



## Dennis L Buchanan and Mark H A Davis: Metals and energy finance: application of quantitative finance techniques to the evaluation of minerals, coal and petroleum projects: 2nd edition

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Dennis Buchanan is Emeritus Professor of Mining Geology and Senior Research Fellow at the Imperial College London and has 38 years of experience in teaching mining geology, mineral exploration and mineral project appraisal. He is the Director of the MSc in Metals and Energy Finance programme at Imperial. In addition, he has practised as a mining geologist in the gold and platinum mines of South Africa. Mark Davis, who is a contributor to the book, is a Senior Research Fellow in the Department of Mathematics at Imperial, where from 2000 to 2012 he was Professor and Head of the Mathematical Finance Group. He has also worked in a number of financial roles in the City of London, including project finance.

As you would imagine from the background of Dennis Buchanan and Mark Davis, this text focuses on the interface between conventional and financial engineering as relating to the world of metals and energy finance. The current MSc programme is a joint degree between the Department of Earth Science and Engineering and the Business School at Imperial. The author also leads courses at Imperial's Centre for Continuing Professional Development, which are aimed at professionals working in finance, geoscience or engineering roles in the natural resources industry and financial institutions covering the sector. In 1994 when I started my career in mining finance at Barclays de Zoete Wedd in the City of London, I was introduced to Dennis Buchanan when he ran and delivered an in-house course on the fundamentals of mineral deposit appraisal from the viewpoint of the investor and lender. Ten years later

when I went on to establish and lead the global Metal and Mining sector team at WestLB, which was at the time one of the four large German banks, we invited the author to deliver specialist in-house courses to the senior management of the bank covering the front-office and credit functions.

Dennis Buchanan draws on his long-standing experience of teaching professionals working in finance and industry and also in leading the MSc programme. As such, this book is both a textbook for the postgraduate student and a practitioner's reference book and guide for the professional working within the natural resources sector, and is aimed at those working in the financial world, such as investment bankers, as well as those working as geologists and conventional engineers, who wish to further their understanding of the corporate finance and trading functions of natural resources companies and the advanced methodologies used by both the finance sector and industry to evaluate mineral and petroleum deposits. Whether at exploration, development or production stage, the author reveals how to apply advanced financial engineering methods in conjunction with geoscience and conventional engineering to better evaluate and appraise metals and energy assets in terms of risk and return and shareholder value. As the name of the text suggests, this book is focused on the natural resources sector as a whole and addresses the energy sector (petroleum, coal, etc.) as well as the metal ones.

The book is split into four main parts: *Management and Business, Mineral & Petroleum Geosciences, Project Evaluation* and concludes with *Quantitative Finance*.

Right from the outset, this book introduces the subjects of financial and conventional engineering. This is the central theme of the text, and in so doing the book establishes how crucial it is to have an understanding of these two disciplines in order to successfully appraise natural resources assets from both an investor's and lender's perspective.

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The first part of the book introduces the various financing instruments and markets that are used to fund natural resources projects. Chapter 2 introduces the main finance methods used to appraise the economic viability of natural resources projects and introduces corporate finance valuation methods, such as discounted cash flow modeling, and explains how these methods are specifically applied to the metals and energy sectors, which clearly differentiates this text from standard corporate finance books. This chapter includes an analysis of risk and uncertainty that naturally leads into an introduction to risk and return and the application of risk-adjusted discount rates and the cost of capital and how to optimise gearing to enhance value and mitigate risk. Again, these corporate finance concepts are specifically applied to the natural resources sector and reinforced by the case studies found in the final part of the book.

Chapter 3 introduces the relationship between commodity prices and resources and reserves and how an understanding of this relationship is crucial to the economic appraisal of a resource. Of course, those exchange-traded commodities that benefit from liquidity and transparency of pricing are particularly suited to some of the more advanced financial subjects, such as real options analysis, which are addressed in the final part of the book.

Chapter 4 introduces the technical constraints relating to mineral resource development and associated technical risks, such as those concerning environmental and social matters and health and safety, which are of ever-growing importance to natural resources stakeholders. Changing tack, this chapter introduces further funding options open to the natural resources sector, such as project finance, joint venture agreements and more recent developments in the financial sector that are becoming increasingly used in the natural resources industries, such as real options analysis and the use of 'streaming' as a means of funding natural resources projects. This chapter also looks at considerations that are specific to the petroleum industry.

The second part of the book addresses mineral and petroleum geosciences and introduces the main types of metallic and energy resources and focuses on the geological risks that are inherent to such resources.

The third part concerns resource evaluation and project appraisal and introduces mining and process engineering.

This part of the book covers how to identify, analyse and understand the associated technical risks inherent within any evaluation of a resource or project.

The fourth part introduces financial engineering techniques and how these can be used to mitigate both technical and financial risk and optimise value. This part of the book integrates the subjects covered in the preceding parts of the text and shows how geoscience, conventional engineering and financial engineering can be brought together to de-risk and optimise the value of a resource or project.

Throughout the text, the author draws on real-life experience and more in-depth case studies are introduced in the three appendices, which clearly and successfully draw together the subjects covered in the book.

I would have liked to see more discussion regarding the process of raising capital, such as the process of raising private equity from private equity houses and the process of raising public equity through primary and secondary issuance. However, this is a minor point as the book addresses the main issues pertaining to raising equity, such as value and risk, and the role of technical reports and due diligence.

Dennis Buchanan's text clearly shows how an understanding of the complementary disciplines of geoscience, conventional engineering and advanced financial engineering is essential to making the right decisions concerning how to appraise a resource or project and how to structure the funding of natural resources assets in order to mitigate technical and financial risk and to maximise value for owners. Crucially, the book also looks at how other sources of capital, such as limited recourse lenders, appraise metals and energy assets. Such an understanding is essential to optimising the capital structure and valuation of natural resources assets. As a financial advisor specialising in the natural resources sector and while running the Metals and Mining team at WestLB Capital Markets, the inter-disciplinary methods discussed in this text have proven invaluable to me. The advanced methodologies revealed in Dennis Buchanan's book will have great value to those working in the technical and financial functions, or to those spanning both functions, of the natural resources industry.

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