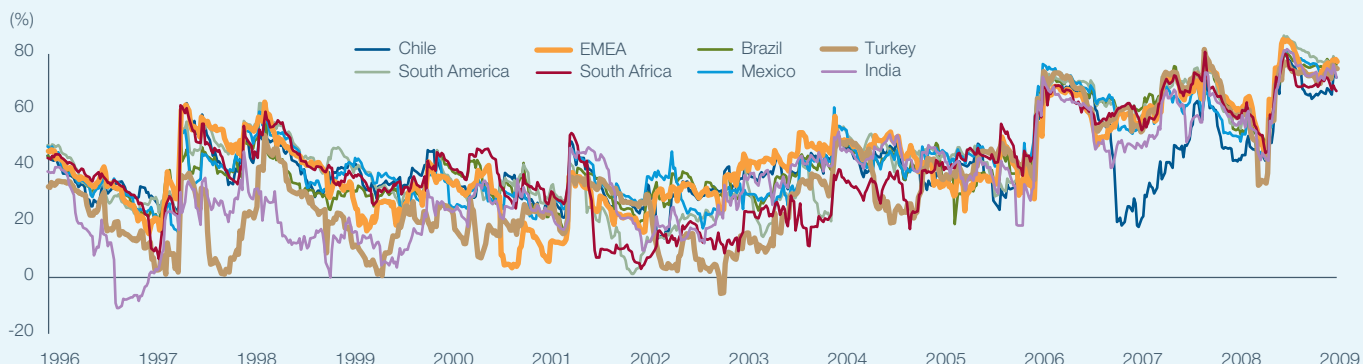
As of 20 May 2009

Countries with heavier lines indicate lowest and highest average equi-correlation over the sample period.

Source: Lazard, Duke University, Russell Indices

Exhibit 5

Average Pairwise Correlations between Each Country and All Other Emerging-market Countries: South American and Eastern European Countries



As of 20 May 2009

Countries with heavier lines indicate lowest and highest average equi-correlation over the sample period.

Source: Lazard, Duke University, Russell Indices

equi-correlations are higher, on average, than for countries; there are also no negative correlations. This confirms our earlier thesis that diversification by country is more important than by sector.

Another, more nuanced, observation is that sector correlations appear to be more stable over time than country correlations. Exhibit 6 also highlights the fact that equi-correlations for the technology sector—average pairwise correlations between technology and every other sector—are consistently lower than other sectors' equi-correlations. Similarly, the discretionary sector has the highest equi-correlations for much of the sample period. This differs from the evidence about countries' correlations from Exhibits 4 and 5, in which the country with the highest or lowest equi-correlation varied considerably over time. This result

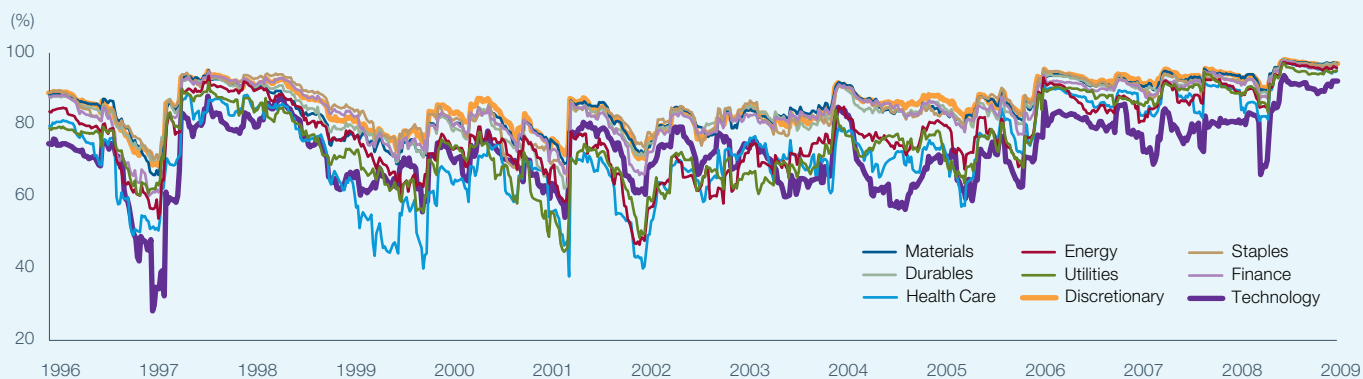
suggests that adding exposure to the technology sector would be beneficial for portfolio variance reduction via diversification throughout the economic cycle.

Country-level and Sector-level Beta-neutral Return Equi-correlations

In this section, we assess whether the low average beta-neutral equi-correlations shown in Exhibit 3B are masking any significant positive and negative values at the country or sector level. For both countries and sectors on a beta-neutral basis, we find both positive and negative correlations; but none are particularly large in magnitude terms. On the other hand, we do find some interesting country- and sector-specific results in this section.

Exhibit 6

Average Pairwise Correlations between Each Sector and All Other Sectors



As of 20 May 2009

Sectors with heavier lines indicate lowest and highest average equi-correlation over the sample period.

Source: Lazard, Duke University, Russell Indices

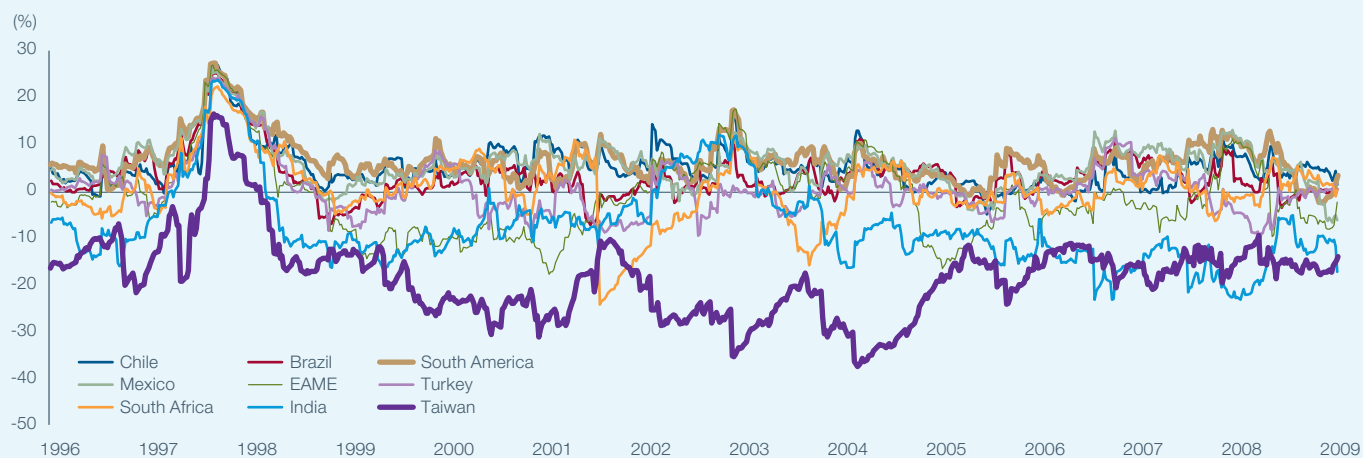
Exhibit 7
Average Beta-neutral Correlations between Each Country and Other Emerging-market Countries: Asia



As of 20 May 2009

Source: Lazard, Duke University, Russell Indices

Exhibit 8
Average Beta-neutral Correlations between Each Country and Other Emerging-market Countries: South America, South Asia/Africa, and Emerging Europe



As of 20 May 2009

Sectors with heavier lines indicate lowest and highest average equi-correlation over the sample period.

Source: Lazard, Duke University, Russell Indices

Beta-neutral Return Correlations by Country

When we look at beta-neutral return equi-correlations on a country by country basis (Exhibits 7 and 8), we see that they rarely exceed 25% in any country, and some Asian countries show persistently negative equi-correlations throughout the sample period. We note that the presence of both negative and positive equi-correlations in different countries means that the average beta-neutral equi-correlation across all countries, shown in Exhibit 3B, is now masking some different behavior between individual countries, although the range is relatively small (between 25% and -30% throughout).

Note that both Korea's and Taiwan's equi-correlations are more consistently negative than those of the other countries, except during the Asian Currency crisis (Exhibits 7 and 8, respectively). These two countries' equi-correlations also appear to be moving in opposite directions relative to the other countries'. This may be because the Korean and Taiwanese equity markets are particularly tech-heavy. We will see similar behavior with the technology sector equi-correlations (see Exhibit 9)—we discuss this in more detail in the next section.

Beta-neutral Return Correlations by Sector

When we look at the beta-neutral equi-correlations sector by sector (Exhibit 9), we see that the technology sector continues to have by far the lowest (most negative) equi-correlations throughout the sample period. Most other sectors also have low to negative equi-correlations, with the same relative consistency on a sector basis that we saw in Exhibit 6. Here again, the technology sector has the lowest equi-correlations throughout the sample.

We note also that the technology sector's beta-neutral returns seem to be moving to the beat of a different drum than those of the other industries. The technology sector's boom and bust in the late 1990s and early 2000s might explain this observation. We saw in Exhibits 7 and 8 that this is reflected in Korea and Taiwan, two countries with considerable weight of technology stocks among their equities.

Country and Sector Correlations in Crisis Periods – Evidence for Contagion?

Asian Currency Crisis and “Asian Contagion”

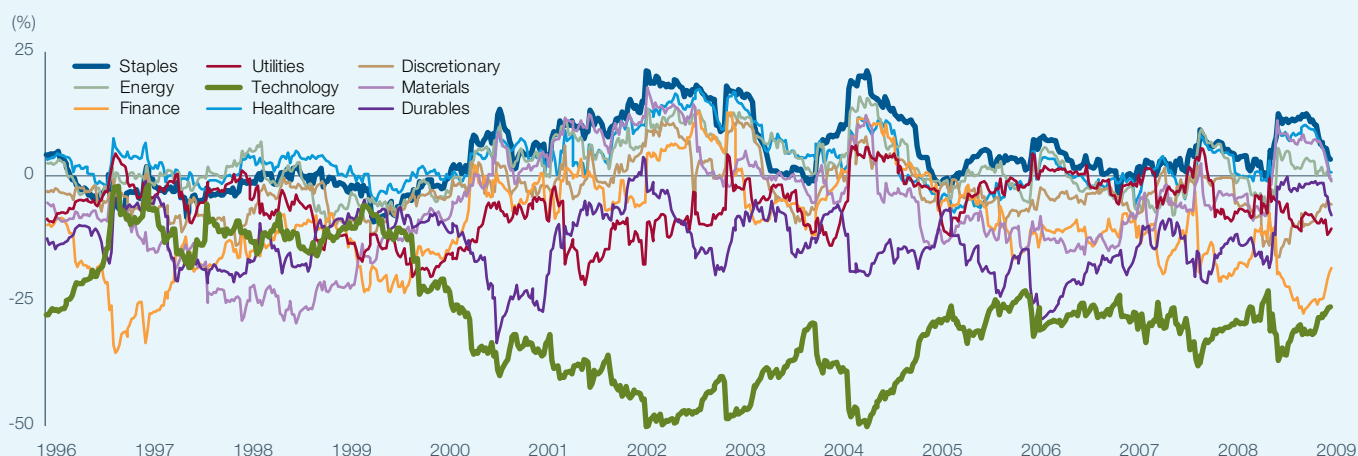
To obtain further insight into the Asian Currency Crisis and Asian Contagion period of 1997–1998 we now use a “heat map” approach to illustrate the moving pattern of pairwise country correlations during a period of crisis. The heat map assigns smoothly transitioning colors to particular values of correlations; very low or negative pairwise correlations are illustrated in dark green, and strongly positive correlations are in dark red. The heat map is a visually intuitive tool for illustrating whether the changes in correlation during this crisis period spread between markets in geographically close regions, as well as further afield to other regions of the emerging markets.

The heat map in Exhibit 10 reflects return correlations between Thailand and each of the other emerging markets countries over the 1997–1998 period. From this chart, we see that the first few weeks of the Asian Currency crisis resulted in a “domino effect” of increased correlations across the Asian markets, with Thailand's closest neighbors succumbing earliest (see the wavy black line). By October, many of these countries had moved into a sustained period of higher correlations with Thailand. Despite the longevity of the crisis, however, most of Latin America, South Asia, and Eastern Europe regions were relatively unaffected—although some experienced a mild increase in correlation with Thailand (see the dashed black line).

To see how this “contagion” looks from the perspective of the less affected Latin American markets, we create a similar heat map with Brazil as the “base” country. Exhibit 11 reflects changing correlations between Brazil and the other emerging markets countries, again around the Asian Contagion period.

As we already noted in Exhibit 10, Brazil's correlation with all of the Asian countries was relatively unaffected by the Asian Currency crisis. However, Brazil experienced its own correlation “shift” with geographically close regions in October 1997 (this occurs in the same week as highlighted with the dashed black line in Exhibit 10). The thick black line in Exhibit 11 highlights the regions with which Brazil experienced a sustained correlation increase, while the dashed line indicates countries with which Brazil had a temporary increase in correlation at this time. It has been suggested (IMF 1997) that the deterioration of the Brazilian current account deficit induced a sell-off in the Brazilian equity markets, which then fed through to its close trading partners, such as Mexico and Argentina (contained in the South American country cluster).

Exhibit 9
Average Pairwise Beta-neutral Correlations between Each Sector and All Other Sectors

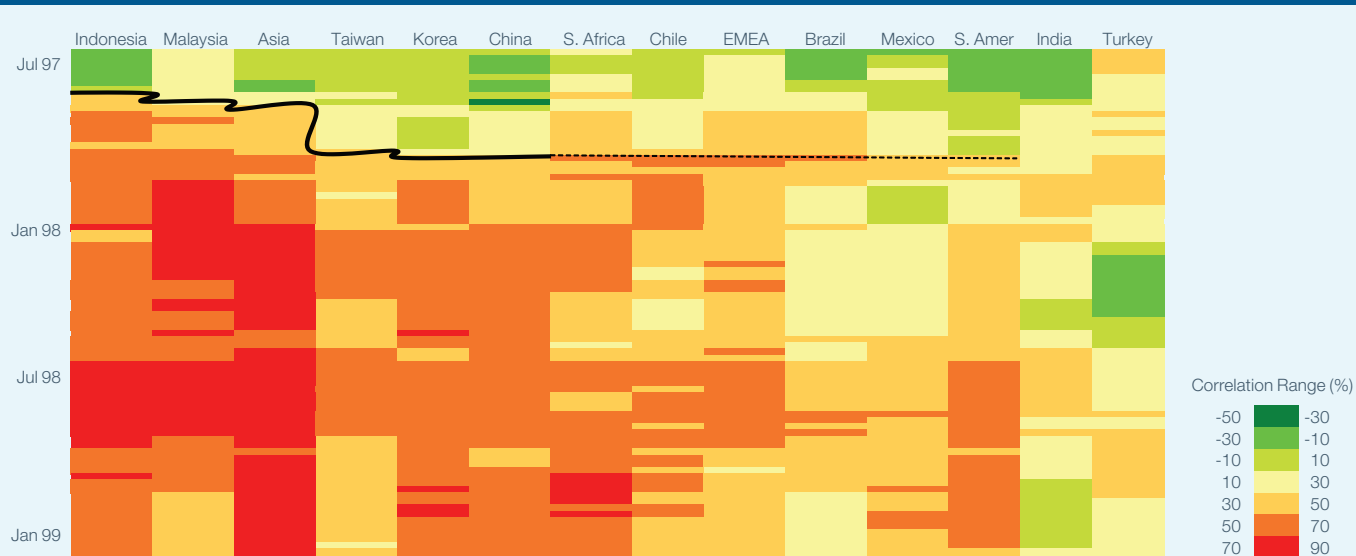


As of 20 May 2009

Source: Lazard, Duke University, Russell Indices

Exhibit 10

Correlations between Returns in Thailand versus All Other Emerging-market Countries before and during the “Asian Contagion” in 1997–1998

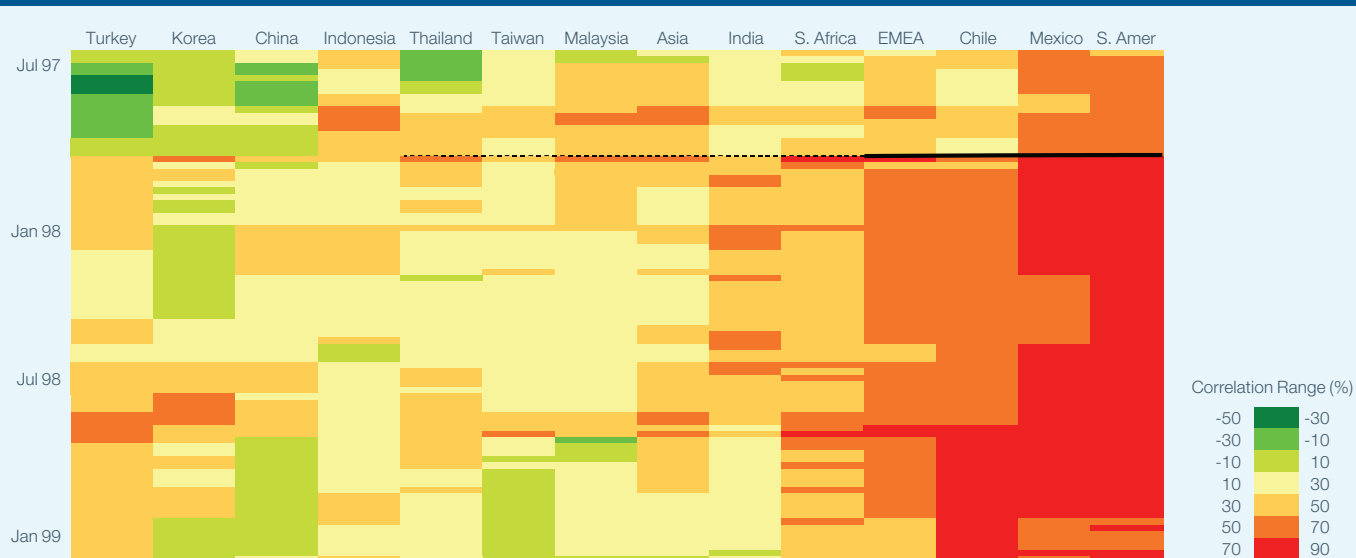


As of 20 January 1999

Source: Lazard, Duke University, Russell Indices

Exhibit 11

Correlations between Returns in Brazil versus All Other Emerging-market Countries before and during the “Asian Contagion” in 1997–1998



As of 20 January 1999

Source: Lazard, Duke University, Russell Indices

The comparison of Exhibits 10 and 11 suggests that the Latin American countries have historically traded more in tandem with one another than Asian countries, regardless of any emerging markets crisis. This suggests that there were more opportunities

to diversify within Asia than South America at that time. We next examine correlation heat maps with Thailand and Brazil in the recent credit crisis. Are correlations within Latin America still higher, ten years on, than those in Asia?

The Credit Crisis—More evidence of contagion in Emerging Markets?

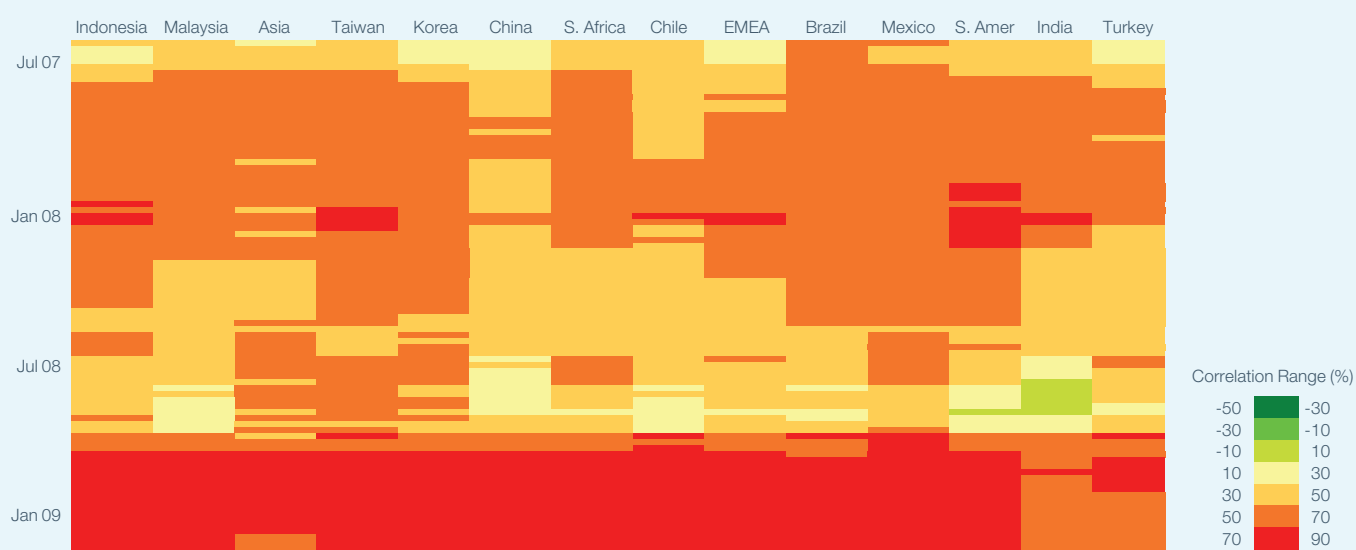
Exhibits 12 and 13 help to answer this question. We see in Exhibit 12 that, even prior to the Credit Crisis, overall levels of correlation between Thailand and the rest of emerging markets in 2007 were much higher than they were a decade earlier. From Exhibit 13, it is also apparent that equities throughout South America were again

more correlated with one another than those in the Asian region, just prior to the Credit Crisis, suggesting that diversification opportunities continued to be greater within Asia than South America.

By 2009, however, all countries' correlations had become extremely high, at greater than 50% for all countries relative to both Thailand and Brazil—indicating that the entire emerging market universe was strongly correlated at that time.

Exhibit 12

Correlations between Returns in Thailand versus All Other Emerging-market Countries before and during the Credit Crisis in 2007–2009

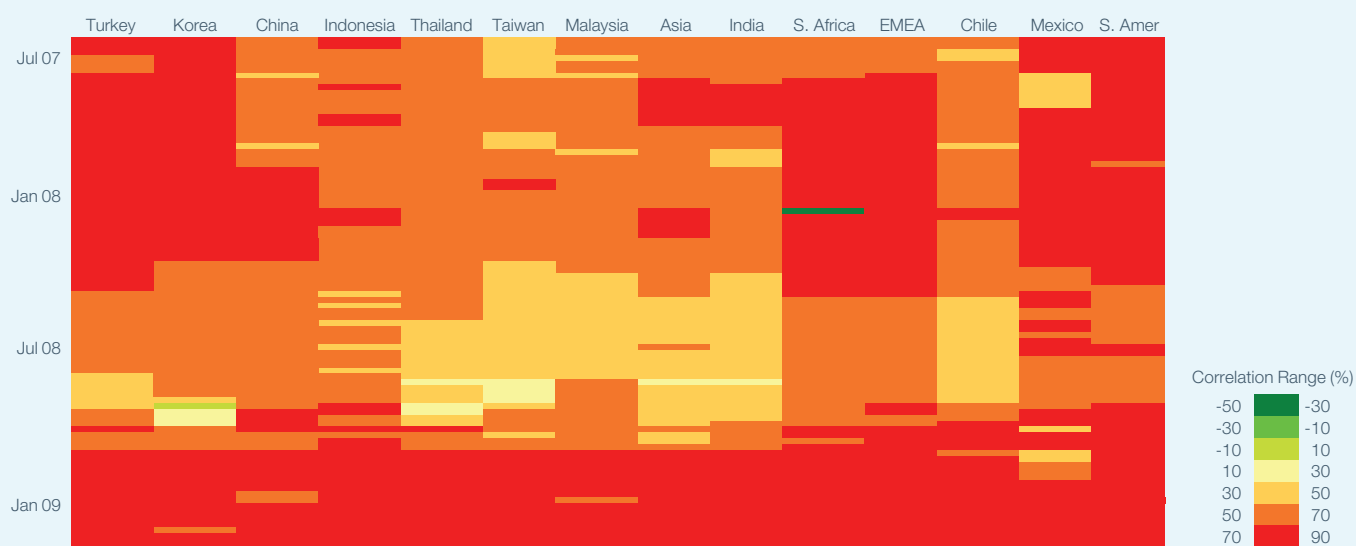


As of 25 February 2009

Source: Lazard, Duke University, Russell Indices

Exhibit 13

Correlations between Returns in Brazil versus All Other Emerging-market Countries before and during the Credit Crisis in 2007–2009



As of 25 February 2009

Source: Lazard, Duke University, Russell Indices

Technology Sector Correlations in Both Bull Markets and Crises

Given the technology sector’s relatively lower equi-correlations versus the other sectors (as seen in Exhibit 6), we use technology as our “base” sector for a heat map analysis that parallels the country heat maps previously shown. If technology’s correlations with returns in other sectors are high, we can safely assume that this must be the case for all sectors.

Exhibit 14 suggests clearly that this is the case. Throughout the entire sample period (1996–2009), correlations between technology and other sectors are consistently high, although slightly less so with certain sectors during the bull market of 2003–2006. This provides further evidence for limited abilities to diversify by sector within emerging markets.

Country Beta-neutral Correlations— Can We Find Alpha During Crises?

Thailand and Brazil: Beta-neutral Return Correlations during the Asian Contagion and Credit Crisis

When we look at beta-neutral return correlations with Thailand and Brazil during the Asian Contagion period, we get further insights into the relationship between non-market-related returns in the Asian versus Latin American regions. The heat map in Exhibit 15 shows a slight increase in the beta-neutral return correlation in Thailand’s closest neighbors during late 1997 (see the wavy black line), but the extent of the increase is very small compared with overall return correlations with Thailand (from Exhibit 10). We also observe a significant *reduction* in correlation between Thailand’s beta-neutral returns and those in the Latin American region (see the wavy white line).

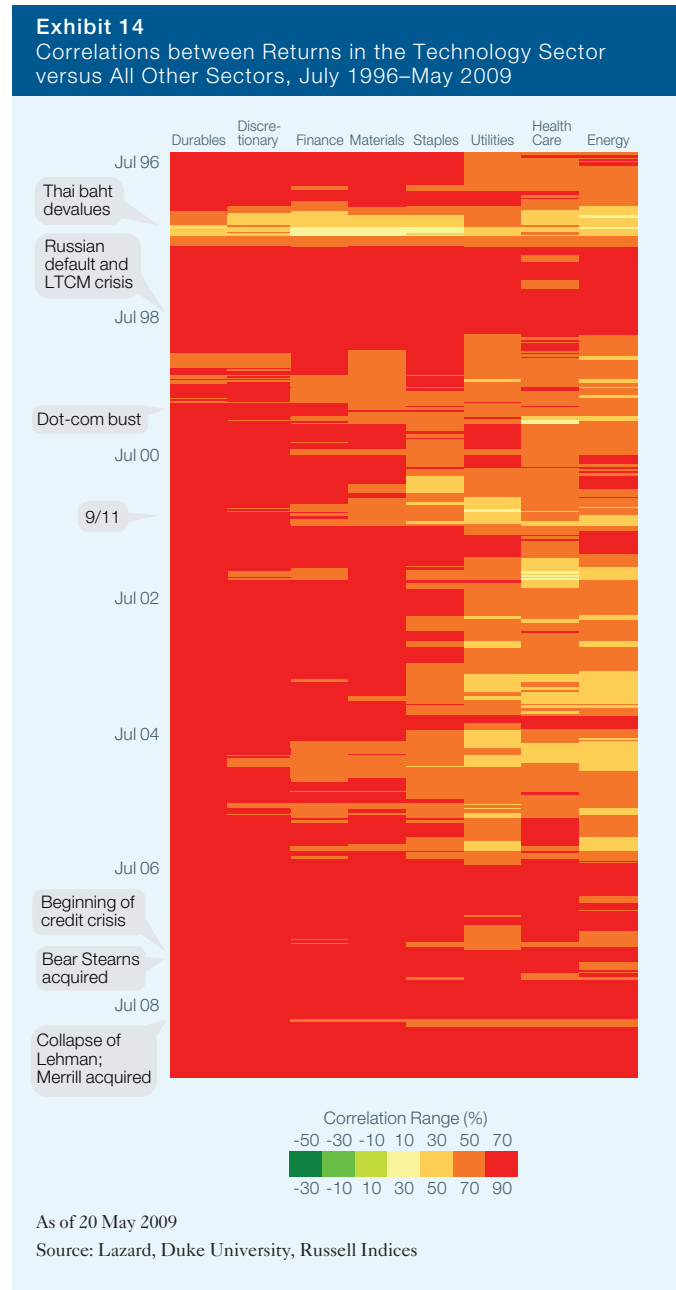
When we look at beta-neutral correlations with Brazil in Exhibit 16, however, we see a clear delineation between Brazil’s correlations with Asia (which are strongly negative) versus with non-Asian emerging market countries (strongly positive). Thus Exhibits 15 and 16 provide further evidence of a clear distinction between the Asian, Latin American, and other emerging-market countries: Latin American countries seem to have been very strongly correlated, even on a beta-neutral basis, during the late 1990s.

This distinction continues to some extent even into the Credit Crisis period, as we see in Exhibits 17 and 18. As before, we see stronger beta-neutral correlations between Brazil and its geographically close partners than we see within Asia. However, note that beta-neutral correlations within South America, while still somewhat positive, were lower during the credit crisis than they were during the Asian Contagion. This suggests that even the non-market-related components of returns in South America

were highly correlated with one another during the late 1990s; during the credit crisis, however, beta-neutral returns in this region are less closely related. This suggests that alpha opportunities within South America have been increasing over time, even within crisis periods.

Conclusion

In this paper, we characterize the dynamic nature of equity correlations between emerging market country and sector returns, and assess the implications for portfolio diversification and security selection. Our findings are summarized in Exhibit 19.



We find that correlations between country returns are lower than those of sectors, suggesting that country selection is more important than sector selection for diversification. This result appears particularly significant during market crises such as the Asian Contagion and the more recent Credit Crisis. However, there appears to be an overall upward trend in emerging market coun-

try correlations over time, suggesting that country selection will become increasingly less important for diversification purposes.

We also evaluate correlations between “beta-neutral” returns (in which the market component of the returns has been extracted), and find the opposite result in this case. That is, sectors show lower

Exhibit 15

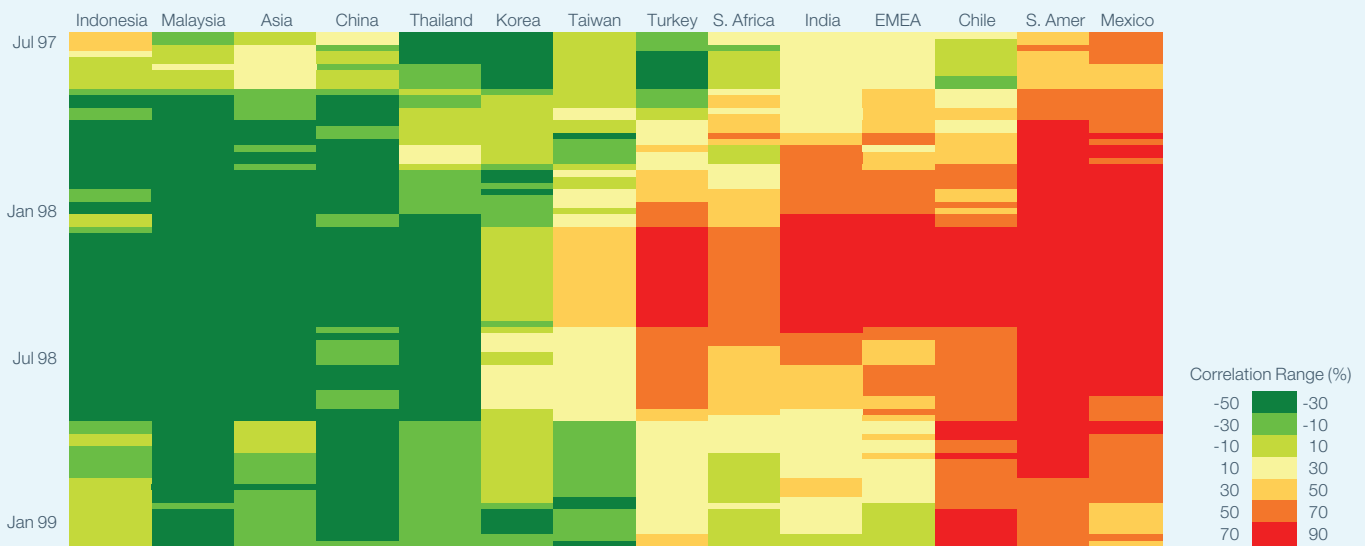
Correlations between Beta-neutral Returns in Thailand versus All Other Emerging-market Countries before and during the “Asian Contagion” in 1997–1998



As of 20 January 1999
 Source: Lazard, Duke University, Russell Indices

Exhibit 16

Correlations between Beta-neutral Returns in Brazil versus All Other Emerging-market Countries before and during the “Asian Contagion” in 1997–1998



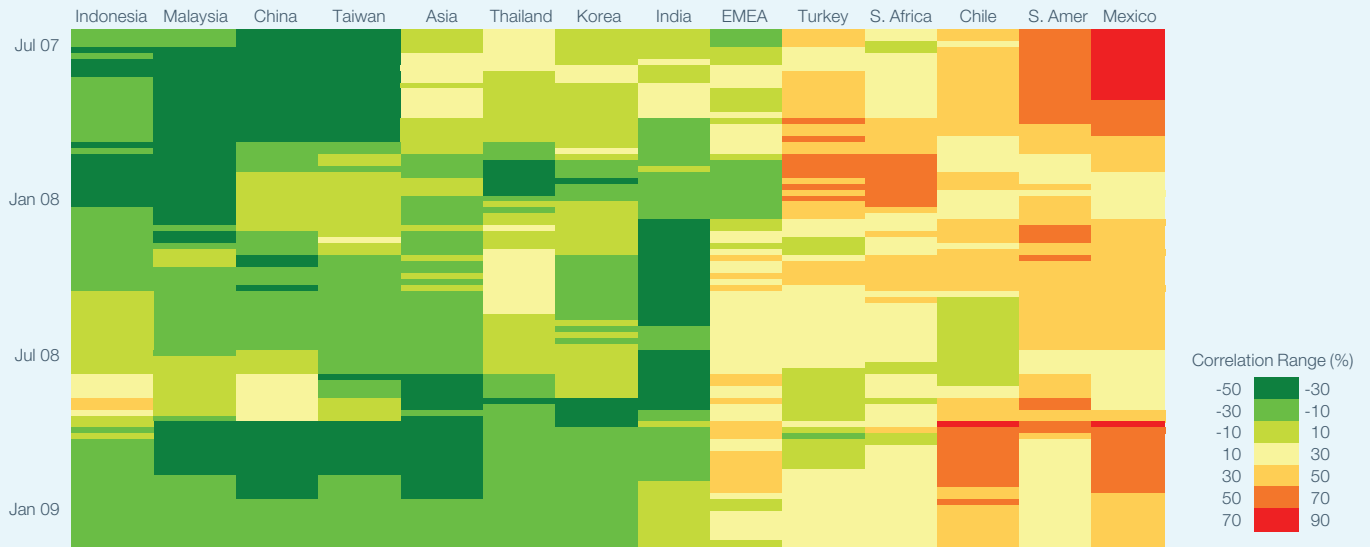
As of 20 January 1999
 Source: Lazard, Duke University, Russell Indices

Exhibit 17
Correlations between Beta-neutral Returns in Thailand versus All Other Emerging-market Countries before and during the Credit Crisis in 2007–2009



As of 25 February 2009
Source: Lazard, Duke University, Russell Indices

Exhibit 18
Correlations between Beta-neutral Returns in Brazil versus All Other Emerging-market Countries before and during the Credit Crisis in 2007–2009



As of 25 February 2009
Source: Lazard, Duke University, Russell Indices

Exhibit 19
 Summary of the Correlation Analysis

		Correlations between country returns	Correlations between sector returns	Consideration
Total Return	Entire period	Lower	Higher. Technology has the lowest correlation among sectors throughout the business cycle	There are limited opportunities for diversification by sector. Country selection is more important than sector selection for diversification
	During crises	Lower	Higher	Particularly significant during market crises
	Trend over time	Upward		Country selection will become increasingly less important for diversification
Beta-neutral returns	Entire period	Higher	Lower. Technology has the lowest correlation among sectors throughout the business cycle	Alpha opportunities may be greater for sectors
	During crises	Stable. However, in South America lower during the Credit Crisis than during the Asian Contagion	Stable	Alpha opportunities within South America are increasing over time, even during crisis periods
	Trend over time	Stable	Very stable	

Source: Lazard

beta-neutral correlations than countries, suggesting that alpha opportunities may be greater for sectors. Moreover, these beta-neutral correlations appear to be relatively stable over time, especially for sectors, and—importantly—in both positive and hostile markets.

Drilling down to the sector-specific level, we find that the technology sector has, overall, the lowest correlation among sectors throughout the business cycle, particularly in the context of beta-neutral returns. On a total return basis, however, emerging-market

sector returns have been very highly correlated throughout the sample period, suggesting that there are limited opportunities for diversification by sector.

At the country/regional level, we note that beta-neutral returns in South America were less correlated during the Credit Crisis than they were during the Asian Contagion, which suggests that alpha opportunities within South America may be increasing over time, even during crisis periods.

Appendix A – Countries and Clusters

The Russell Emerging Markets Index includes equities from 39 individual countries. Of these, 12 countries had at least 15 equities in the index throughout the sample period: Brazil, Chile, China, India, Indonesia, Korea, Malaysia, Mexico, Taiwan, Thailand, Turkey, and South Africa.

For countries with fewer than 15 equities, we created three regional “clusters”: Eastern Europe, Middle East, and Africa (EMEA); South America; and Asia.

EMEA: Bahrain, Botswana, Bulgaria, Croatia, Cyprus, Czech Republic, Egypt, Estonia, Greece, Hungary, Israel, Kazakhstan, Kuwait, Jordan, Latvia, Libya, Morocco, Oman, Mauritius, Pakistan, Qatar, Poland, Portugal, Romania, Russia, Slovakia, Slovenia, Tunisia, Ukraine, United Arab Emirates

South America: Argentina, Columbia, Panama, Peru, Venezuela

Asia: Laos, Philippines, Vietnam

Appendix B

B.1 Calculating Correlations by an Exponentially Weighted Moving Average

For estimating the correlation between returns we employ an exponentially weighted moving average filter or “exponential smoother,” popularized by RiskMetrics (J.P. Morgan/Reuters 1996). The exponential smoother estimator for the covariance, $h_{i,j,t}$, and correlation, $\rho_{i,j,t}$, between two series of zero-mean random variables uses a weighted average of the most recent observations in estimating the conditional covariance (and correlation), as shown in equations 1 and 2 below:

$$h_{i,j,t} = \lambda \varepsilon_{i,t-1} \varepsilon_{j,t-1} + (1-\lambda)h_{i,j,t-1} \quad \text{for all } i, j \quad (1)$$

Where λ is the weight parameter, which we set equal to 0.94 for weekly data, and ε are the most recent observations. The exponential smoother estimate for correlation is calculated according to equation 2.

$$\rho_{i,j,t} = \frac{h_{i,j,t}}{\sqrt{h_{i,i,t} h_{j,j,t}}} \quad (2)$$

B.2 Calculating Average Pairwise Correlations

To calculate the time series of average pairwise correlations (underlying Exhibit 3A for total returns and Exhibit 3B for beta-neutral returns) we simply calculate the cross sectional average of the pairwise correlation estimates for each country and sector for each week obtained using the exponential smoother. The calculation is performed according to equation 3 below.

$$\bar{\rho}_t = \frac{1}{n(n-1)} \sum_{j=1, j \neq i}^n \sum_{i=1}^n \rho_{i,j} \quad (3)$$

B.3 Calculating Beta-neutral Returns

To estimate a country’s beta-neutral return at a given time period, we assume that the CAPM model holds; thus:

$$r_{it} = \beta_i r_{mt} - \varepsilon_{it} \quad (4)$$

where r_i = return on country i , and β_i = country i ’s β , which we estimate as $\beta_i = \frac{\sigma_{im}}{\sigma_m^2}$, and m is the market portfolio: the equally weighted average return of all equities within the Russell Emerging Markets Index.

Then the *beta-neutral* return at each period is simply ε_{it} , which reflects the non-market-related component of country i ’s return. Beta-neutral components of industry sector returns were estimated similarly.

Acknowledgements

Special thanks to Giuseppe Ricotta and Susan Lee of Lazard Asset Management.

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Notes

- 1 See Appendix A for the list of emerging market countries, regional clusters, and industry sectors.
- 2 Appendix B, section B.1 explains how pairwise correlations are calculated using an exponentially weighted moving average filter.
- 3 Section B.2 in Appendix B further describes the equi-correlation calculation.
- 4 See Appendix B, Section B.3 for more details of this regression model.
- 5 Note, however, that the pairwise correlation for each country in the graphs is computed relative to all other emerging-market countries in our sample, not just the countries in the same graph.

Important Information

Published on 19 July 2011.

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