3. The Limiting Case: The Market Portfolio

- **The big assumptions & the follow up:** Assuming diversification costs nothing (in terms of transactions costs), and that all assets can be traded, the limit of diversification is to hold a portfolio of every single asset in the economy (in proportion to market value). This portfolio is called the market portfolio.

- **The consequence:** Individual investors will adjust for risk, by adjusting their allocations to this market portfolio and a riskless asset (such as a T-Bill):

Preferred risk level	Allocation decision
No risk	100% in T-Bills
Some risk	50% in T-Bills; 50% in Market Portfolio;
A little more risk	25% in T-Bills; 75% in Market Portfolio
Even more risk	100% in Market Portfolio
A risk hog..	Borrow money; Invest in market portfolio

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4. The Risk & Expected Return of an Individual Asset

- The essence: The risk of any asset is the risk that it adds to the market portfolio Statistically, this risk can be measured by how much an asset moves with the market (called the covariance)

- The measure: Beta is a standardized measure of this covariance, obtained by dividing the covariance of any asset with the market by the variance of the market. It is a measure of the non-diversifiable risk for any asset can be measured by the covariance of its returns with returns on a market index, which is defined to be the asset's beta.

- The result: The required return on an investment will be a linear function of its beta:
  - Expected Return = Riskfree Rate+ Beta * (Expected Return on the Market Portfolio - Riskfree Rate)

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Limitations of the CAPM

1. The model makes unrealistic assumptions

2. The parameters of the model cannot be estimated precisely

   ◻ The market index used can be wrong.

   ◻ The firm may have changed during the 'estimation' period'

3. The model does not work well

   ◻ - If the model is right, there should be:

      ■ A linear relationship between returns and betas

      ■ The only variable that should explain returns is betas

   ◻ - The reality is that

      ■ The relationship between betas and returns is weak

      ■ Other variables (size, price/book value) seem to explain differences in returns better.

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Alternatives to the CAPM

Step 1: Defining Risk

The risk in an investment can be measured by the variance in actual returns around an expected return

Riskless Investment   *Low Risk Investment*   *High Risk Investment*

E(R)   E(R)   E(R)
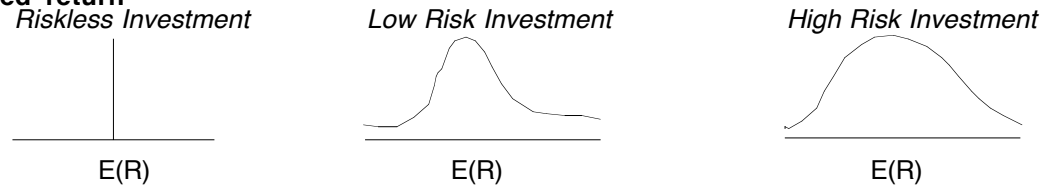
Step 2: Differentiating between Rewarded and Unrewarded Risk

Risk that is specific to investment (Firm Specific) Can be diversified away in a diversified portfolio 1. each investment is a small proportion of portfolio 2. risk averages out across investments in portfolio	*Risk that affects all investments (Market Risk)* Cannot be diversified away since most assets are affected by it.

The marginal investor is assumed to hold a "diversified" portfolio. Thus, only market risk will be rewarded and priced.

Step 3: Measuring Market Risk

The CAPM	The APM	Multi-Factor Models	Proxy Models
If there is 1. no private information 2. no transactions cost the optimal diversified portfolio includes every traded asset. Everyone will hold this market portfolio **Market Risk = Risk added by any investment to the market portfolio:**	If there are no arbitrage opportunities then the market risk of any asset must be captured by betas relative to factors that affect all investments. **Market Risk = Risk exposures of any asset to market factors**	Since market risk affects most or all investments, it must come from macro economic factors. **Market Risk = Risk exposures of any asset to macro economic factors.**	In an efficient market, differences in returns across long periods must be due to market risk differences. Looking for variables correlated with returns should then give us proxies for this risk. **Market Risk = Captured by the Proxy Variable(s)**
Beta of asset relative to Market portfolio (from a regression)	Betas of asset relative to unspecified market factors (from a factor analysis)	Betas of assets relative to specified macro economic factors (from a regression)	Equation relating returns to proxy variables (from a regression)

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Why the CAPM persists…

- <u>The CAPM, notwithstanding its many critics and limitations, has survived as the default model for risk in equity valuation and corporate finance</u>. The alternative models that have been presented as better models (APM, Multifactor model..) have made inroads in performance evaluation but not in prospective analysis because:

  - The alternative models (which are richer) do a much better job than the CAPM in explaining past return, but their effectiveness drops off when it comes to estimating expected future returns (because the models tend to shift and change).

  - The alternative models are more complicated and require more information than the CAPM.

  - For most companies, the expected returns you get with the the alternative models is not different enough to be worth the extra trouble of estimating four additional betas.

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Application Test: Who is the marginal investor in your firm?

- You can get information on insider and institutional holdings in your firm from:
  - http://finance.yahoo.com/
  - Enter your company's symbol and choose profile.
- Looking at the breakdown of stockholders in your firm, consider whether the marginal investor is
  - An institutional investor
  - An individual investor
  - An insider
- Follow up by evaluating whether the marginal investor is likely to be diversified.
  - If yes, you are on safer ground using the risk and return models that assume that only non-diversifiable risk is rewarded.
  - If no, you will have to adapt your risk measure to bring in some or all o fthe company-specific risk that you were ignoring.

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From Risk Models to Hurdle Rates: Estimation Challenges

"The price of purity is purists…"

Anonymous

Inputs required to use the CAPM -

- ☐ The capital asset pricing model yields the following expected return:

  - ▫ Expected Return = Riskfree Rate+ Beta * (Expected Return on the Market Portfolio - Riskfree Rate)

- ☐ To use the model, we need three inputs:

  a. The current risk-free rate

  b. The expected market risk premium, the premium expected for investing in risky assets, i.e. the market portfolio, over the riskless asset.

  c. The beta of the asset being analyzed.

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The Riskfree Rate and Time Horizon

- On a riskfree asset, the actual return is equal to the expected return. Therefore, there is no variance around the expected return.

- For an investment to be riskfree, i.e., to have an actual return be equal to the expected return, two conditions have to be met –

  - There <u>can be no default risk</u>, which generally implies that the security has to be issued by the government. Note, however, that not all governments can be viewed as default free.

  - There can be <u>no uncertainty about reinvestment rates</u>, which implies that it is a zero-coupon security with the same maturity as the cash flow being analyzed.
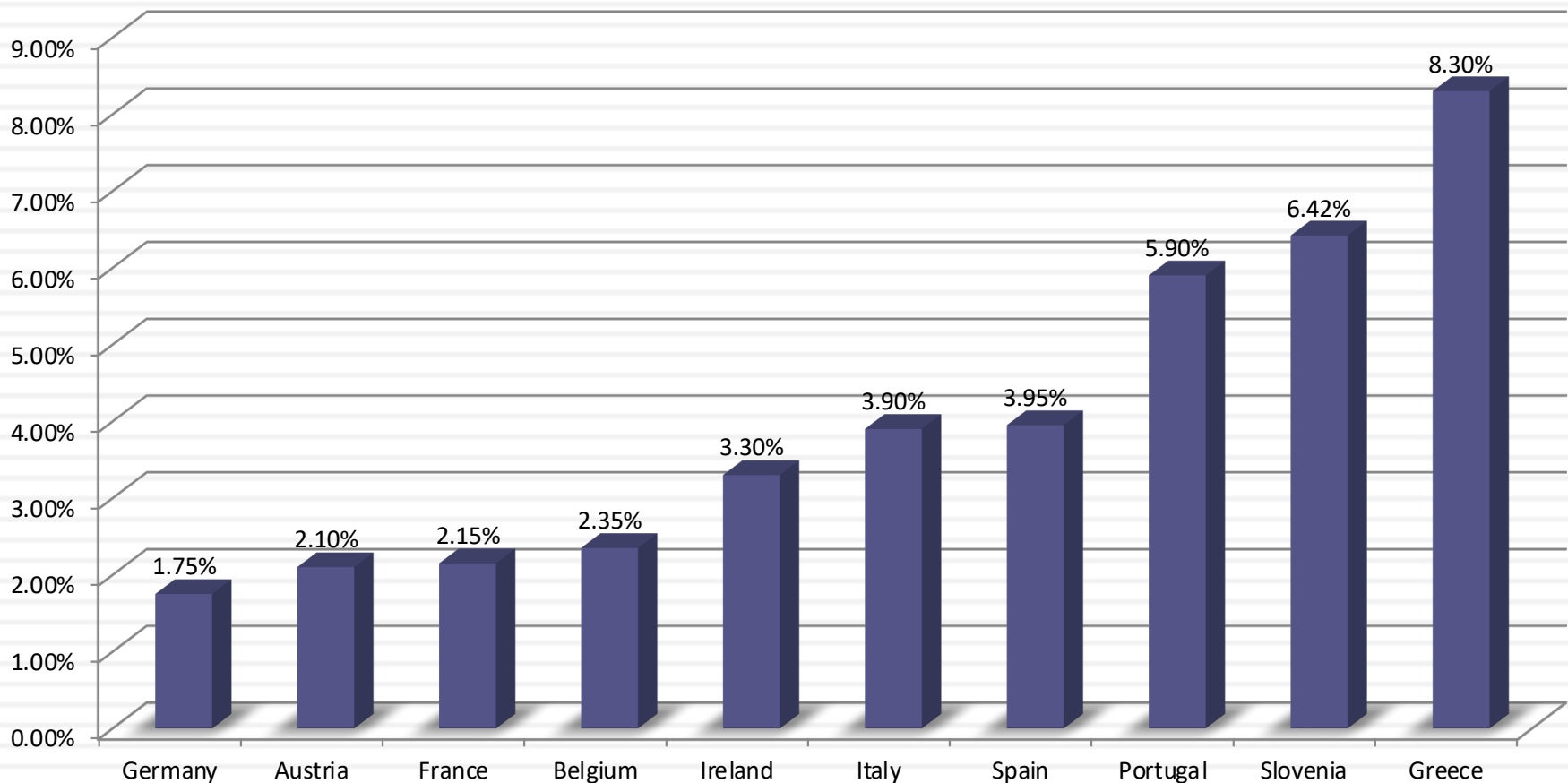
Riskfree Rate in Practice

- Definition: The riskfree rate is the rate on a zero coupon default-free bond matching the time horizon of the cash flow being analyzed.

- Implication: Theoretically, this translates into using different riskfree rates for each cash flow - the 1 year zero coupon rate for the cash flow in year 1, the 2-year zero coupon rate for the cash flow in year 2 …

- A Practical Solution: Practically speaking, if there is substantial uncertainty about expected cash flows, the present value effect of using time varying riskfree rates is small enough that it may not be worth it.

- **In corporate finance, almost everything we do is long term. So, using a long-term default free rate as the riskfree rate makes sense.**
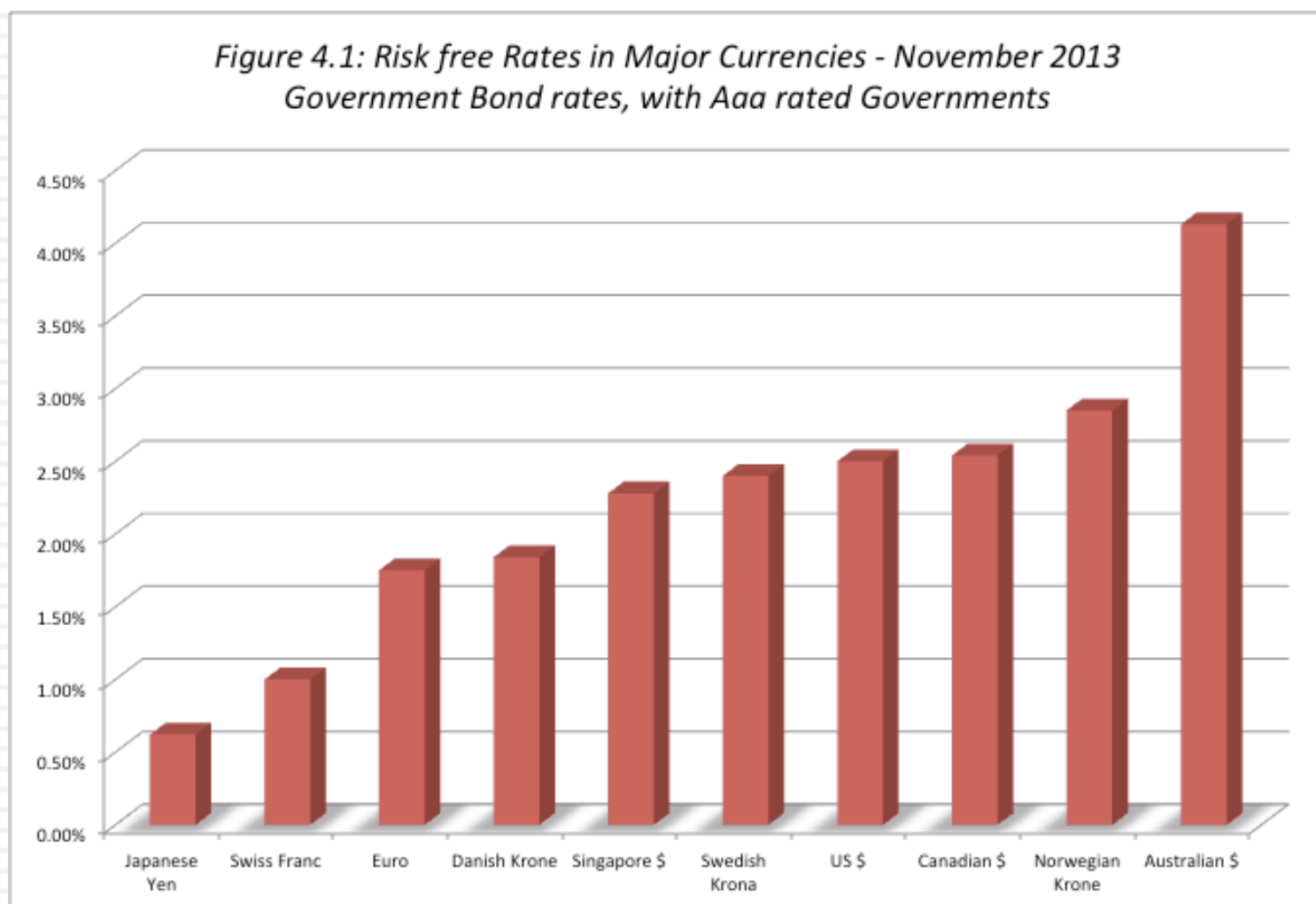
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The Bottom Line on Riskfree Rates

- **Currency Matching**: The riskfree rate that you use in an analysis should be in the same currency that your cashflows are estimated in.
  - In other words, if your cashflows are in U.S. dollars, your riskfree rate has to be in U.S. dollars as well.
  - If your cash flows are in Euros, your riskfree rate should be a Euro riskfree rate.

- **Just use the government bond rate?** The conventional practice of estimating riskfree rates is to use the government bond rate, with the government being the one that is in control of issuing that currency. **In November 2013**, for instance, the rate on a ten-year US treasury bond (2.75%) is used as the risk free rate in US dollars.

- **If the government is default-fre**e, using a long term government rate (even on a coupon bond) as the risk free rate on all of the cash flows in a long term analysis will yield a close approximation of the true value. For short term analysis, it is entirely appropriate to use a short term government security rate as the riskfree rate.

What is the Euro riskfree rate? An exercise in November 2013

Rate on 10-year Euro Government Bonds: November 2013

Bar chart values:
- Germany: 1.75%
- Austria: 2.10%
- France: 2.15%
- Belgium: 2.35%
- Ireland: 3.30%
- Italy: 3.90%
- Spain: 3.95%
- Portugal: 5.90%
- Slovenia: 6.42%
- Greece: 8.30%

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When the government is default free: Risk free rates – in November 2013

Figure 4.1: Risk free Rates in Major Currencies - November 2013
Government Bond rates, with Aaa rated Governments

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What if there is no default-free entity? Risk free rates in November 2013

- **Adjust the local currency government borrowing rate** for default risk to get a riskless local currency rate.
  - In November 2013, the Indian government rupee bond rate was 8.82%. the local currency rating from Moody's was Baa3 and the default spread for a Baa3 rated country bond was 2.25%.

  Riskfree rate in Rupees = 8.82% - 2.25% = 6.57%
  - In November 2013, the Chinese Renmimbi government bond rate was 4.30% and the local currency rating was Aa3, with a default spread of 0.8%.

  Riskfree rate in Chinese Renmimbi = 4.30% - 0.80% = 3.50%

- **Do the analysis in an alternate currency**, where getting the riskfree rate is easier. With Vale in 2013, we could choose to do the analysis in US dollars (rather than estimate a riskfree rate in R$). The riskfree rate is then the US treasury bond rate.

- **Do your analysis in real terms**, in which case the riskfree rate has to be a real riskfree rate. The inflation-indexed treasury rate is a measure of a real riskfree rate.

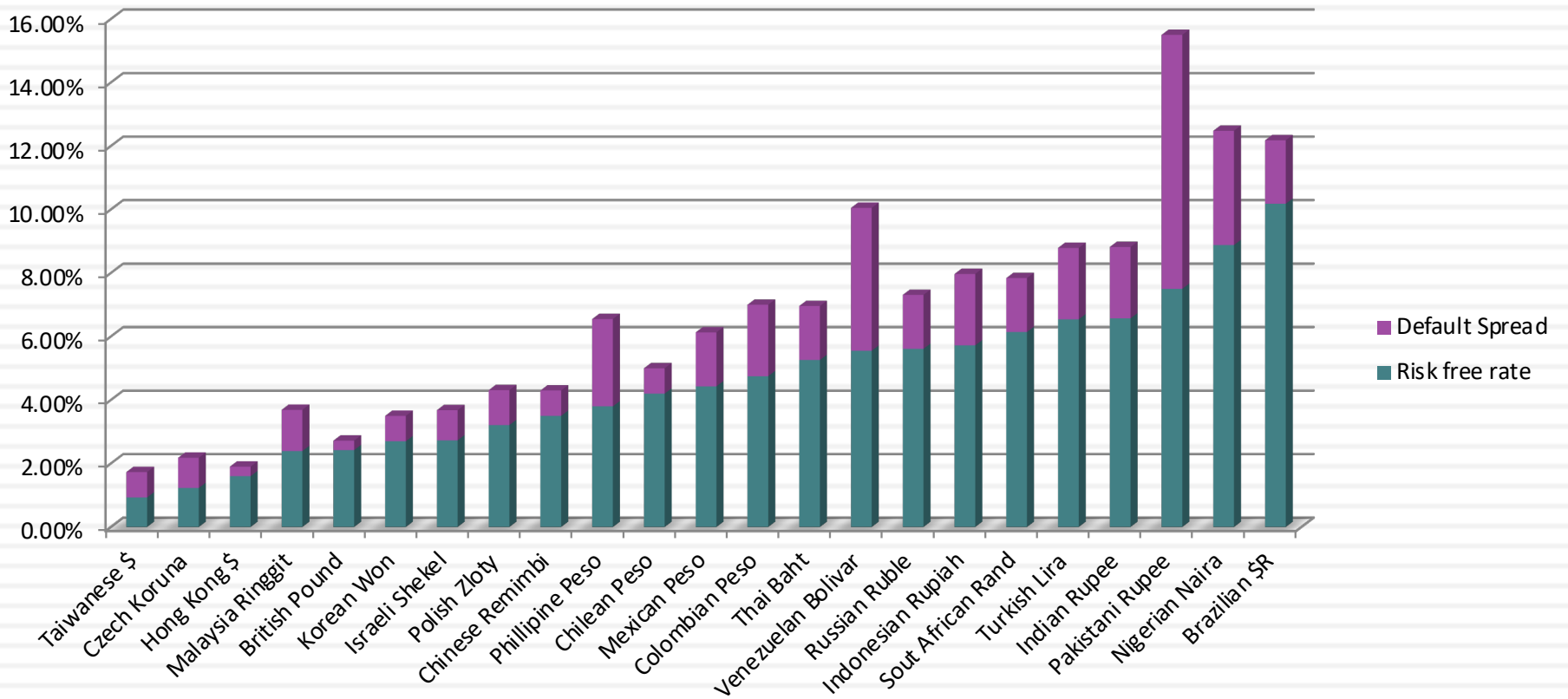# Three paths to estimating sovereign default spreads

- <u>Sovereign dollar or euro denominated bonds</u>: The difference between the interest rate on a sovereign US $ bond, issued by the country, and the US treasury bond rate can be used as the default spread. For example, in November 2013, the 10-year Brazil US $ bond, denominated in US dollars had a yield of 4.25% and the US 10-year T.Bond rate traded at 2.75%.

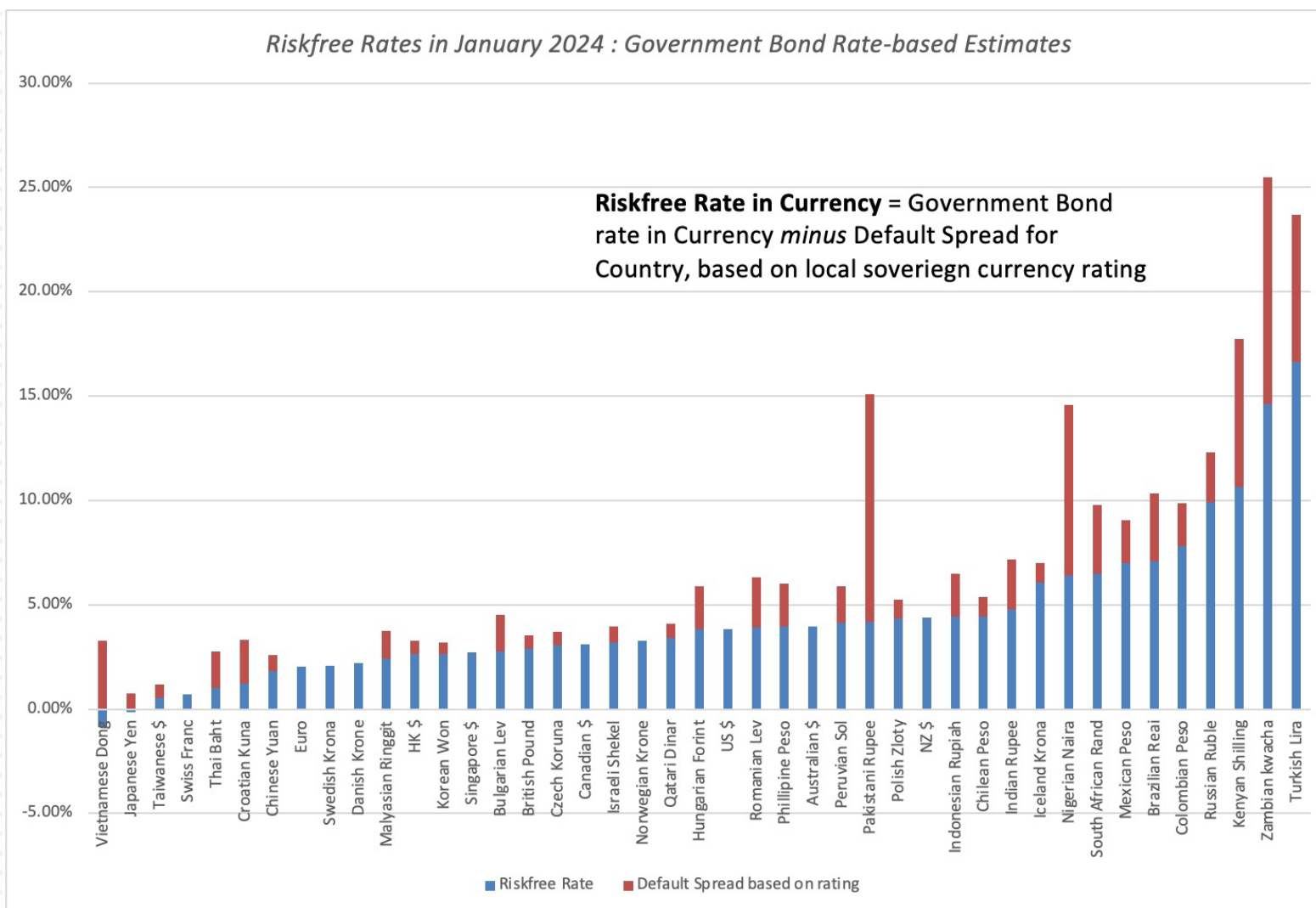   Default spread = 4.25% - 2.75% = 1.50%

- <u>CDS spreads</u>: Obtain the default spreads for sovereigns in the CDS market. The CDS spread for Brazil in November 2013 was 2.50%.

- <u>Average spread</u>: If you know the sovereign rating for a country, you can estimate the default spread based on the rating. In November 2013, Brazil's rating was Baa2, yielding a default spread of 2%.

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Risk free rates in currencies: Sovereigns with default risk in November 2013

Figure 4.2: Risk free rates in Currencies where Governments not Aaa rated

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Risk free Rates in January 2024

Riskfree Rates in January 2024 : Government Bond Rate-based Estimates

Riskfree Rate in Currency = Government Bond rate in Currency *minus* Default Spread for Country, based on local soveriegn currency rating

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Measurement of the equity risk premium

- The equity risk premium is the premium that investors demand for investing in an average risk investment, relative to the riskfree rate. In short, it is the price of risk in equity markets, rising with fear.

- As a general proposition, this premium should be
  - Greater than zero
  - Increase with the risk aversion of the investors in that market
  - Increase with the riskiness of the "average" risk investment

- If so, it also follows that equity risk premiums should change over time, as economic circumstances change and investor composition also changes.

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What is your risk premium?

- Assume that stocks are the only risky assets and that you are offered two investment options:
  - a riskless investment (say a Government Security), on which you can make 3%
  - a mutual fund of all stocks, on which the returns are uncertain
- How much of an expected return would you demand to shift your money from the riskless asset to the mutual fund?
  a. Less than 3%
  b. Between 3% - 5%
  c. Between 5% - 7%
  d. Between 7% -9%
  e. Between 9%- 11%
  f. More than 11%

Risk Aversion and Risk Premiums

- □ If this were the entire market, the risk premium would be a <u>weighted average of the risk premiums</u> demanded by each and every investor.

- □ The weights will be determined by the wealth that each investor brings to the market. Thus, Warren Buffett's risk aversion counts more towards determining the "equilibrium" premium than yours' and mine.

- □ As investors become more risk averse, or the market becomes "more risky", you would expect the "equilibrium" premium to increase.

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Risk Premiums do change..

- Go back to the previous question. Assume now that you are making the same choice but that you are making it in the aftermath of a stock market crash (it has dropped 25% in the last month). Would you change your answer?

  a. I would demand a larger premium

  b. I would demand a smaller premium

  c. I would demand the same premium

- If your equity risk premium rises, what should happen to stock prices, all else held constant?

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Estimating Risk Premiums in Practice

1. Survey Premiums: <u>Survey investors</u> on their desired risk premiums and use the average premium from these surveys.

2. <u>Historical Premiums</u>: Assume that the actual premium delivered over long time periods is equal to the expected premium - i.e., use <u>historical data.</u>

3. <u>Implied Premiums</u>: Estimate a <u>forward-looking premium</u>, based upon today's asset prices.

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1. The Survey Approach

- Surveying all investors in a marketplace is impractical.
- However, you can survey a few individuals and use these results. In practice, this translates into surveys of the following:

Group Surveyed	Survey done by	Estimated ERP	Notes
Individual Investors	Securities Industries Association	8.3% (2004)	One year premium
Institutional Investors	Merrill Lynch	4.8% (2013)	Monrthly updates
CFOs	Campbell Harvey & Graham	4.48% (2012)	5-8% response rate
Analysts	Pablo Fernandez	5.0% (2011)	Lowest standard deviation
Academics	Pablo Fernandez	5.7% (2011)	Higher for emerging markets

- The limitations of this approach are:
  - There are no constraints on reasonability (the survey could produce negative risk premiums or risk premiums of 50%)
  - The survey results are more reflective of the past than the future.
  - They tend to be short term; even the longest surveys do not go beyond one year.

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2. The Historical Premium Approach

- ☐ This is the default approach used by most to arrive at the premium to use in the model
- ☐ In most cases, this approach does the following
  - ◻ Defines a time period for the estimation (1928-Present, last 50 years...)
  - ◻ Calculates average returns on a stock index during the period
  - ◻ Calculates average returns on a riskless security over the period
  - ◻ Calculates the difference between the two averages and uses it as a premium looking forward.
- ☐ The limitations of this approach are:
  - ◻ it assumes that the risk aversion of investors has not changed in a systematic way across time. (The risk aversion may change from year to year, but it reverts back to historical averages)
  - ◻ it assumes that the riskiness of the "risky" portfolio (stock index) has not changed in a systematic way across time.

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Historical ERP: A Historical Snapshot

	Arithmetic Average		Geometric Average	
	Stocks - T. Bills	Stocks - T. Bonds	Stocks - T. Bills	Stocks - T. Bonds
1928-2023	8.32%	6.80%	6.50%	5.23%
Std Error	2.03%	2.14%		
1974-2023	8.18%	5.95%	6.79%	4.97%
Std Error	2.45%	2.73%		
2014-2023	11.70%	11.17%	10.63%	10.44%
Std Error	4.97%	3.86%		

Historical premium for the US

□ If you are going to use a historical risk premium, make it
- □ Long term (because of the standard error)
- □ Consistent with your choice of risk free rate
- □ A "compounded" average

□ No matter which estimate you use, recognize that it is backward looking, is noisy and may reflect selection bias.

3. A Forward-Looking ERP

- If you <u>know the price paid for an asset</u> and have <u>estimates of the expected cash flows</u> on the asset, you can <u>estimate the IRR</u> of these cash flows. If you paid the price, this is your expected return.
    - In the bond market, that is exactly what we do when we compute the <u>yield to maturity</u> on a bond.
    - If you assume that stocks are correctly priced in the aggregate and you can estimate the expected cashflows from buying stocks, you can <u>estimate the expected rate of return on stocks</u> by finding that discount rate that makes the present value equal to the price paid.
- Subtracting out the riskfree rate should yield an implied equity risk premium. This implied equity premium is a forward-looking number and can be updated as often as you want.

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Implied ERP in November 2013: Watch what I pay, not what I say..

□ If you can observe what investors are willing to pay for stocks, you can back out an expected return from that price and an implied equity risk premium.

Base year cash flow (last 12 mths)
Dividends (TTM):   33.22
+ Buybacks (TTM):   49.02
= Cash to investors (TTM): 82.35
Earnings in TTM:

Expected growth in next 5 years
Top down analyst estimate of earnings growth for S&P 500 with stable payout: 5.59%

Beyond year 5
Expected growth rate =
Riskfree rate = 2.55%
Expected CF in year 6 =
108.1(1.0255)

E(Cash to investors)   86.96   91.82   96.95   102.38   108.10

S&P 500 on 11/1/13= 1756.54

$$1756.54 = \frac{86.96}{(1+r)} + \frac{91.82}{(1+r)^2} + \frac{96.95}{(1+r)^3} + \frac{102.38}{(1+r)^4} + \frac{108.10}{(1+r)^5} + \frac{110.86}{(r-.0255)(1+r)^5}$$

r = Implied Expected Return on Stocks = 8.04%

Minus

Risk free rate = T.Bond rate on 1/1/14=2.55%

Equals

Implied Equity Risk Premium (1/1/14) = 8.04% - 2.55% = 5.49%

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