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Christian Hürlimann

Valuation of Renewable Energy Investments

Practices among German and Swiss Investment Professionals

Springer Gabler

Christian Hürlimann
Zurich, Switzerland

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Dedication

This thesis is dedicated to my wife, Andrea; our new-born daughter, Emma Lou; my parents, Elsbeth and Bernhard; and my brother, Michael.

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Christian Hürlimann

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Abbreviations

AHP	Analytical hierarchy process
APM	Arbitrage pricing model
APT	Arbitrage pricing theory (=APM)
β_j or β_{asset}	Beta coefficient
CAPM	Capital asset pricing model
CAQDAS	Computer-assistant qualitative data analysis software
CCAPM	Consumption-based CAPM
CF	Net cash inflow
CI	Capital invested
CIO	Chief investment officer
CoC	Cost of capital
DAX	Deutscher Aktienindex
DCF	Discounted cash flow
DD	Due diligence
DNPV	Decoupled net present value
DSCR	Debt service coverage ratio
DV	Dependent variable
eNPV	Expected net present value
EPC	Engineering procurement construction
ERP	Equity risk premium
EVA	Economic value added
EVCaP model	Equity value creation and value protection model
EVDIF model	Equity value driver and influencing factor model
FF	Fama-French
FiT	Feed-in tariff
FCF	Free cash flow
FCFE	Free cash flow to equity
FCFF	Free cash flow to firm
FTE	Flow to equity
GDB	Gross domestic product
I_0	Initial investment
ICAPM	Intertemporal CAPM
ICF	Initial coding frame
IV	Independent variable
LCOE	Levelised cost of electricity
IPP	Independent power producer

iRADR	Implied risk-adjusted discount rate
IRR	Internal risk of return
LDD	Legal DD
LR	Literature review
M&As	Mergers and acquisitions
MA	Multiple approach (in valuation)
MIRR	Modified IRR
MM	Mixed-methods
MMR	Mixed-methods research
NOPAT	Net operating profit after tax
NPV	Net present value
NTA	Non-traded asset[3] on the public market
OPEX	Operational expenditure
O&M	Operation and maintenance
P	Probability (for example, in the term P value)
PB	Payback period
PCA	Principal component analysis
PD	Project developer
PDF	Probability density function
PI	Profitability index
PPA	Power purchase agreement
PTC	Publicly traded company
PV	Present value
QDA	Quantitative data analysis
qual	Minor qualitative research phase
QUAL	Primary qualitative research phase
QUAN	Primary quantitative research phase
r	Discount rate
RE	Renewable energy
RES	Renewable energy source
RES-E	Power plants producing electricity from renewable energy sources
RAPV	Risk adjusted project valuation
RRM	Risk ranking matrix
ROV	Real option valuation
R&D	Research and development
SMI	Swiss market index
SPA	Share purchase agreement
SPV	Special purpose vehicle

TDD	Technical DD
t	Time and period
VaR	Value at risk
VBM	Value-based management
WACC	Weighted average cost of capital

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Abstract

This research aims to evaluate the currently applied valuation approaches in practice among German and Swiss professional investors for renewable energy (RE) projects based on an explanatory, sequential, mixed-methods (MM) research approach, compared to existing financial theory. It additionally explores associated influencing factors, key equity value drivers, and 'best practice' approaches and/or improvements in order to propose a revised valuation approach specifically for such investments. The inferences (INFs) taken are obtained by integrating quantitative (QUAN) results from a survey of 111 practitioners with qualitative (QUAL) findings through in-depth interviews with 16 purposefully selected individuals from the pool of participants from the previous QUAN phase to explore those results in more detail.

The results and findings were both reassuring and surprising while still detecting a certain gap between theory and practice. As main research outcomes, it can be illustrated that both systematic and unsystematic risks are relevant for performing valuations of such investments. More specifically, for the former, political and market risks are the most important risk components, and for the latter, weather-related volume risk is most important. Risk preferences and subsequently valuation are clearly influenced by experienced materialisation of risk. Discounted cash flow (DCF)-based valuation is state of the art in this valuation, even if multiples are applied as a simplified benchmarking approach. Encountered risk leads either to adjustment in the cash flows or in the applied discount rate, the former being the main approach to treat risk in valuation. The internal rate of return (IRR) approach is the most frequently applied valuation methodology, even if the net present value (NPV) approach is theoretically more consistent and even though many practitioners do not seem to be aware of the former's potential drawbacks. Moreover, the market for such investments has agreed to apply a simplified flow to equity (FTE) valuation approach. It thus ignores the consideration of the right type of discount rate (a dynamic discount rate) for the typically applied autonomous financing structure based on project financing for simplification reasons. Market participants surprisingly still use the weighted average cost of capital (WACC) of the investing company, mostly as a basis for defining hurdle rates, even if finance theory could clearly demonstrate its irrelevance as a cost of capital (CoC) approach in DCF-based valuation. More sophisticated valuation methods are less known and not applied, even if the certainty equivalent (CE) and adjusted present value (APV) methods are promising, complementary methods to support conventional approaches for assessing the investment's value protection ability and performing impairment test respectively.

The discussion of the INF analysis results helps to increase the understanding of this complex topic and provides valuable insights into this usually hidden procedure. The applied MM approach allowed for the exploration of issues and the discussion of possible improvements in valuation practices, which would not be possible within a classic quantitative study. The developed concepts in this thesis provide practitioners, particularly equity investors, with powerful tools to define the relevant equity value drivers, to understand additional influencing factors in valuation and considerations of risk treatments in projects, and to value RE investments along the two dimensions of value creation and value protection.