Chapter 20
International Portfolio Diversification

20.1 The Algebra of Portfolio Diversification
20.2 Mean-Variance Efficiency
20.3 The Benefits of International Portfolio Diversification
20.4 Variances on Foreign Stock and Bond Investments
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Perfect financial markets ...a starting point

- **Frictionless markets**
  - no government intervention or taxes
  - no transaction costs or other market frictions
- **Rational investors with equal access to costless information and market prices**
  - All investors rationally price financial securities
  - All investors have equal access to costless information
  - All investors have equal access to market prices

The algebra of portfolio theory

Assumptions
- Nominal returns are **normally distributed**
- Investors want **more return** and **less risk** in their functional currency

x_i = proportion of wealth in asset i, s.t. $\Sigma_i x_i = 1$

Expected return on a portfolio

$E[r_P] = \Sigma_i x_i E[r_i]$

Portfolio variance

$Var(r_P) = \sigma_P^2 = \Sigma_i \Sigma_j x_i x_j \sigma_{ij}$

where $\sigma_{ij} = \rho_{ij} \sigma_i \sigma_j$

Expected return on a portfolio

	$E[r_i]$	σ_i
A American	11.8%	17.8%
J Japanese	15.4%	36.5%

Example: Equal weights of A and J

$$E[r_P] = x_A E[r_A] + x_J E[r_J] = (½)(0.118)+(½)(0.154) = 0.136, \text{ or } 13.6\%$$

Variance of a portfolio

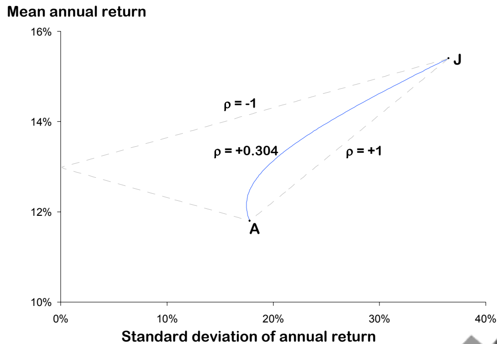
	$E[r_i]$	σ_i	Correlation A	Correlation J
A American	11.8%	17.8%	1.000	0.304
J Japanese	15.4%	36.5%	0.304	1.000

$$\sigma_P^2 = x_A^2 \sigma_A^2 + x_J^2 \sigma_J^2 + 2\, x_A x_J\, \rho_{AJ} \sigma_A \sigma_J$$
$$= (½)^2(0.178)^2 + (½)^2(0.365)^2 + 2(½)(½)(0.304)(0.178)(0.365) = 0.0511$$
$$\sigma_P = (0.0511)^{1/2} = 0.226, \text{ or } 22.6\%$$

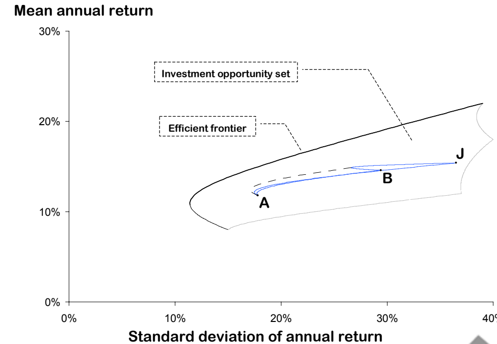
Key results of portfolio theory

- The extent to which risk is reduced by portfolio diversification depends on the correlation of assets in the portfolio.
- As the number of assets increases, portfolio variance becomes more dependent on the covariances (or correlations) and less dependent on variances.
- The risk of an asset when held in a large portfolio depends on its covariance (or correlation) with other assets in the portfolio.

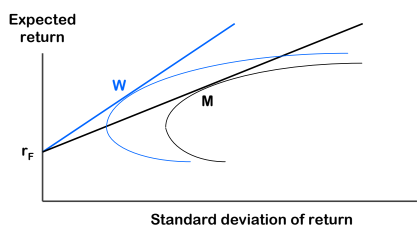
Diversification



Mean-variance efficiency

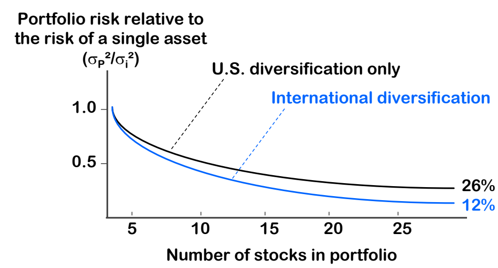


The promise of international portfolio diversification

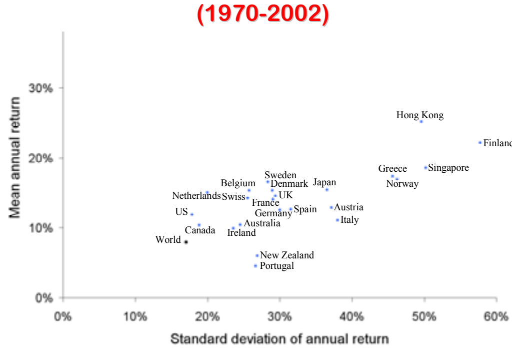


- Potential for higher returns
- Potential for lower portfolio risk

Domestic versus international diversification



Historical stock market performance
(1970-2002)



International stock returns
(Dollar returns to US investors from 1970-2002)

	Mean	Stdev	β_W	SI
Canada	10.4	18.8	0.79	0.17
France	14.0	29.1	1.09	0.23
Germany	12.5	30.0	1.05	0.18
Japan	15.4	36.5	1.39	0.23
Switzerland	14.2	25.5	0.98	0.28
U.K.	14.6	29.4	1.14	0.25
U.S.	11.8	17.8	0.87	0.26
World	0.112	0.176	1.00	0.23

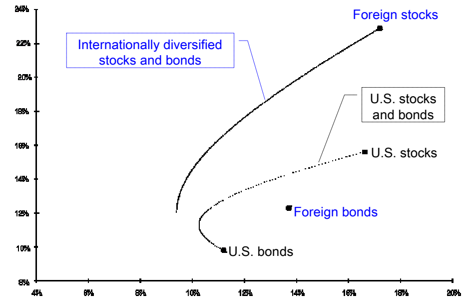
β_W versus the MSCI world stock market index

Sharpe Index (SI) = $(r_P - r_F) / \sigma_P$

International equity correlations
(Dollar returns to US investors from 1970-2002)

	Can	Fra	Ger	Jap	Swi	UK	US
France	0.472						
Germany	0.388	0.645					
Japan	0.320	0.399	0.364				
Swiss	0.464	0.618	0.670	0.430			
U.K.	0.513	0.559	0.451	0.369	0.569		
U.S.	0.727	0.482	0.443	0.304	0.504	0.522	
World	0.735	0.657	0.618	0.671	0.674	0.685	0.855

International asset allocation



"Asset Allocation." Jorion, *Journal of Portfolio Management*, Summer 1989.

Return on a foreign asset

Recall $P_t^d = P_t^f S_t^{d/f}$

$(P_t^d/P_{t-1}^d) = (1+r^d)$

and $(S_t^{d/f}/S_{t-1}^{d/f}) = (1+s^{d/f})$

Return on a foreign asset

$(1+r^d) = (P_t^d/P_{t-1}^d) = (P_t^f S_t^{d/f}/P_{t-1}^f S_{t-1}^{d/f})$

$= (P_t^f/P_{t-1}^f)(S_t^{d/f}/S_{t-1}^{d/f})$

$= (1+r^f)(1+s^{d/f})$

$= 1+r^f+s^{d/f}+r^f s^{d/f}$ (20.7)

Return statistics on foreign assets

Expected return

$E[r^d] = E[r^f]+E[s^{d/f}]+E[r^f s^{d/f}]$

$Var(r^d)$

$= Var(r^f)+Var(s^{d/f})+Var(r^f s^{d/f})$

$+2Cov(r^f,s^{d/f})+2Cov(r^f,r^f s^{d/f})+2Cov(s^{d/f},r^f s^{d/f})$

$= Var(r^f) + Var(s^{d/f}) +$ (interaction terms)

Variance of return on foreign stocks
(from the perspective of a US investor)

	$Var(r^f)$	+	$Var(s^{\$/f})$	+	Interaction terms	=	$Var(r^{\$})$
Canada	0.915	+	0.033	+	0.053	=	1.000
France	0.937	+	0.149	+	-0.086	=	1.000
Germany	0.973	+	0.194	+	-0.167	=	1.000
Japan	0.813	+	0.182	+	0.005	=	1.000
Switzerland	0.928	+	0.298	+	-0.225	=	1.000
U.K.	0.902	+	0.127	+	-0.029	=	1.000
Average	0.911	+	0.164	+	-0.075	=	1.000

- The dominant risk in foreign stock markets is return variability in the local currency
- Exchange rate variability is less important

Variance of return on foreign bonds
(from the perspective of a US investor)

	$Var(r^f)$	+	$Var(s^{\$/f})$	+	Interaction terms	=	$Var(r^{\$})$
Canada	0.601	+	0.184	+	0.215	=	1.000
France	0.242	+	0.823	+	-0.065	=	1.000
Germany	0.124	+	0.818	+	0.058	=	1.000
Japan	0.172	+	0.701	+	0.126	=	1.000
Switzerland	0.090	+	0.936	+	-0.026	=	1.000
U.K.	0.287	+	0.599	+	0.114	=	1.000
Average	0.253	+	0.677	+	0.070	=	1.000

- The dominant risk in foreign bond markets is exchange rate variability
- Return variability in the local currency is less important

Home asset bias

- Despite the potential benefits of international portfolio diversification, most investors tilt their portfolios toward domestic securities.

The extent of home bias

	Portfolio weights	
	Predicted	**Actual**
	Market cap as percent of total	Percentage in domestic equities
France	2.6%	64.4%
Germany	3.2%	75.4%
Italy	1.9%	91.0%
Japan	43.7%	86.7%
Spain	1.1%	94.2%
Sweden	0.8%	100.0%
U.K.	10.3%	78.5%
U.S.	36.4%	98.0%

Source: Cooper & Kaplanis, "Home Bias in Equity Portfolios, Inflation Hedging, and International Capital Market Equilibrium," *Review of Financial Studies*, Spring 1994.

Why is there home bias? Portfolio theory can argue either way

- Tilt toward more domestic assets
  - Domestic stock portfolios can hedge domestic inflation risk
  - Banks and insurance companies with domestic liabilities have an incentive to hedge with domestic assets
- Tilt toward fewer domestic assets
  - Labor income is highly correlated with other domestic assets, so investors' portfolios of tradable assets should be tilted away from domestic assets

Why is there home bias? Market imperfections

- Financial market imperfections
  - Market frictions
    - Government controls
    - Taxes
    - Transactions costs
  - Investor irrationality
  - Unequal access to market prices
  - Unequal access to information

Investor irrationality

- Hueristics (decision rules)
  - While hueristics can simplify decision-making, they also lead to cognitive biases
- Frame dependence
  - The form in which a problem is presented can influence decisions

    Overconfidence

    should lead to higher trading volume

    Regret avoidance

    tendency to hold losers & sell winners

Unequal access to prices

	Weight in a U.S. investor's portfolio		
		Predicted	Adjusted prediction
	Actual	(% of cap)	(% of available cap)
Australia	0.24	1.30	1.25
Brazil	0.24	1.12	0.47
Canada	0.54	2.49	1.63
France	0.65	2.96	2.34
Germany	0.49	3.62	2.55
Hong Kong	0.21	1.81	1.32
Italy	0.32	1.51	1.21
Japan	1.04	9.72	7.65
Mexico	0.27	0.69	0.65
Netherlands	0.81	2.05	1.74
Sweden	0.30	1.20	1.21
Switzerland	0.47	2.53	2.39
U.K.	1.66	8.76	10.07
U.S.A.	91.29	49.60	58.32

Source: Dahlquist, Pinkowitz, Stulz, and Williamson, "Corporate Governance and the Home Bias," *Journal of Financial and Quantitative Analysis*, March 2003.

Unequal access to information

- **Unequal access to information**
  - It is difficult to get and interpret information from distant markets
  - Once invested, it is difficult to monitor the actions of distant managers
- **Empirical evidence**
  - Individuals prefer investments that are culturally similar and geographically nearby

Appendix 20-A
Continuous compounding and emerging market returns

$r_t = \ln(1+r_t) = \ln(P_t/P_{t-1}) = \ln(P_t)-\ln(P_{t-1})$

$r_{0,T} = \ln[\,(1+r_1)\,(1+r_2)\ldots(1+r_T)\,]$
$= \ln(1+r_1) + \ln(1+r_2) + \ldots + \ln(1+r_T)]$
$= [r_1+r_2+\ldots+r_T] = \ln(P_T/P_0)$

$r_{avg} = [r_1+r_2+\ldots+r_T]/T$

Continuously compounded returns are additive over time

Continuously compounded returns are symmetric

r_1=100%

100 → (r_1=+69.3%) → 200 → (r_2=-69.3%) → 100

r_2=-50%

$r_{avg} = \ln[(1+r_1)(1+r_2)]/2$
$= \ln[(1+r_1)+\ln(1+r_2)]/2$
$= (r_1+r_2)/2$
$= (+0.693-0.693)/2 = 0$

Emerging markets: Holding period returns

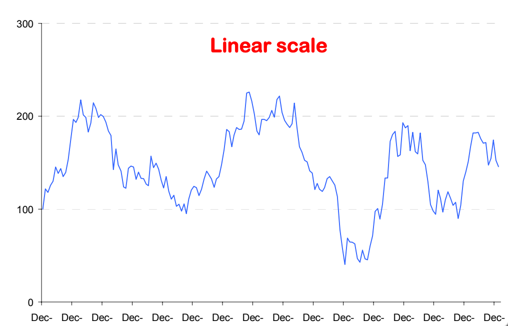
- The normal distribution is not a good fit to holding period return distributions
- Based on monthly returns to the MSCI emerging market indices over 1988-2002
  - 20 of 26 have positive skewness
  - 25 of 26 have excess kurtosis relative to the normal distribution

Emerging markets: Continuously compounded returns

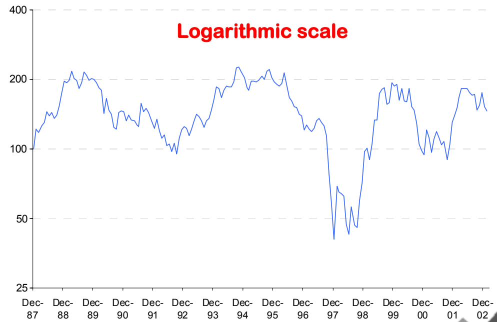
- The normal distribution is a better fit to continuously compounded returns
- Based on monthly returns to the MSCI emerging market indices over 1988-2002
  - 10 of 26 have positive skewness
  - 25 of 26 have excess kurtosis relative to the normal distribution

There remains evidence of leptokurtosis (a few extreme returns in each tail)

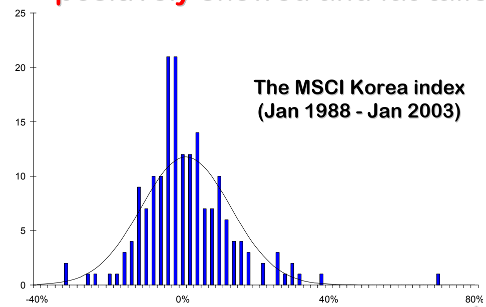
Returns to MSCI's S. Korea index



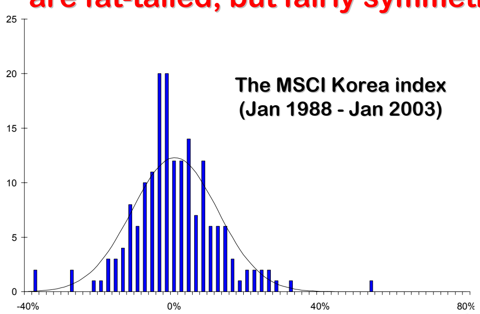
Returns to MSCI's S. Korea index



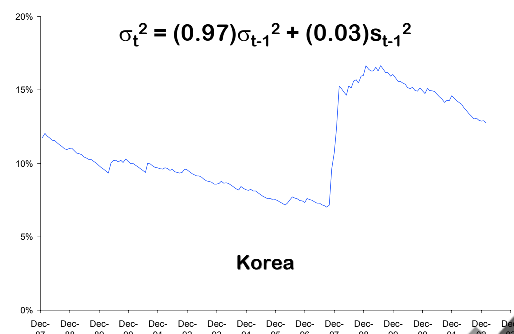
Monthly returns are positively skewed and fat-tailed



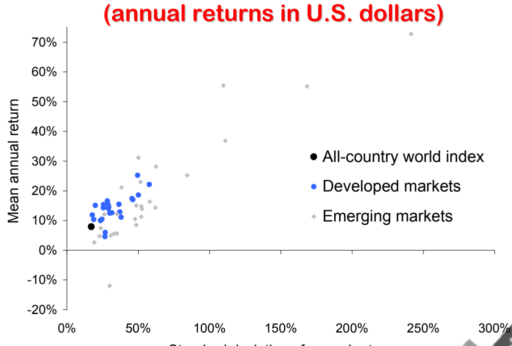
Continuously compounded returns are fat-tailed, but fairly symmetric



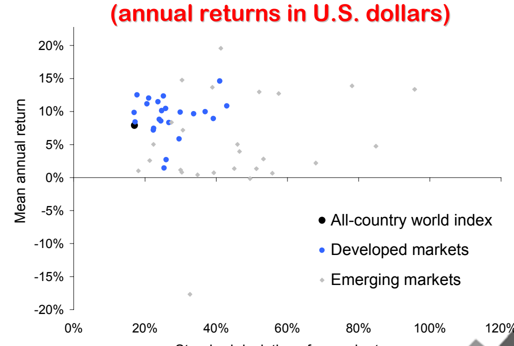
RiskMetrics conditional volatility



Holding period returns
(annual returns in U.S. dollars)



Continuously compounded returns
(annual returns in U.S. dollars)



Correlations, betas, and risks

- Periodic compounding exaggerates the arithmetic means and standard deviations
- The compounding method has much less of an effect on correlations and betas

The Korean market provides an example

- With holding period returns
  μ = 16.3%, σ = 58%, $\rho_{K,W}$ = 0.424, β_K = 1.214
- With continuous compounding
  μ = 2.8%, σ = 53%, $\rho_{K,W}$ = 0.434, β_K = 1.183