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Last Lectures
We study the FX Market and how firms are affected by S_t. We pay particular attention to FX risk.

This Lecture
In this chapter we change a bit the direction of the class. From now on, we study how firms (& their policies/decisions) are affected by the international context, not just the FX Market.

Chapter 13 - DFI

A domestic firm has choice regarding selling goods abroad: It can produce at home and export production. Or, the firm can invest to produce abroad (do a *Direct Foreign Investment*, DFI). Depending on the author/organization it can also be called Foreign Direct investment (FDI).

DFI
Definition: It is a controlling ownership in a business enterprise in one country by an entity based in another country.

DFI is different from investing in foreign stocks, which is a more passive investment.

The World Bank/OECD defines DFI as the net inflows of investment to acquire a lasting management interest (10% or more of voting stock) in an enterprise operating in an economy other than that of the investor. DFIs can be done through mergers & acquisitions, setting up a subsidiary, a joint venture, etc.

From the point of view of national accounts, DFI is calculated as the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balance of payments.

According to the World Bank, the total DFI in 2013 was USD 1.65 trillion (7.3% growth with respect to 2012), with China getting the biggest part (USD 347.8 billion), followed by the U.S. (USD 235.9 billion), Brazil (USD 80.8 billion) and Hong Kong (USD 70.7 billion).

Q: Why DFI instead of exports?

DFI requires capital, sometimes a lot of capital, and, thus, DFI decisions are difficult to reverse. So, why choose DFI over the simpler exports?

A:
- ◊ Avoid tariffs and quotas
- ◊ Access to cheap inputs
- ◊ Reduce transportation costs & trade frictions
- ◊ Local management
- ◊ Take advantage of government subsidies

- ◊ Access to new technology
- ◊ Access to local expertise (including: local contacts, dealing with red tape, etc.)
- ◊ Reduce economic exposure
- ◊ Diversification
- ◊ Real option (an investment today helps to make investments elsewhere later).

Q: What is the main disadvantage of a DFI?
A: A DFI usually requires a large investment, which is not easy to revert. There is a higher risk relative to exports, where the decision to export can easily be changed. To penetrate a new market and limit risk, licensing agreements and joint ventures (a "limited DFI") are used by MNCs.

Diversification through DFI

MNCs have many DFI projects. Since all investments have risks, they will select the project that will improve the company's risk-reward profile (think of a company as a portfolio of projects). We will evaluate projects according to risk-adjusted performance measures (RAPM).

We need to know how to calculate E[r] and Var[r] for a portfolio. Suppose X and Y are two investments, then the return on the portfolio of the two investments (X+Y):

$$E[r_{x+y}] = w_x * E[r_x] + (1- w_x)*E[r_y]$$

$$Var[r_{x+y}] = \sigma^2_{x+y} = w_x^2(\sigma_x^2) + w_y^2 (\sigma_y^2) + 2\, w_x\, w_y\, \rho_{x,y}\, \sigma_x\, \sigma_y$$

We need given this information, we can evaluate the risk-reward profile of the portfolio using the *Sharpe Ratio* (SR), also called *reward-to-variability ratio (*RVAR), defined as:

SR = Reward-to-variability ratio = $E[r_i - r_r]/ \sigma_i$ = RVAR

But, total volatility (σ) may not be the appropriate measure of risk for a portfolio. Another measure of a portfolio's risk is β. To calculate the β of the X+Y portfolio, you should remember that the beta of a portfolio is the weighted sum of the betas of the individual assets:

$$\beta_{x+y} = w_x * \beta_x + (1- w_x)*\beta_y$$

Now, we can define another RAPM, the *Treynor Ratio* (TR), or *reward-to-volatility ratio* (RVOL):

Treynor Ratio = TR = Reward-to-volatility ratio = $E[r_i - r_f]/ ß_i$ = RVOL

Note: SR uses total risk (σ), this measure is appropriate when total risk matters –i.e., when most of an investor's wealth is invested in asset i. When the asset i is only a small part of a diversified portfolio, measuring risk by total volatility is inappropriate. TR emphasizes systematic risk, the appropriate measure of risk, according to the CAPM.

Example: A US company E[r] = 13%; SD[r] = 12% (recall SD = σ), β=.90
Two potential DFIs: Colombia and Brazil
(1) Colombia: $E[r_c]$ = 18%; $SD[r_c]$ = 25%, β_c = .60
(2) Brazil: $E[r_b]$ =23%; $SD[r_b]$ =30%, β_b = .30

r_f = 3%
$\rho_{ExistPort,\, Col}$ = 0.40
$\rho_{EP,Brazil}$ = 0.05

$w_{Col} = .30, \quad \Rightarrow (1- w_{col}) = w_{EP} = .70$
$w_{Brazil} = .35, \quad \Rightarrow (1- w_{Brazil}) = w_{EP} = .65$

The US company evaluates the Projects according to SR and TR.

We need to calculate for each project E[r], σ =SD[r], β:
$E[r_{EP+Col}]$, $Var[r_{EP+Col}]$, β_{EP+Col}
$E[r_{EP+Brazil}]$, $Var[_{EP+Brazil}]$, $\beta_{EP+Brazil}$

Recall: The higher the SR or RVOL, the better the project

Calculate the SR for both countries (we'll work with excess returns, directly):

1. Colombia

$E[r_{EP+Col} - r_f] = w_{EP}*E[r_{EP} - r_f] + (1- w_{EP})*E[r_{col} - r_f]$
$= .70*.10 + .30*.15 = 0.115$

$\sigma_{EP+Col} = (\sigma^2_{EP+Col})^{1/2}$
$\sigma^2_{EP+Col} = w_{EP}^2(\sigma_{EP}^2) + w_{Col}^2(\sigma_{Col}^2) + 2\, w_{EP}\, w_{Col}\, \rho_{EP,Col}\, \sigma_{EP}\, \sigma_{Col}$
$= (.70)^2*(.12)^2 + (.30)^2*(.25)^2 + 2*.70*.30*0.40*.12*.25 = 0.0177210$
$\Rightarrow \sigma_{EP+Col} = (0.017721000)^{1/2} = 0.1331$

$\beta_{EP+Col} = w_{EP} *\beta_{EP} + w_{Col}*\beta_{Col}$
$= .70*.90 + .30*.60 = 0.81$
$SR_{EP+Col} = E[r_{EP+Col} - r_r]/ \sigma_{EP+Col} = .115/.1331 = 0.8640$
$TR_{EP+Col} = E[r_{EP+Col} - r_r]/ \beta_{EP+Col} = .115/.81 = 0.14198$

Interpretation of SR: An additional unit of total risk (1%) increases returns by .864%
Interpretation of TR: An additional unit of systematic risk increases returns by .142%

2. Brazil

$E[r_{EP+Brazil} - r_f] = 0.135$
$\sigma_{EP+Brazil} = 0.1339$
$\beta_{EP+Brazil} = 0.69$
$SR_{EP+Brazil} = 0.135/0.1339 = 1.0082$
$TR_{EP+Brazil} =.135/.69 = 0.19565$

Interpretation of SR: An additional unit of total risk increases returns by 1.0082%

Under both measures, Brazilian project is superior.

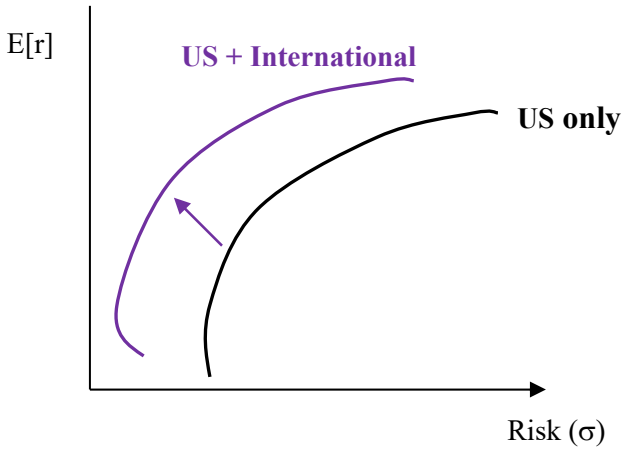
Now, compare existing portfolio of the company with the Brazilian project
$SR_{EP} = (.13-.03)/.12 = .833$
$TR_{EP} = (.13-.03)/.90 = .111$

Using both measures, the company should diversify internationally through DFI in Brazil Why? Because it improves the risk-reward profile for the company.

Note: There is another RAPM - *Jensen's alpha measure*
It estimates a constant (α) on a CAPM-like regression. You regress the excess returns on a portfolio against the excess market returns (and/or Fama-French factors.) The Jensen's alpha measure is often used to rank mutual funds.

Aside: Diversification and International Investments

Recall the Efficient Frontier:



When you go international, you improve the tradeoff and move the frontier up, in the northwest direction.

Key**:** The correlation of the project that we are considering to add to our existing portfolio should be low to achieve a significant movement in the efficient frontier.

• Risk-Return in international investments

Table 13.1 reports the USD mean annual returns on MSCI equity indexes from 11 developed markets, along with the World and EAFE Indexes (based on monthly data, 1970-2017 period).Over the past 47 years, Hong Kong and Singapore show the best returns in Developed Markets, but we need to take into consideration the risk taken by an investor. Using the Sharpe ratio (with a 4.74% risk-free rate) to measure the risk-return trade-off, Switzerland and Japan have the best performances over the past 47 years.

Table 13.1: MSCI Index USD Annual Returns: (1970-2017)

Market	Return	Standard Dev	Sharpe Ratio
U.S.	8.19	15.04	0.2295
Canada	8.22	19.35	0.1801
France	9.02	22.17	0.1927
Germany	9.37	21.67	0.2135
Italy	5.08	25.38	0.0315
Switzerland	10.44	17.83	0.3193
U.K.	7.77	21.44	0.1411
Japan	9.94	20.74	0.2506
Hong Kong	16.80	33.72	0.3578
Singapore	12.26	27.79	0.2705
Australia	7.68	23.79	0.1233
World	7.70	14.58	0.2026
EAFE	8.00	16.78	0.1945

We can use the above numbers to compute the equity risk premium. If we consider that the average U.S. T-bill rate during the 1970-2017 period was 4.74%, the realized equity risk premium for the U.S. is 3.45% (= 8.19 - 4.74). There is no agreement on what the equity risk premium should be; in general, the reported numbers for the U.S. market are between 3% and 8%, which place our 3.45% estimate on the lower side of the range.

Since stock returns are calculated with error (even for large portfolios, like the above indexes), using a long data set is important: the longer the data set, the smaller the sampling error and, thus, the more precise the estimation. Dimson, Marsh and Staunton (2011) used data from 1900-2010 to report for mainly 19 developed markets. For example, they calculated mean annual return (standard deviation in parenthesis) for the U.S., Switzerland and Italy are 7.2% (19.8%), 5.1% (18.9%), and 9.8% (32%), respectively. The numbers are a bit different from the ones reported in Table 13.1, though within the usual estimation error.

For emerging markets, the estimation error is considerable, given that quality data, following international standards, started to be collected in 1988 (Brazil, Greece, Ireland, Malaysia, Mexico, Thailand, etc), and for Russia, India and China, considered then the major "frontier markets," data started to be collected in 1993 (along with Israel, Pakistan, Poland, South Africa, etc). In Table 13.2, we report annual USD returns, standard deviation and Sharpe Ratio (using the U.S. T-bill average rate in the period, 2.43%) for the period 1993-2017 for some emerging markets, two emerging market indexes (EM-Asia and EM-Latin America), and, for reference purposes the U.S., World and EAFE Indexes.

In general, we observe the typical emerging market behavior: high returns and high volatility. In terms of Sharpe ratios, in Table 13.2, the U.S. market provided the best trade-off, closely followed only by the Russian market.

Table 13.2: MSCI Index USD Annual Returns: (1993-2017)

Market	Return	Standard Deviation	Sharpe Ratio
Brazil	16.58	37.54	0.3768
China	5.40	33.25	0.0785
Greece	-0.18	35.46	-0.0736
India	12.05	28.99	0.3318
Malaysia	6.54	27.82	0.1477
Mexico	10.00	27.75	0.2728
Pakistan	6.79	34.91	0.1248
Poland	18.62	44.78	0.3615
Russia	22.65	50.09	0.4035
South Africa	11.30	26.30	0.3373
EM-Asia	7.24	24.13	0.1990
EM-Latin America	10.65	27.68	0.2969
U.S.	8.72	14.25	0.4409
World	7.06	14.44	0.3207
EAFE	5.48	16.06	0.1899

We see a big dispersion in expected returns (and risk!) in international markets, which cannot be explained by the usual World CAPM. Several papers have been proposed to explain these differences, among them:

◊ Global economic risks −Ferson and Harvey (1994).
◊ Inflation risk −Chaieb and Errunza (2007).
◊ Liquidity risk −Karolyi, Lee, and van Dijk (2012), Malkhozov, et al. (2014).
◊ Momentum and a global cash-flow-to-price factor −Hou, Karolyi, and Kho (2011).
◊ Investment restrictions −Karolyi and Wu (2014).
◊ Currency risk −Dumas and Solnik (1995).

There is also an international version of the 3-factor Fama-French model, extended by Fama and French (1998, 2012), which finds that only two factors matter in their model: world (say, a global equity benchmark) and value (HML).

• Empirical facts related to international investments

Empirical fact 1: Low Correlations (first reported by Gruber (1970).) Correlations in international equity markets tend to be moderate to low. This fact puzzles economists. Table 13.3 reports return correlations for several international market indexes.

Correlations between neighboring markets tend to be higher: Correlation between the U.S. and Canada is 0.74; the U.S. and Japan is 0.36. (Data: 1970-2015).

Average correlation between the US and international markets is around .40.

Table 13.3: MSCI Index USD Returns: Correlation Matrix (1970-2015)*

A. European Markets

MARKET	Bel	Den	France	Gerrn	Italy	Neth	Spain	Swed	Switz	U.K.	World
Belgium	1.00	0.59	0.72	0.70	0.54	0.75	0.56	0.55	0.68	0.59	0.69
Denmark		1.00	0.53	0.59	0.48	0.62	0.51	0.54	0.55	0.49	0.61
France			1.00	0.73	0.59	0.73	0.59	0.57	0.68	0.63	0.73
Germany				1.00	0.56	0.78	0.58	0.64	0.71	0.54	0.71
Italy					1.00	0.55	0.57	0.50	0.50	0.57	0.57
Netherlands						1.00	0.59	0.63	0.75	0.69	0.81
Spain							1.00	0.57	0.50	0.47	0.62
Sweden								1.00	0.57	0.52	0.69
Switzerland									1.00	0.62	0.72
U.K.										1.00	0.73
World											1.00

B. Pacific Markets

MARKET	Australia	HK	Japan	Korea	Singap	Taiwan	U.S.	World
Australia	1.00	0.32	0.37	0.50	0.51	0.33	0.56	0.65
Hong Kong		1.00	0.34	0.40	0.57	0.41	0.39	0.48
Japan			1.00	0.48	0.39	0.24	0.36	0.67
Korea*				1.00	0.46	0.33	0.45	0.53
Singapore					1.00	0.45	0.53	0.60
Taiwan*						1.00	0.35	0.38

C. North American Markets

MARKET	Canada	U.S.	Mexico	World	EAFE	EM-LA	EM-ASIA
Canada	1.00	0.74	0.54	0.77	0.62	0.60	0.65
U.S.		1.00	0.58	0.88	0.62	0.57	0.61
Mexico *			1.00	0.56	0.49	0.72	0.52

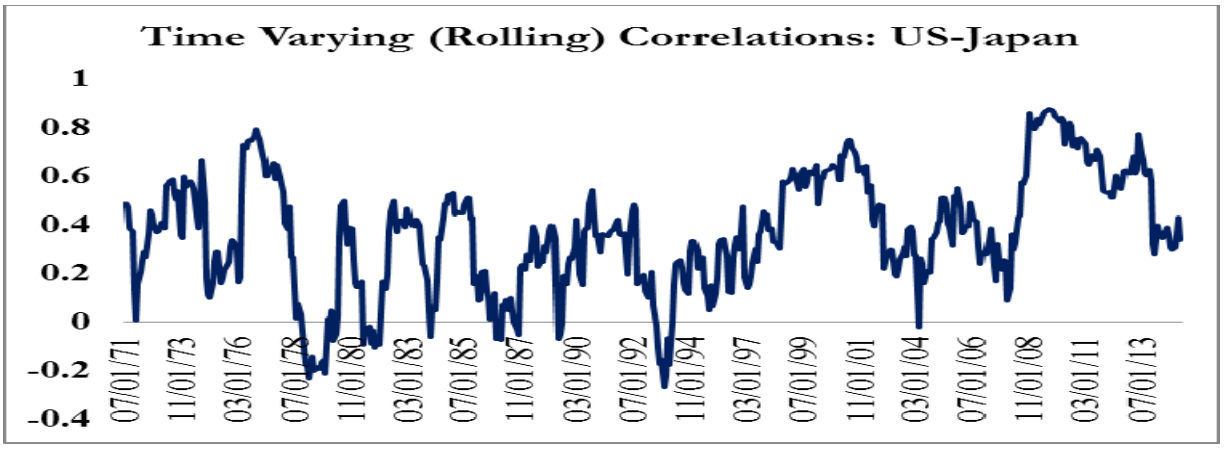
Notes:
*: The sample for South Korea, Taiwan, Mexico, the EM-Latin America and the EM-Asia indexes start in January 1988.

Empirical fact 2: Correlations are time-varying

Correlations change over time. In general, during bad global times, correlations go up:

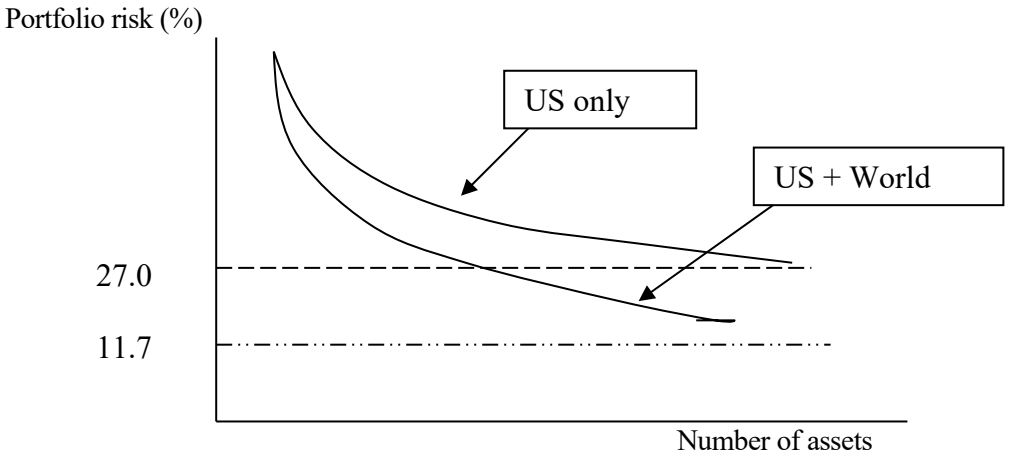
=> When you need diversification, you tend not to have it!

In the graph below, we plot the US-Japan rolling monthly correlations from 1970:Jan -2015:Feb. There is a lot of movement for the correlation coefficient (average correlation close to 0.35).



Empirical Fact 3: Risk Reduction (from Solnik, B. (1974), "Why Not Diversify Internationally?" *Financial Analyst Journal*, 20, 48-54).

Figure 13.2: Effect of International Investment on Risk



Solnik's observes that past 12 stocks, the risk in a portfolio levels off, around .27. For international stocks, the risk levels off at .117. (See Figure 13.2.)

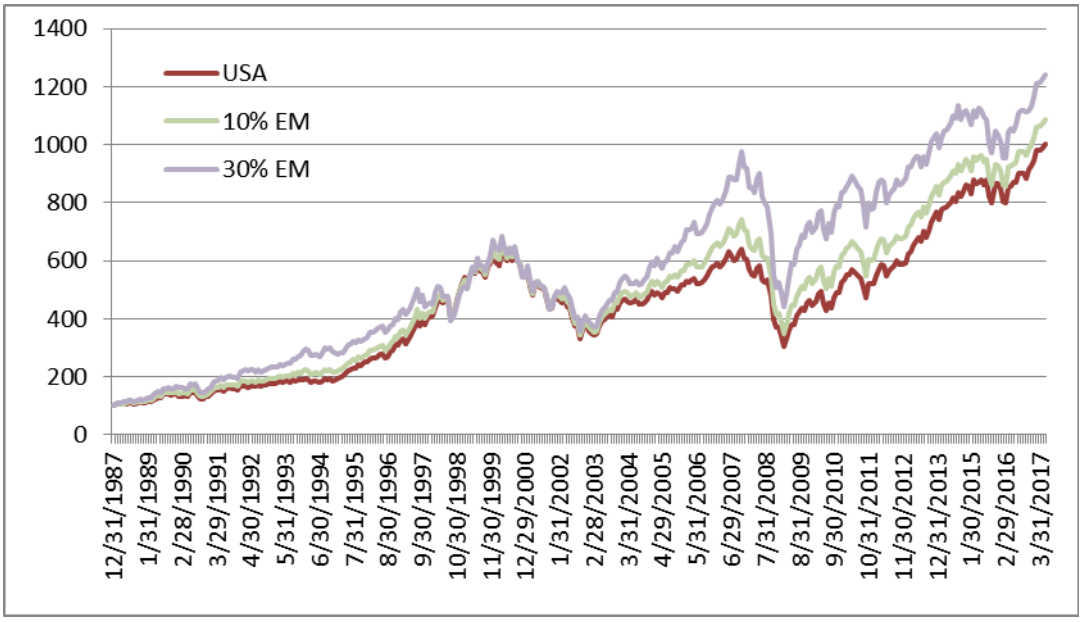
Empirical Fact 4: Returns Increase (from P. Jorion and S. J. Khoury (1996), **Financial Risk Management: Domestic and International Dimensions**, published by Blackwell.)

Portfolios with international stocks have outperformed domestic portfolios in the past years. About 1% difference (1978-1993).

Recent Past (1988:Jan-2017:May): The case of emerging markets (see Graph 13.1 below).
Three portfolios:
- A US purely domestic portfolio, with 7.76% annualized return.
-A 90% US, 10% EM portfolio, with 8.01% annualized return (or extra 85% over 29.5 years).

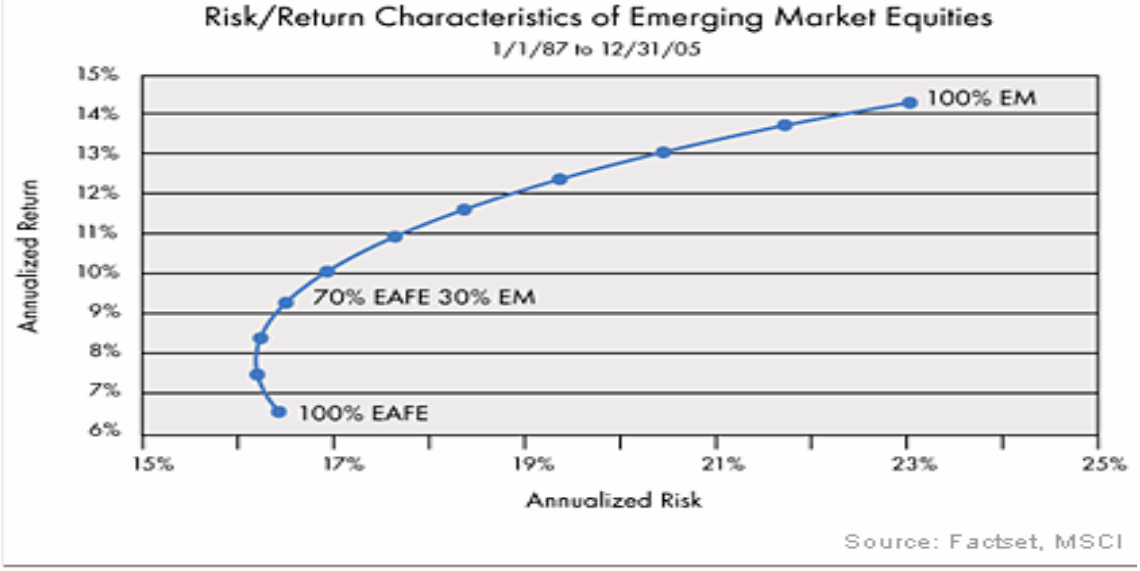
- A 70% US, 30% EM portfolio, with 8.55% annualized return (or extra 239% over 29.5 years!).

Graph 13.1: The Case for Emerging Markets (1988-2017)

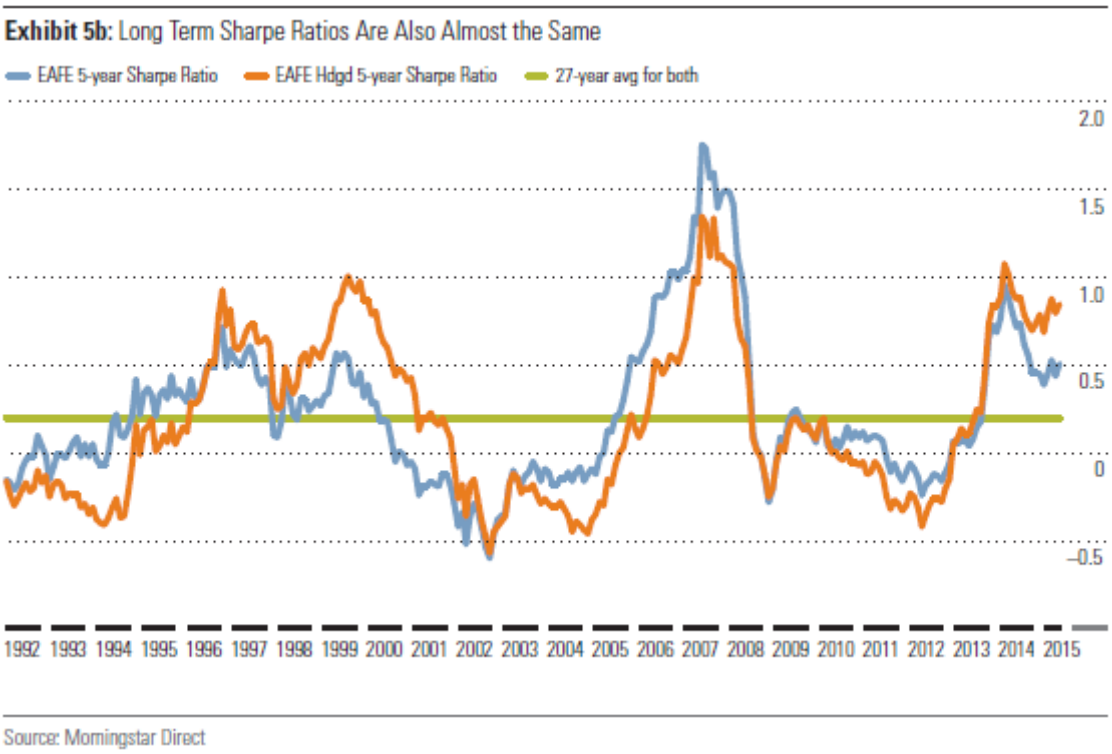


Q: Free lunch?
A: In the equity markets: Yes! Higher return (1% more), lower risks (2% less).

More Emerging Market, More Return
At each point on the curve (going upward), the hypothetical investor owned 10% more of the MSCI Emerging Markets Index and 10% less of the MSCI EAFE Index, which represents non-U.S. developed assets. At 30% EM ownership, returns have increased to more than 9% with no increased risk.



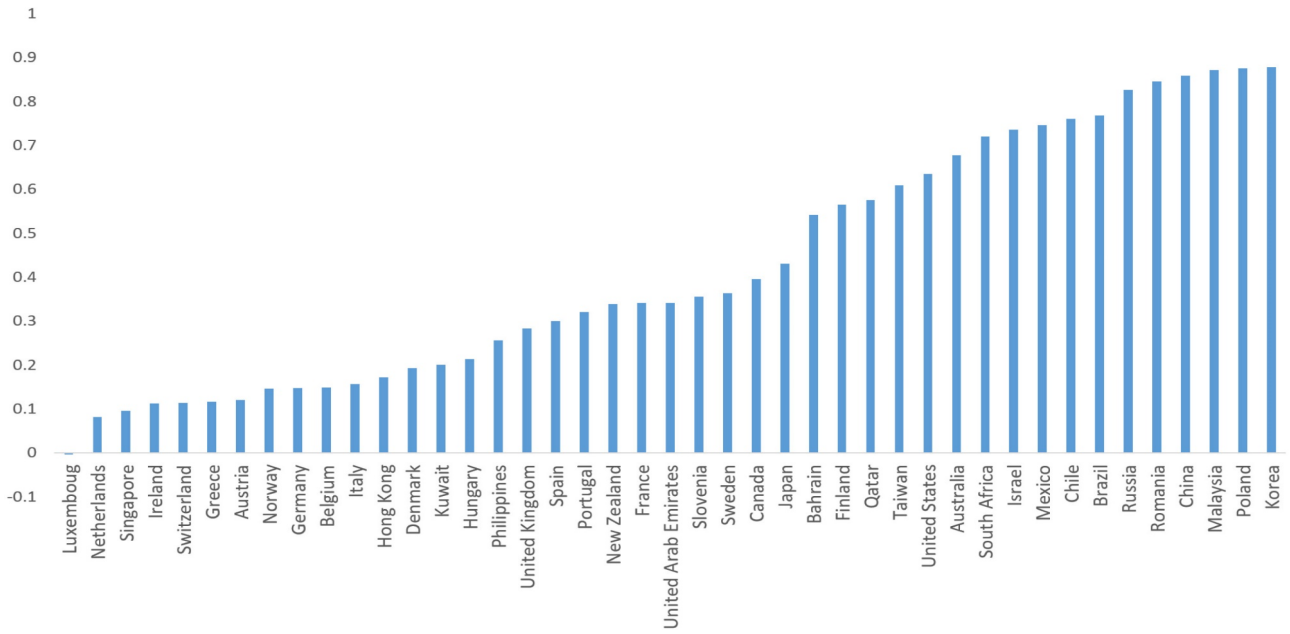
Q: Does hedging FX risk affect the risk-return of a exposed portfolio?
Unhedged international portfolios add an additional risk to a portfolio: FX. Unhedged international portfolios have higher volatility, but if we look at the long-term risk-adjusted performance of hedged and unhedged international portfolios we get similar results. During periods of USD appreciation, hedging adds to returns, but during periods of USD depreciation the opposite occurs. On average, Sharpe ratios are very similar. See Graph below taken from Oey (2015, Morningstar research note).



Q: How to take advantage of facts 3 and 4?
A: True diversification: invest internationally.

Empirical Fact 5: Investors do not diversify enough internationally (first discussed by French and Poterba (1991, *American Economic Review*).
⋄ A 2002 report by UBS on the proportion of foreign bonds and foreign equities in the total equity and bond portfolio of local residents for several OECD countries:
- Most internationally diversified investors: Netherlands (62%), Japan (27%) and the U.K. (25%).
- U.S. ranked at the bottom of list: only 12% of internationally diversified investors.
⋄ More recent estimates show a decreasing home bias. Hu (2020) estimates the proportions of the U.K. at 70% and of the U.S. at 30%, an improvement.

Graph 13.2: Hu (2020) estimates of Home Bias by Country



◊ Does home bias hurt your portfolio? Yes!
In 2004, the Kansas City Fed estimates that:
(a) With the actual 12% share of foreign equity investments, the mean return and SD for the US equity portfolio were 10.30% and 14.47%.
(b) Increasing to 41% the share of foreign equity investments increases the mean return to 10.44% and decreases the SD to 13.78% for the U.S. equity portfolio.

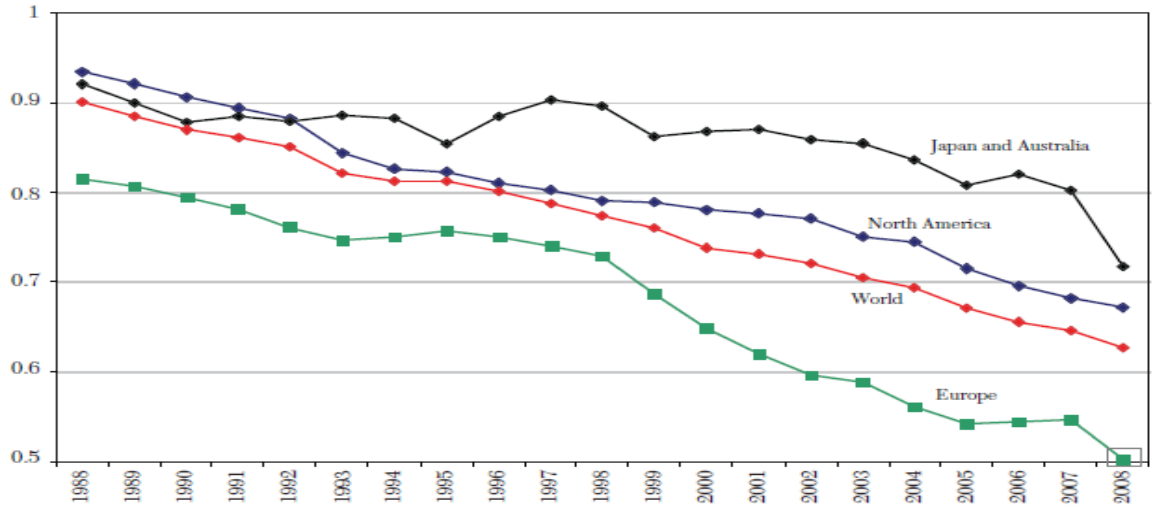
$\Rightarrow$ Sharpe Ratio up $\Rightarrow$ US equity portfolio is inefficient!

(From Meirelles Aurélio (2006) "Going Global: The Changing Pattern of U.S. Investment Abroad," *Kansas City Federal Reserve*, Quarter III.)

◊ Popular measure for Equity Home Bias (EHB) –only equity, not bonds and other assets:

$$EHB_i = 1 - \frac{\text{Share of Foreign Equity in Country i Equity Holding}}{\text{Share of Foreign Equity in World Market Portfolio}}$$

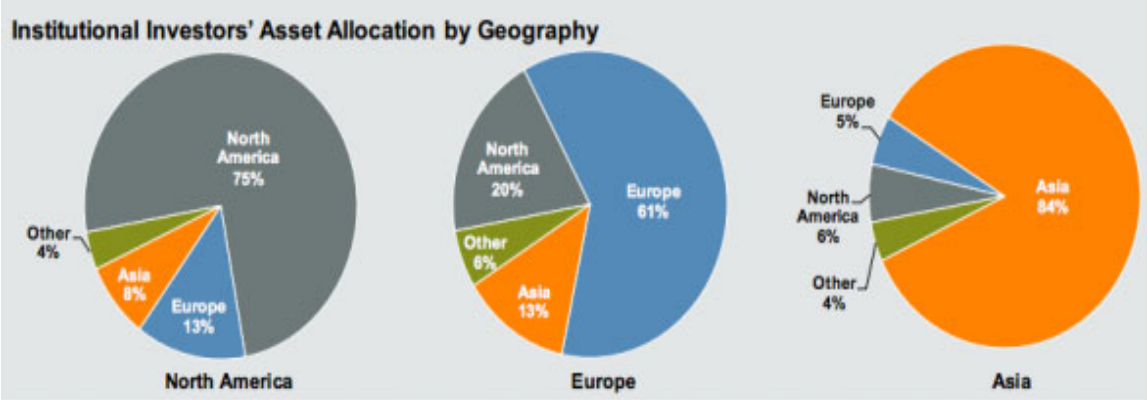
EHB has been decreasing over time, from Coeurdacier and Rey (2013):



For bonds, the BHB (Bond Home Bias) also shows a similar pattern over time

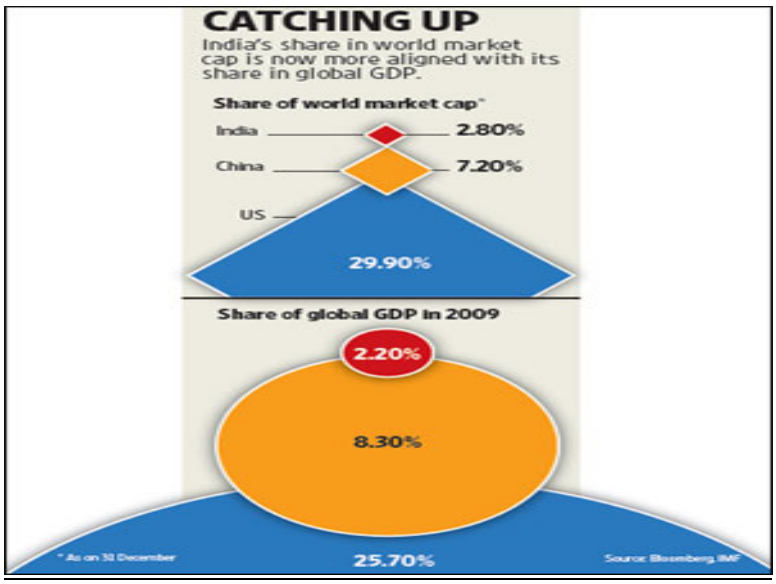
Europe the more diversified region. In general, emerging markets have very low international diversification.

Institutional Investors also have a home bias (maybe driven by domestic investors' tastes?). Data from 2013:



Source: Ipreo, BNY Mellon, McKinsey Global Institute, J.P. Morgan Asset Management "Guide to the Markets – Asia."

◊ Aside Question: What should drive your exposure?
- Global GDP?
- Market capitalization?



Puzzle: Home Bias (Investors tend to ignore the benefits of international diversification.)

⋄ Proposed explanations for home bias and low correlations:
(1) Real exchange rate risk (local assets show a better correlation with the domestic consumption basket).
(2) Information costs/frictions (locals may have better information about local assets).
(3) Controls to the free flow of capital.
(4) Currency & country/political risk.
(5) Behavioral biases (investors trust more the local information/signals; *cognitive bias*).
(6) Indirect exposure through local assets (local firms may be already exposed to international markets)

CHAPTER 13 - BONUS COVERAGE: Another RAPM: RAROC

Bankers Trust created a modification of RVAR to evaluate the performance of its managers, the so-called risk-adjusted return on capital (RAROC) system.

RAROC adjusts returns taking into account the capital at risk, which is defined as the amount of capital needed to cover 99 percent of the maximum expected loss over a year. The one-year horizon is used for all RAROC comparisons, regardless of the actual holding period. All traders can be compared using the same measure.

Example: Two traders, working for a bank, dealing in different markets.
Trader I position (Mexican bonds):
Annualized profits: USD 3.3 million.
Position: USD 45 million.
Volatility (σ): 21% annualized
Trader II position (Spot exchange rates):
Annualized profits: USD 3 million.
Position: USD 58 million.
Volatility (σ): 14% annualized

1) Calculate the worst possible loss in a 99% Confidence Interval –i.e., VaR(99%).
Using a normal distribution: The 1% lower tail of the distribution lies 2.33σ below the mean.

Mexican bonds: 2.33 x 0.21 x USD 45,000,000 = USD 22,018,500.
Spot FX: 2.33 x 0.14 x USD 58,000,000 = USD 18,919,600.

2) Calculate RAROC:
Mexican bonds: RAROC = USD 3,300,000/USD 22,018,500 = .1499.
Spot FX: RAROC = USD 3,000,000/USD 18,919,600 = .1586.

Conclusion: Once adjusted for risk, Trader II provided a better return.¶

• **SUMMARY: RAPM - Pros and Cons**
- RVOL and Jensen's alpha:
  - Pros: They take systematic risk into account. Appropriate to evaluate diversified portfolios. Comparisons are fair if portfolios have the same systematic risk, which is not true in general.
  - Cons: They use the CAPM => Usual CAPM's problems apply.

- RVAR
  -Pros: It takes unsystematic risk into account =>can be used to compare undiversified portfolios. Free of CAPM's problems.
  - Cons: Not appropriate when portfolios are well diversified. SD is sensible to upward movements, something irrelevant to Risk Management.
- RAROC
  - Pros: It takes into account only left-tail risk.
  - Cons: Calculation of VaR is more of an art than a science.

CHAPTER 13 – BRIEF ASSESMENT

1. Cammy Inc., a U.S. firm, plans to invest in a new project that will be located either in Ecuador or in Colombia. Assume the U.S. risk free rate is 3%. You have the following data on expected returns, volatility, correlations, and weights for each project:

	Cammy	Ecuador	Colombia
Expected return	10%	20%	30%
Standard deviation	15%	25%	50%
Correlation with existing Cammy's portfolio	1.00	.35	.11
Weight on overall portfolio	-	.20	.10
Beta	.90	1.10	1.40

A. Based on the Sharpe Ratio, which project would you recommend to Cammy?
B. Based on the Treynor Ratio, which project would you recommend to Cammy?
C. Is Cammy, under both criteria, better off without adding any project?

2. Two traders, working for a bank, dealing in different markets.

Trader I position (FX futures):
- Annualized profits: USD 12 million.
- Position: USD 41 million.
- Volatility (σ): 15% annualized

Trader II position (FX spot):
- Annualized profits: USD 23 million.
- Position: USD 68 million.
- Volatility (σ): 25% annualized

Use the RAROC (see Bonus material) measure to determine which trader provides the bank a better risk-return trade-off.