Application of CAPM for investment decisions in emerging countries

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Abstract

The paper is focused on investment decisions of companies with a diversified shareholder base in emerging countries. We assume net present value (NPV) as an appropriate procedure for evaluating investment without significant impact on investor’s portfolio. The NPV method is based on discounting forecasted cash flows at a discount rate that is consistent with project risk. For estimation of this rate the capital asset pricing model (CAPM) is used. In the paper the CAPM for discount rate determination is introduced. In the main part, we analyze and criticize traditional approach to treating country risk as an important part of risk premium. As a result, we propose a modification of CAPM for investment evaluation in emerging countries taking into consideration investment project’s cash flow sensitivity to various markets and involving only the country’s systematic risk. This modification is an improvement over the existing model for conditions prevailing in emerging countries.

Key words

capital asset pricing model, investment decisions, country risk, emerging markets

1. Introduction

Investment opportunities have usually significant impact on firm’s value. Therefore we need a method that enables managers to make investment decision appropriately, with focus on value maximization, and because of given fragmented shareholders base, independently. This method is the expected net present value (NPV) maximization rule, used in conjunction with a discount rate corresponding with project’s risk.

According to NPV rule, an investment project should only be undertaken when the discounted value of all the project’s cash flow exceeds zero (De Reyck, 2005). For discounting, a risk-adjusted discount rate should be used and this rate should be appropriate for the level of risk in the project. This rule is based on the concept of opportunity cost. Therefore, financial theory suggests comparing an investment opportunity with other investments or assets with equivalent risk to determine whether or not the investment should be made. The expected rate of return of the equivalent asset(s) then determines the hurdle rate, or risk-adjusted discount rate for the investment opportunity.

There is a variety of methods and approaches that can be used to estimate discount rate. The financial theory considers the capital asset pricing model (CAPM) to be a most popular and widely used concept for estimation of discount rate in discounted cash flow calculations to establish the fair value of an investment.

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2. CAPM and investment decisions - theoretical framework

The CAPM is considered to be a complex approach and one of most important paradigms in financial economics since its introduction in Sharpe (1964) and Lintner (1965). The empirical validation of CAPM was in centre of academic and practical debates for long time but its theoretical power as an equilibrium model is undisputed. According to (Ross, Westerfield and Jaffe, 1999, p. 269) this model is useful in corporate finance since the discount rate on a project is a function of the project’s beta.

The CAPM allows for investment valuation at the firm level without any consideration of investors’ preferences and gives us the expected return for any asset or portfolio as a function on the Security Market Line (SML) and his expected rate of return is given by the relation: assuming that a security market is in equilibrium, any asset i traded in the security market lies

\[ \bar{r}_i = r_f + \beta_i \sigma_m \]

where \( \lambda := \frac{E(r_m) - r_f}{\sigma_m} \) is the so-called market price of risk and \( \bar{r}_m = \frac{E(r_m)}{P_m} \) is the equilibrium rate of return of the asset. Starting from this classical relation, Rubinstein (1973) proves that a firm i facing a project j should undertake the project if

\[ \bar{r}_j > \bar{r}_f + \lambda \sigma_m (r_f - \bar{r}_f) \]

where

\[ \bar{r}_j := \frac{F_j - I_j}{I_j} \]

is the (disequilibrium) expected rate of return of project j (Rubinstein, 1973, pp. 171-172). Eq. (1) above may be equivalently rewritten as

\[ \bar{r}_j > \bar{r}_f + \beta_j (\bar{r}_m - \bar{r}_f) \]

where

\[ \beta_j := \frac{\text{cov}(r_j, r_m)}{\sigma_m^2} \]

is the systematic risk of the project j. Henceforth, we let

\[ I_f := r_f + \beta_j (\bar{r}_m - r_f) \]

so that eq. 3 becomes

\[ \bar{r}_j > \bar{r}_f \]

Equation (5) means that a project is worth undertaking if the (expected) rate of return of the project is greater than the (expected) rate of return of a security with the same risk. In Rubinstein’s words, the project is worth undertaking if its expected internal rate of return … exceeds the appropriate risk-adjusted discount rate for the project …; this discount rate is equal to the expected rate of return on a security with the same risk as the project (Rubinstein, 1973, p. 172).
An alternative present-value formulation of equations (3) and (5) is easily derived:

\[-I_j + \frac{I_j (1 + \gamma_f)}{1 + I_j} = -I_j + \frac{\bar{F}_j}{1 + I_j} > 0\]  

(6)

In a nutshell, the decision maker should accept the project if its NPV, calculated at the risk-adjusted cost of capital, is positive. Note that the second addend in (6) is the disequilibrium value of project j:

\[V(j) = \frac{\bar{F}_j}{1 + I_j} = \frac{\bar{F}_j}{1 + \gamma_f + \beta_j(\bar{\gamma}_m - \gamma_f)}\]  

(7)

We may then say that a project is worth undertaking if its disequilibrium value exceeds its cost: \(V(j) > I_j\).

Other authors have formulated capital budgeting criteria with usage of CAPM: Tuttle and Litzenberger (1968), Stapleton (1971), Bierman and Hass (1973), Bogue and Roll (1974), starting from the CAPM relations as well, present criteria for valuing project profitability. These criteria are actually equivalent to Rubinstein’s (and therefore equivalent one another).

As a result, in the literature there is a unanimous agreement that equations (1)-(7) represent a theoretically impeccable capital budgeting criterion. Despite the universal agreement on this criterion, equations (2) and (4) are critical in understanding the theoretical flaws a decision maker incurs by using this criterion for investment valuation and decision. As for now, suffice it to say that placing equation (2) in equation (4) and reminding that the covariance operator is homogenous and additive, we have

\[\beta_j = \frac{\text{cov} \left( \frac{\bar{F}_j}{1 + \gamma_f}, \frac{\bar{\gamma}_m}{\sigma^2_m} \right)}{I_j \sigma^2_m} - \frac{\text{cov} \left( \bar{F}_j, \bar{\gamma}_m \right)}{\sigma^2_m} \]  

(8)

Note that the project beta does not depend on the equilibrium value of the project, but on project cost. This boils down to saying that the project beta is a disequilibrium beta, not an equilibrium beta. The difference between the equilibrium covariance term and the disequilibrium covariance term is not always appreciated. Magni (2007) argues that the standard use of the CAPM for project appraisal in the corporate finance literature is grounded, implicitly or explicitly, on disequilibrium values; as opposed to equilibrium values (see also Ekern, 2006).

We introduced the CAPM as a basic tool for the determination of the expected return from real investments. Although it has a number of flaws, in the absence of a better model we will try to adjust the CAPM to make it more suitable for investment analysis in emerging countries.

3. Modification of CAPM for emerging countries

Despite many limitations of the model, the CAPM is the most popular model for discount rate determination in real investments in the financial community. Much of its popularity stems from its ease of applicability. However, the CAPM is not relevant in the developing world for the following reasons:
1. Greater uncertainty causes investments in emerging countries to tend to be riskier than investments in developed markets. When applying the CAPM, this particular risk factor, referred to as “country risk”, must be somehow quantified.

2. The main indicator for what could be considered to be the “market portfolio” in emerging markets is the stock price index. But this index is rarely a good proxy of the real local business environment.

3. Local businesses are subject to strong foreign impacts in much greater measure than their counterparts in developed countries.

4. To a far larger degree than in the developed world, the great majority of companies are controlled by family groups or a few shareholders. In general, such investors are not well diversified, since these businesses usually represent an important proportion of their proportions. The CAPM ignores the impact of the project on investors’ portfolios, but often this cannot be done in developing countries.

We do not envision a practical way out of this problem. We will, therefore, be aware that the more relevant this situation is, the less significant will be the results obtained through the CAPM (or modified CAPM) and the NPV rule, and greater importance must be given to a portfolio analysis approach.

3.1 Country risk

According to the CAPM, the only relevant risk is given by beta: a measure of the covariance between the project’s return and the return of the market portfolio. Hence, companies in different industries have different (relevant) risk. Nonetheless, this rationale does not account for geography. The companies in the same industry but in different countries could have the same risk but investors frequently demand different returns from the same business depending on its location. This particular risk associated with the geographical location of the investment is known as country risk.

Reputation is the key for assessing country risk. Reputation is built upon a country’s social peace and institutional behaviour through time. A high degree of social stability and extended periods of institutional consistency and continuity earn a nation trustworthiness and low levels of country risk. Observe that country risk does not have as much to do with the quality of economic policies as with their stability and consistency.

Traditionally, country risk is quantified as the difference between the yield of what is considered a zero risk investment in a country of reference and its closest equivalent in the country under analysis. This incremental return is known as the country risk premium. The adjusted (for country risk) discount rate is computed by adding the country risk premium to the discount rate that would correspond to an equivalent investment in the country of reference.

Alternative way of country’s risk assessment offer rating agencies. They use a scale to classify long-term debts issued by emerging countries. The position in the scale depends on perceived default risk that is mirrored by a corresponding yield on financial markets. The greater the risk, the larger the yield, and vice versa. The difference between these yields and the return on a “risk-free” instrument can be interpreted as country risk premium.

This traditional approach to country risk has been widely adopted by most financial analysts, and for many years it has been practiced without questioning. However, it is necessary to mention critical notes to this approach:

- country risk is not totally systematic and is unstable;
- country risk is not the same for all projects;
- credit risk is not equivalent to country risk.
For this reasons, many analysts are less comfortable with the traditional method of accounting for country risk. As a response, in an alternative approach the country risk premium (CR) should be added to the market risk premium and not to the risk-free rate as follows:

\[ E(r_p) = r_f + \beta_p [E(r_m) - r_f + CR] \]  

(9)

There is also a variant to this method. Instead of being added to the market premium, country risk is added to the risk-free rate but multiplied by a factor lambda that can vary between zero and one, depending on how much of the project’s income comes from export.

3.2 The modified CAPM

Before introducing modified CAPM we have to establish two important assumptions:
1. diversified portfolios - project’s investors hold well diversified international portfolios and as a consequence, only systematic risk is relevant.
2. hard currency consumption basket - investor’s consumption baskets are denominated in a particular hard currency (e.g. USD, EUR, JPY).

The modified CAPM model recognizes that a project’s result can be significantly related to two or more markets. The income (and risk) of company in country A exporting to the country B and C must be affected by what happens in these countries. This is why we use a weighted beta for the project.

The modification of CAPM can be developed in five steps. In the first step, the beta of given industry companies in the U.S. market \( \beta_{M} \) is estimated. This can be obtained from a financial information services.

In the second step we estimate the betas of each local market with respect to the U.S. market. If we name these markets m and n, their corresponding betas will be \( \beta_{m,M} \) and \( \beta_{n,M} \). These betas can be estimated by regressing the historical returns of local stock indexes against the U.S. stock market returns.

In the third step we compute the project beta in each market with respect to the U.S. market (\( \beta_{m,M} \) and \( \beta_{n,M} \)) as follows:

\[
\beta_{tm,M} = \beta_{t,M} \beta_{m,M} \\
\beta_{tn,M} = \beta_{t,M} \beta_{n,M}
\]

where \( \beta_{t,M} \) is the beta corresponding to the given business in the U.S. market.

In the forth step it is necessary to find weighted beta \( \beta_p \) with the following formulas:

\[
\beta_p = \alpha_M \beta_{t,M} + \alpha_n \beta_{tm,M} \beta_{m,M} + \alpha_n \beta_{tn,M} \\
\alpha_M + \alpha_n + \alpha_n = 1
\]

where the alpha values represent proportional income originated in each market.

The final step gives the modified CAPM as follows:

\[ E(R_p) = R_f + \beta_p [E(R_M) - R_f] \]

where \( a \) \( R_f \) is the yield of a U.S. government bond in USD with maturity (or duration) approximately equal to the project’s horizon and \( b \) \( E(R_M) \) is the expected return of the proxy for the market portfolio (e.g. S&P 500 index of the United States).

4. Conclusions

In the paper a modified CAPM is proposed. It assumes that emerging market investors evaluate investment proposal in hard currency. The model allows for income and expenses in different countries and uses a (representative) developed stock market as the proxy for the
market portfolio and the basis for the computation of project beta. The correct incorporation of systematic risk remains a challenge for different reasons.

The first problem with the application of modified CAPM is connected with indirect estimation of beta. Publicly traded securities are the natural information source for those interested in estimating beta for a real investment. In developed countries it is straightforward process to select one or more publicly traded companies in the same or similar line of business as the company being analyzed. Then their corresponding betas are obtained from an information service. The project beta should be within the range of these company betas. However, generally this procedure is not as easily done in developing countries because of short history and high volatility of the stock markets, illiquidity of these markets, limited number of firms in many lines of businesses and low frequency at which each stock is traded with respect to the average.

The solution of this problem is adjustment of beta for cash flow composition, level of operating leverage, business portfolio composition and liquid assets proportion. Even after adjustments are made, given the considerable imprecision surrounding the estimation of beta, it is always advisable to evaluate the project for a range of betas around the original estimate. This is even more important in recent situation of fluctuations in the systematic risk of world market. The more uncertain estimate of beta, the wider the range should be. Naturally, the NPV of the project will not be a single figure but a range of values, as well.

Secondly, we have to consider impact of country risk and the main challenge is how the systematic component of country risk can be estimated and incorporated in the discount rate. There is no clear-cut solution to this problem, and we must accept a degree of ambiguity in systematic risk. The only way out is to add this imprecision to the other factors associated with the estimation of beta and experiment with different values of this parameter. The less accurately the local exchanges reflect their corresponding economies, the wider will have to be the range of betas. In the end, the assessment of the impact of country risk on the discount rate will rest on the good sense and intuition of the analyst.

Another possibility is to avoid the stock indexes and look for another proxy of the local economy (e.g. the gross national product). The problem with this approach is the difficulty of finding a truly representative indicator that provides data frequently enough to assure a statistically acceptable estimate of beta.

Third problem stems from the quality of information sources. Good projections of project’s cash flow depend critically on the analyst’s experience and the proper use of all available information sources. As a solution, one can use useful web pages with data and information on many countries (Transparency International, Reuters, Bloomberg etc.) information of main rating agencies.

Risk and flexibility is the final problem in the correct application of modified CAPM. Country risk is often manageable. The task for investors in developing countries is to structure investments in such a way that country risk is minimized (hence expected cash flows are maximized). A common country risk management strategy is to build in future project flexibility.

Finally, we point out that the proposed modified CAPM is not a panacea. On the contrary, it still has many of the same flaws of the classic CAPM. These include, particularly, the need to assume that all investors have the same investment horizon and the same expectations and that there are no transactions costs. However, in spite of these important limitations we believe it to be a more appropriate model for emerging countries than the traditional country risk premium approach.
References


Summary

Príspevok sa zaoberá investičným rozhodovaním v podmienkach rozvíjajúcich sa trhov. Ako základný koncept pre investičné rozhodovanie predpokladáme metódu čistej súčasnej hodnoty (NPV), ktorá diskontuje budúce očakávané príjmy na súčasnosť. Spôsob kvantifikácie diskontného faktora môže byť rôzny, pre účely tohto príspevku budeme používať a vyhodnocovať klasický model CAPM. Zameriame sa na beta faktor ako mieru rizika a rozdiskutujeme riziko krajin ako súčasť investičného rizika v rozvíjajúcich sa krajinách. Ťažisko tvori predstavanie modifikovaného CAPM, ktorý zohľadňuje špecifická rozvíjajúci sa krajin.