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Issues in real options with shadow costs of incomplete information and short sales ☆

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ABSTRACT

This paper presents the valuation of real options and the capital budgeting models within shadow costs of incomplete Information and short sales. Shadow costs are sunk costs in the spirit of Merton's (1987) model of capital market equilibrium with incomplete information.

The shadow cost includes two components. The first component is the product of pure information cost due to imperfect knowledge and heterogeneous expectations. The second component represents the additional cost caused by the short-selling constraint. Information costs are linked to Merton's (1987) model of capital market equilibrium with incomplete information, CAPMI. This model is extended by Wu, Li and Wei (1996) who propose an incomplete-information capital market equilibrium with heterogeneous expectations and short sale restrictions, GCAPM. This model is used in our paper to provide for the first time in the literature analytic solutions for derivatives in the presence of both shadow costs of incomplete information and short sales.

Shadow costs are used in standard discounted cash flow techniques and real options. The justification of shadow costs in real projects is based on the observation that R&D needs to be done before investment decisions. The main results regarding real options and shadow costs of incomplete information and short sales are proposed by extending the analysis in Bellalah (1999, 2000) and Bellalah and Wu (2009).

Our results have important implications in terms of pricing derivative assets and different types of real options. In particular, this framework can be easily implemented in investment decisions and the valuation of flexibility embedded in real projects. In fact, several investment decisions under uncertainty can be reformulated and their results can be implemented in the presence of incomplete information and investment constraints.

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1. Introduction

Managers make capital investments to create future growth for shareholders. Investments lead to patents or technologies, which open up new growth possibilities. They use capital asset pricing model (CAPM), the cost of capital, the discount cash flow techniques, DCF, net present value (NPV), decision tree analysis (DTA), payback time, or scenario/simulation.

These methods ignore intangible factors such as future competitive advantage, future opportunities, managerial flexibility, the strategic value of an investment, etc.

New techniques for capital budgeting incorporate real options, and strategic interactions between investment and financing decisions. For a survey of the literature on real options, the reader can refer to Trigeorgis (1990, 1993, 1996), Pindyck (1991), Paddock, Siegel, and Smith (1987, 1988), Newton (1996), Myers (1984), Myers and Majd (1990), Smith and Nau (1994), Lee (1988), Agmon (1991) among others.

The main objective of this paper is to analyse the real option approach in capital budgeting investment decisions and compare it to the traditional NPV.

Information plays a central role in the capital budgeting process and in investment and financing decisions.

Edwards and Wagner (1999) study the role of information in capturing the research advantage and how to incorporate information into the decision process of active investment management. They show that managers must measure and develop confidence in the value of their research and then incorporate feedback from the market.

Merton (1987) adopts most of the assumptions of the original CAPM and relaxes the assumption of equal information across investors. His model shows that asset returns are an increasing function of their beta risk, residual risk, and size and a decreasing function of the available information for these assets.

The analysis in Merton (1987) shows that a reconciling of finance theory with empirical violations of the complete-information, perfect market model need not imply a departure from the standard paradigm. Wu, Li, and Wei (1996) extend Merton' (1987) model. They propose an incomplete information capital market equilibrium with heterogeneous expectations and short sale restrictions, GCAPM. They show that the equilibrium asset returns are affected by short selling constraints and divergent beliefs. Wu et al. (1996) find that short sale restrictions mitigate the inefficiency of the market portfolio due to divergent beliefs. This is because short sales can reduce the opportunity cost of ignorance. The effect of short sales restrictions on equilibrium prices is more evident and more pronounced for smaller and less known securities. The analysis increases the robustness of Merton's asset pricing model.

Short-sale constraints affect investors' use of information in financial markets. Investors who face short-sale constraints may not be able to trade based on their private information, so asset prices will not fully reflect their views.

Theoretical models on short-sale constraints examine the effects of these constraints on information use by market participants. They study the implications for investment decisions and equilibrium prices.

Short-sale constraints not only can affect investors' use of information in their investment decisions, but also can affect their incentives to acquire information. For example, one important type of short-sale constraint is that some investors, such as mutual fund and pension fund managers, are explicitly prohibited from short-selling.

Nezafat and Wang (2013) develop a model of information acquisition and portfolio choice under short-sale constraints. The model follows the recent theoretical literature on endogenous information acquisition in financial markets and explicitly incorporates the information acquisition decision in investors' overall investment decision. We refer the reader to Mackowiak and Wiederholt (2012) and Van Nieuwerburgh and Veldkamp (2009, 2010), for models of information acquisition in financial markets. In the model by Nezafat and Wang (2013), investors take short-sale constraints into consideration in their information acquisition decisions before they acquire the information. Short sale constraints and the information acquisition decisions then jointly determine the investment decisions. In the baseline model, two assets – a risk-free asset and a risky asset – are traded in the market. Acquiring information is costly; however, doing so reduces the uncertainty that the investor is facing regarding the return of the risky asset. With short-sale constraints, the acquired information may be "wasted" if the investor is not allowed to sell an asset short.

Beber and Pagano (2013) study short-selling bans around the world global financial crisis.

Boehmer and Wu (2013) analyses short selling and the price discovery process. Boehmer, Jones and Zhang investigate shackling short sellers around the 2008 shorting ban.

Bris, Goetzmann, and Zhu (2007) study the efficiency and the bear and focus on short sales and markets around the world.

Cabrales, Gossner, and Serrano (2013) study entropy and the value of information for investors.

Cao (1999) investigates the effect of derivative assets on information acquisition and price behaviour in rational expectations equilibrium. Cao, Zhang, and Zhou (2007) study short-sale constraint, informational efficiency, and asset price bias. Massa (2002) analyses financial innovation and information and they focus on the role of derivatives when a market for information exists. Mackowiak and Wiederholt (2012) investigate information processing and limited liability

The above literature reveals the importance of shadow costs in the pricing of real and financial assets. Using a similar framework, Bellalah (1999) and Bellalah and Wu (2009) develop simple models for the pricing of financial options in the presence of information costs. A similar analysis can be extended to real options within shadow costs of incomplete Information and short sales.

This paper is organised as follows: Section 1 introduces the general context for the valuation within shadow costs of incomplete information and short sales. Section 2 reminds the use of traditional capital budgeting models. It incorporates shadow costs in standard discounted cash flow techniques. Section 3 presents specific features of real options. Section 4 proposes an extension of existing models for the pricing of real options within shadow costs of incomplete Information and short sales.