Energy Policy 40 (2012) 49–58

Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

Figuring what's fair: The cost of equity capital for renewable energy in emerging markets

Charles Donovan *, Laura Nuñez

IE Business School, María de Molina 11, Madrid 28006, Spain

ARTICLE INFO

Article history:
Received 4 December 2009
Accepted 29 June 2010
Available online 28 September 2010

Keywords:
Investment theory
Asset pricing
Government policy

ABSTRACT

The appropriate cost of capital for a renewable energy project depends upon an accurate measure of investment risk. Employing the conceptual framework of a commonly accepted asset pricing model, we analyze the risk faced by renewable energy investors in large emerging markets. We find that firms in Brazil, China and India expose multinational investors to the same risk as investing in emerging markets generally. The risk to domestic investors in those same firms ranges from substantially below-average to above-average, depending upon the country. The results are robust across several model versions and statistical techniques. With an eye toward government efforts to encourage the deployment of renewable energy in developing countries, we establish a range of estimates for the required return on equity capital in this fast-growing and politically important economic sector.

1. Introduction

Recent studies have forecasted more than $10 trillion of investment in the renewable energy sector over the next 20 years, much of it in developing countries (IEA, 2009). Because most renewable energy technologies are not cost-competitive in the current economic system, fiscal incentives have been implemented in nearly all large energy-consuming countries to encourage investment in the sector. A coordinated effort to support RE projects in the developing countries of Asia, Africa and Latin America will likely lead to rapid expansion of public funding programs and new economic support mechanisms (UNEP, 2009). Much of the funding for these programs will be drawn from the developed countries of Europe, North America and Asia.

Rapidly growing subsidies to the private sector have raised questions about the effectiveness of current investment incentives. The Clean Development Mechanism, an initiative of the UN Framework Convention on Climate Change and one of the primary ways in which developed countries subsidize renewable energy projects beyond their own borders, has proven to be a lightning rod for this debate. More than 1,670,000 CDM carbon credits are expected to be issued to renewable energy project developers in developing countries though 2012 (UNFCCC, 2009), comprising a wealth transfer of some $20 billion.[2] Concerns have been raised that the CDM approval process is too lenient, allowing firms to earn supra-normal profits from projects that would have occurred anyway (Harvey, 2007; Wara and Victor, 2008). Others contend that the CDM has become too restrictive (Harvard Project on International Climate Agreements, 2009) with its most serious flaw being a failure to attract sufficient levels of private sector capital (Economist, 2007).

To obtain CDM subsidy, a firm must demonstrate that it would not have implemented the project without financial support. The evaluation of "investment additionality" by CDM regulators relies upon a comparison of investment alternatives and/or internal rate of return (IRR) benchmarking (UNFCCC, 2008), with individual firms proposing a benchmark cost of capital for each project requesting subsidy. Projects having a rate of return without CDM subsidy less than their self-reported benchmark cost of capital should be approved while those with a rate of return without CDM subsidy greater than the benchmark may be rejected (UNFCCC, 2008). In the same vein as observed by Lewis (1996) about marketable permit and emissions tax programs generally, CDM regulators must balance the cost of making a type-one error (in this case, rejecting a deserving project) against the cost of making a type-two error (approving a project that would have occurred without extra support).

The regulator's view on required rate of return is a basic building block of all renewable energy investment policies. It is particularly important in the CDM. But while economists have long debated the efficiency of subsidies on climate change policy objectives, very little consideration has been made in the academic literature to the firm cost of capital and its critical role in determining investment patterns in climate-friendly industries. Without a clear view on industry cost of capital, it is exceedingly

* Corresponding author.
E-mail address: cwdonovan.dba2011@alumno.ie.edu (C. Donovan).

[2] Assumes a price of Certified Emissions Reductions (CERs) of $12/CER

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doi:10.1016/j.enpol.2010.06.060

difficult for national and supra-national regulatory agencies to deliver the right amount of fiscal support to the right projects. The result of over-leniency may be, as has been the case in up to 60% of past environmental investment subsidy programs, that firms receive windfall profits at taxpayer expense (Arguedas and van Soest, 2009). Conversely, regulatory overshoot could deny fiscal support to projects that would not otherwise attract private sector investment, thereby exacerbating carbon lock-in (Unruh and Carrillo-Hermosilla, 2006). By directly comparing various models for estimating the cost of equity capital, our aim with this paper is to guide regulators, researchers and corporate managers who evaluate funding decisions within the industry.

While the literature concerning industry-generic costs of capital is extensive in both its theoretical and empirical contributions, studies on climate change mitigation have tended to side-step difficult questions about the cost of capital in greenhouse gas-reducing industries. An authoritative report by Stern (2006), for example, used a social cost of capital[3] to estimate the present value of future investment required to meet pollution reduction targets.

Perhaps due to its relatively short track record as a stand-alone industry, there are very few studies in the academic literature concerning the cost of capital of clean energy firms, a key economic sector in the effort to slow human-induced global warming. When touching upon environmental issues more broadly, studies on cost of capital have observed a reduction in the cost of corporate funding due to environmental risk management practices (Feldman et al., 1997; Sharfman and Fernando, 2008) but have not investigated investment hurdle rates in new industries gaining strength from rising ecological pressures. The limited number of references to internal rates of return for renewable energy companies have either lacked solid grounding in financial theory (Dunlop, 2006), been focused on companies in well established European markets (Muñoz et al., 2009), or are proprietary to investment banks and consultancies. On the issue of market risk, a key component of the cost of capital estimation, a recent study by Henriques and Sadorsky (2008) found that renewable energy companies have market beta values close to 2.

Employing an empirical research design and using multiple asset pricing models, we take up the challenge of estimating the expected return on equity for renewable energy investors in emerging markets. We focus on the most complicated element of the cost of equity calculation, the market risk factor. The models considered in our study include the single-factor CAPM (Sharpe, 1964; Lintner, 1965) and the downside beta CAPM (Estrada, 2000) as well as their "global" and "local" variants. A visual summary of the analysis is shown in Fig. 1.

Our paper is organized as follows. Section 2 briefly describes the theory of investment decision-making by the firm and introduces the models used for estimating the return on equity capital. We give specific consideration to issues associated with estimating the cost of equity in emerging markets. Section 3 lays out the method we have employed to test the accuracy of the pricing models. Section 4 provides our results and a discussion of them. Section 5 concludes.

2. Investment decision-making and the cost of equity capital

A firm that has identified projects matching its overall business strategy must endeavour to select the projects that maximize total value for the firm. Discounted cash flow (DCF) analysis is the standard approach for calculating net present value (NPV) and assessing whether a project creates value for the firm's shareholders (Copeland et al., 2000). DCF models calculate the present value of forecasted cash flows using a discount rate that reflects the opportunity cost of making the investment. The discount rate is the same as the project's weighted average cost of capital (WACC), expressed as

$$\text{WACC} = [\text{Cost of Equity}(\text{Equity}/(\text{Equity}+\text{Debt}))] + [\text{Cost of Debt}(\text{Debt}/(\text{Equity}+\text{Debt}))]$$

The cost of equity capital is the most challenging aspect of the WACC calculation as it reflects the *expected* rate of return for the investor. Whereas yields on debt instruments are easily inferred from market rates, expected returns to shareholders are subject to a much greater degree of uncertainty. Nonetheless, accurate estimation of the cost of equity is critical for estimating a project WACC and making sound investment decisions.

2.1. The traditional CAPM

The capital asset pricing model (Sharpe, 1964; Lintner, 1965) provided the first coherent framework to estimate the cost of equity and has been widely applied by practitioners. As reported by Graham and Campbell (2001), three-quarters of companies in a survey of 392 firms use the capital asset pricing model (CAPM) to obtain their cost of equity. Bruser et al. (1998) similarly found that the single-factor CAPM is the single most common method used by practitioners for estimating equity hurdle rates.

According to the CAPM, the appropriate cost of equity (R_e) is determined by the risk free rate (R_f), a market risk premium ($R_m - R_f$)[4] and the sensitivity of the project or company to market fluctuations (the beta or β). Expected return on equity in the CAPM formula is given by the equation:

$$R_e = R_f + \beta(R_m - R_f) \quad (1)$$

Despite its widespread use, the standard CAPM is viewed by many in the academic community as an empirical failure. A large body of literature has identified return patterns in stocks that cannot be explained by it.[5] Of particular interest to this study, several authors have claimed that the CAPM is generally not applicable in emerging markets. Cheung et al. (1993) show that the applicability of CAPM in Asia appears to be weak, while Hwang and Satchell (1999) found evidence that the inclusion of additional systematic risks factors related to the skewness and kurtosis of return distributions are needed to explain the cost of equity in emerging markets. In another example, Gupta and Sehgal (1993) failed to establish a linear risk-return relationship, a crucial aspect of the conventional CAPM, when studying historical returns in the Indian stock market. Similarly, Mobarek and Mollah (2004) reported that, in general, CAPM is not applicable in the emerging Asian markets.

Many extensions of the CAPM have been proposed to improve the model's estimation capabilities. These newer models seek to rectify the empirical failures of the CAPM and improve our understanding of the cost of equity within industries, companies and at the project level. In the light of the proven limitations of the "practitioner's method" and the importance of cost of equity to investment subsidy schemes like the Clean Development Mechanism, we have evaluated an alternative to the standard CAPM designed for non-normal return distributions.

[3] Typically ranging from 1% to 3%

[4] The equity or market risk premium is the return of the market portfolio minus the risk-free rate.

[5] See Basu (1983), Banz (1981) or Fama and French (1993).