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Using DNPV for valuing investments in the energy sector: A solar project case study

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A B S T R A C T

In this paper, a practical application of a valuation method that decouples the time value of money from the risk associated with the project is used to value an investment on a solar project. The proposed method is termed decoupled net present value (DNPV). A simple investment renewable energy project is presented using both the traditional NPV techniques and the proposed DNPV. The proposed methodology provides a consistent valuation method free from the problems typically associated with the application of traditional NPV and, more importantly, it allows a seamless integration of project risk assessment performed by technical experts and risk management implemented by business executives into the financial evaluation of the project.

1. Introduction

Although a boom in innovative techniques for risk quantification and management has been taking place in the financial industry over the last three decades, nonfinancial institutions have been slow in adopting these modern tools [1]. Different from investing in liquid financial securities where managers are mostly concerned with market forces and financial risk, infrastructure investments are more illiquid, can take several years to develop and additional time to show a profit. As a result, infrastructure investment requires a thorough understanding of the different aspects of the investment such that a proper assessment and quantification of the risks can be made. In addition, because most managers (business executives) only have a limited amount of financial resources, they need to evaluate competing investment alternatives to decide which investment opportunity is the most attractive one. In order to make a sound investment decision, these evaluations need to consider the many different risks surrounding each project under consideration.

The standard tool to value and compare investment propositions is the Net Present Value (NPV) method. However, as discussed in Ref. [4]; the use of a single discount rate to account for the riskiness of the project as it is done in the NPV method is fraught with a number of drawbacks that can lead to over (or under) invest when the opposite would have been more appropriate. The classical NPV method is a top-down approach that resulted from the process of acquiring capital in the form of debt and equity and mandating that all investments must earn its weighted average cost of capital (WACC). If the project is deemed to have a risk profile different from the firms overall risk, business executives heuristically adjust the company's WACC to account for the project perceived risk and, more often than not, inflated discount rates are adopted [3]. In essence, the discount rate in the classical NPV is more concerned with the source of funding than the project itself (i.e., it is exogenous to the project representing the demand of equity investors and debt holders) and adjustments of the discount rate to account for idiosyncratic risk is a feeble attempt to correlate the discount rate to the overall risk of the project. Although more sophisticated probability-based approaches such as real options, decision analysis, or a combination of the two have been proposed as a tool for valuation of risky projects and strategy [2], the use of such methods has been deemed difficult to apply and, more importantly, the results difficult to explain to decision makers [6].

To complement the NPV method, a new valuation methodology termed decoupled NPV (DNPV) has been recently proposed. Contrary to NPV, DNPV is a bottom-up approach that first identifies the project risks, uses probabilistic analysis and modern financial techniques (e.g., option pricing) to price these risks as a cost to the project, and then integrates these synthetic costs to the project valuation (i.e., it is endogenous to the project). Hence, DNPV can be

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Table 1
Free cash flow analysis.

Financial model (all figures in € unless otherwise indicated)					
Unlevered Proforma	Year				
Revenues	**1**	**2**	**...**	**19**	**20**
1) Installed capacity (inc. degradation) (kwp)	3970	3954	...	3694	3679
2) Average radiation (P_{50}) (Kwh/Kwp)	1164	1164	...	1164	1164
3) Average feed-in Tariff (€/Kwh)	0.43	0.44	...	0.68	0.69
Total revenues:	**2,003,847**	**2,045,727**	**...**	**2,907,784**	**2,968,557**
4) Maintenance	125,054	128,180	...	195,041	199,917
5) Administration costs	72,000	73,800	...	112,295	115,103
6) Inverter replacement	14,292	14,649	...	22,290	22,848
7) Land lease (prepaid)	–	–	...	–	–
8) Insurance	14,292	14,649	...	22,290	22,848
9) Local tax	40,111	41,114	...	62,560	64,124
EBITDA	**1,738,098**	**1,773,335**	...	**2,493,307**	**2,543,718**
10) Corporate tax	272,339	286,311	...	586,719	608,882
Free cash flow (FCF)	**1,465,759**	**1,487,024**	...	**1,906,588**	**1,934,836**

used to measure the risk performance of the project whereas NPV (using WACC unadjusted for risk) can be used as a measure of the financial performance of the project and both measures should be calculated when evaluating capital allocations or infrastructure projects. In the DNPV methodology, an investor is viewed as an insurance provider who gets compensated for all risks that have not been diversified away (i.e., risks owned by the investor) and the value of each of these risks are represented by synthetic insurance premiums estimated using either risk-neutral probability for market (public) risks and actual probabilities for non-market (private) risks. The use of neutral and actual probabilities along with decision tree analysis for valuation of risky projects was first introduced to analyze oil and gas investment projects [9,10]. The procedure, termed the Integrated Approach, consists of developing a decision tree that maps the possible future outcomes and assigns probabilities to each of the branches of the tree. Despite the soundness of the approach, the implementation of the integrated approach is not straight forward and, more importantly, the results are often difficult to convey to decision makers.

As in the case of the integrated approach, DNPV allows for risk integration but in a simple and easy-to-communicate manner. Furthermore, similar to the integrated approach, DNPV is a tool that can be used to align risk management, financial objectives, operational alternatives and strategic options. Thus, the five-step Integrated Risk Return Management (IRRM) program for corporate risk management proposed by Ref. [3] can be adapted as described below to evaluate infrastructure projects using the proposed DNPV methodology. Accordingly, the five-step process in an infrastructure project evaluation are: (i) Step 1: Project risk identification and understanding; (ii) Step 2: Risk ownership selection; (iii) Step 3: Identification of acceptable amount of risk; (iv) Step 4: Selection of risk mitigation mechanisms; and (v) Step 5: Risk monitoring and management.

To show the capabilities of the proposed DNPV method along with the IRRM concept, a simple solar renewable project is presented in this paper. The project consists of solar panels installed in France generating approximately 4.6 GWh per year since 2012. To incentivize the development of renewable energy projects, the French government offered a significant premium for energy from renewable sources. At this particular facility, a purchase power agreement (PPA) that guarantees the solar plant owner a tariff of €0.43/kWh for a period of 20 years was signed. After this period, the price will revert back to the price of non-renewable energy (i.e., €0.06/kWh in 2012 prices).

2. NPV analysis

After financing, developing, and initially operating the power plant, the project developer was interested in selling the facility to interested buyers. The projected revenues and expected costs base are presented in Table 1 and are labeled from 1 through 10. Prices were adjusted assuming a 2.5% annual inflation whereas the installed capacity degraded at about 0.4% per year. Using this information, the earnings before interest, taxes, depreciation and amortization (EBITDA) were calculated. The free cash flow (FCF) for years 1 through 20 is presented in Table 1. Using the FCF information along with a discount rate of 10%, the present value of the future revenues was estimated to be €13.7 million. The discount rate was selected based on rates used for similar solar projects in France. A similar project in Germany would typically require a lower discount rate (i.e., 8%); thus, apparently, the market imposes an additional 2% premium to account for country risk. In such a case, the present value of the project future revenues would be worth €16 million. Hence, if the transacted price for the project is

Table 2
Hazard identification analysis.

Source	Parameter	Potential risk	Risk management
Revenue	Installed Capacity	Less capacity than advertised	Minimal risk mitigated by obtaining an expert report supported by professional liability insurance.
	Radiation[a]	Lower than expected performance on any given year	Moderate risk (to be assumed by the buyer).
	Feed in tariff[a,b]	Unilateral change in PPA that results in a net tariff reduction	Significant risk as it can reduce permanently future revenues. Risk can be either assumed by buyer or shared with seller.
Operating costs	Maintenance[a]	Company breaks contract and an alternative needs to be found	Moderate risk (to be assumed by buyer).
	Administration costs[a]	Fixed price contract broken and new contract/management needs to be put in place	Minimal risk (to be assumed by buyer) as cost estimated appears to be above market prices.
	Inverter replacement[a]	More inverters going wrong in any given year	Negligible risk (to be assumed by buyer) compared to other risks in this project.
	Land lease[a]	Lease increase	Negligible risk as a 20-year lease is already prepaid.
	Insurance	Insurance does not pay its commitments	Negligible risk mitigated by obtaining insurance from AAA insurance providers.
	Local sales tax[a b]	Increase in tax rates that could affect profit	This risk can be addressed under the feed in Tariff risk.
Additional costs	Financial Costs	Changes in interest rates	Negligible risk. Fixed rate loans are structured.
	Corporate tax[a b]	Increase in corporate tax rates	This risk can be addressed under the feed in Tariff risk.

[a] Risk to be partially or completely borne by investor.
[b] Reducing feed in tariffs, increasing local taxes or corporate taxes have the similar effect (i.e., reduce FCF) and they are all government decisions, therefore only one will be evaluated.