company. Note that converting the peso cash flows into dollar cash flows, using currency exchange rates, does nothing to alleviate this problem.

*Illustration 1: Currency mismatch effects on valuation*

Assume that you are valuing a Brazilian company and have been provided with the following estimates of cash flows in nominal Brazilian Reais (BR) for the next 3 years and beyond:

| *Year* | *Expected Cash flow in BR* |
|---|---|
| 1 | 100 million BR |
| 2 | 110 million BR |
| 3 | 121 million BR |
| Beyond | Grow at 6% a year forever |

Assume that the current exchange rate is 2 BR/US $ and that the current cost of capital computed in US dollars, based upon the current Treasury bond rate of 4% is 9%. Finally, assume that the inflation rate in US dollars is 2% and the inflation rate in BR is 6%. If we use the current exchange rate to convert the cash flows and leave the growth rate after year 3 intact, the value of the business that we arrive at will be $1,789.55 million (3,579.10 million BR).



| *Year* | *Cash flow in BR* | *Exchange rate* | *Cash Flow in US $* | *Present value* |
|---|---|---|---|---|
| 1 | 100 | 0.50 | $50.00 | $45.87 |
| 2 | 110 | 0.50 | $55.00 | $46.29 |
| 3 | 121 | 0.50 | $60.50 | $46.72 |
| Terminal value | | | $2,137.67 | $1,650.67 |
| Value of firm = | | | | $1,789.55 |

Note that the terminal value is computed at the end of year 3:

Terminal value = 60.50 (1.06)/ (.09-.06) = $ 2,137.67

By using the current exchange rate to convert future BR cash flows into US dollars, we have in effect built in the 6% inflation rate in BR into the expected cash flows, while using a discount rate that reflects the 2% inflation rate in US dollars. In addition, the terminal value has been computed using a growth rate in nominal BR and a discount rate in US dollars. Not surprisingly, the mismatch in inflation rates leads us to over value the company.

| | | | | | |
|---|---|---|---|---|---|
| 2 | 110 | 2.1599 | 0.462976148 | $50.93 | $42.86 |
| 3 | 121 | 2.2446 | 0.44550535 | $53.91 | $41.63 |
| Terminal value | | | | $785.49 | $606.54 |
| | | | | | $735.17 |

The higher inflation rate in BR leads to a depreciation in the currency's value over time. In addition, the terminal value is computed using the US dollar cash flow of $53.91 million in year 3 and an expected growth rate of 2% (reflecting the inflation rate in US dollars and not in BR):

Terminal value = $53.91 (1.02)/ (,09-.02) = $785.49 million

The value that we derive for the firm today is $735.17 million (1,470.35 million BR) and it reflects more consistent assumptions about inflation in the cash flows and discount rates and is much lower than the value of $1,789.55 million that we derived in illustration 1.



*Local Currency valuation*

The valuation can be done in the local currency, with the discount rate converted into a local currency discount rate; the expected cash flows in this case will remain in the local currency. There are three ways in which we can overcome the absence of a local currency, long term government bond rate as a starting point. In the first two, we try to estimate a local currency risk free rate, with estimates of inflation, and in the third, we convert a foreign currency discount rate, using expected inflation rates.

- The build-up option: Since the riskfree rate in any currency can be written as the sum of expected inflation in that currency and the expected real rate, we can try to estimate the two components separately. To estimate expected inflation, we can start with the current inflation rate and extrapolate from that to expected inflation in the future. For the real rate, we can use the rate on the inflation indexed US treasury bond rate, with the rationale that real rates should be the same globally. In 2005, for instance, adding the expected inflation rate of 8%, in India, to the interest rate of 2.12% on the inflation indexed US treasury would have yielded a riskfree rate of 10.12% in Indian rupees.

seem, can be challenged in some countries where investors build in the likelihood that of default risk into government bonds.

***The Scenario***

Our discussion, hitherto, has been predicated on the assumption that governments do not default, at least on local currency borrowing. There are many emerging market economies where this assumption might not be viewed as reasonable. Governments in these markets are perceived as capable of defaulting even on local borrowing. The ratings agencies capture this potential by providing two sovereign ratings for most countries, one for foreign currency borrowing and the other for local currency borrowing. While the latter is usually higher than the former, for most countries, there are several countries with local currency ratings that are not Aaa (the standard from Moody's for a default free country). Table 2 lists local currency and foreign currency ratings for selected emerging markets (and appendix 1 has the complete listing):

*Table 2: Local and Foreign currency ratings for selected markets– October 2008*

| *Country* | *Local Currency Rating* | *Foreign Currency Rating* |
|---|---|---|
| Brazil | Ba1 | Ba1 |
| China | A1 | A1 |
| India | Baa3 | Baa2 |
| Russia | Baa2 | Baa2 |



To the extent that we accept Moody's assessment of country risk, the long term, local currency bonds issued by each of these governments will have default risk embedded in them, with the risk being greater in the Brazilian government bond than it is in the Chinese government bond.

***Common (and dangerous) practices***

When there are local currency long term bonds, analysts often choose to use the market interest rate on these bonds, notwithstanding the default risk embedded in them, as riskfree rates. To illustrate, the interest rate on long term, rupee denominated bonds issued by the Indian government in October 2008, which was 10.7%, would be used as the riskfree rate in computing the rupee cost of equity and capital for an Indian company. As table 2 shows, India's local currency rating of Baa3 suggests that there is default risk in the Indian rupee bond, and that some of the observed interest rate can be attributed to

was your use of the normalized riskfree rate of 5%, instead of the actual rate of 4%. If the firm had been valued using the actual cost of capital of 8%:

Value of firm = Expected FCFF next year/ (Cost of capital –g)

= 2400/(.08-.03) = $ 48,000 million

At its current market value, the firm would have been undervalued. In effect, your initial conclusion that about Dow Chemical being over valued reflected both your assumptions about the company and your views on interest rates, with the latter being the main reason for your final conclusion. In effect, your views on interest rates reduced the value of the firm by $ 8 billion (from $48 billion to $ 40 billion).

***Solutions***

As a general rule, it is not a good idea to bring in our idiosyncratic views on interest rates, no matter how well thought on and reasoned they may be, into individual company valuations. Does this mean we are stuck using the current riskfree rate when valuing companies today? Not necessarily. We can still draw on market expectations of interest rates in valuing companies. For instance, assume that the current ten-year treasury bond rate is 3.5%. That will be the riskfree rate for the next 10 years. However, we can use futures or forward markets on treasury bonds to get a sense of what the market sees as the expected interest rate ten years from now, and use that as the riskfree rate in the future (perhaps in computing terminal value). Our views on market interest rates can be offered separately, because they do have consequences for the overall value of equities and asset allocation decisions. In effect, we let the users of our research make a judgment on what aspect of the research they trust more. If they trust our macro views but not the micro views, they will attach more weight to the interest rate and asset allocation views that we present. If, on the other hand, they feel more confident in our company analyses than in our interest rate views, they will focus on the corporate valuation and recommendation.



## Closing Thoughts on Riskfree Rates

Looking at the bigger picture, we can break down the estimation of a riskfree rate into steps, starting with a choice of currency and working down to include views on future rate levels. The steps are captured in figure 7:

Rule 3: *If you have strong views on interest rates, try to keep them out of the valuation of individual companies*. In other words, even if you believe that riskfree rates will rise or fall over time, it is dangerous to reflect those views in your valuation. If you do so, your final valuation will be a joint result of your views on interest rates and your views on the company, with no easy way of deciphering the results of each effect.

## Conclusion

The risk free rate is the starting point for all expected return models. For an investment to be risk free, it has to meet two conditions. The first is that there can be no risk of default associated with its cash flows. The second is that there can be no reinvestment risk in the investment. Using these criteria, the appropriate risk free rate to use to obtain expected returns should be a default-free (government) zero coupon rate that is matched up to when the cash flow or flows that are being discounted occur. In practice, however, it is usually appropriate to match up the duration of the risk free asset to the duration of the cash flows being analyzed. In corporate finance and valuation, this will lead us towards long-term government bond rates as risk free rates.

In this paper, we considered three problem scenarios. The first is when there are no long-term, traded government bonds in a specific currency. We suggested either doing the valuation in a different currency or estimating the riskfree rate from forward markets or fundamentals. The second is when the long-term government bond rate has potential default risk embedded in it, in which case we argued that the riskfree rate in that currency has to be net of the default spread. The third is when the current long term riskfree rate seems too low or high, relative to historic norms. Without passing judgments on the efficacy of this view, we noted that it is better to separate our views about interest rates from our assessment of companies.