Expected Returns and Volatility in 135 Countries

Projected returns and variances in countries with and without equity markets.

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The idea of this research is to develop a simple country risk model that can be used to establish hurdle rates for emerging country investments. These rates are appropriate for markets that are segmented in the sense that the same risk project may receive a different expected return, depending on its domicile.

The model uses *Institutional Investor's* country credit ratings. We establish rates that represent expected returns on investments of average risk within each country. These hurdle rates are forward-looking. We also calculate expected volatilities for each of the countries.

Combining the expected hurdle rate with the expected volatility, we develop two measures of payback that are directly related to the literature in statistics on "hitting time." We calculate the time in years necessary to recover the investment with 90% probability. We also calculate the number of years necessary to double the investment with 90% probability.

MEASURES OF COUNTRY RISK IN DEVELOPED MARKETS

There are remarkably diverse ways to calculate country risk and expected returns. The risk that we will concentrate on is risk that is "systematic." That is, by definition, this risk is not diversifiable. Importantly, systematic risk will be rewarded by investors. That is, higher systematic risk should be linked to higher expected returns.

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A simple, and well-known, approach to systematic risk is the beta of the Sharpe [1964], Lintner [1965], and Black [1972] capital asset pricing model. This model was initially presented and applied to U.S. data. The classic empirical studies, such as Fama and MacBeth [1973], Gibbons [1982], and Stambaugh [1982] present some evidence in support of the formulation. The model is used in an international setting by Solnik [1974a, 1974b, 1977]. The risk factor is no longer the U.S. market portfolio but the world market portfolio.

Evidence on using the beta factor as a country risk measure in an international context is mixed. The early studies find it difficult to reject a model that relates average beta risk to average returns. For example, Harvey and Zhou [1993] find it difficult to reject a positive relation between beta risk and expected returns in eighteen markets. When more general models are examined, however, the evidence against the model becomes stronger.

Harvey [1991] presents evidence against the world CAPM when both risks and expected returns are allowed to change through time. Ferson and Harvey [1993] extend this analysis to a multifactor formulation that follows the work of Ross [1976] and Sharpe [1982]. Ferson and Harvey's model also allows for dynamic risk premiums and risk exposures.

The bottom line for these studies is that the beta approach has some merit when applied in developed markets. The beta, whether measured against a single factor or against multiple world sources of risk, appears to have some ability to discriminate between expected returns. The work of Ferson and Harvey [1994, 1995] is directed at modeling the conditional risk functions for developed capital markets. They show how to introduce economic variables, fundamental measures, and both local and worldwide information into dynamic risk functions.

This work, however, applies only to twenty-one developed markets. What about the other 114 countries?

COUNTRY RISK IN DEVELOPING MARKETS

One might consider measuring systematic risk the same way in emerging as well as developed markets. Harvey's [1995] study of emerging market returns suggests that there is no relation between expected returns and betas measured with respect to the world market portfolio. A regression of average returns on average betas produces an R^2 of zero. Harvey documents that the country variance does a better job of explaining the cross-sectional variation in expected returns.

Bekaert and Harvey [1995c] pursue a model where expected returns are influenced by both world factors (like a world CAPM) and local factors (like a CAPM that holds only in that country). They propose a conditional regime-switching methodology that allows the country to evolve from a developing segmented country to a developing country that is integrated in world capital markets.

The Bekaert and Harvey [1995c] work is very promising, and the authors have applied this idea to the cost of capital estimation for individual securities in emerging markets (see Bekaert and Harvey [1995a]). All the estimation is calibrated using the data for only the twenty developing markets collected by the International Finance Corporation, however.

It is straightforward to estimate a relation (the "reward for risk") between, say, a beta and expected return. The cost of capital is obtained by multiplying this reward for risk times the beta. The beta is measured by analyzing the way the equity returns covary with a benchmark return.

What if there is no equity market? That is, even if we estimate the risk premium using the forty-seven countries where data are available, we have no way of using the reward for risk, because we do not have betas for many of the developing economies' markets — because the equity market does not yet exist.

ALTERNATIVE RISK MEASURES

We start our exercise with the requirement that the candidate risk measure must be available for all 135 countries, and it must be available in a timely fashion. This eliminates risk measures based solely on the equity market. It also eliminates measures based on macroeconomic data that are subject to irregular releases and often dramatic revisions. We focus on country credit ratings.

Our country credit ratings source is *Institutional Investor*'s semiannual survey of bankers. *Institutional Investor* has published this survey in its March and September issues every year since 1979. The survey represents the responses of 75-100 bankers. Respondents rate each country on a scale of 0 to 100, with 100 representing the smallest risk of default. *Institutional Investor* weights these responses by its perception of each bank's level of global prominence and credit analysis sophistication (see Shapiro [1994] and Erb, Harvey, and Viskanta [1994, 1995]).

How do credit ratings translate into perceived risk, and where do country ratings come from? Most globally oriented banks have credit analysis staffs. Their charter is to estimate the probability of default on their bank's loans. One dimension of this analysis is the estimation of sovereign credit risk. The higher the perceived credit risk of a borrower's home country, the higher the rate of interest that the borrower will have to pay. There are many factors that simultaneously influence a country credit rating: political and other expropriation risk, inflation, exchange rate volatility and controls, the nation's industrial portfolio, its economic viability, and its sensitivity to global economic shocks, to name some of the most important.

The credit rating, because it is survey-based, may proxy for many of these fundamental risks. Through time, the importance of each of these fundamental components may vary. Most important, lenders are concerned with future risk. In contrast to traditional measurement methodologies, which look back in history, a credit rating is forward-looking.

Our idea is to fit a model using the equity data in forty-seven countries and the associated credit ratings. Using the estimated reward-to-credit risk measure, we will forecast "out-of-sample" the expected rates of return in the eighty-eight countries that do not have equity markets.

MODEL

We fit our model using equity data from forty-seven national equity markets. Morgan Stanley Capital International (MSCI) publishes twenty-one of the indexes, and the International Finance Corporation (IFC) of the World Bank publishes the other twenty-six. We view the MSCI national equity indexes as developed market returns and the IFC indexes as emerging market returns.

Our sample begins in September 1979 and ends in March 1995. Twenty-eight of the country indexes existed at the beginning of this analysis. We add country indexes to the analysis during the month that they were first introduced by either MSCI or the IFC.

A list of the countries included in the equity analysis with the inclusion date for each country index is provided in Exhibit 1 along with some summary statistics.

The equity returns presented in Exhibit 1 are calculated in U.S. dollars. This is especially appropriate in the segmented developing markets, where the evidence in Liew [1995] suggests that purchasing power parity closely holds. There are a wide range of average returns and volatility in this sample. Some of the most extreme average returns are found in the newly added markets (Poland and Hungary). Unfortunately, there is only a short sample of equity returns available for these countries.

Exhibit 1 also presents the correlation with the world portfolio calculated over the full sample and over the last five years. The beta with respect to the world market index is also presented. This beta is an appropriate ex ante measure of risk if:

- Investors hold a diversified world market portfolio (i.e., there is no home-country bias).
- The measured MSCI world market portfolio is a true representation of the value-weighted world wealth.
- The local equity market is integrated into world capital markets.
- Expected returns and risk are constant.

Even in this group of forty-seven equity markets, there are strong reasons to believe that conditions one, three, and four do not hold.

The simplest model relating expected returns to credit rating is a linear model:

$$R_{i,t+1} = \gamma_0 + \gamma_1 CCR_{it} + \varepsilon_{i,t+1}$$

where R is the semiannual return in U.S. dollars for country I, CCR is the country credit rating, which is available at the end of March and the end of September each year, t is measured in half years, and epsilon is the regression residual.

We estimate a time series cross-sectional regression by combining all the countries and credit ratings into one large model. In this sense, the γ coefficient is the "reward for risk." Consistent with asset pricing traditions, this reward for risk is worldwide — it is not specific to a particular country.

This model forces a linear relation between credit rating and expected returns, although intuition suggests that a linear model may not be appropriate. That is, as a credit rating falls quite low, expected returns may go up faster than a linear model may suggest. Indeed, at very low credit ratings, such as in the

EXHIBIT 1
Summary Analysis of Data

Country	Source	Sample Start	Market Capitalization U.S.$ Mil. September 1995	Monthly Arithmetic Mean Return Annualized (%)	Monthly Geometric Mean Return Annualized (%)	Monthly Standard Deviation Annualized (%)	Correlation with World Market Full Sample Monthly	Correlation with World Market Last Five Years Monthly	Correlation of IFC Investables with World Market Last Five Years Monthly	Beta with World Market Last Five Years Monthly	Beta of IFC Investables with World Market Last Five Years Monthly	Conditional Beta with World Market September 1995
Argentina	IFC	October 1979	$18,783	41.1	8.0	91.7	−0.01	0.14	0.15	0.72	0.75	−0.28
Australia	MSCI	October 1979	$137,352	15.5	12.5	26.3	0.52	0.46		0.69		0.75
Austria	MSCI	October 1979	$17,751	13.3	10.8	24.9	0.30	0.45		0.72		0.13
Belgium	MSCI	October 1979	$56,328	17.5	16.6	21.0	0.62	0.68		0.76		0.97
Brazil	IFC	October 1979	$106,821	33.8	15.5	63.1	0.10	0.22	0.21	1.05	1.08	0.05
Canada	MSCI	October 1979	$193,156	9.9	8.4	19.3	0.68	0.46		0.48		0.44
Chile	IFC	October 1979	$48,020	24.7	21.6	31.9	0.07	0.11	0.12	0.25	0.28	−0.64
China*	IFC	April 1993	$30,232	9.2	−13.6	79.3	0.04	0.04	0.15	0.29	0.61	4.86
Colombia	IFC	October 1985	$9,079	36.6	37.4	31.3	0.05	−0.01	0.05	−0.02	0.19	−0.58
Denmark	MSCI	October 1979	$40,560	15.6	14.5	20.0	0.52	0.61		0.91		0.10
Finland	MSCI	April 1988	$38,688	13.4	10.3	27.1	0.47	0.46		1.10		5.15
France	MSCI	October 1979	$315,085	14.4	12.3	23.2	0.65	0.71		1.03		0.74
Germany	MSCI	October 1979	$344,087	14.3	12.6	22.1	0.57	0.60		0.85		1.00
Greece	IFC	October 1979	$10,765	8.3	2.0	37.4	0.17	0.30	0.29	0.74	0.76	0.70
Hong Kong	MSCI	October 1979	$158,014	24.3	20.1	33.5	0.42	0.37		0.84		0.79
Hungary*	IFC	April 1993	$876	2.5	−3.9	38.2	0.46	0.46	0.47	1.62	2.25	0.62
India	IFC	October 1979	$66,772	16.5	13.1	29.2	−0.05	−0.11	0.03	−0.32	0.08	−1.09
Indonesia	IFC	October 1990	$26,995	6.5	1.9	30.7	0.11	0.14	0.14	0.35	0.37	2.89
Ireland	MSCI	April 1988	$14,864	14.6	12.9	21.9	0.68	0.74		1.28		0.91
Italy	MSCI	October 1979	$117,314	15.5	12.5	27.4	0.47	0.37		0.83		2.29
Japan	MSCI	October 1979	$2,050,510	17.2	15.1	25.0	0.74	0.80		1.79		1.47
Jordan	IFC	October 1979	$3,451	9.6	8.4	17.5	0.13	0.09	0.11	0.11	0.14	0.38
Malaysia	IFC	October 1985	$144,069	16.2	13.2	27.1	0.40	0.28	0.27	0.57	0.58	−1.43
Mexico	IFC	October 1979	$65,585	22.4	11.0	46.2	0.24	0.19	0.20	0.59	0.64	0.81
Netherlands	MSCI	October 1979	$199,691	18.7	18.5	17.9	0.75	0.77		0.84		0.85

EXHIBIT 1
Continued

Country	Source	Sample Start	Market Capitalization U.S.$ Mil. September 1995	Monthly Arithmetic Mean Return Annualized (%)	Monthly Geometric Mean Return Annualized (%)	Monthly Standard Deviation Annualized (%)	Correlation with World Market Full Sample Monthly	Correlation with World Market Last Five Years Monthly	Correlation of IFC Investables with World Market Last Five Years Monthly	Beta with World Market Last Five Years Monthly	Beta of IFC Investables with World Market Last Five Years Monthly	Conditional Beta with World Market September 1995
New Zealand	MSCI	April 1988	$20,605	18.3	2.0	54.6	0.09	0.15		0.89		0.86
Nigeria	IFC	October 1985	$1,443	14.6	11.3	27.6	0.56	0.57	NA	1.11	NA	−0.21
Norway	MSCI	October 1979	$24,715	10.0	7.2	25.0	0.40	0.50		0.92		0.90
Pakistan	IFC	October 1985	$7,799	18.4	16.9	24.1	0.00	0.00	−0.03	0.01	−0.12	−0.18
Peru*	IFC	April 1993	$7,356	39.1	36.2	41.0	0.39	0.39	0.38	1.49	1.45	2.17
Philippines	IFC	October 1985	$32,829	41.7	41.7	36.8	0.31	0.22	0.09	0.57	0.27	0.93
Poland*	IFC	April 1993	$2,236	93.3	81.3	90.3	0.44	0.44	0.44	3.70	3.70	5.89
Portugal	IFC	October 1986	$11,416	30.5	24.5	43.7	0.41	0.60	0.58	1.07	1.10	−0.64
Singapore	MSCI	October 1979	$56,200	15.5	12.8	25.4	0.53	0.56		0.83		−0.64
South Africa*	IFC	April 1993	$147,685	37.5	40.8	24.5	0.31	0.31	0.32	0.72	0.74	−1.11
South Korea	IFC	October 1979	$136,648	16.1	12.3	30.3	0.24	0.26	0.18	0.59	0.44	0.90
Spain	MSCI	October 1979	$86,363	16.0	14.1	23.8	0.56	0.71		1.31		1.14
Sri Lanka*	IFC	April 1993	$1,242	6.3	0.9	33.5	−0.04	−0.04	0.03	−0.13	0.11	−5.81
Sweden	MSCI	October 1979	$107,947	23.0	22.2	24.0	0.59	0.63		1.23		2.28
Switzerland	MSCI	October 1979	$285,171	14.8	13.8	19.0	0.69	0.65		0.80		1.11
Taiwan	IFC	October 1985	$111,461	31.6	21.3	50.5	0.22	0.25	0.27	0.88	0.90	2.23
Thailand	IFC	October 1979	$95,829	21.9	19.9	26.9	0.27	0.12	0.12	0.30	0.33	0.82
Turkey	IFC	October 1987	$16,938	41.3	20.1	71.5	0.07	0.03	0.02	0.13	0.09	2.81
United Kingdom	MSCI	October 1979	$842,965	16.5	15.3	21.2	0.76	0.78		1.08		0.87
United States	MSCI	October 1979	$3,540,304	15.4	15.3	14.8	0.77	0.58		0.50		0.88

EXHIBIT 1
Continued

Country	Source	Sample Start	Market Capitalization U.S.$ Mil. September 1995	Monthly Arithmetic Mean Return Annualized (%)	Monthly Geometric Mean Return Annualized (%)	Monthly Standard Deviation Annualized (%)	Correlation with World Market Full Sample Monthly	Correlation with World Market Last Five Years Monthly	Correlation of IFC Investables with World Market Last Five Years Monthly	Beta with World Market Last Five Years Monthly	Beta of IFC Investables with World Market Last Five Years Monthly	Conditional Beta with World Market September 1995
Venezuela	IFC	October 1985	$2,998	20.8	11.1	45.0	−0.08	0.23	0.19	0.75	0.91	−2.10
Zimbabwe	IFC	October 1979	$1,469	14.5	8.8	34.9	0.08	0.17	0.06	0.50	0.22	−0.62

All returns are in U.S. dollars.
World market refers to the MSCI World Equity Index in U.S. dollars.
Asterisks denote countries with under five years of data. Betas and correlations calculated with available data.
Conditional beta calculated from regressing country return on the world market return and the world market return multiplied by the lagged log country credit rating minus its time series average value.

Sudan, it may be unlikely that any hurdle rate is acceptable to the multinational corporation considering a direct investment project. As a result, we pursue a log-linear model that captures the potential non-linearity at low credit ratings:

$$R_{i,t+1} = \gamma_0 + \gamma_1 \ln(CCR_{it}) + \varepsilon_{i,t+1}$$

The slope coefficient should be negative, implying that a higher credit rating is associated with lower average returns.

We are also interested in any differences in the reward for risk across different markets. We estimate augmented versions of the model:

$$R_{i,t+1} = \gamma_0 + \gamma_1 \ln(CCR^{D}_{it}) +$$

$$\gamma_2 \ln(CCR^{E}_{it}) + \varepsilon_{i,t+1}$$

The superscripts D and E denote emerging and developed markets, respectively. The model allows for different rewards for credit risk depending on the type of market.

Finally, we fit the identical specifications to explain the variance of the returns over the period:

$$\sigma_{i,t+1} = \gamma_0 + \gamma_1 \ln(CCR_{it}) + \varepsilon_{i,t+1}$$

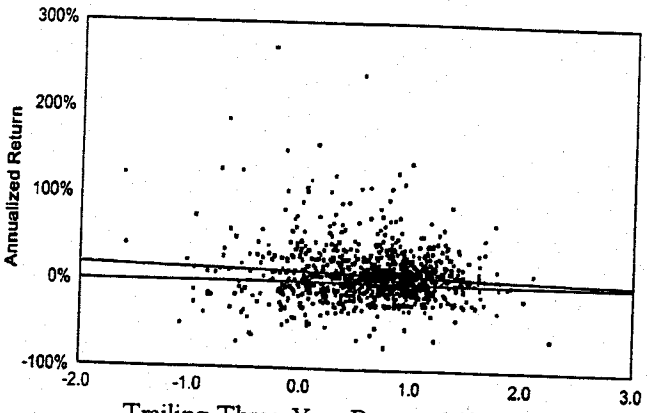
where σ is the unconditional standard deviation of the monthly returns six months after the credit rating is observed.

RESULTS — BETA RISK AND TOTAL RISK MODELS

Exhibit 2 presents the average returns three years following the observation of a beta coefficient against the beta estimated with respect to the MSCI world market portfolio. There is no significant relation between beta and average return. The regression equation suggests that the slope is negative (higher beta risk is associated with lower expected returns) but insignificant. Hence, this particular model, while potentially a useful one for developed markets, is potentially problematic when applied to emerging markets. This extends the results of Harvey [1995] to a broader cross-section of countries.

We also estimate a conditional beta model that

EXHIBIT 2
ANNUALIZED RETURNS AND BETA WITH MSCI WORLD PORTFOLIO



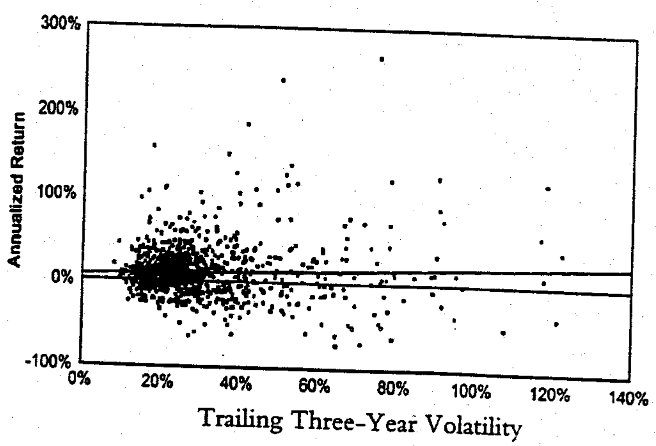
Time series cross-sectional regression based on U.S. dollar returns. Semiannual observations (October 1979-September 1995).

follows Shanken [1990] and Ferson and Harvey [1991, 1995]. The model is:

$$R_{i,t} = b_{i,0} + b_{i,1}R_{w,t} + b_{i,2}\,[R_{w,t} \times CCR^*_{i,t-1}] + v_{i,t}$$

where the asterisk denotes the log-demeaned credit rating. This interaction term tells us the impact of credit

EXHIBIT 3
ANNUALIZED RETURNS AND THREE-YEAR STANDARD DEVIATION OF RETURNS



Time series cross-sectional regression based on U.S. dollar returns. Semiannual observations (October 1979-September 1995).

rating on the risk.

The last column in Exhibit 1 reports the conditional beta. While the coefficient on the interaction term is negative in thirty-three of the forty-seven markets (lower credit rating means higher risk), it is clear that the patterns in the conditional betas from this formulation are insufficient to explain the expected returns in the developing markets.

Exhibit 3 presents the volatility plotted against the subsequent average return over three years. There is a weak positive relation observed here. Higher standard deviation is associated with higher returns. This is particularly the case among the emerging equity markets and is consistent with the economic model proposed in Bekaert and Harvey [1995c].

As mentioned earlier, both these models are problematic when going to the other eighty-eight countries. In those countries, there is no way to estimate a beta coefficient or volatility. Even if significant cross-sectional relation were obtained, this framework will not produce expected returns because data on the determining attribute (equity risk) are not available for this broader set of countries.

RESULTS — CREDIT RISK MODELS

Exhibit 4 presents the regression results for the credit risk model. In Panel A, the slope coefficient is significantly different from zero and the correct sign (heteroscedasticity-consistent t-statistic of −3.7). Exhibit 5 graphs the fitted values of the regression and extends the fitted values to credit ratings lower than the ones observed in our sample.

We also estimate (but do not report) a linear model. Even within the sample of countries with equity returns, though, the linear model does not seem appropriate. The fitted values for the highest-rated countries (like Switzerland) are too low compared to the average returns. The fitted values for the lowest-rated countries are also too low. This is immediate evidence of non-linearity.

The log model appears to capture this non-linearity. The difference between the linear and the log models is most evident at the very low credit risk points. In this region, the log model gives much higher fitted values. It is difficult to judge the model in this region because we are in "no man's land." That is, there are no observations of the dependent variable available for a reasonableness check — a problem we inevitably

EXHIBIT 4
Time Series Cross-Sectional Predictive Models

	Intercept T-Stat	All Countries Slope T-Stat	Emerging Countries Slope T-Stat	Developed Countries Slope T-Stat	Adjusted R-Square
A. Expected Return Model					
Full Sample	53.71	−10.47			1.76%
	4.42	3.68			
Split Sample	66.21		−14.09	−13.15	1.80%
	3.48		−2.80	−3.04	
B. Expected Volatility Model					
Full Sample	25.13	−4.27			10.97%
	10.98	−7.98			
Split Sample	20.17		−3.21	−2.84	11.63%
	5.71		−3.10	−4.00	

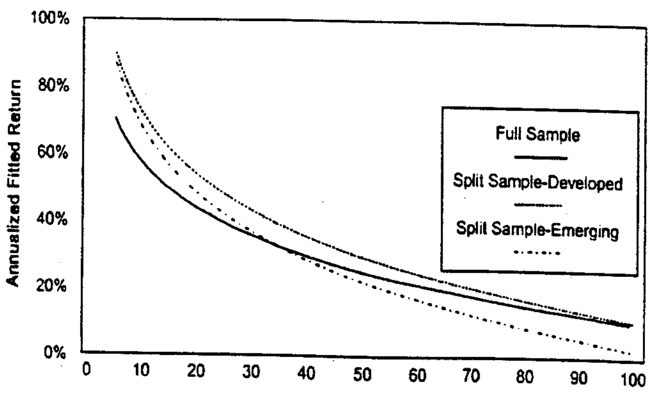
Coefficients are based on time series cross-sectional regressions of semiannual U.S. dollar total returns or the standard deviation of the returns over the next six months on the log of the credit rating.
T-statistics are based on heteroscedasticity-consistent standard errors.
Split sample regression estimates separate slope coefficients for emerging and developed markets.
Note that no other conditioning information is used in these models.

face when trying to estimate the cost of capital for all countries in the world.

It turns out that the split sample regression offers little compared to the full sample regression. The difference between coefficients on the credit rating variable for developed countries and developing countries is not significantly different from zero. In addition, the amount of variance explained, adjusted for the number of regressors, is only slightly higher with the augmented model.

The fitted values are presented in Exhibit 5. Notice that the model fitted on the developed country returns and extended to the low credit rating region is very similar to the model estimated on just the emerging market returns. This analysis suggests that the reward for credit risk is similar across emerging and developed markets.

EXHIBIT 5
FITTED RETURNS FROM COUNTRY CREDIT RISK MODEL



Time series cross-sectional regression based on U.S. dollar returns. Semiannual observations (October 1979-September 1995).

FITTED EXPECTED RATES OF RETURN

The graphs provide fitted expected rates of return for the full range of credit ratings. Exhibit 6 presents the most recent forecast of expected (annual) returns for 135 countries. These expected returns are presented for the log model. The formula is simple. The natural logarithm of the September 1995 credit rating is multiplied by −10.47 (slope coefficient from Exhibit 4) and added to 53.17 (the intercept from Exhibit 4). This gives a semiannual expected return. This quantity is doubled and presented in Exhibit 6.

To calculate hitting times, we need both the ex ante expected return and variance. The results of estimating the volatility models are presented in Panel B of

EXHIBIT 6
Expected Returns, Volatility, and Hitting Times

Country	Credit Rating Sept. 1995	Expected Returns	Expected Volatility	Hitting Time in Years Break-Even	Hitting Time in Years Doubling
Afghanistan	8.3	63.1	55.7	1.70	4.62
Albania	12.5	54.5	49.7	1.74	5.04
Algeria	22.8	41.9	40.8	1.88	5.98
Angola	11.3	56.6	51.2	1.73	4.92
Argentina	38.8	30.8	32.9	2.16	7.52
Australia	71.2	18.1	23.9	3.13	11.86
Austria	86.2	14.1	21.1	3.93	15.02
Bahrain	51.9	24.7	28.6	2.47	9.01
Bangladesh	25.6	39.5	39.0	1.93	6.24
Barbados	37.3	31.6	33.5	2.13	7.37
Belarus	15.5	50.0	46.5	1.78	5.31
Belgium	79.2	15.9	22.3	3.51	13.41
Benin	15.4	50.2	46.6	1.78	5.31
Bolivia	22.4	42.3	41.0	1.88	5.94
Botswana	49.0	25.9	29.4	2.39	8.65
Brazil	34.9	33.0	34.5	2.09	7.13
Bulgaria	16.9	48.2	45.2	1.80	5.44
Burkina Faso	22.2	42.5	41.2	1.87	5.93
Cameroon	18.7	46.1	43.7	1.82	5.61
Canada	80.3	15.6	22.1	3.57	13.64
Chile	57.4	22.6	27.1	2.63	9.72
China	57.0	22.8	27.2	2.61	9.67
Colombia	46.5	27.0	30.2	2.33	8.36
Congo	14.6	51.3	47.4	1.77	5.23
Costa Rica	31.0	35.5	36.2	2.02	6.75
Cote d'Ivoire	17.4	47.6	44.8	1.80	5.49
Croatia	18.5	46.3	43.9	1.82	5.59
Cuba	8.7	62.1	55.0	1.70	4.66
Cyprus	54.3	23.8	27.9	2.54	9.31
Czech Republic	58.4	22.3	26.8	2.66	9.86
Denmark	79.9	15.7	22.2	3.55	13.56
Dominican Republic	22.6	42.1	40.9	1.88	5.96
Ecuador	25.1	39.9	39.3	1.92	6.19
Egypt	33.9	33.6	34.9	2.07	7.03
El Salvador	20.1	44.6	42.6	1.84	5.73
Estonia	26.3	39.0	38.6	1.94	6.30
Ethiopia	14.1	52.0	47.9	1.76	5.19
Finland	71.4	18.0	23.9	3.13	11.89

EXHIBIT 6
Continued

Country	Credit Rating Sept. 1995	Expected Returns	Expected Volatility	Hitting Time in Years Break-Even	Hitting Time in Years Doubling
France	89.1	13.4	20.6	4.13	15.78
Gabon	25.3	39.8	39.2	1.92	6.21
Georgia	8.1	63.6	56.1	1.69	4.60
Germany	90.9	13.0	20.3	4.27	16.29
Ghana	29.1	36.8	37.1	1.98	6.57
Greece	50.0	25.5	29.1	2.42	8.77
Grenada	9.4	60.5	53.9	1.71	4.73
Guatemala	22.1	42.6	41.2	1.87	5.92
Guinea	14.1	52.0	47.9	1.76	5.19
Haiti	8.8	61.9	54.9	1.70	4.67
Honduras	15.9	49.5	46.1	1.78	5.35
Hong Kong	67.0	19.4	24.8	2.95	11.15
Hungary	45.0	27.7	30.7	2.30	8.19
Iceland	57.6	22.5	27.0	2.63	9.75
India	46.1	27.2	30.3	2.32	8.32
Indonesia	52.4	24.5	28.4	2.48	9.07
Iran	24.8	40.2	39.5	1.91	6.16
Iraq	8.2	63.4	55.9	1.69	4.61
Ireland	73.4	17.5	23.5	3.22	12.26
Israel	49.2	25.8	29.4	2.40	8.68
Italy	72.3	17.8	23.7	3.17	12.06
Jamaica	26.3	39.0	38.6	1.94	6.30
Japan	91.6	12.8	20.2	4.33	16.49
Jordan	27.7	37.9	37.9	1.96	6.43
Kazakhstan	19.3	45.4	43.2	1.83	5.66
Kenya	26.4	38.9	38.6	1.94	6.31
Kuwait	53.4	24.1	28.2	2.51	9.20
Latvia	23.4	41.4	40.4	1.89	6.04
Lebanon	25.3	39.8	39.2	1.92	6.21
Liberia	6.3	68.9	59.8	1.68	4.41
Libya	30.0	36.2	36.7	2.00	6.65
Lithuania	22.9	41.9	40.7	1.88	5.99
Luxembourg	85.5	14.3	21.2	3.88	14.85
Malawi	19.1	45.7	43.4	1.83	5.64
Malaysia	69.1	18.7	24.3	3.04	11.49
Mali	17.4	47.6	44.8	1.80	5.49
Malta	61.8	21.1	26.0	2.77	10.34
Mauritius	45.9	27.3	30.4	2.32	8.29
Mexico	41.8	29.3	31.8	2.23	7.84

EXHIBIT 6
Continued

Country	Credit Rating Sept. 1995	Expected Returns	Expected Volatility	Hitting Time in Years Break-Even	Doubling
Morocco	39.1	30.7	32.8	2.17	7.55
Mozambique	12.8	54.0	49.3	1.75	5.06
Myanmar	17.3	47.7	44.8	1.80	5.48
Nepal	25.1	39.9	39.3	1.92	6.19
Netherlands	89.3	13.4	20.6	4.15	15.84
New Zealand	69.4	18.6	24.3	3.05	11.55
Nicaragua	9.6	60.1	53.6	1.71	4.75
Nigeria	15.8	49.6	46.2	1.78	5.34
North Korea	7.2	66.1	57.8	1.68	4.51
Norway	84.6	14.5	21.4	3.83	14.63
Oman	51.8	24.8	28.6	2.47	8.99
Pakistan	30.7	35.7	36.4	2.01	6.72
Panama	26.4	38.9	38.6	1.94	6.31
Papua New Guinea	33.9	33.6	34.9	2.07	7.03
Paraguay	30.7	35.7	36.4	2.01	6.72
Peru	25.8	39.4	38.9	1.93	6.26
Philippines	36.8	31.9	33.7	2.12	7.32
Poland	37.6	31.5	33.4	2.14	7.40
Portugal	68.4	18.9	24.5	3.01	11.38
Qatar	53.6	24.0	28.1	2.52	9.22
Romania	29.7	36.4	36.8	1.99	6.62
Russia	19.4	45.3	43.2	1.83	5.67
Saudi Arabia	55.3	23.4	27.6	2.56	9.44
Senegal	21.6	43.1	41.6	1.86	5.87
Seychelles	24.3	40.6	39.8	1.90	6.12
Sierra Leone	8.1	63.6	56.1	1.69	4.60
Singapore	84.0	14.6	21.5	3.79	14.48
Slovakia	35.7	32.6	34.1	2.10	7.21
Slovenia	42.4	29.0	31.6	2.24	7.91
South Africa	45.2	27.6	30.6	2.30	8.21
South Korea	72.2	17.8	23.7	3.17	12.04
Spain	73.7	17.4	23.4	3.24	12.31
Sri Lanka	33.0	34.2	35.3	2.05	6.94
Sudan	6.0	69.9	60.5	1.67	4.37
Swaziland	29.2	36.8	37.1	1.98	6.58
Sweden	74.1	17.3	23.3	3.25	12.39
Switzerland	92.2	12.7	20.1	4.37	16.67
Syria	24.6	40.4	39.6	1.91	6.15

EXHIBIT 6
Continued

Country	Credit Rating Sept. 1995	Expected Returns	Expected Volatility	Hitting Time in Years Break-Even	Doubling
Taiwan	79.9	15.7	22.2	3.55	13.56
Tanzania	16.7	48.5	45.4	1.80	5.43
Thailand	63.8	20.4	25.5	2.84	10.64
Togo	17.0	48.1	45.1	1.80	5.45
Trinidad & Tobago	34.4	33.3	34.7	2.08	7.08
Tunisia	44.0	28.2	31.0	2.28	8.08
Turkey	40.9	29.7	32.1	2.21	7.74
Uganda	13.1	53.5	49.0	1.75	5.09
Ukraine	15.7	49.8	46.3	1.78	5.33
United Arab Emirates	60.8	21.4	26.2	2.73	10.20
United Kingdom	87.8	13.7	20.8	4.04	15.44
United States	90.7	13.0	20.3	4.25	16.23
Uruguay	38.5	31.0	33.0	2.16	7.49
Uzbekistan	15.3	50.3	46.7	1.78	5.30
Venezuela	31.4	35.2	36.0	2.02	6.79
Vietnam	29.5	36.6	36.9	1.99	6.60
Yugoslavia	7.3	65.8	57.6	1.69	4.52
Zaire	7.4	65.5	57.4	1.69	4.53
Zambia	15.1	50.6	46.9	1.77	5.28
Zimbabwe	31.0	35.5	36.2	2.02	6.75

Expected return and risk estimates are calculated from an unhedged U.S. dollar perspective.
Expected returns are the annualized arithmetic returns based on Exhibit 4.
Expected volatilities are based on Exhibit 7.

Exhibit 4. There is one difference between the results for the expected returns and the volatilities. There appears to be more of a difference between developed countries and developing countries. Although credit rating is strongly negatively related to expected returns in both groups of countries, the magnitude of the coefficient is greater in emerging markets. In economic terms, a 10-point drop in credit rating would increase volatility by 6.6 percentage points in a developed market and 7.4 percentage points in an emerging market. Nevertheless, the two coefficients are only one standard error from each other.

HITTING TIME

Often potential investors calculate the net present value of the investment and the internal rate of return. Another useful piece of information is the hitting time. The intuition is as follows.

Suppose returns are symmetrically distributed. If you know that expected return on a U.S. investment is 14.7%, what is the probability that 14.7% will be achieved in the first year? The answer is 50%. That is, the expected return is just the mean of the probability distribution, and, by definition of a symmetric distribution, there is equal probability on both sides. If we were given more information on the distribution, such as the shape of the distribution (normal) and the standard deviation, we could calculate the probability of achieving certain returns over the year.

The idea of hitting time is to fix the probability, the expected returns, and the volatility, and to calculate how long it would take to achieve a certain return. We choose two hurdles: break-even and doubling of investment. We ask how long it will take to achieve these hurdles with 90% confidence.

We assume that the distribution of data is normal.* It is possible, of course, to make other assumptions about the distribution of returns. Indeed, it is also possible to use the historical returns as the empirical distribution and by using Monte Carlo methods answer the same question.

The hitting times have a wide range of values, depending on the country examined. For example, it takes almost two years for the investment in Afghanistan to break even with 90% confidence. This amount of time may be too long for an investor worried about the potentially volatile downside political and economic risk. On the other hand, the U.S. investment takes a little over four years to break even with 90% probability. One has to wait sixteen years for the investment to double in value with 90% confidence.

OTHER MEASURES OF RISK

There are alternative metrics that can be used to develop volatility and expected returns in these countries. To be useful, the variable must be available for a wide range of countries on a timely basis. Some fundamental variables might include: per capita gross domestic product, the growth in GDP, the size of the trade sector, inflation growth, the change in the exchange rate versus a benchmark, the volatility of exchange rate changes, size of the government sector, the indebtedness of the country, the number of years of schooling, life expectancy, quality of life index, and political risk indexes. Using the same technique, a regression model can be fitted on the forty-seven countries and extended to the other eighty-eight countries.

The country credit rating is likely correlated with many of these measures. For example, the correlation between the average country credit ratings and the average International Country Risk Guide's (ICRG) political risk ratings used in Diamonte, Liew, and Stevens [1996] and Erb, Harvey, and Viskanta [1996] is 85%, which is reported in Exhibit 7. The correlation between the credit ratings and the ICRG economic risk rating is 81%. The highest correlation is found for the credit rating and the ICRG financial risk, 92%.

CONCLUSIONS

Developing countries represent about 20% of world GDP and 85% of the world population, yet only 9% of world equity capitalization. It is reasonable to suppose that these markets will grow in the future — especially as more countries create new equity markets. This article provides a method of assessing what to expect in these new markets.

The other contribution of the research is to examine the investment process. In segmented capital markets, it is not appropriate to use the beta of the country with respect to the world market portfolio as a measure of risk. Indeed, a misapplication of this methodology could lead to gross underestimates of the cost of capital in segmented equity markets.

The method we propose to forecast expected returns and volatility is simple and parsimonious. Of course, it is not necessarily the best model for expected returns and volatility. Because of the nature of the problem, there is no way to verify the accuracy of the results until some of the developing countries "emerge" into the MSCI or IFC data bases.

ENDNOTES

The authors appreciate the comments of Bernard Dumas, who suggested the "hitting time" approach.

To ensure the widest possible dissemination of our methodology, we have established a country risk homepage:
http://www.duke.edu/~charvey/Country_Risk/covindex.htm
This site includes the most recent estimates of the expected returns

EXHIBIT 7
Relationship of *Institutional Investor* Country Credit Ratings with Alternative Measures of Risk

Country	II CCR	ICRGC	ICRGP	ICRGF	ICRGE
	Sample Average				
Argentina	25.4	53.1	62.4	22.9	20.7
Australia	73.1	80.4	81.0	42.4	37.1
Austria	83.9	86.3	86.4	46.2	39.8
Belgium	77.6	81.4	80.1	44.5	37.9
Brazil	29.8	59.1	64.9	29.7	23.3
Canada	84.7	83.7	82.6	45.9	38.6
Chile	36.5	62.6	58.8	35.4	30.8
China	57.6	69.3	67.4	39.1	33.4
Colombia	38.8	62.7	57.9	34.5	32.6
Denmark	73.6	83.9	85.8	43.3	38.3
Finland	74.5	81.9	85.1	43.7	34.7
France	85.1	80.8	79.6	44.2	37.6
Germany	92.2	86.6	83.3	48.5	41.3
Greece	48.6	63.0	63.7	30.7	31.2
Hong Kong	66.9	73.6	67.3	40.8	38.7
Hungary	46.0	73.2	75.4	40.0	32.2
India	45.1	54.8	49.2	29.6	30.5
Indonesia	50.4	67.6	57.6	41.1	36.2
Ireland	67.7	79.7	78.2	42.9	38.1
Italy	75.9	77.4	74.1	43.5	36.9
Japan	93.7	88.0	84.9	48.5	42.4
Jordan	29.9	56.5	51.9	26.3	34.5
Malaysia	61.5	72.5	67.3	37.6	39.8
Mexico	37.0	64.1	67.7	32.1	28.2
Netherlands	87.5	87.6	86.5	46.7	41.7
New Zealand	64.4	82.6	82.4	45.8	36.8
Nigeria	20.4	50.0	47.8	23.9	28.1
Norway	80.7	87.0	85.4	46.3	42.0
Pakistan	29.2	49.0	40.4	25.0	32.2
Peru	20.3	58.0	53.6	31.3	28.3
Philippines	25.3	51.8	46.8	26.2	30.4
Poland	32.8	75.8	77.0	38.3	36.0
Portugal	67.2	79.6	75.0	42.6	41.0
Singapore	78.0	81.8	79.5	43.9	40.0
South Africa	40.5	73.4	72.3	37.8	36.6
South Korea	65.7	74.7	67.4	43.7	38.0
Spain	72.5	74.3	71.1	40.7	36.5
Sri Lanka	29.8	63.3	57.0	33.2	36.0
Sweden	78.1	84.0	85.0	45.0	37.7
Switzerland	93.6	92.3	91.8	49.9	42.6

EXHIBIT 7
Continued

Country	II CCR	ICRGC	ICRGP	ICRGF	ICRGE
	Sample Average				
Taiwan	76.4	83.2	76.3	46.8	43.1
Thailand	58.0	67.1	59.9	37.1	37.0
Turkey	42.2	55.6	55.0	28.3	27.8
United Kingdom	86.8	82.2	80.7	47.6	35.9
United States	91.4	84.6	82.6	48.6	37.8
Venezuela	36.3	64.5	66.1	31.4	31.2
Zimbabwe	25.1	52.6	52.9	25.7	26.4
Correlation with II CCR		91.8%	85.0%	92.4%	81.1%

Legend
II CCR *Institutional Investor* Country Credit Rating
ICRGC International Country Risk Guide Composite Index
ICRGP International Country Risk Guide Political Index
ICRGF International Country Risk Guide Financial Index
ICRGE International Country Risk Guide Economic Index

Time Period: January 1984-September 1995.

Source: Erb, Harvey, and Viskanta [1996].

for 135 countries as well as the associated hitting time measures.

*This assumption is made for convenience. There is sharp evidence of departures from normality in Harvey [1995] and Bekaert and Harvey [1995a].

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