tility of returns) and to the "double burden" problem during the transition period; similarly, they do not overrate the effects of funding on increased capital accumulation and GDP. These are the reasons, together with the attraction – in terms of risk compensation – of a mixed system, why they end up in suggesting an only partial switch to funding.

Within this framework of general agreement, the present reviewer's minor remarks may be expressed as follows.

The demographic projections are perhaps a bit outdated and overdone: for the world population in 2050, the latest UN figures do no longer indicate 9,3 billion people but (as the authors themselves mention in a footnote) some 400 million less.

The reference model, by which projections are made, is often quoted as the ECFIN one. But on p. 187 "a new model which has been constructed for this analysis" is mentioned and on pp. 277–290 a "modified version" is described. These multiple hints could perhaps be made clearer.

The book abounds, or over-abounds, in overviews, introductions and summaries. Moreover, some of the "boxes", such as the ones on demographic change and savings behavior and on income convergence, sum up the conventional, textbook wisdom on these subjects. Amidst the scholarly and far-reaching analysis which characterizes the rest of the volume, these didactic features belong to a different and less elegant style.

One final remark: the impact of funding is examined under two different assumptions (a compulsory and a voluntary pillar). In the second case, it is stated that "a lot of the gain from the fall in payroll taxes is spent and not saved… leading to a serious underfunding of pension income". Yet, without any apparent reason, the final suggestion opts for a voluntary private pillar.

Remarks such as these do not detract from a substantially positive opinion. The book is really worth reading.

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Hanke, M.: *Credit Risk, Capital Structure, and the Pricing of Equity Options*. XVI, 208 pp. Springer, Wien New York 2003. Softcover € 55.00.

The classical approach to option pricing pioneered by Black, Scholes and Merton starts with an exogenous model for the price process of the underlying (stock, say) and then uses noarbitrage or replication arguments to derive the value of derivatives written on that asset. In the standard model where the stock price process is a geometric Brownian motion with constant parameters, the value of a European call option is then given by the Black-Scholes formula, and explicit closed-form results an be obtained for the prices of many other derivative contracts.

But what if the underlying is the equity of a firm? This is the starting point of this book. Its goal is again to obtain closed-form expressions for many derivative products, but in a model which is more realistic in that it takes into account the possibility of the firm's default. By adapting parameters, the approach also allows one to explicitly see the effects of the capital structure of the firm on option prices.

The basic result of the entire approach is the following. If we consider Brownian motion W on a finite interval, there is an explicit expression for the joint density of the final value W_T and the maximum $M_T = \max_{0 \le t \le T} W_t$. (The same is true for the joint density of final value and minimum m_T.) As a consequence, the expectation of functionals $F(W_T, M_T)$ of W_T and M_T can very often be computed explicitly. Using Girsanov's theorem, these results extend to Brownian motion with a constant drift as well.

Now suppose we model the equity V of a firm as follows. We start with geometric Brownian motion, but view the firm as having defaulted if either the running minimum $m_t^V = \min_{0 \le s \le t} V_s$ drops below a threshold L or the final value V_T lies below a threshold F. (Alternatively, one could also work with exponential thresholds by changing the drift via Girsanov's theorem.) Then derivatives written on equity (more precisely, on its final value) will be functionals of W_T and m_T (or M_T) so that it should be possible to obtain closed-form expressions for their prices, assuming as usual that pricing is done by taking risk-neutral expectations. A closer look shows that many such derivatives have the structure of a simple or compound barrier option so that one can use the wealth of existing formulas for barrier option prices.

In a nutshell, this is the idea behind the results in the present book. It should be added that this approach is not original, but goes back to papers by Ericsson and Reneby (1996; 1998). In particular, the often quoted emphasis on using probabilistic rather than PDE-based techniques and on modularity by working with basic building blocks is already present in those earlier papers.

Apart from the short chap. 11 on conclusions and further research directions, the book has ten chapters. Chapter 1 is a short review of option pricing with an exogenous stock price process. This is done first for the binomial model and then for the Black-Scholes-Merton model of geometric Brownian motion. The chapter is meant as a warm-up, so it does not contain any new ideas, and anyone familiar with option pricing will skip it. Chapter 2 presents the idea of modelling equity as a call on the firm's value, with the consequence that a call on equity is then a compound option on the firm's value. This is again classical, and the main interest here lies in the numerical examples that illustrate some of the effects that the capital structure of the firm has on option prices. Chapter 3 contains a lot of formulas for the prices of one-sided barrier options for the geometric Brownian motion model. These are obtained by systematically using the reflection principle for Brownian motion and changes of numeraire, and the chapter has two main objectives. The formulas themselves are meant to be used later as building blocks, and the derivation techniques are meant to be taken up again later. While this is fine in conceptual terms, I personally found that the notations are rather heavy, the derivations often use unexplained notations that one has to look up in other books, and the entire presentations is not as self-contained as it could have been. An alternative to this chapter is certainly to look at chap. 9 of the book by Dana and Jeanblanc (2003)[1].[1]

Chapter 4 presents the basic framework due to Ericsson and Reneby (1998) (ER98, for short) and adds some more basic derivatives for alter use as building blocks. Unfortunately, this chapter is not well written at all, and it will be much more efficient to go directly to the original paper. Most proofs are omitted anyway (readers are just sent to ER98) and even the presentation is not clear. For instance, τ appears in two different meanings on pages 60 and 61 (final horizon, $\mathscr{T}$ in ER98, versus first passage to L, τ in ER98), and the basic process (V_t) is never defined for arbitrary t; there is just a formula for V_0.

Chapter 5 gives a review of a number of firm value based models with the goal of embedding these later into a common framework. These include Merton (1974), Black and Cox (1976), Geske (1977), Ingersoll (1977), Brennan and Schwartz (1977; 1978; 1980), Galai and Schneller (1978), Kim and Ramaswamy and Sundaresan (1993), Longstaff and Schwartz (1995), Leland (1994; 1998), Leland and Toft (1996). This is mainly addressed to specialists who know one or several of these models already; the uninformed reader will probably find it difficult to follow the sometimes rather specialized discussion.

Chapter 6 discusses an extension of ER98 due to Ericsson and Reneby (1996). It first corrects an error in the latter paper (although I must confess

1 Dana, R. A., and Jeanblanc, N. (2003): *Financial Markets in Continuous Time*. Berlin: Springer.

that I was unable to verify the correctness of the correction from its presentation without making a considerable effort) and then generalizes ER96 by removing some restrictions on the parameters. This is followed by another collection of formulas for certain products; as before, the main point seems to be that one is able to find close-form expressions.

From chap. 7 onwards, the more interesting applications are dealt with. Chapter 7 is a short overview of some earlier approaches to option pricing in firm value based models; these include Geske (1979), Toft and Prucyk (1997), and Hanke and Pötzelberger (2002). Chapter 8 continues this line by providing explicit option pricing results for several other firm value based models by exploiting the basic building blocks and formulas presented earlier. This is used chap. 9 to study the term structure of implied volatilities resulting for the option prices in some of these models, giving some insights into the effects of using a firm value based model instead of a standard exogenous one. In particular, it allows to see some of the effects that the capital structure of the firm has on option prices. While these are static effects in the sense that one compares option prices with and without a firm value based model, chap. 10 studies how changes in a firm's capital structure affect option prices. All these comparisons are made on a numerical basis.

While the book will certainly be useful and of interest to specialists in the field, I personally found the reading not always easy. As already mentioned, there are many detailed references to the literature which makes parts of the book not understandable without going back to the original sources. I also think that some of the main ideas could have been presented more transparently; explicit closed-form expressions always introduce the risk that one focused on formulas instead of concepts. On the other hand, the studies started at the end of the book on how the capital structure and default risk affect option prices are certainly of interest and may be expected to stimulate further research in that direction.

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