

3. The Limiting Case: The Market Portfolio

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- 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):

<i>Preferred risk level</i>	<i>Allocation decision</i>
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

4. The Risk & Expected Return of an Individual Asset

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- 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. Beta 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:
 - $\text{Expected Return} = \text{Riskfree Rate} + \text{Beta} * (\text{Expected Return on the Market Portfolio} - \text{Riskfree Rate})$

Limitations of the CAPM

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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.

Alternatives to the CAPM

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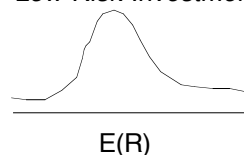
Step 1: Defining Risk

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

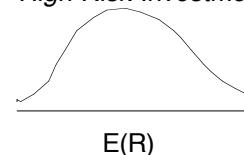
Riskless Investment



Low Risk Investment



High Risk Investment



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
<p>If there is</p> <ol style="list-style-type: none"> 1. no private information 2. no transactions cost <p>the optimal diversified portfolio includes every traded asset. Everyone will hold this <u>market portfolio</u></p> <p>Market Risk = Risk added by any investment to the market portfolio:</p>	<p>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.</p> <p>Market Risk = Risk exposures of any asset to market factors</p>	<p>Since market risk affects most or all investments, it must come from macro economic factors.</p> <p>Market Risk = Risk exposures of any asset to macro economic factors.</p>	<p>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.</p> <p>Market Risk = Captured by the Proxy Variable(s)</p>
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)

Why the CAPM persists...

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- The CAPM, notwithstanding its many critics and limitations, has survived as the default model for risk in equity valuation and corporate finance. 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.

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

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- 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



From Risk Models to Hurdle Rates: Estimation Challenges

“The price of purity is purists...”

Anonymous

Inputs required to use the CAPM -

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- 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.

The Riskfree Rate and Time Horizon

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- 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 has to be no default risk, 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 no uncertainty about reinvestment rates, which implies that it is a zero coupon security with the same maturity as the cash flow being analyzed.

Riskfree Rate in Practice

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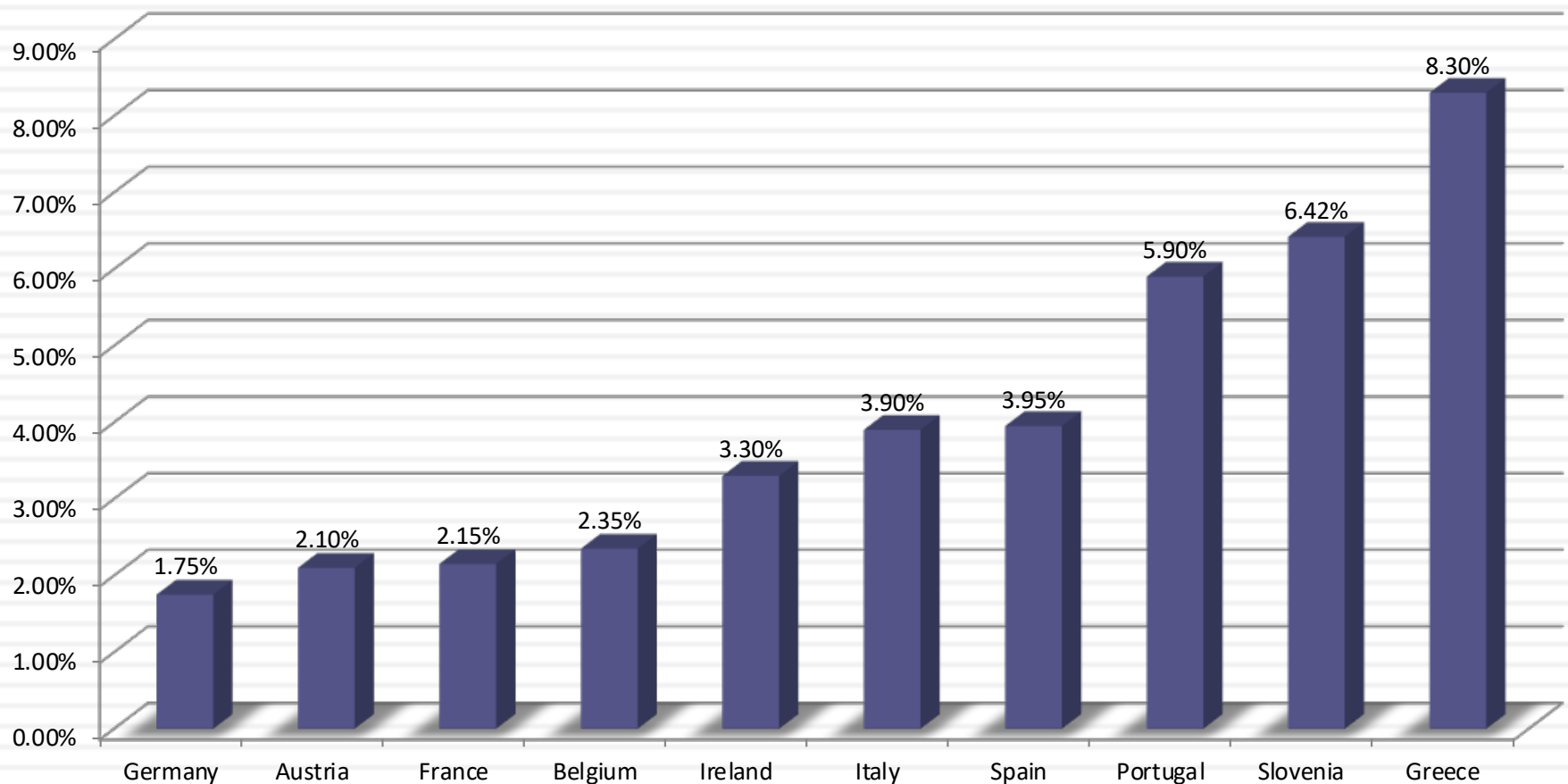
- Definition: The riskfree rate is the rate on a zero coupon default-free bond matching the time horizon of the cash flow being analyzed.
- Implication: Theoretically, this translates into using different riskfree rates for each cash flow - the 1 year zero coupon rate for the cash flow in year 1, the 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 risk free rate makes sense.**

The Bottom Line on Riskfree Rates

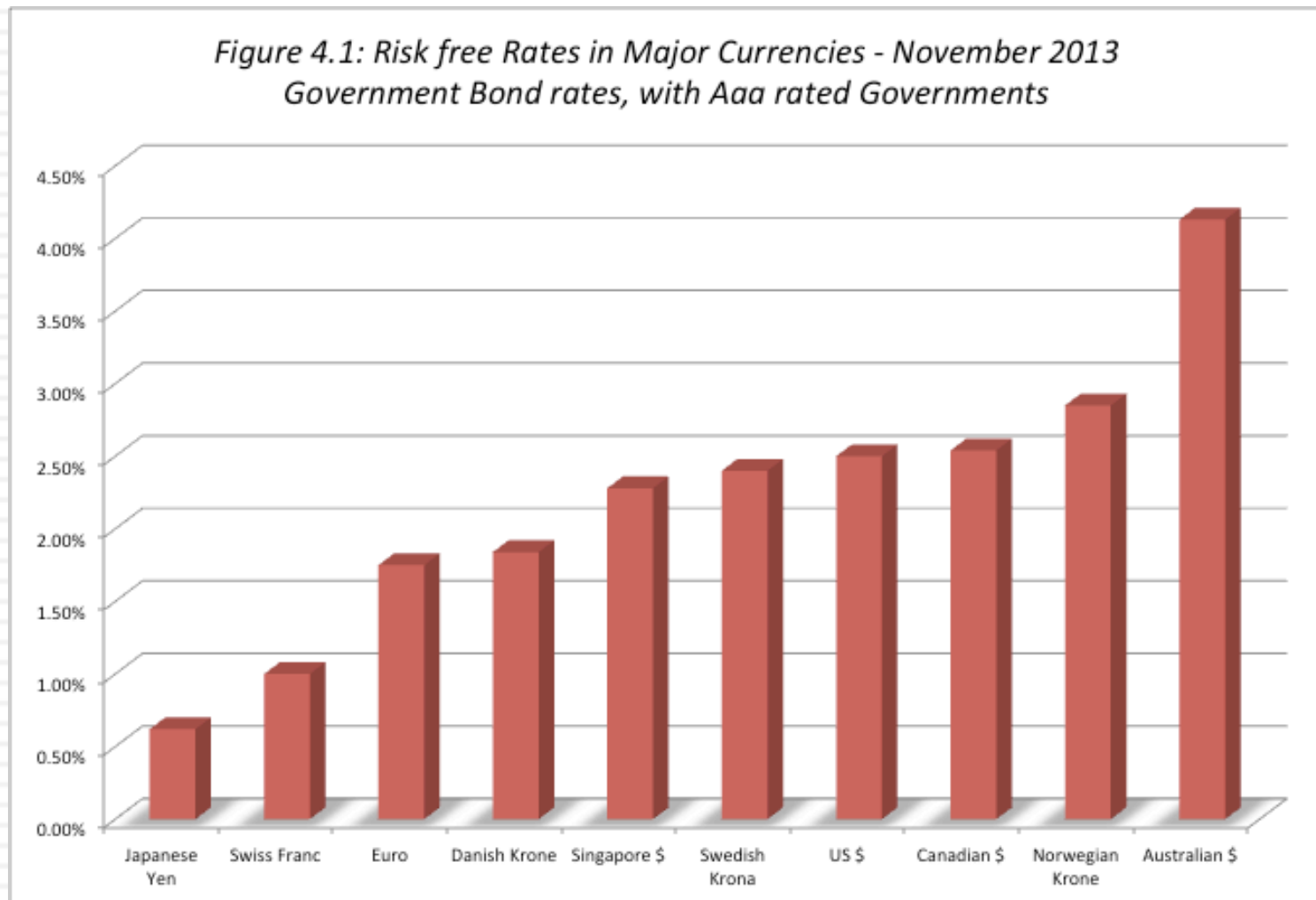
- **Currency Matching:** The riskfree rate that you use in an analysis should be in the same currency that your cashflows are estimated in.
 - ▣ In other words, if your cashflows are in U.S. dollars, your riskfree rate has to be in U.S. dollars as well.
 - ▣ If your cash flows are in Euros, your riskfree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



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



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 = $4.30\% - 0.8\% = 3.5\%$
- **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

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- Sovereign dollar or euro denominated bonds: 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%.

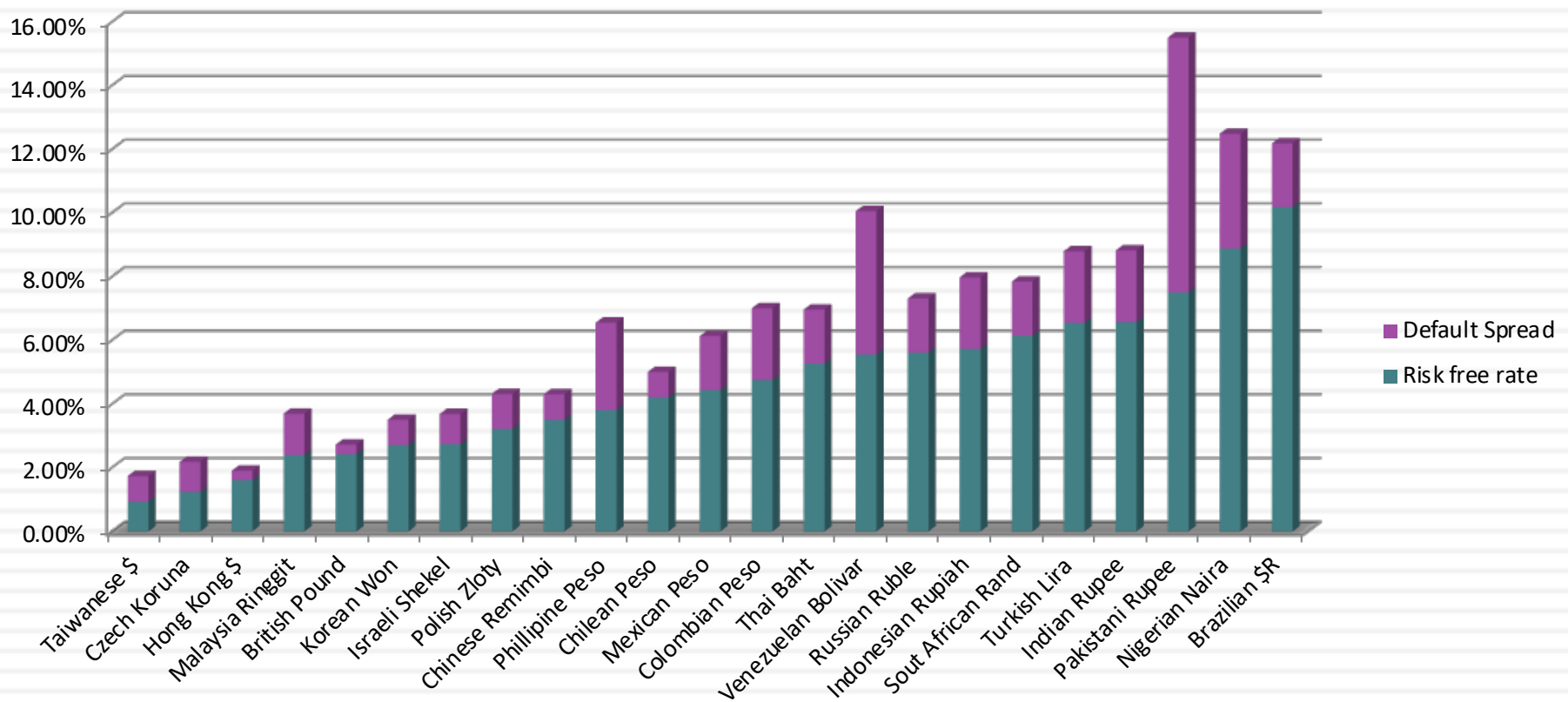
$$\text{Default spread} = 4.25\% - 2.75\% = 1.50\%$$

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

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

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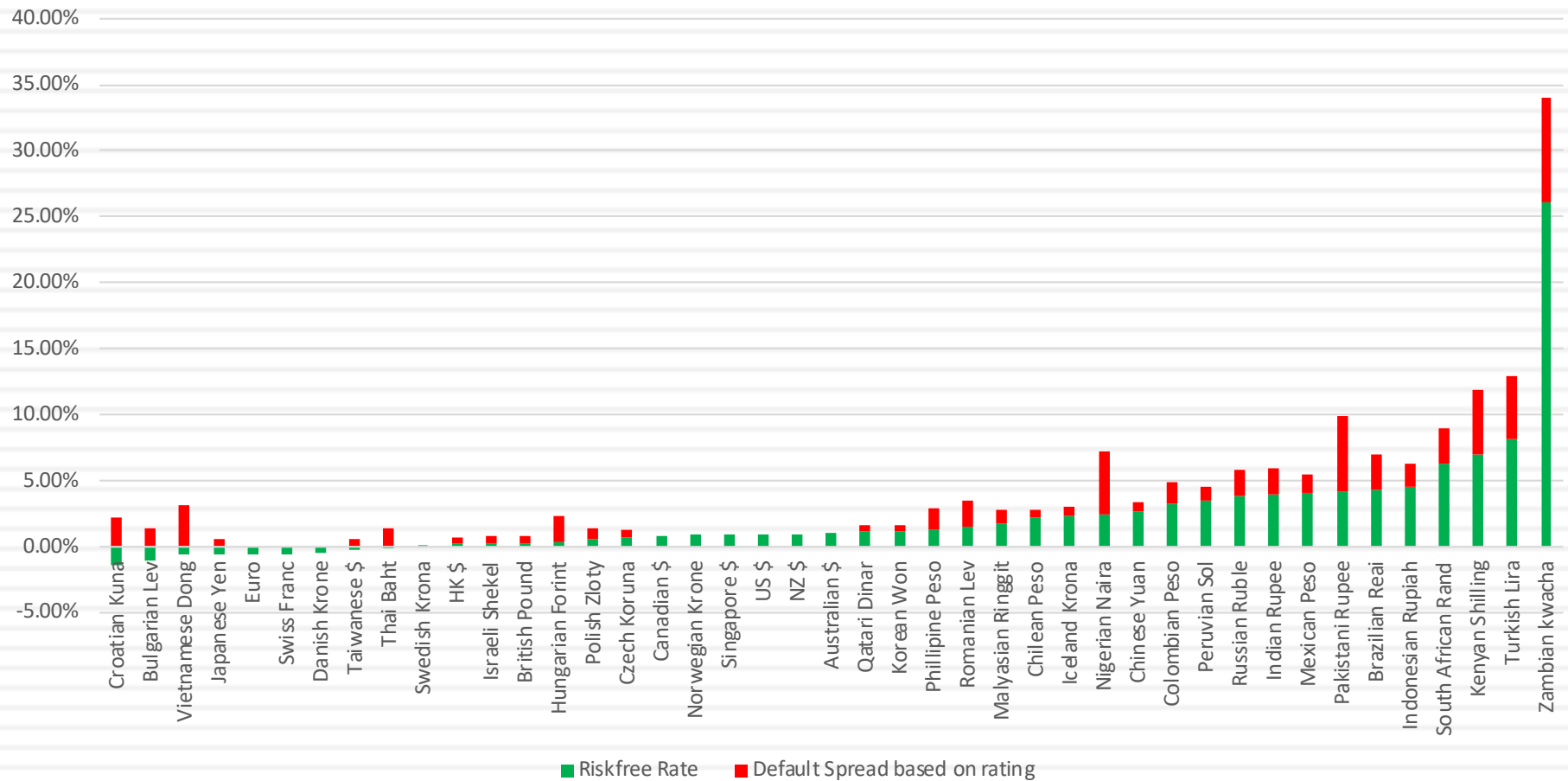
Figure 4.2: Risk free rates in Currencies where Governments not Aaa rated



Risk free Rates in January 2021

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Riskfree Rates in January 2021 : Government Bond Rate



Measurement of the equity risk premium

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- The equity risk premium is the premium that investors demand for investing in an average risk investment, relative to the riskfree rate.
- 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

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

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- If this were the entire market, the risk premium would be a weighted average of the risk premiums 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, you would expect the “equilibrium” premium to increase.