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# Discount Rates in Emerging Markets: Four Models and An Application

by Javier Estrada, IESE Business School\*

**E**valuating investment opportunities is a mix of art and science. Finance theory has contributed to the science part of the evaluation by providing two widely-used tools, the net present value (NPV) method and the internal rate of return (IRR), and more recently the real options approach. But there is an “art component” which, correctly or incorrectly, largely determines the final decisions made. Forecasting cash flows, after all, is more art than science.

However difficult the evaluation of investment opportunities may be in developed markets, it is even more difficult in emerging markets. The financial, economic, and institutional environments are more uncertain in emerging economies than in developed ones, and this higher uncertainty must be taken into account when evaluating projects. The interesting question, of course, is how to do it properly.

Circumstantial evidence shows that many companies engage in the unfortunate practice of increasing the discount rate substantially when evaluating investment opportunities in emerging markets; because these markets are riskier, the reasoning goes, a higher return should be required. And however plausible that may sound, the problem is that there is no widely-accepted method to determine how much higher the discount rate should be. In fact, there is no standard, widely-accepted, and widely-used model to estimate required returns on equity (hence discount rates) in emerging markets. The ultimate aim of this article is to shed some light on this issue.

## The Models

In order to evaluate investment opportunities, companies typically use the ubiquitous NPV and IRR. When using the former, the discount rate for a project’s expected cash flows is the company’s cost of capital; when using the latter, the rate to which the project’s IRR is compared is, again, the company’s cost of capital. This widely accepted practice, however, is not so widely accepted when evaluating investment opportunities in emerging markets. In this case, companies often arbitrarily increase the discount rate above the rate they would

use for an identical project in the home (developed) market. This arbitrary increase in the discount rate, in turn, may lead companies to bypass valuable investment opportunities.

In order to estimate the “correct” discount rate for investment opportunities in emerging markets, many approaches have been proposed, four of which are discussed below. It is important to keep in mind, however, that *none* of the existing models has emerged as the standard to which all other models are compared. While the CAPM plays this role in developed markets, no model currently does so in emerging markets.

## A General Model

Unlike the CAPM, which is solidly grounded in financial theory, the four models we will discuss are rather ad-hoc. Furthermore, because these models assess and incorporate risk in quite different ways, they may also yield, as we will see below, substantially different estimates of the required return on equity. Although these four models are different, they can all be thought of as variations of a general model in which the required return on equity ( $R$ ) is expressed as:

$$R = R_f + \text{MRP} \cdot \text{SR} + A, \quad (1)$$

where  $R_f$  denotes the risk-free rate, MRP the (world) market risk premium, SR the specific risk of an investment opportunity, and  $A$  some additional adjustment.

Before going any further, three remarks are in order. First, in their original versions, the first three models take a U.S.-based approach and therefore take the U.S. market as the benchmark. However, in order to take a more global view, we will use here the *world* market portfolio as the benchmark. Second, calculations in emerging markets are always performed in a strong currency (the dollar, the euro, or the pound, among others), and the discussion below will focus, as is the case more often than not, on dollar-based cash flows. And finally, for this reason, the risk-free rate considered will be that of U.S. bonds.

Both the specific risk of the investment opportunity (SR) and the additional adjustment ( $A$ ) differ across the models.

\*This article draws heavily from my case study “Project Evaluation in Emerging Markets: Exxon Mobil, Oil, and Argentina,” F-803-E (Copyright © 2006, IESE Publishing). Lydia Nikolova and Gabriela Giannattasio provided valuable research assistance. The views expressed below and any errors that may remain are entirely my own.

All four models, however, share two inputs, the risk-free rate ( $R_f$ ) and the world market risk premium (MRP). For dollar-based calculations, the former can be approximated with the yield on U.S. government bonds at the time the project is evaluated, and the latter with the long-term average difference between the dollar returns of the world stock market and the returns of the U.S. bond market.

### The Lessard Approach<sup>1</sup>

This model proposes measuring specific risk similarly, but also somewhat differently from the CAPM. More precisely, it proposes measuring specific risk as the product between a project beta ( $\beta_p$ ) and a country beta ( $\beta_c$ ); that is,

$$SR = \beta_p \cdot \beta_c,$$

where the first beta intends to capture the risk of the industry, and the second the risk of the country in which the company will invest. In this approach the required return on equity when investing in industry  $p$  located in country  $c$  is given by

$$R = R_f + MRP \cdot (\beta_p \cdot \beta_c). \quad (2)$$

The project beta can be estimated as the beta of the relevant industry with respect to the world market, and the country beta as the beta of the relevant country also with respect to the world market. No further adjustments are implemented in this approach and, therefore,  $A=0$ .

### The Godfrey-Espinosa Approach<sup>2</sup>

This model proposes two adjustments with respect to the CAPM. First, it adjusts the risk-free rate by the yield spread of a country relative to the U.S. ( $YS_c$ ); and second, measures risk as 60% of the volatility of the stock market of the country in which the project is based relative to the volatility of the world market ( $\sigma_c/\sigma_w$ ). More precisely,

$$A = YS_c, \\ SR = (0.60) \cdot (\sigma_c/\sigma_w),$$

where  $\sigma_c$  and  $\sigma_w$  are the standard deviation of returns of country  $c$ 's stock market and that of the world market. In this approach, the required return on equity when investing in country  $c$  is given by

$$R = (R_f + YS_c) + MRP \cdot \{(0.60) \cdot (\sigma_c/\sigma_w)\}. \quad (3)$$

The adjustment by the yield spread intends to reflect the additional risk of investing in the country in which the project is based, and it is measured by the spread between the rate at which the country borrows in dollars and the rate at which the U.S. borrows (at the same maturity). The specific risk, in turn, attempts to capture other sources of risk specific to the country in which the project is based, with the coefficient 0.60 meant to avoid double counting risk. This last number is a crude average across emerging economies of the risk reflected by the stock market, but not reflected by the bond market. (In other words, the bond market reflects 40% of the risk reflected by the stock market.)

Note that in this model the specific nature of the project is ignored. Put differently, it makes no difference whether a company is evaluating a project in the oil, airline, or telecommunications industries; what matters is the country in which the project is based.

### The Goldman Sachs Approach<sup>3</sup>

This model can be thought of simply as proposing a better adjustment for double counting than that incorporated in the Godfrey-Espinosa model. More precisely, Goldman Sachs proposes replacing the fixed adjustment of 0.60 by one minus the observed correlation between the stock market and the bond market of the country in which the project is based. In other words, the investment bank proposes estimating the specific risk as

$$SR = (1 - \rho_{SB}) \cdot (\sigma_c/\sigma_w),$$

where  $\rho_{SB}$  denotes the correlation between the stock and bond markets of country  $c$ . In addition, as in the Godfrey-Espinosa model, the Goldman Sachs model includes the adjustment

$$A = YS_c.$$

In this approach, the required return on equity when investing in country  $c$  is given by

$$R = (R_f + YS_c) + MRP \cdot \{(1 - \rho_{SB}) \cdot (\sigma_c/\sigma_w)\}. \quad (4)$$

The intuition behind this more sophisticated double counting adjustment is as follows. If the stock market and the bond market are perfectly correlated ( $\rho_{SB}=1$ ), they both reflect the same sources of risk; in that case  $YS_c$  will capture all the relevant risk of investing in country  $c$  and, therefore,  $R = R_f + YS_c$ . If, on the other hand, the stock market and the bond market are uncorrelated ( $\rho_{SB}=0$ ), each reflects different

1. See Donald Lessard, (1996). "Incorporating Country Risk in the Valuation of Off-shore Projects," *Journal of Applied Corporate Finance*, Fall, 52-63.

2. See Stephen Godfrey and Ramon Espinosa, (1996). "A Practical Approach to Calculating Costs of Equity for Investments in Emerging Markets," *Journal of Applied Corporate Finance*, Fall, 80-89.

3. See Jorge Mariscal and Kent Hargis, (1999), "A Long-Term Perspective on Short-Term Risk – Long-Term Discount Rates for Emerging Markets," *Global Emerging Markets report*, Goldman Sachs, October 26, 1999.

sources of risk; in that case,  $YS_c$  quantifies the risk reflected by the bond market,  $\sigma_c/\sigma_w$  the additional risk reflected by the stock market and  $R = (R_f + YS_c) + MRP \cdot (\sigma_c/\sigma_w)$ . For all practical purposes it is the case that  $0 < \rho_{SB} < 1$ . Therefore, this model incorporates the risk reflected by both the stock market and the bond market without double counting sources of risk.

### The SalomonSmithBarney Approach<sup>4</sup>

This model proposes accounting for the risk of investing in a specific industry, for the risk of investing in a specific country, and for some characteristics of both the project and the company considering the investment. The first adjustment is implemented by incorporating the project beta ( $\beta_p$ ) and the other two by incorporating an adjusted political risk premium. This second adjustment requires some explanation.

The first step consists of estimating the unadjusted political risk premium, which is simply the yield spread discussed for the previous two models ( $YS_c$ ). The second step consists of adjusting this political risk premium by three factors: A company's access to capital markets, the susceptibility of the investment to political risk, and the financial importance of the project for the company. More precisely, in this model,

$$A = \{(\gamma_1 + \gamma_2 + \gamma_3)/30\} \cdot YS_c,$$

where each  $\gamma$  coefficient is measured on a scale from 0 to 10. In particular,

- $\gamma_1$  captures a company's access to capital markets, with 0 indicating full access and 10 indicating no access;
- $\gamma_2$  captures the susceptibility of the investment to political risk, with 0 indicating no susceptibility to political intervention and 10 indicating maximum susceptibility;
- $\gamma_3$  captures the financial importance of the project for the company, with 0 indicating that the project involves a small proportion of the company's capital and 10 indicating a large proportion.

Note that  $\gamma_1$  will be low for large international companies and high for small undiversified companies. Also note that  $\gamma_2$  is directly related to the probability of expropriation; hence it will be high for projects in industries that are likely to be expropriated (such as natural resources) and low for projects in industries where that is unlikely (such as retail). Finally,  $\gamma_3$  will be low for large companies investing in relatively small projects and large for small companies investing in relatively large projects.

It should be clear that the sum of the  $\gamma$  coefficients will vary between 0 and 30, which in turn implies that the adjustment to the yield spread will vary between 0 and 1. As a result,

in the worst-case scenario  $A = YS_c$  and in the best-case scenario  $A = 0$ . To illustrate, a large international company investing a small proportion of its capital in an industry unlikely to be expropriated would have to make no adjustment for political risk ( $A = 0$ ); a small undiversified company investing a large proportion of its capital in an industry likely to be expropriated, in turn, would have to incorporate a full adjustment for political risk ( $A = YS_c$ ).

This model further proposes quantifying the specific risk with the project beta which, as mentioned above, is the beta of the relevant industry with respect to the world market; hence,

$$SR = \beta_p.$$

In sum, according to this approach, the discount when investing in industry  $p$  located in country  $c$  is given by

$$R = R_f + MRP \cdot \beta_p + \{(\gamma_1 + \gamma_2 + \gamma_3)/30\} \cdot YS_c. \quad (5)$$

It is important to keep in mind that in this model, unlike in the previous three, the required return on equity for a specific project in a specific country may be different depending on the company that considers the investment. In other words, according to the first three models, given the project and the country in which the project will take place, the required return on equity would be the same regardless of the company that considers the project; in this fourth approach, in contrast, that is not necessarily the case.

### A Case Study

In order to get a sense of the different estimates generated by the four models discussed in the previous section, let's consider a hypothetical set-up and put some real numbers into it. Assume that a company in a developed market, Exxon Mobil, needs to evaluate an investment opportunity, extracting oil from the ground, in an emerging market, Argentina.

Exxon Mobil is the world's largest integrated oil company. It engages in oil and gas exploration, production, supply, transportation, and marketing around the world. In 2005, Exxon Mobil earned profits of \$36.9 billion on revenues of \$328.2 billion, topping the Fortune 500 ranking. At year-end 2005, the company boasted a market capitalization of \$344.5 billion, making it the largest company not only by revenues but also by capitalization.

Let's further assume that Exxon Mobil is considering the investment opportunity summarized in Exhibit 1. This opportunity calls for digging 100 wells, which requires an initial investment of \$130 million—\$70 million for drill-

4. See Marc Zenner and Ecehan Akaydin, (2002), "A Practical Approach to the International Valuation and Capital Allocation Puzzle," Global Corporate Finance report, SalomonSmithBarney, July 26, 2002.

## Exhibit 1 Profits and Cash Flows – Annual Estimates, 2006-2011

	Per Well	Total
Production		
Per well (Barrels per year)	10,000	
Total (Barrels per year)		1,000,000
Revenues		
Per well	\$580,000	
Total		\$58,000,000
Operating costs		
Per well	\$70,000	
Total		\$7,000,000
Depreciation		
Per well	\$100,000	
Total		\$10,000,000
Pre-tax profit		
Per well	\$410,000	
Total		\$41,000,000
Taxes		\$14,350,000
<b>After-tax profit</b>		<b>\$26,650,000</b>
Depreciation add-back		\$10,000,000
<b>Free cash flow</b>		<b>\$36,650,000</b>

Start-up costs of \$130 million not included in the figures above. 'Total' figures refer to 100 wells. Revenues based on a price of \$58 per barrel. Operating costs based on estimate of \$7 per barrel. Production facilities assumed to depreciate linearly over six years. Profits and free cash flows assumed to be received at year end, beginning in 2006 and ending in 2011. Corporate tax rate: 35%.

## Exhibit 2 Financial Information

Risk-free rate	4.40%
World market risk premium	5.00%
Argentina's yield spread	5.00%
Oil industry beta	0.69
Argentina's beta	1.10
Argentina's stock market volatility	40.60%
World stock market volatility	14.71%
Correlation between Argentina's stock market and bond market	0.35

Risk-free rate is the yield on 10-year US Treasury Notes at year-end 2005. Market risk premium estimated for the world market over the 1900-2000 period. Yield spread calculated with respect to US bonds at year-end 2005. Betas calculated with respect to the world market over the Jan/96-Dec/05 period. Volatility measured by the standard deviation of returns over the Jan/96-Dec/05 period, annualized. Correlation between Argentina's stock market and bond market estimated over the Jan/96-Dec/05 period.

ing the wells and \$60 million for the production facilities required to process and transport the oil. Each of the 100 wells is expected to produce 60,000 barrels of oil over an estimated life of 6 years, or 10,000 barrels per year. Operating costs are estimated at \$7 per barrel. At year-end 2005 Brent crude oil stood at \$58 per barrel. The project was expected to generate after-tax profits and free cash flows of almost \$27 million and \$37 million a year for six years. No new capital investments were expected during this time; at the end of this period the production facilities would be fully depreciated and the wells exhausted.

Exxon Mobil typically finances its activities almost exclusively with equity. At year-end 2005, the company had just over \$6 billion of long-term debt out of over \$200 billion of total capital, for a debt ratio of just 3% at book value. Furthermore, considering that the market value of the compa-

ny's equity (almost \$345 billion) was over three times its book value of equity (just over \$111 billion), the debt ratio at market value was even lower and, for all practical purposes, 0. In other words, Exxon Mobil was essentially an unlevered company and its cost of capital was in effect equal to its cost of equity.

The magnitudes necessary to estimate the discount rates according to the four models discussed in the previous section are shown in Exhibit 2. Before estimating these discount rates, let's for the sake of comparison estimate the discount rate that follows from the CAPM. Given Exxon Mobil's beta of 0.48 (not reported on Exhibit 2), a risk-free rate of 4.40%, and a world market risk premium of 5% (both reported on Exhibit 2), the CAPM would yield a required return on equity (hence a discount rate) of 6.8%.

This number helps illustrate why some companies find

### Exhibit 3 Discount Rates

Model	R
Lessard	8.2%
Godfrey-Espinosa	17.7%
Goldman Sachs	18.4%
SalomonSmithBarney ( $\gamma_1=\gamma_2=\gamma_3=0$ )	7.9%
SalomonSmithBarney ( $\gamma_1=\gamma_2=\gamma_3=10$ )	12.9%
SalomonSmithBarney ( $\gamma_1=\gamma_3=0$ and $\gamma_2=10$ )	9.5%

Based on information provided in Exhibit 2.

### Exhibit 4 NPVs

Model	NPV
Lessard	\$35.5m
Godfrey-Espinosa	-\$0.6m
Goldman Sachs	-\$2.6m
SalomonSmithBarney ( $\gamma_1=\gamma_2=\gamma_3=0$ )	\$37.3m
SalomonSmithBarney ( $\gamma_1=\gamma_2=\gamma_3=10$ )	\$15.2m
SalomonSmithBarney ( $\gamma_1=\gamma_3=0$ and $\gamma_2=10$ )	\$29.1m

Based on information provided in Exhibit 2 and 3.

the CAPM unsuited to evaluate investment opportunities in emerging markets: They find this required return “too low” for such “risky investments.” For this reason, many companies prefer to err on the side of caution and arbitrarily increase the discount rate above the rate obtained from the CAPM. As mentioned before, the result of this unfortunate practice may be to bypass valuable investment opportunities.

Using the magnitudes shown in Exhibit 2 and expressions (2)-(5), the four models discussed in the previous section yield the discount rates shown in Exhibit 3. Note that not only are these discount rates substantially higher than the 6.8% obtained from the CAPM, but they are also substantially different from each other. The discount rate obtained from the Goldman Sachs model, for example, is more than twice as high as that obtained from the Lessard model.

The SalomonSmithBarney model requires judgment when assigning a numerical value to the  $\gamma$  coefficients. The 7.9% and 12.9% represent extreme cases, neither of which seems plausible for the situation at hand. Given that Exxon Mobil has wide access to capital markets and that the project considered requires a very small investment compared to the company’s capital, it seems reasonable to assume that  $\gamma_1=\gamma_3=0$ . However, given that oil is an industry in which the probability of expropriation is high, it also seems reasonable to assume a high  $\gamma_2$ . If we assume, in the limit, that  $\gamma_2=10$ , the discount rate of 9.5% shown in the exhibit follows.

Given the substantially different rates obtained, it is important to keep in mind some essential differences among these four models:

- The Lessard model, based on systematic risk, considers both industry risk ( $\beta_p$ ) and country risk ( $\beta_c$ ).
- The Godfrey-Espinosa model, based on total risk, considers country risk but not industry risk; it also considers risk as reflected by both the stock market ( $\sigma_c$ ) and the bond market ( $YS_c$ ), and implements a fixed adjustment (0.60) for double counting.
- The Goldman-Sachs model is very similar to the Godfrey-Espinosa model but implements a better, time-varying adjustment ( $1-\rho_{SB}$ ) for double counting.
- The SalomonSmithBarney model considers both industry and country risk; it is the only model that, given the industry and country, may yield different discount rates depending on the company considering the investment.

Finally, it is important to notice that substantial differences among discount rates are likely to generate conflicting signals regarding investment decisions. If we discount the cash flows shown in Exhibit 1 at the rates in Exhibit 3, we obtain the NPVs in Exhibit 4. And, as this exhibit shows, not all models suggest that the investment opportunity adds value for Exxon Mobil.

What is Exxon Mobil supposed to do in this case? What is *any* company supposed to do when substantially different discount rates lead to different investment recommendations? Ideally, theory should help; unfortunately, in these cases it basically does not. The four models we discussed, and the vast majority of the others proposed for emerging markets, are largely ad-hoc approaches and therefore theory offers little guidance to select among them.

## Exhibit 5 Sensitivity Analysis

Oil price	Discount Rate				
	7.9%	10.0%	13.0%	15.0%	18.4%
\$20	-\$69.1	-\$70.9	-\$72.8	-\$73.7	-\$74.8
\$25	-\$55.2	-\$58.0	-\$61.3	-\$63.0	-\$65.3
\$30	-\$41.2	-\$45.1	-\$49.8	-\$52.3	-\$55.8
\$35	-\$27.2	-\$32.3	-\$38.3	-\$41.6	-\$46.3
\$40	-\$13.3	-\$19.4	-\$26.8	-\$30.9	-\$36.8
\$45	\$0.7	-\$6.5	-\$15.3	-\$20.2	-\$27.3
\$50	\$14.7	\$6.3	-\$3.8	-\$9.5	-\$17.8
\$55	\$28.6	\$19.2	\$7.7	\$1.1	-\$8.3
\$60	\$42.6	\$32.1	\$19.2	\$11.8	\$1.3
\$65	\$56.6	\$44.9	\$30.7	\$22.5	\$10.8
\$70	\$70.5	\$57.8	\$42.2	\$33.2	\$20.3
\$75	\$84.5	\$70.7	\$53.7	\$43.9	\$29.8
\$80	\$98.5	\$83.5	\$65.2	\$54.6	\$39.3
\$85	\$112.4	\$96.4	\$76.7	\$65.3	\$48.8
\$90	\$126.4	\$109.3	\$88.2	\$76.0	\$58.3

Sensitivity analysis always helps and should be implemented. It can be performed over discount rates and over the variables that affect cash flows. A range of discount rates can be obtained from each pricing model. Different scenarios for cash flows, on the other hand, can be generated by considering different prices for the product involved in the project (the oil price in the case discussed above) or various cost structures.

Exhibit 5, which shows a sensitivity analysis performed over two variables, the discount rate and the oil price, also shows how this type of analysis may help in the investment decision. As the exhibit shows, only under very high discount rates and/or very low oil prices will this investment opportunity become unattractive. In this example, the wide dispersion of discount rates does not generate much confusion about whether or not to go ahead with this investment opportunity. Unless Exxon Mobil has a good reason to use very high discount rates (unlikely) or it is reliably forecasting very low oil prices (again unlikely), the company should go ahead with the project considered.

### An Assessment

Evaluating investment opportunities in emerging markets is a mix of art and science. Unlike CAPM for developed markets, there is no standard pricing model for emerging markets that serves as a benchmark. The proposed models are

many and varied, but none has gained wide acceptance and use. Currently, investors, companies, and investment banks use different models, based on different assumptions, and consider different variables. The confusion and controversy that follows is therefore unsurprising.

The four models reviewed in this article and the case study underscore at least one important point: Lacking a good underlying theory, it is important to have good reasons to choose one model over the many competing alternatives. Therefore, when evaluating investment opportunities in emerging markets, it is essential to be clear about the factors considered and ignored by each model; to carefully balance the pros and cons of each model; and to evaluate the overall plausibility of each model. And of course, it is essential to perform a thorough sensitivity analysis, which is critical in any project evaluation, but even more so in emerging markets.

Although much has been published about discount rates in emerging markets, there is probably a long way to go until a convergence of opinions finally arises. Hopefully this article takes us one step closer to that desirable goal.

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JAVIER ESTRADA is Professor of Finance at IESE Business School in Barcelona, Spain. He is also the author of *Finance in a Nutshell. A No Nonsense Companion to the Tools and Techniques of Finance*, FT Prentice Hall (2005).

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