Lesson X: Overview

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1. International Portfolio Investment
2. Wrap up (Exercises, Q&A…)

International Portfolio Investment

Terminology

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Portfolio Investment: investment where the investor's holding is too small to provide any effective control (Just to revise, could you define what a FDI is?).

Rust Off I

Diversification means building **multi-asset portfolios**, such that <u>**only**</u> a **portion of total wealth is invested** in each **individual asset**. This allows in turn to **spread out exposure to security-specific factors**, so as to **reduce** the overall level of **risk**.

Even common wisdom suggests that putting all eggs in one basket can be very risky!

Rust Off II

Diversification thus helps reduce **"Asset-Specific Risk"** (a.k.a. "**Non-Systematic Risk**" or "**Diversifiable Risk**").

↓

The risk that remains even after extensive diversification is called **"Market Risk"** (or, equivalently, "**Systematic Risk**" – "**Non Diversifiable Risk**"

Terminology

Systematic risk: risk that cannot be diversified away

Systemic risk: risk of collapse of an entire financial system or entire market

The benefits of diversification I

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$$E[r_p] = \sum_{i=1}^{n} x_i E[r_i]$$

$$\sigma_p^2 = \sum_{i=1}^{n} x_i^2 \sigma_i^2 + \sum_{i=1}^{n} \sum_{j \neq i=1}^{n} x_i x_j \sigma_{ij}$$

With σ_{ij} = Cov(i;j)

The benefits of diversification II

The **benefits of diversification** for risk reduction (for a given E[r]) are closely related to the **correlation term**.

↓

The portfolio standard deviation is reduced if the correlation terms are **negative**, but, even when they are **positive**, the portfolio standard deviation is still less than the weighted average of the individual securities standard deviations

The benefits of diversification III

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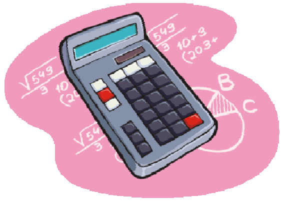
	Equity1	Equity2
E(R)	.08	.055
Risk(σ)	.15	.1
Weights	.75	.25



	E(R*p*)	**Risk**	***Wrisk***
ρ(Equity1;Equity2) = -1	.07375	**.0875**	.1375
ρ(Equity1;Equity2) = -.5	.07375	**.1023**	.1375
ρ(Equity1;Equity2) = -.2	.07375	**.1103**	.1375
ρ(Equity1;Equity2) = 0	.07375	**.1152**	.1375
ρ(Equity1;Equity2) = .2	.07375	**.1200**	.1375
ρ(Equity1;Equity2) = .5	.07375	**.1269**	.1375
ρ(Equity1;Equity2) = 1	.07375	**.1375**	.1375

The benefits of diversification IV

Portfolios of less than perfectly correlated assets always offer **better risk-return opportunities** than the individual constituent securities on their own.

What about perfect positive correlations?

Getting started I

Assuming **risk aversion**, investors demand **higher returns** for taking on **higher risk**.

Risk relates to returns' volatility - variability over a given time period (generally defined as standard deviation of returns)

Getting started II

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How to select the most suitable **combination of assets** so as to maximize portfolio return for a given level of risk?

Adopted Selection Criteria:

RETURN – RISK – CORRELATION

Portfolio Investment (Risky Assets) I

Suppose there are only 2 risky assets on the market ($Equity_1$ and $Equity_2$) and assume further that:

	$Equity_1$	**$Equity_2$**
E(R)	.08	.055
Risk(σ)	.15	.1
$\rho(Equity_1;Equity_2)$	**-.5**	

Portfolio Investment (Risky Assets) II

Depending on the different weighting schemes, we would have…

	Equity$_1$	**Equity$_2$**	***E(Rp)***	***Risk***	**Wrisk**
Weighting Scheme	X_1	X_2			
1	1	0	…	…	…
2	.75	.25	…	…	…
3	.5	.5	…	…	…
4	.25	.75	…	…	…
5	0	1	…	…	…

Portfolio Investment (Risky Assets) III

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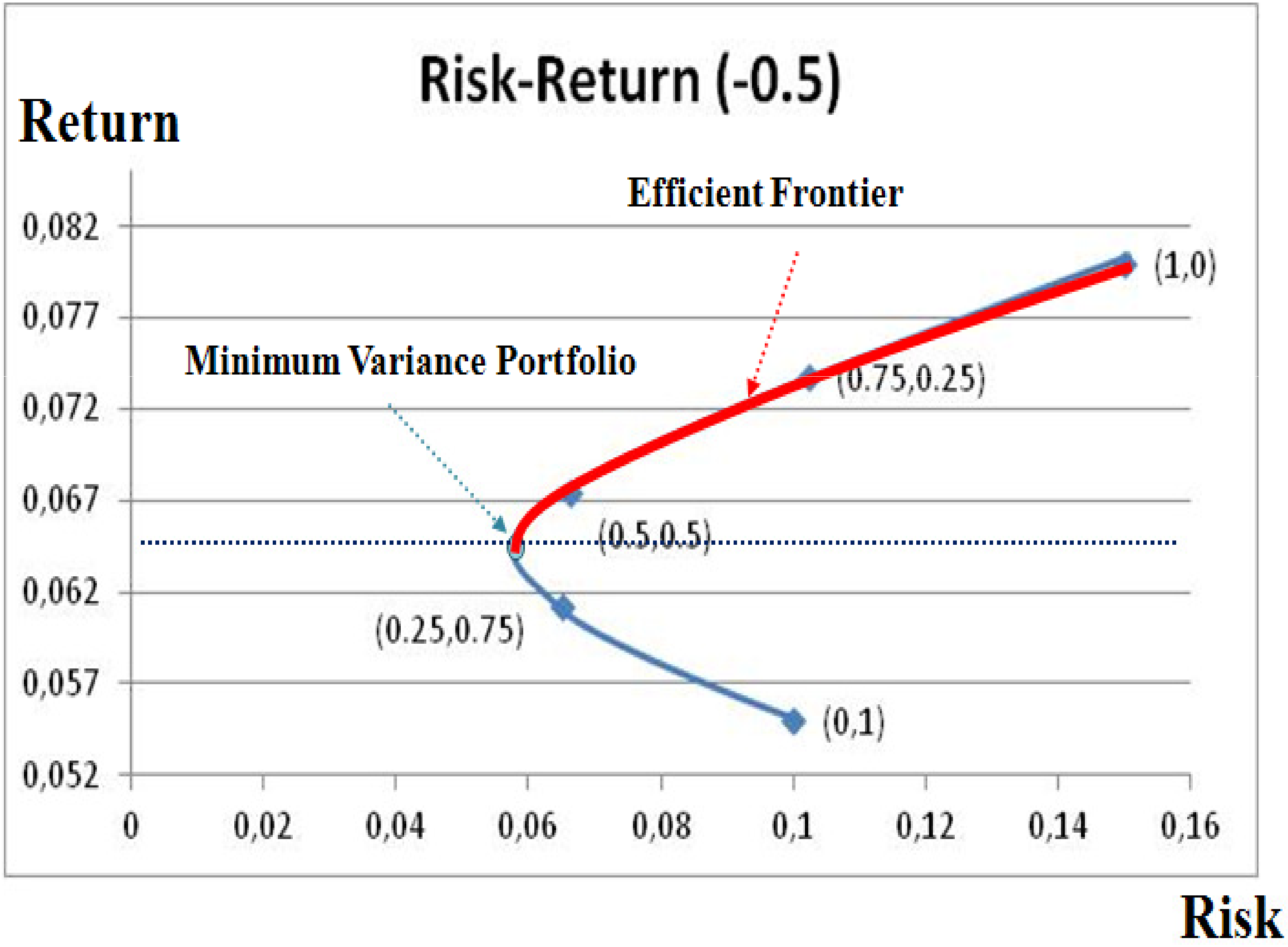

Portfolio Investment (Risky Assets) IV

Assume now that:

	Equity$_1$	**Equity$_2$**
E(R)	.08	.055
Risk(σ)	.15	.1
ρ(Equity$_1$;Equity$_2$)	**.2**	

Portfolio Investment (Risky Assets) V

Depending on the different weighting schemes, we would have…

	Equity$_1$	**Equity$_2$**	***E(R$_p$)***	***Risk***	**Wrisk**
Weighting Scheme	X_1	X_2			
1	1	0	…	…	…
2	.75	.25	…	…	…
3	.5	.5	…	…	…
4	.25	.75	…	…	…
5	0	1	…	…	…

Portfolio Investment (Risky Assets) VI

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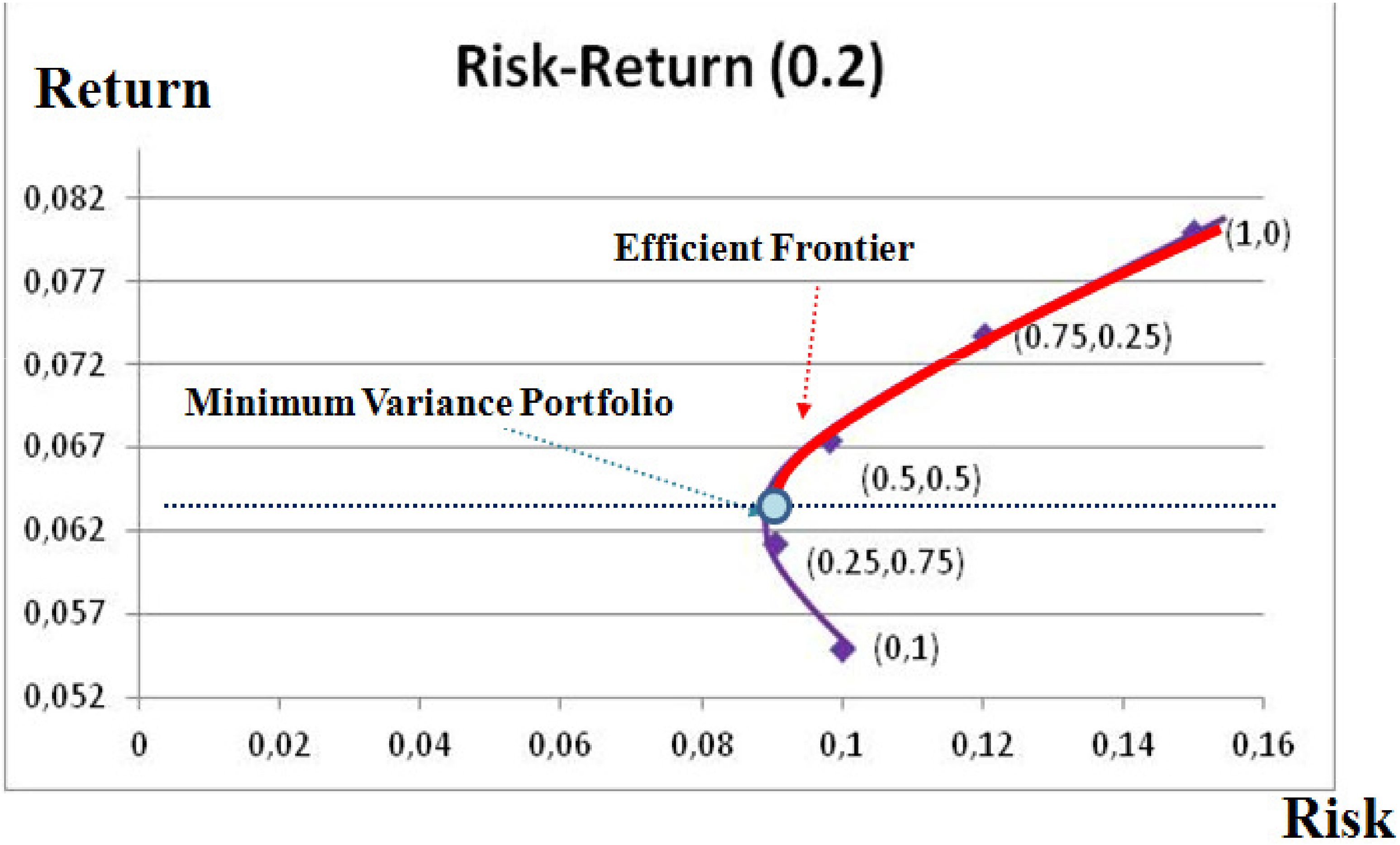

Terminology

Efficient Frontier (Markowitz, 1952): optimal set of portfolios that offer the highest expected return for a specific level of risk.

Portfolio Investment (Risky Assets) VII

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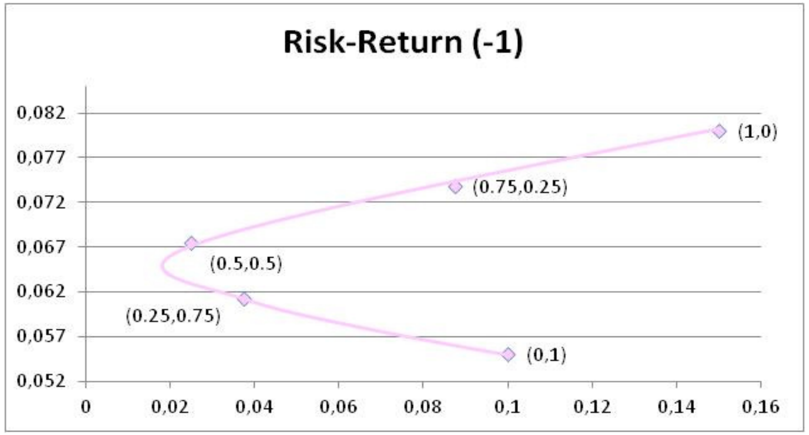
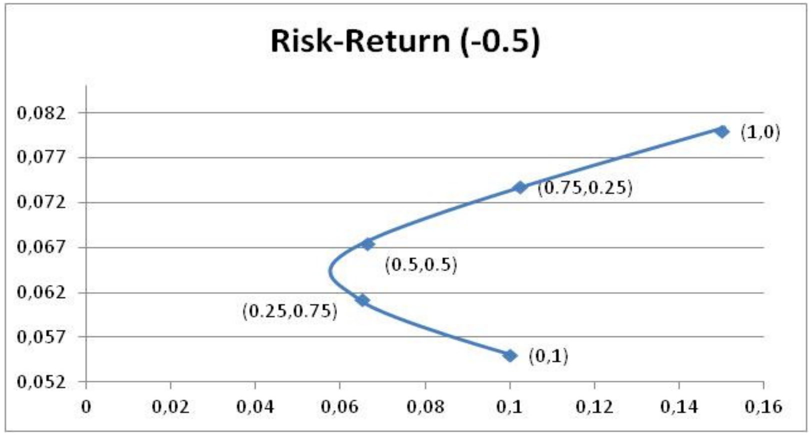
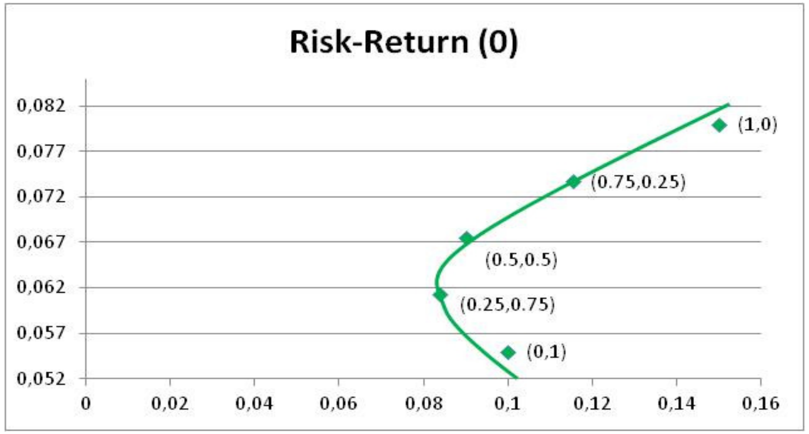
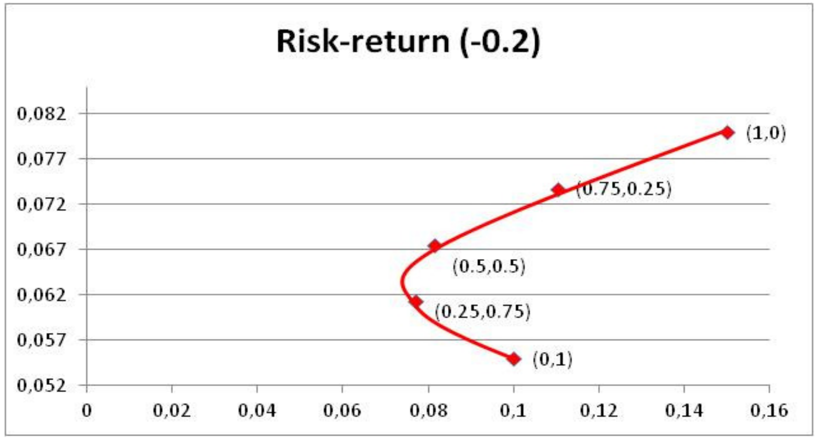
The **shape of the Efficient Frontie**r varies depending on **inter-assets correlation**.



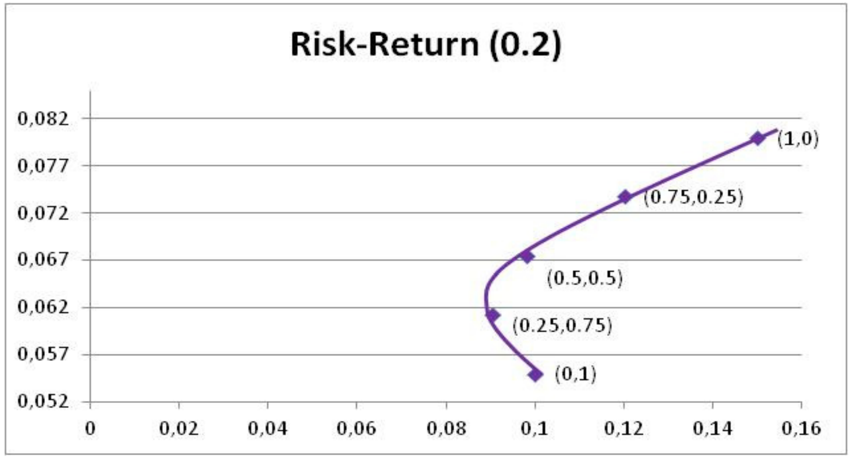


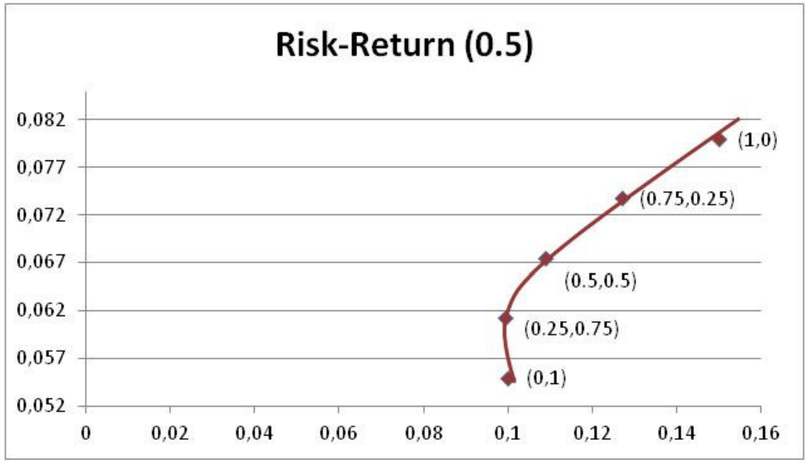


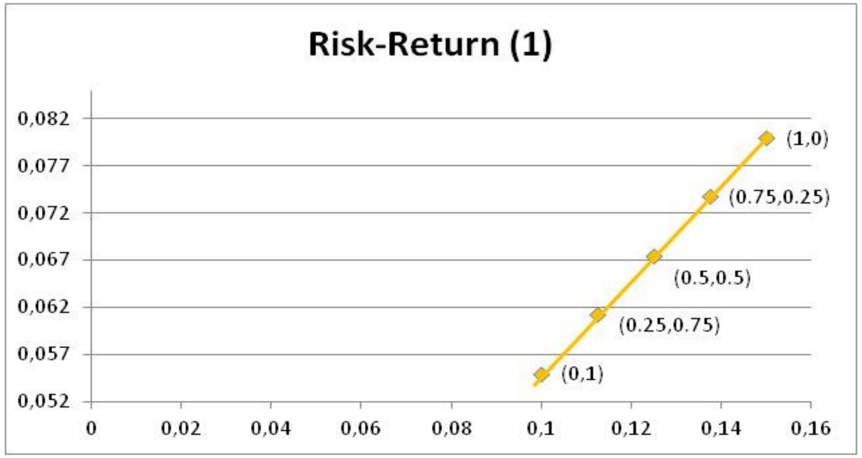


Portfolio Investment (Risky Assets) VIII

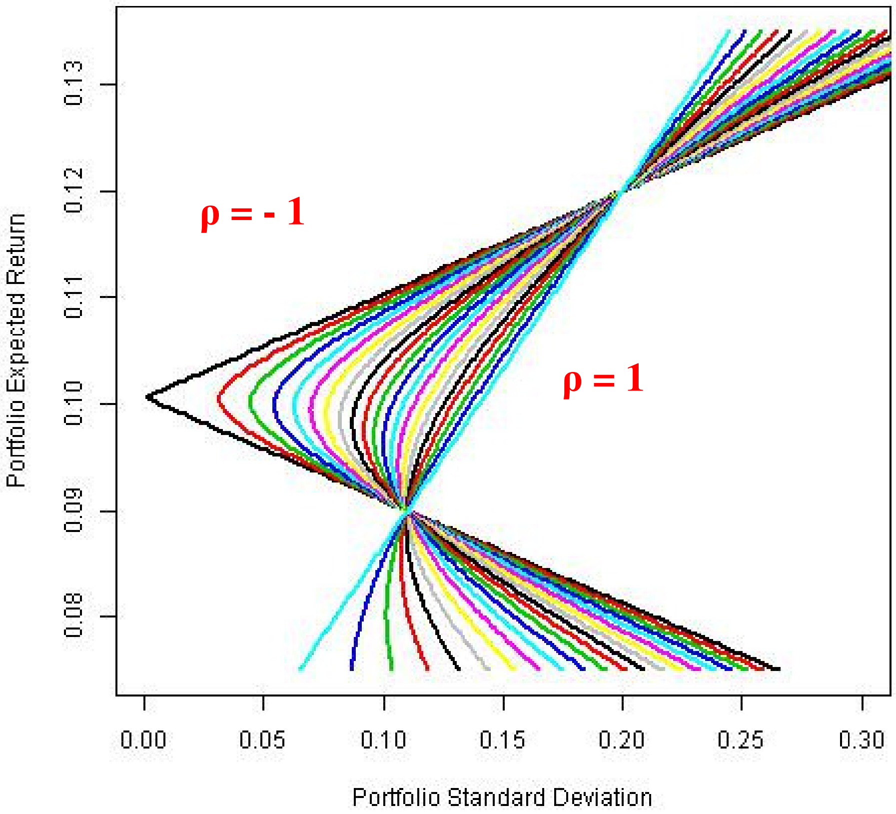
The **shape of the Efficient Frontie**r varies depending on **inter-assets correlation**.







Portfolio Investment (Risky Assets) IX



Source: www. complete-markets.com

The **final portfolio selection** will exclusively depend on **individual risk appetite**

What if we added a **risk-free asset**?

Terminology

Risk-free assets: financial instruments that have a certain future return (MM securities, Government bonds…).

↓

Are they truly (and completely) risk-free in practice?

Risky and Risk-free Assets I

Suppose there are only 2 risky assets on the market ($Equity_1$ and $Equity_2$) and a risk-free portfolio (made up of MM instruments and Govt Bonds), yielding 3.5%. Assume further that:

	Equity $_1$	**Equity $_2$**
E(R)	.08	.055
Risk(σ)	.15	.1
ρ($Equity_1$;$Equity_2$)	**-.5**	

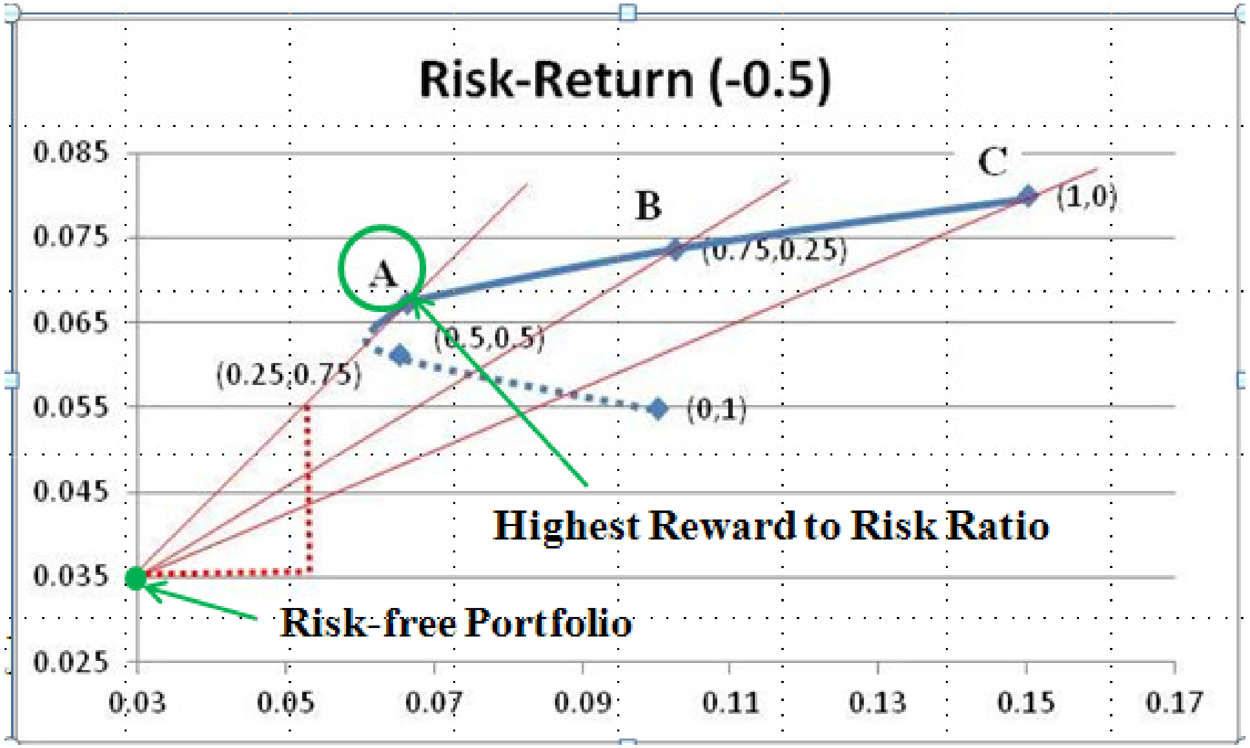
Risky and Risk-free Assets II

How to determine which **optimal risky portfolio** is to be **best combined with the risk-free** security basket?

Adopted Selection Criteria:

Max[REWARD to RISK]

Risky and Risk-free Assets III



A is the **optimal risky portfolio** to be **combined with the risk-free asset set.**

Can you understand why the Risk-free portfolio lies on the vertical axis?

Risky and Risk-free Assets IV

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Assume now that x_r = % of total wealth invested in the risky portfolio and x_{rf} = % of total wealth invested in the risk-free assets ($x_r + x_{rf} = 1$),

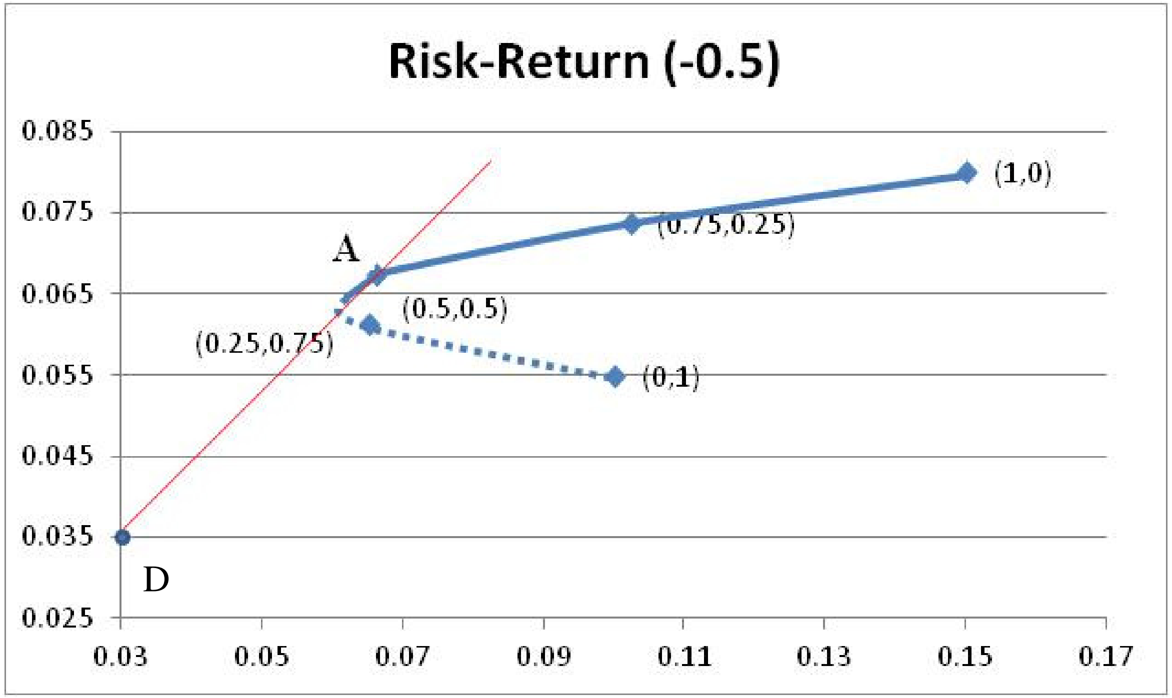
$$E[r_p] = x_r E[r_r] + x_{rf} E[r_{rf}]$$

$$\sigma_p^2 = x_r^2 \sigma_r^2$$

Depending on x_r and x_{rf}, we will move along the **straight line** spanning from the risk-free portfolio to point A.

→ **Capital Allocation Line**

Risky and Risk-free Assets V



Which **point** on the line represents **x_r = 0, x_{rf} = 1**?

Which **point** on the line represents **x_r = 1, x_{rf}** = 0?

What about the other **intermediate weighting schemes**?

The final **choice of x_r and x_{rf}** depends on **individual risk appetite**.

A broader perspective

What about **international portfolio management**?

The underlying rationale is exactly the same, but the **benefits of international diversification** can be **much larger**…

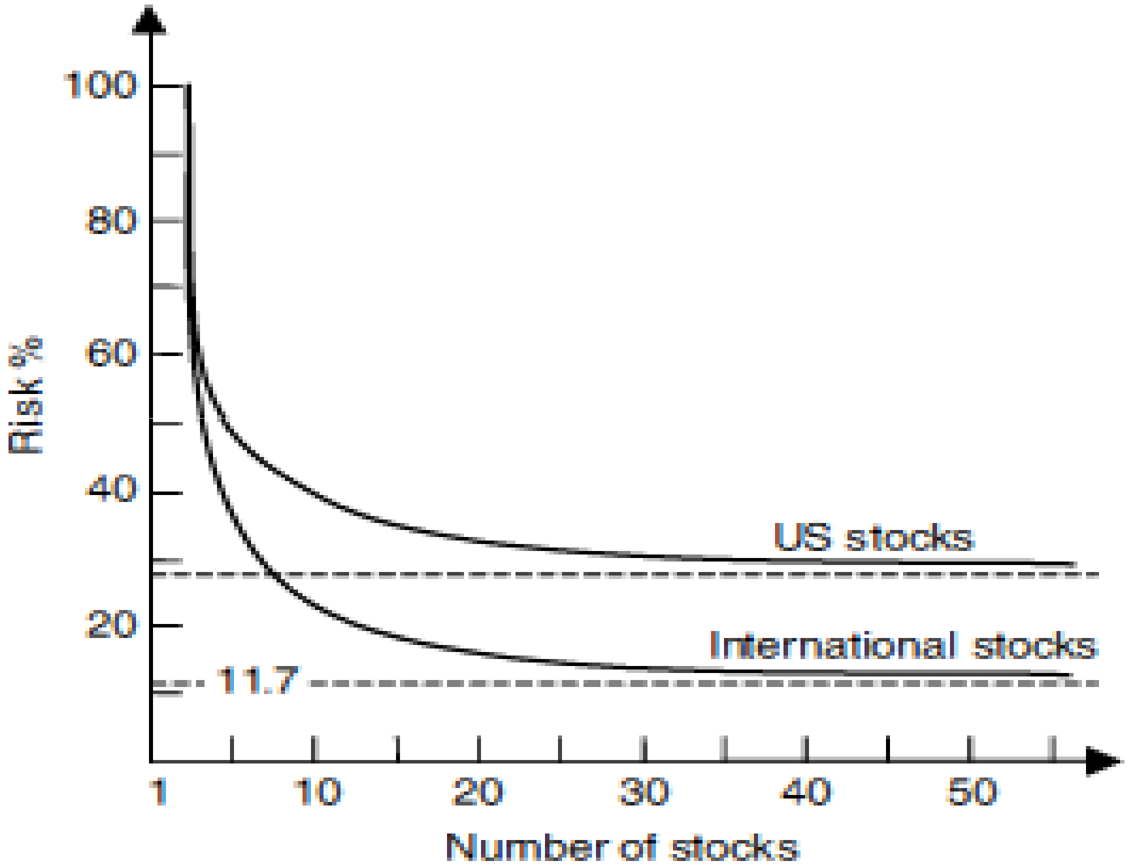
“International” correlations

Correlation coefficients computed on monthly USD returns (1994-2002)

	Correlation coefficient										
	Aus	Can	Fr	Ger	Ind	Ital	Jap	Holl	Sing	Swed	UK
Australia											
Canada	0.66										
France	0.46	0.59									
Germany	0.50	0.62	0.85								
India	0.43	0.41	0.21	0.21							
Italy	0.37	0.47	0.70	0.68	0.31						
Japan	0.57	0.44	0.37	0.32	0.25	0.28					
Holland	0.54	0.60	0.87	0.88	0.27	0.67	0.37				
Singapore	0.63	0.53	0.40	0.41	0.36	0.28	0.41	0.44			
Sweden	0.59	0.71	0.80	0.83	0.38	0.68	0.39	0.76	0.45		
UK	0.55	0.64	0.75	0.74	0.13	0.50	0.34	0.76	0.49	0.70	
USA	0.57	0.76	0.67	0.74	0.25	0.49	0.43	0.72	0.54	0.71	0.82

Source: IMF, *International Financial Statistics*, December 2003

The benefits of worldwide diversification



Source: B.H. Solnik, “Why not diversify internationally rather than domestically?”, *Financial Analysts Journal*, 1974

Watch out

International diversification

Rewards

Lower σ_p^2

Risks

Unanticipated changes in FX rates

The Exchange Rate Risk I

The risk arising from unexpected changes in FX rates depends **both** on:

1. The **σ^2 of exchange rates**;
2. On the existing **relationship between exchange rates and security prices**

The exchange rates contribute a fraction of the total portfolio returns' volatility via the **direct effect** of the exchange rate volatility and via the **indirect effect** of positive covariance between exchange rates and (local) stock mkt returns

The Exchange Rate Risk II

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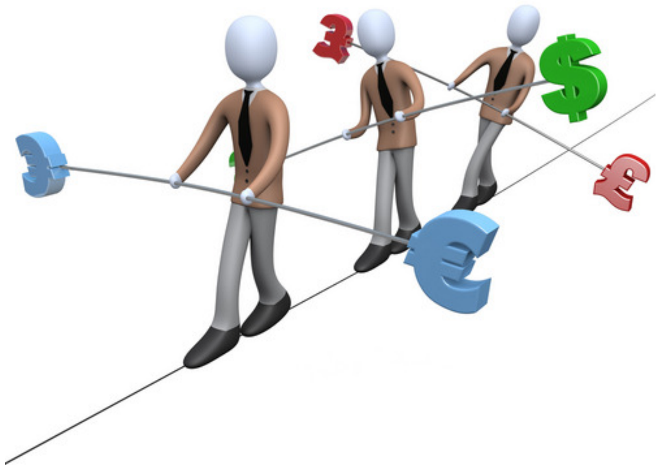
The **potential risk** deriving from **exchange rates fluctuations** can be judged by **comparing the σ^2 of stock values** measured in **local currencies** to the **σ^2 of stock prices expressed in domestic currency terms** (assume the USD is our home currency)



The Exchange Rate Risk III

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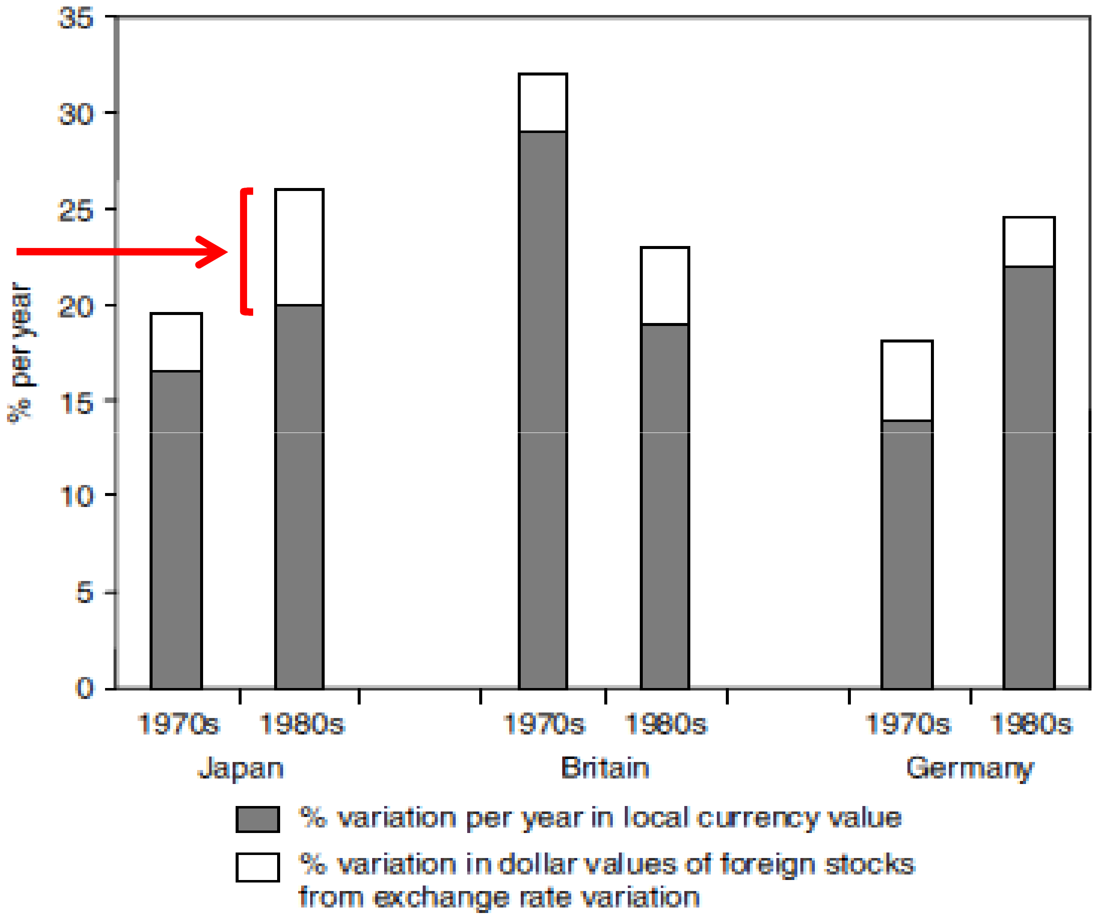
The difference between the two σ^2 can be conceived as the σ^2 contributed to the $ value by variations in FX rates:
relatively <u>SMALL</u> contribution



Source: *International finance*, M. D. Levi, 2009

The Exchange Rate Risk IV

Expected $ return on a foreign stock:

$$E[r] = r_F + \Delta S \frac{F}{\$}$$

Variance of the $ return on a foreign stock:

$$\sigma^2 = \sigma^2 \Delta S \frac{F}{\$} + \sigma^2{}_r + 2\sigma(r; \Delta S \frac{F}{\$})$$

The Var of the USD rate of return on the foreign stock depends on…

…the Var of the FX rate…

…the Var of the returns on the foreign stock…

…and the Cov between the FX rate and r.

The Exchange Rate Risk V

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Table 15.4 *Composition of US dollar weekly returns on individual foreign stock markets, 1980–85*

Country	Percentage of variance in US dollar returns from		
	Exchange rate	Local return	2 x Covariance
Canada	4.26	84.91	10.83
France	29.66	61.79	8.55
Germany	38.92	41.51	19.57
Japan	31.85	47.65	20.50
Switzerland	55.17	30.01	14.81
UK	32.35	51.23	16.52

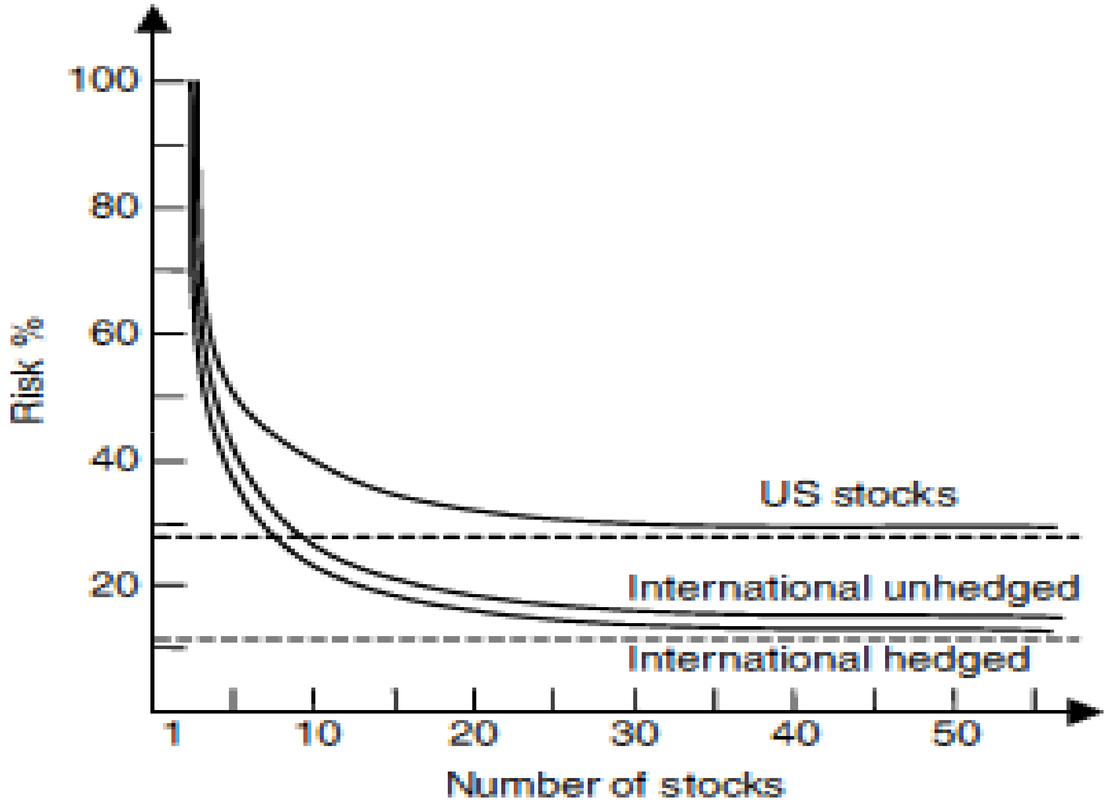
Source: Cheol S. Eun and Bruce G. Resnick, "Exchange Rate Uncertainty, Forward Contracts, and International Portfolio Selection," *Journal of Finance*, March 1988, pp. 197–215.

Given some Exchange Rate Risk…I

Does it completely nullify the benefits arising from international diversification? **NO!**

1. It is always possible to hedge against FX risk;
2. Even without hedging, the σ^2 of an internationally diversified portfolio < the variance of a domestically diversified portfolio

Given some Exchange Rate Risk…II



Source: B.H. Solnik, "Why not diversify internationally rather than domestically?", *Financial Analysts Journal*, 1974

International K Asset Pricing

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The pricing (and, consequently, the returns) of assets depends on whether prices are determined in an **integrated** or in a **segmented** international K mkt

- *Integrated*: the connection between countries' capital markets is seamless
- *Segmented*: different countries' capital markets are not integrated because of implicit or explicit factors inhibiting the free movement of capital between the countries.

Integration vs Segmentation

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- Whenever international K mkts are **integrated**, the **returns** on a given stock will depend on its **contribution to the risk** of an **internationally diversified portfolio**;
- Conversely, if assets are priced in **segmented** K mkts, their **returns** will also depend on the **systematic risk of their domestic mkt**

⇓

If we were able to circumvent the causes of mkt segmentations, we would be able to enjoy higher benefits deriving from international diversification

CAPM: Main Assumptions

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1. Investors are purely **price-takers**;
2. Investments are **limited** to a **universe** of publicly traded **financial assets**;

3. No **taxes** and no **transaction costs**;
4. Investors are rational **mean-variance optimizers** and have the **same investment horizon**;
5. Homogeneous expectations (**same views**) and risk appetite.

CAPM: One Major Implication I

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If all investors use **identical mean-variance analysis**, applied to the **same** universe of **securities**, for the **same time horizon** and use the **same information set**, they all must arrive at the **same determination of the optimal risky portfolio** on the efficient frontier…

CAPM: One Major Implication II

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…however, if all the investors hold an identical risky portfolio…

⇓

…this portfolio has to be the **MARKET PORTFOLIO** (including all tradable assets).

CAPM I

The CAPM relies on the idea that the **appropriate risk premium** on an asset will be determined by its **contribution to the risk of the overall portfolio**.

Risk-Reward Ratio for a generic asset (j)

$$\frac{E(r_j) - r_f}{Cov(r_j; r_m)}$$

Risk-Reward Ratio for the mkt portfolio

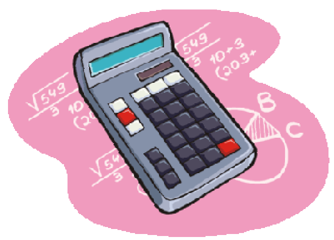
$$\frac{E(r_m) - r_f}{\sigma^2(r_m)}$$

CAPM II

The two foregoing risk-reward ratios must be strictly equal (could you explain why?), so that

$$\frac{E(r_j) - r_f}{Cov(r_j; r_m)} = \frac{E(r_m) - r_f}{\sigma^2(r_m)}$$

Rearranging the terms..



CAPM III

$$r_j = r_f + \beta(r_m - r_f)$$

$$\beta = \frac{Cov(r_j, r_m)}{\sigma^2_{rm}}$$

- **r_j**: E[r] on the j^{th} security/portfolio
- **r_f**: risk-free rate of interest
- **r_m**: E[r] on the mkt portfolio
- **Cov(r_j; r_m)**: covariance between the j^{th} security/portfolio and the mkt portfolio
- **σ^2_{rm}**: variance of the mkt portfolio

CAPM IV

$$r_j - r_f = \beta(r_m - r_f)$$

$$\beta = \frac{\rho(r_j, r_m)}{\sigma^2_{r_m}}$$

The risk premium is linearly related to…

…the risk that the single asset/portfolio contributes to the mkt as a whole→ **SYSTEMATIC RISK**

ICAPM

$$r_j = r_f + \beta(r_w - r_f)$$

$$\beta = \frac{\rho(r_j, r_w)}{\sigma^2_{r_w}}$$

- **r_j**: E[r] on the j^{th} security/portfolio
- **r_f**: risk-free rate of interest
- **r_w**: E[r] on the world portfolio
- **$\rho(r_j; r_w)$**: cov between the j^{th} security/portfolio and the world portfolio
- **σ^2_{rw}**: variance of the world portfolio

Very appealing→ no possibility of further diversification (no further returns to be enjoyed), yet **difficult to implement** (what is a "world portfolio"?)

K mkts integration I

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By holding the internationally diversified portfolio in a integrated K mkt, an investor could enjoy the best possible risk-return profile

Are K mkts really integrated?

K mkts integration II

The available empirical evidence tends to support the view that international K mkts are still quite segmented

↓

The most obvious example of segmentation is in the form of a bias towards domestic investments (so called "**Home-equity Bias**")→ the global holdings of foreign securities is largely sub-optimal

Reasons behind the HEB

- Legal **barriers to foreign investments**;
- Higher **transaction costs** on foreign equities;
- Indirect barriers to foreign investments→ e.g. the difficulty in finding (and interpreting) **information** about foreign securities;
- Additional **risks** to be hedged (FX risk, country risk…)

To put it into practice I

- Suppose that the risk premium on the market portfolio is estimated at 8% with a standard deviation of 22%. What is the risk premium on a portfolio invested 25% in Apple and 75% in Google, if they have βs 1.10 and 1.25, respectively?
- Stock ABC has an expected return of 12% and β = 1. Stock XYZ has expected return of 13% and β = 1.5. The market's expected return is 11% and rf = 5%. According to the CAPM, which stock is a better buy? Why?

To put it into practice II

- Given the data here below, please find the Expected Return and the Variance of both portfolios. Which one would you choose? Why?

		Weight	E(r)	Var(r)	Cov(a,b)
Portfolio 1	Stock a	60%	15%	19%	0.4
	Stock b	40%	7%	25%	
		Weight	**E(r)**	**Var(r)**	**Cov(c,d)**
Portfolio 2	Stock c	30%	10%	23%	0.3
	Stock d	70%	15%	12%	

To put it into practice III

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- Given the data here below, please find the Expected Return and the Variance of both portfolios. Which one would you choose? Why?

		Weight	E(r)	Var(r)
Portfolio A	Stock i	30%	20%	15%
	Stock j	45%	5%	19%
	Stock k	25%	10%	25%
		Weight	**E(r)**	**Var(r)**
Portfolio B	Stock s	30%	10%	23%
	Stock t	60%	5%	29%
	Stock w	10%	6%	15%

To put it into practice IV

Covariance Matrix

		Stock i	Stock j	Stock k
Portfolio A	Stock i	--	0.3	0.4
	Stock j	0.3	---	0.15
	Stock k	0.4	0.15	---
		Stock s	Stock t	Stock w
Portfolio B	Stock s	---	0.25	0.35
	Stock t	0.25	---	0.2
	Stock w	0.35	0.2	---