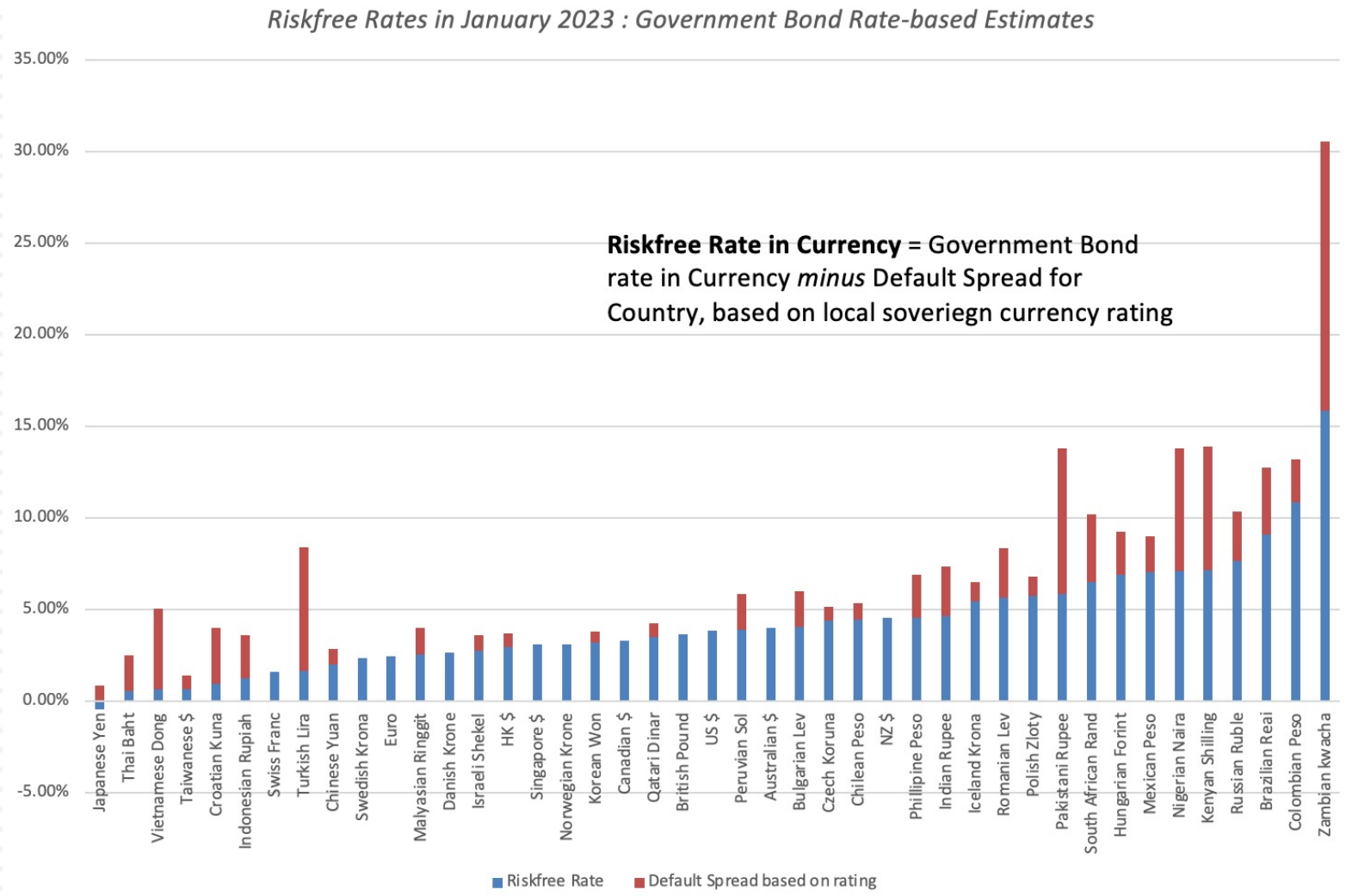
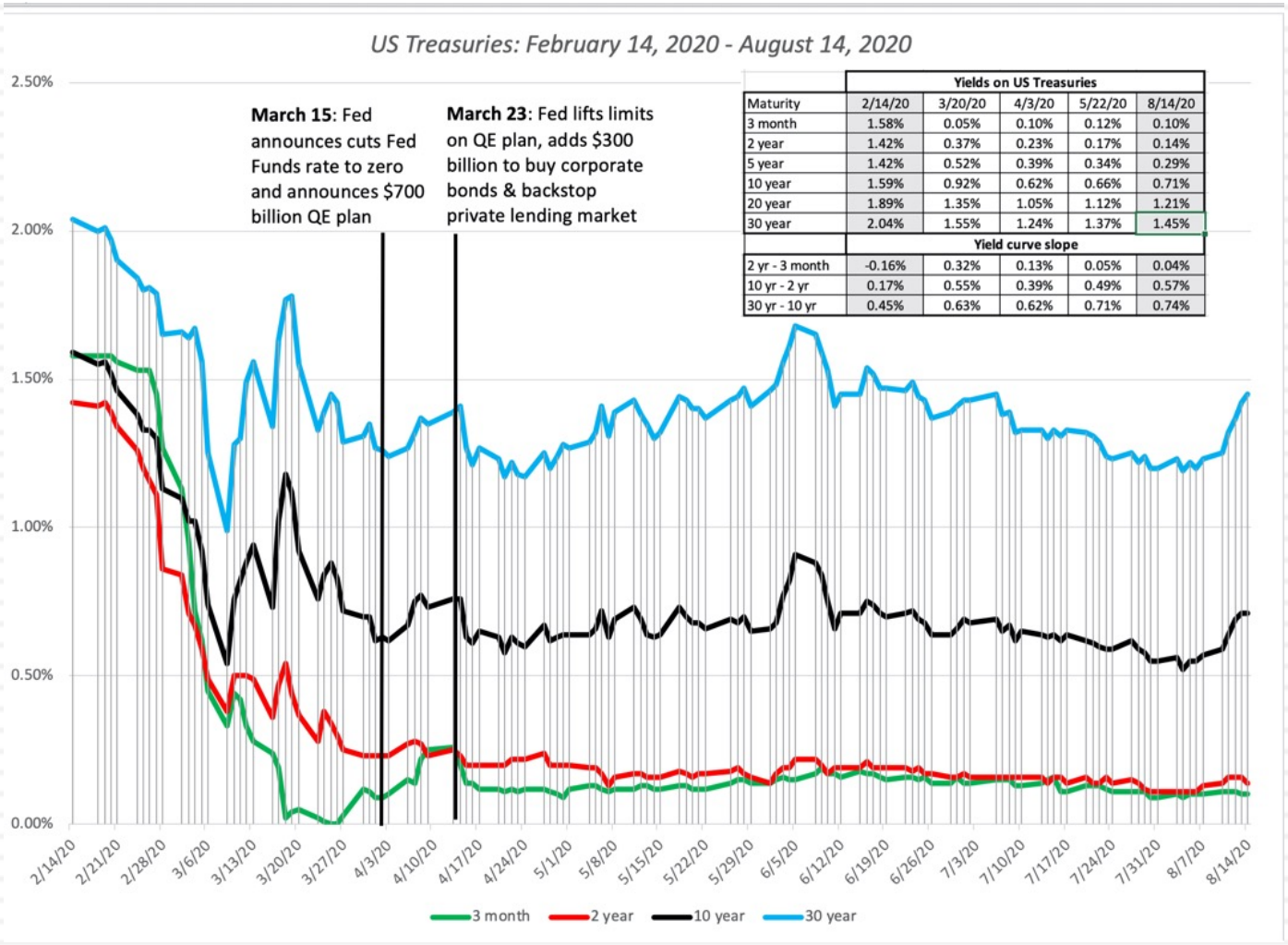
Why do risk free rates vary across currencies? January 2023 Risk free rates



Or across time…



	Yields on US Treasuries				
Maturity	2/14/20	3/20/20	4/3/20	5/22/20	8/14/20
3 month	1.58%	0.05%	0.10%	0.12%	0.10%
2 year	1.42%	0.37%	0.23%	0.17%	0.14%
5 year	1.42%	0.52%	0.39%	0.34%	0.29%
10 year	1.59%	0.92%	0.62%	0.66%	0.71%
20 year	1.89%	1.35%	1.05%	1.12%	1.21%
30 year	2.04%	1.55%	1.24%	1.37%	1.45%
	Yield curve slope				
2 yr - 3 month	-0.16%	0.32%	0.13%	0.05%	0.04%
10 yr - 2 yr	0.17%	0.55%	0.39%	0.49%	0.57%
30 yr - 10 yr	0.45%	0.63%	0.62%	0.71%	0.74%

Risk free Rate: Don't have or don't trust the government bond rate?

- You can scale up the riskfree rate in a base currency ($, Euros) by the differential inflation between the base currency and the currency in question. In US $:

Risk free rate$_{Currency}$ = $(1 + Riskfree\ rate_{US\ \$}) \frac{(1 + Expected\ Inflation_{Foreign\ Currency})}{(1 + Expected\ Inflation_{US\ \$})} - 1$

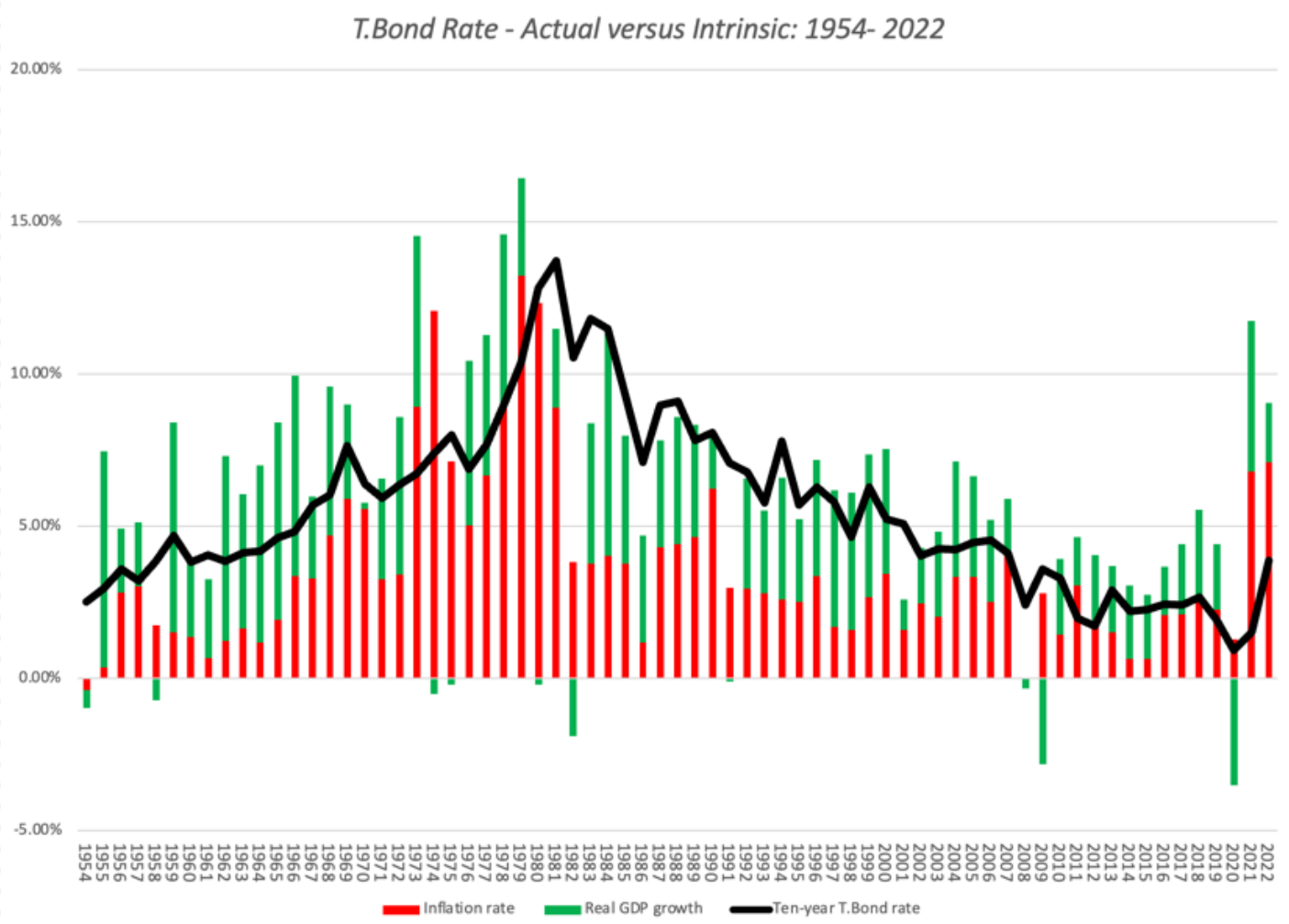
- Thus, if the US $ risk free rate is 2.00%, the inflation rate in Egyptian pounds is 15% and the inflation rate in US $ is 1.5%, the foreign currency risk free rate is as follows:

Risk free rate = $(1.02)\frac{(1.15)}{(1.015)} - 1 = 15.57\%$

One more test on riskfree rates…

- On January 1, 2022, the 10-year treasury bond rate in the United States was 1.51%, low by historic standards. Assume that you are valuing a company in US dollars then but are wary about the riskfree rate being too low. Which of the following should you do?
  a. Replace the current 10-year bond rate with a more reasonable normalized riskfree rate (the average 10-year bond rate over the last 30 years has been about 5-6%)
  b. Use the current 10-year bond rate as your riskfree rate but make sure that your other assumptions (about growth and inflation) are consistent with the riskfree rate.
  c. Something else…

Some perspective on risk free rates



Negative Interest Rates?

- In 2022, there were at least three currencies (Swiss Franc, Japanese Yen, Euro) with negative interest rates. Using the fundamentals (inflation and real growth) approach, how would you explain negative interest rates?
  - How negative can rates get? (Is there a bound?)
  - Would you use these negative interest rates as risk free rates?
    - If no, why not and what would you do instead?
    - If yes, what else would you have to do in your valuation to be internally consistent?

Discount Rates: II

The Equity Risk Premium

II. The Equity Risk Premium
The ubiquitous historical risk premium

- The historical premium is the premium that stocks have historically earned over riskless securities.
- While the users of historical risk premiums act as if it is a fact (rather than an estimate), it is sensitive to
  - How far back you go in history…
  - Whether you use T.bill rates or T.Bond rates
  - Whether you use geometric or arithmetic averages.
- For instance, looking at the US:

	Arithmetic Average		*Geometric Average*	
	Stocks - T. Bills	Stocks - T. Bonds	Stocks - T. Bills	Stocks - T. Bonds
1928-2022	8.17%	6.64%	6.34%	5.06%
Std Error	*2.05%*	*2.15%*		
1973-2022	7.30%	5.14%	5.87%	4.12%
Std Error	*2.51%*	*2.75%*		
2013-2022	12.64%	13.08%	11.50%	12.32%
Std Error	*5.50%*	*4.81%*		

The perils of trusting the past…….

- Noisy estimates: Even with long time periods of history, the risk premium that you derive will have substantial standard error. For instance, if you go back to 1928 (about 90 years of history) and you assume a standard deviation of 20% in annual stock returns, you arrive at a standard error of greater than 2%:

  Standard Error in Premium = 20%/√90 = 2.1%

- Survivorship Bias: Using historical data from the U.S. equity markets over the twentieth century does create a sampling bias. After all, the US economy and equity markets were among the most successful of the global economies that you could have invested in early in the century.

The simplest way of estimating an additional country risk premium: The country default spread

- Default spread for country: In this approach, the country equity risk premium is set equal to the default spread for the country, estimated in one of three ways:
  - The default spread on a dollar denominated bond issued by the country. (In January 2023, that spread was % for the Brazilian $ bond) was 2.27%.
  - The sovereign CDS spread for the country. In January 2023, the ten-year CDS spread for Brazil, adjusted for the US CDS, was 3.20%.
  - The default spread based on the local currency rating for the country. Brazil's sovereign local currency rating is Ba2 and the default spread for a Ba2 rated sovereign was about 3.68% in January 2023.
- Add the default spread to a "mature" market premium: This default spread is added on to the mature market premium to arrive at the total equity risk premium for Brazil, assuming a mature market premium of 5.94%.
  - Country Risk Premium for Brazil = 3.68%
  - Total ERP for Brazil = 5.94% + 3.68% = 9.62%

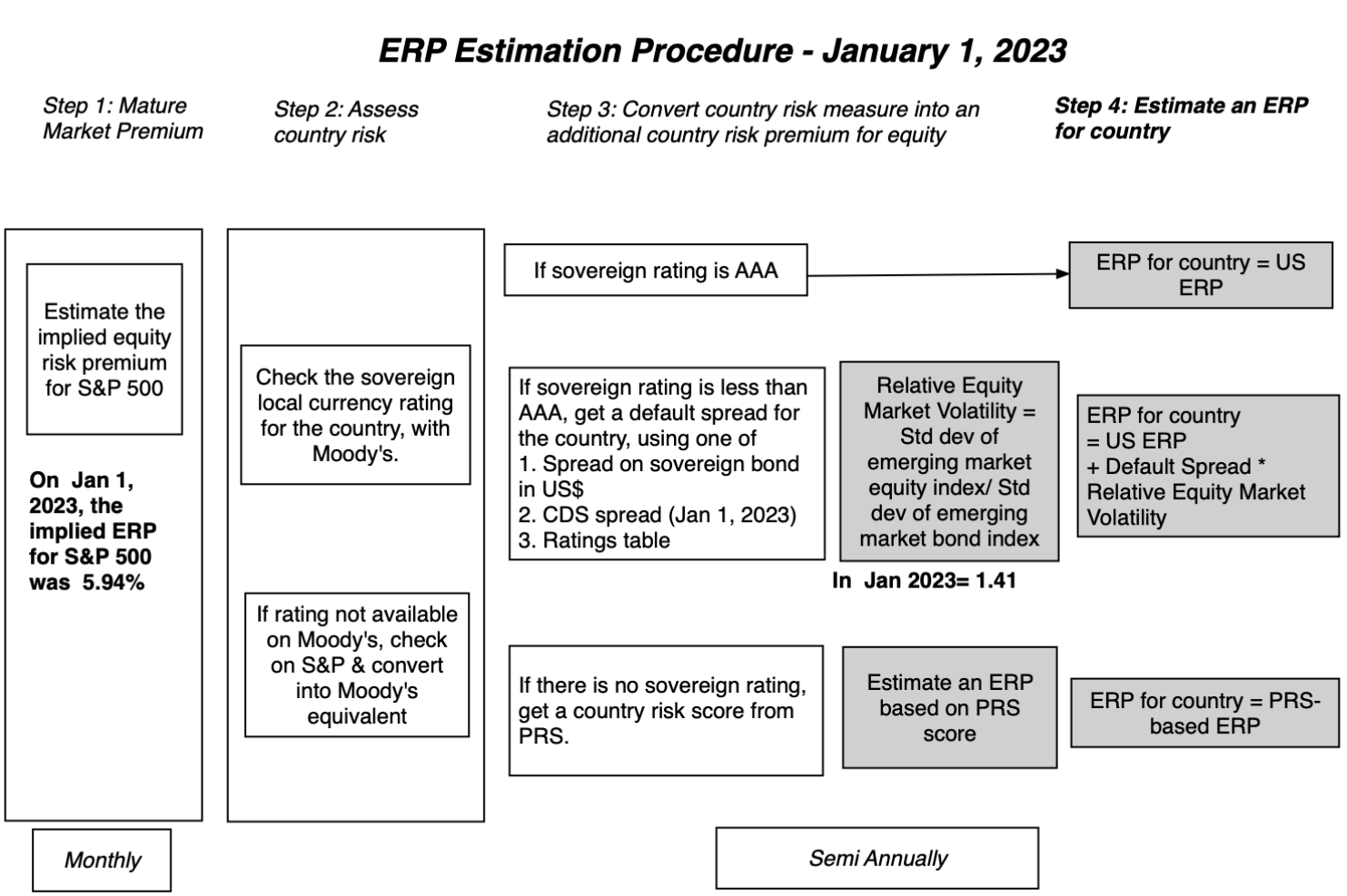
An equity volatility based approach to estimating the country total ERP

- This approach draws on the standard deviation of two equity markets, the emerging market in question and a base market (usually the US). The total equity risk premium for the emerging market is then written as:
  - Total equity risk premium = Risk Premium$_{US}$ * $\sigma_{\text{Country Equity}}$ / $\sigma_{\text{US Equity}}$
- The country equity risk premium is based upon the volatility of the market in question relative to U.S market.
  - Assume that the equity risk premium for the US is 5.94%.
  - Assume that the standard deviation in the Bovespa (Brazilian equity) is 30% and that the standard deviation for the S&P 500 (US equity) is 18%.
  - Total Equity Risk Premium for Brazil = 5.94% (30%/18%) = 9.90%
  - Country equity risk premium for Brazil = 9.90% - 5.94% = 3.96%

A melded approach to estimating the additional country risk premium

- Country ratings measure default risk. While default risk premiums and equity risk premiums are highly correlated, one would expect equity spreads to be higher than debt spreads.
- Another is to multiply the bond default spread by the relative volatility of stock and bond prices in that market. Using this approach for Brazil in January 2022, you would get:
  - Country Equity risk premium = Default spread on country bond* $\sigma_{\text{Country Equity}} / \sigma_{\text{Country Bond}}$
    - Standard Deviation in Bovespa (Equity) = 30%
    - Standard Deviation in Brazil government bond = 20%
    - Default spread for Brazil= 3.68%
  - Brazil Country Risk Premium = 3.68% (30%/20%) = 5.52%
  - Brazil Total ERP = Mature Market Premium + CRP = 5.94% + 5.52% = 11.46%

A Template for Estimating the ERP



ERP : Jan 2023

Andorra	Baa2	3.29%	9.23%
Austria	Aa1	0.69%	6.63%
Belgium	Aa3	1.03%	6.97%
Cyprus	Ba1	4.32%	10.26%
Denmark	Aaa	0.00%	5.94%
Finland	Aa1	0.69%	6.63%
France	Aa2	0.85%	6.79%
Germany	Aaa	0.00%	5.94%
Greece	Ba3	6.21%	12.15%
Guernsey (States of)	Aaa	0.00%	5.94%
Iceland	A2	1.46%	7.40%
Ireland	A1	1.22%	7.16%
Isle of Man	Aa3	1.03%	6.97%

Italy	Baa3	3.79%	9.73%
Jersey (States of)	Aaa	0.00%	5.94%
Liechtenstein	Aaa	0.00%	5.94%
Luxembourg	Aaa	0.00%	5.94%
Malta	A2	1.46%	7.40%
Netherlands	Aaa	0.00%	5.94%
Norway	Aaa	0.00%	5.94%
Portugal	Baa2	3.29%	9.23%
Spain	Baa1	2.76%	8.70%
Sweden	Aaa	0.00%	5.94%
Switzerland	Aaa	0.00%	5.94%
Turkey	B3	11.22%	17.16%
United Kingdom	Aa3	1.03%	6.97%
Western Europe		**1.51%**	**7.45%**

Albania	B1	7.77%	13.71%
Armenia	Ba3	6.21%	12.15%
Azerbaijan	Ba1	4.32%	10.26%
Belarus	Ca	20.71%	26.65%
Bosnia and Herzegovina	B3	11.22%	17.16%
Bulgaria	Baa1	2.76%	8.70%
Croatia	Baa2	3.29%	9.23%
Czech Republic	Aa3	1.03%	6.97%
Estonia	A1	1.22%	7.16%
Georgia	Ba2	5.19%	11.13%
Hungary	Baa2	3.29%	9.23%
Kazakhstan	Baa2	3.29%	9.23%
Kyrgyzstan	B3	11.22%	17.16%
Latvia	A3	2.07%	8.01%
Lithuania	A2	1.46%	7.40%
Macedonia	Ba3	6.21%	12.15%
Moldova	B3	11.22%	17.16%
Montenegro	B1	7.77%	13.71%
Poland	A2	1.46%	7.40%
Romania	Baa3	3.79%	9.73%
Russia	Caa1	12.94%	18.88%
Serbia	Ba2	5.19%	11.13%
Slovakia	A2	1.46%	7.40%
Slovenia	A3	2.07%	8.01%
Tajikistan	B3	11.22%	17.16%
Ukraine	Caa3	17.26%	23.20%
Uzbekistan	B1	7.77%	13.71%
E. Europe & Russia		**7.79%**	**13.73%**

Country	PRS	CRP	ERP
Algeria	69.25	5.19%	11.13%
Brunei	79.5	1.46%	7.40%
Gambia	65	9.49%	15.43%
Guinea	57.25	15.54%	21.48%
Guinea-Bissau	64	11.22%	17.16%
Guyana	75.75	2.76%	8.70%
Haiti	54.25	20.71%	26.65%
Iran	66.5	7.77%	13.71%
Korea, D.P.R.	51	20.71%	26.65%
Liberia	58	15.54%	21.48%
Libya	70.75	5.19%	11.13%
Madagascar	62.5	11.22%	17.16%
Malawi	51	20.71%	26.65%
Myanmar	55.75	17.26%	23.20%
Sierra Leone	53.5	20.71%	26.65%
Somalia	52	20.71%	26.65%
Sudan	43	24.69%	30.63%
Syria	43.75	24.69%	30.63%
Yemen, Republic	48.25	24.69%	30.63%
Zimbabwe	61.5	12.94%	18.88%

Canada	Aaa	0.00%	5.94%
United States	Aaa	0.00%	5.94%
North America		0.00%	5.94%

Caribbean	**NA**	**11.19%**	**17.13%**

Angola	B3	11.22%	17.16%
Benin	B1	7.77%	13.71%
Botswana	A3	2.07%	8.01%
Burkina Faso	Caa1	12.94%	18.88%
Cameroon	B2	9.49%	15.43%
Cape Verde	B3	11.22%	17.16%
Congo (DR)	B3	11.22%	17.16%
Congo (Rep of)	Caa2	15.54%	21.48%
Côte d'Ivoire	Ba3	6.21%	12.15%
Egypt	B2	9.49%	15.43%
Ethiopia	Caa2	15.54%	21.48%
Gabon	Caa1	12.94%	18.88%
Ghana	Ca	20.71%	26.65%
Kenya	B2	9.49%	15.43%
Mali	Caa2	15.54%	21.48%
Mauritius	Baa3	3.79%	9.73%
Morocco	Ba1	4.32%	10.26%
Mozambique	Caa2	15.54%	21.48%
Namibia	B1	7.77%	13.71%
Niger	B3	11.22%	17.16%
Nigeria	B3	11.22%	17.16%
Rwanda	B2	9.49%	15.43%
Senegal	Ba3	6.21%	12.15%
South Africa	Ba2	5.19%	11.13%
Swaziland	B3	11.22%	17.16%
Tanzania	B2	9.49%	15.43%
Togo	B3	11.22%	17.16%
Tunisia	Caa1	12.94%	18.88%
Uganda	B2	9.49%	15.43%
Zambia	Ca	20.71%	26.65%
Africa		**9.64%**	**15.58%**

Bangladesh	Ba3	6.21%	12.15%
Cambodia	B2	9.49%	15.43%
China	A1	1.22%	7.16%
Fiji	B1	7.77%	13.71%
Hong Kong	Aa3	1.03%	6.97%
India	Baa3	3.79%	9.73%
Indonesia	Baa2	3.29%	9.23%
Japan	A1	1.22%	7.16%
Korea	Aa2	0.85%	6.79%
Laos	Caa3	17.26%	23.20%
Macao	Aa3	1.03%	6.97%
Malaysia	A3	2.07%	8.01%
Maldives	Caa1	12.94%	18.88%
Mongolia	B3	11.22%	17.16%
Pakistan	Caa1	12.94%	18.88%
Papua New Guinea	B2	9.49%	15.43%
Philippines	Baa2	3.29%	9.23%
Singapore	Aaa	0.00%	5.94%
Solomon Islands	Caa1	12.94%	18.88%
Sri Lanka	Ca	20.71%	26.65%
Taiwan	Aa3	1.03%	6.97%
Thailand	Baa1	2.76%	8.70%
Vietnam	Ba2	5.19%	11.13%
Asia		**1.93%**	**7.87%**

Argentina	Ca	20.71%	26.65%
Belize	Caa2	15.54%	21.48%
Bolivia	B2	9.49%	15.43%
Brazil	Ba2	5.19%	11.13%
Chile	A2	1.46%	7.40%
Colombia	Baa2	3.29%	9.23%
Costa Rica	B2	9.49%	15.43%
Ecuador	Caa3	17.26%	23.20%
El Salvador	Caa3	17.26%	23.20%
Guatemala	Ba1	4.32%	10.26%
Honduras	B1	7.77%	13.71%
Mexico	Baa2	3.29%	9.23%
Nicaragua	B3	11.22%	17.16%
Panama	Baa2	3.29%	9.23%
Paraguay	Ba1	4.32%	10.26%
Peru	Baa1	2.76%	8.70%
Suriname	Caa3	17.26%	23.20%
Uruguay	Baa2	3.29%	9.23%
Venezuela	C	24.69%	30.63%
Latin America		**6.57%**	**12.51%**

Abu Dhabi	Aa2	0.85%	6.79%
Bahrain	B2	9.49%	15.43%
Iraq	Caa1	12.94%	18.88%
Israel	A1	1.22%	7.16%
Jordan	B1	7.77%	13.71%
Kuwait	A1	1.22%	7.16%
Lebanon	C	24.69%	30.63%
Oman	Ba3	6.21%	12.15%
Qatar	Aa3	1.03%	6.97%
Ras Al Khaimah	A3	2.07%	8.01%
Saudi Arabia	A1	1.22%	7.16%
Sharjah	Ba1	4.32%	10.26%
United Arab Emirates	Aa2	0.85%	6.79%
Middle East		**2.51%**	**8.45%**

Australia	Aaa	0.00%	5.94%
Cook Islands	B1	7.77%	13.71%
New Zealand	Aaa	0.00%	5.94%
Australia & NZ		**0.00%**	**5.94%**

Aswath Damodaran

Blue: Moody's Rating
Red: Added Country Risk
Green #: Total ERP

From Country Equity Risk Premiums to Corporate Equity Risk premiums

- Approach 1: Assume that every company in the country is equally exposed to country risk. In this case,
  - E(Return) = Riskfree Rate + CRP + Beta (Mature ERP)
- Approach 2: Assume that a company's exposure to country risk is similar to its exposure to other market risk.
  - E(Return) = Riskfree Rate + Beta (Mature ERP+ CRP)
- Approach 3: Treat country risk as a separate risk factor and allow firms to have different exposures to country risk (perhaps based upon the proportion of their revenues come from non-domestic sales)
  - E(Return)=Riskfree Rate+ β (Mature ERP) + λ (CRP)

Mature ERP = Mature market Equity Risk Premium

CRP = Additional country risk premium

Approaches 1 & 2: Estimating country risk premium exposure

- Location based CRP: The standard approach in valuation is to attach a country risk premium to a company based upon its country of incorporation. Thus, if you are an Indian company, you are assumed to be exposed to the Indian country risk premium. A developed market company is assumed to be unexposed to emerging market risk.
- Operation-based CRP: There is a more reasonable modified version. The country risk premium for a company can be computed as a weighted average of the country risk premiums of the countries that it does business in, with the weights based upon revenues or operating income. If a company is exposed to risk in dozens of countries, you can take a weighted average of the risk premiums by region.

Operation based CRP: Single versus Multiple Emerging Markets

- Single emerging market: Embraer, in 2004, reported that it derived 3% of its revenues in Brazil and the balance from mature markets. The mature market ERP in 2004 was 5% and Brazil's CRP was 7.89%.

	Revenues	Total ERP	CRP
US and other mature markets	97%	5.00%	0.00%
Brazil	3%	12.89%	8%
Embraer		**5.24%**	**0.24%**

- Multiple emerging markets: Ambev, the Brazilian-based beverage company, reported revenues from the following countries during 2011.

	Revenues	%	Total ERP	CRP
Argentina	19	9.31%	15.00%	9.00%
Bolivia	4	1.96%	10.88%	4.88%
Brazil	130	63.73%	8.63%	2.63%
Canada	23	11.27%	6.00%	0.00%
Chile	7	3.43%	7.05%	1.05%
Ecuador	6	2.94%	12.75%	6.75%
Paraguay	3	1.47%	12.00%	6.00%
Peru	12	5.88%	9.00%	3.00%
Ambev	**204**		**9.11%**	**3.11%**

Extending to a multinational: Regional breakdown
Coca Cola's revenue breakdown and ERP in 2012

Region	*Revenues*	*Total ERP*	*CRP*
Western Europe	19%	6.67%	0.67%
Eastern Europe & Russia	5%	8.60%	2.60%
Asia	15%	7.63%	1.63%
Latin America	15%	9.42%	3.42%
Australia	4%	6.00%	0.00%
Africa	4%	9.82%	3.82%
North America	40%	6.00%	0.00%
Coca Cola	100%	7.14%	1.14%

Things to watch out for

1. Aggregation across regions. For instance, the Pacific region often includes Australia & NZ with Asia
2. Obscure aggregations including Eurasia and Oceania

Two problems with these approaches..

- Focus just on revenues: To the extent that revenues are the only variable that you consider, when weighting risk exposure across markets, you may be missing other exposures to country risk. For instance, an emerging market company that gets the bulk of its revenues outside the country (in a developed market) may still have all of its production facilities in the emerging market.
- Exposure not adjusted or based upon beta: To the extent that the country risk premium is multiplied by a beta, we are assuming that beta in addition to measuring exposure to all other macro economic risk also measures exposure to country risk.

A Production-based ERP: Royal Dutch Shell in 2015

Country	*Oil & Gas Production*	*% of Total*	*ERP*
Denmark	17396	3.83%	6.20%
Italy	11179	2.46%	9.14%
Norway	14337	3.16%	6.20%
UK	20762	4.57%	6.81%
Rest of Europe	*874*	*0.19%*	*7.40%*
Brunei	823	0.18%	9.04%
Iraq	20009	4.40%	11.37%
Malaysia	22980	5.06%	8.05%
Oman	78404	17.26%	7.29%
Russia	22016	4.85%	10.06%
Rest of Asia & ME	*24480*	*5.39%*	*7.74%*
Oceania	*7858*	*1.73%*	*6.20%*
Gabon	12472	2.75%	11.76%
Nigeria	67832	14.93%	11.76%
Rest of Africa	6159	1.36%	12.17%
USA	104263	22.95%	6.20%
Canada	8599	1.89%	6.20%
Brazil	13307	2.93%	9.60%
Rest of Latin America	*576*	*0.13%*	*10.78%*
Royal Dutch Shell	**454326**	**100.00%**	**8.26%**

Approach 3: Estimate a lambda for country risk

- Country risk exposure is affected by where you get your revenues and where your production happens, but there are a host of other variables that also affect this exposure, including:
  - Use of risk management products: Companies can use both options/futures markets and insurance to hedge some or a significant portion of country risk.
  - Government "national" interests: There are sectors that are viewed as vital to the national interests, and governments often play a key role in these companies, either officially or unofficially. These sectors are more exposed to country risk.
- It is conceivable that there is a richer measure of country risk that incorporates all of the variables that drive country risk in one measure. That way my rationale when I devised "lambda" as my measure of country risk exposure.

A Revenue-based Lambda

- The factor "λ" measures the relative exposure of a firm to country risk. One simplistic solution would be to do the following:

  λ = % of revenues domestically$_{firm}$/ % of revenues domestically$_{average\ firm}$

- Consider two firms – Tata Motors and Tata Consulting Services, both Indian companies. In 2008-09, Tata Motors got about 91.37% of its revenues in India and TCS got 7.62%. The average Indian firm gets about 80% of its revenues in India:

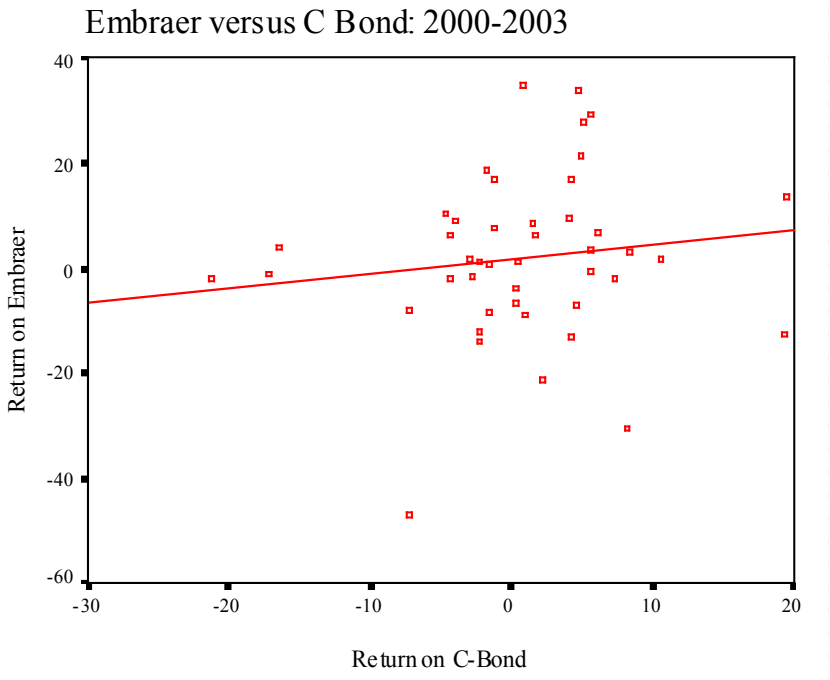
  $\lambda_{Tata\ Motors}$= 91%/80% = 1.14

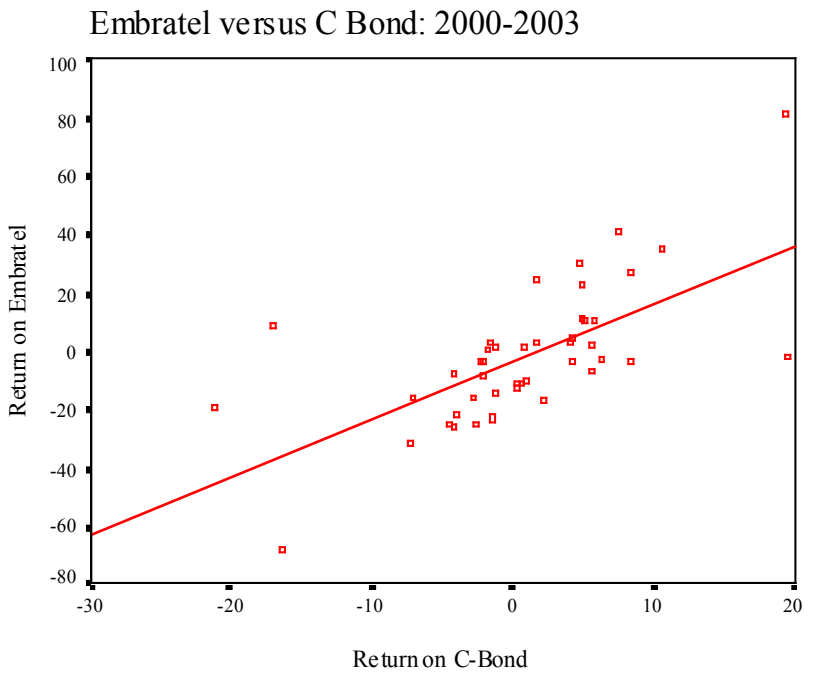
  λ_{TCS}= 7.62%/80% = 0.09

- There are two implications
  - A company's risk exposure is determined by where it does business and not by where it is incorporated.
  - Firms might be able to actively manage their country risk exposures

A Price/Return based Lambda

$$\text{Return}_{\text{Embraer}} = 0.0195 + \mathbf{0.2681}\ \text{Return}_{\text{C Bond}}$$
$$\text{Return}_{\text{Embratel}} = -0.0308 + \mathbf{2.0030}\ \text{Return}_{\text{C Bond}}$$





Estimating a US Dollar Cost of Equity for Embraer - September 2004

- Assume that the beta for Embraer is 1.07, and that the US $ riskfree rate used is 4%. Also assume that the risk premium for the US is 5% and the country risk premium for Brazil is 7.89%. Finally, assume that Embraer gets 3% of its revenues in Brazil & the rest in the US.
- There are five estimates of $ cost of equity for Embraer:
  - Approach 1: Constant exposure to CRP, Location CRP
    - E(Return) = 4% + 1.07 (5%) + 7.89% = 17.24%
  - Approach 2: Constant exposure to CRP, Operation CRP
    - E(Return) = 4% + 1.07 (5%) + (0.03*7.89% +0.97*0%)= 9.59%
  - Approach 3: Beta exposure to CRP, Location CRP
    - E(Return) = 4% + 1.07 (5% + 7.89%)= 17.79%
  - Approach 4: Beta exposure to CRP, Operation CRP
    - E(Return) = 4% + 1.07 (5% +(0.03*7.89%+0.97*0%)) = 9.60%
  - Approach 5: Lambda exposure to CRP
    - E(Return) = 4% + 1.07 (5%) + 0.27(7.89%) = 11.48%

Valuing Emerging Market Companies with significant exposure in developed markets

- The conventional practice in investment banking is to add the country equity risk premium on to the cost of equity for every emerging market company, notwithstanding its exposure to emerging market risk. Thus, in 2004, Embraer would have been valued with a cost of equity of 17-18% even though it gets only 3% of its revenues in Brazil. As an investor, which of the following consequences do you see from this approach?
  a. Emerging market companies with substantial exposure in developed markets will be significantly over valued by analysts
  b. Emerging market companies with substantial exposure in developed markets will be significantly under valued by analysts

Can you construct an investment strategy to take advantage of the mis-valuation? What would need to happen for you to make money of this strategy?