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资产估值原理

〔美〕Frank Hugh Koger III 著

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Asset Valuation Theory

Frank Hugh Koger III[1]

[1]Peking University, HSBC Business School; fritzkoger@phbs.pku.edu.cn

For Kelly, Lynn, Kiel

and for CQG MM YY.

Preface

It is with great pleasure that I offer this textbook regarding a subject of general interest. My goal is to impart to the student not only relevant financial knowledge, but also improved abilities regarding how to approach and to solve related problems. Furthermore, I hope to enhance the readers enthusiasm for the subject. The material is relevant for not only professional purposes to those working in finance, but also personal reasons regarding management of one's private wealth. Hence, the student should have great motivation for studying this book.

The purpose of this text is to offer a mathematically rigorous approach to valuing assets. That is to say, the book is not overly technical, as it does not offer math for the sake of math. The subject is treated in such a manner that the student can learn how to use valuation techniques and apply them to assets beyond those included in this book. As the book is primarily intended to offer theory, little reference is made directly to current topics and issues. Hence, I hope that the book will be somewhat timeless.

As the book stresses theory, numerical examples are chosen judiciously. They are offered where they are able to help drive home relevant intuition and/or for concepts not covered in other textbooks. However, to strike a balance for those desiring a focus on applications, problem sets primarily feature numerical examples. A generous helping of exhibits enhances the book, as I believe that these are great in exposing intuition. Liberal usage of comparative statics analysis aids the student in developing her/his ability to extract key relationships between value and its drivers.

Knowledge of multi-variable calculus is helpful as it is used in developing comparative statics. Familiarity with probability & statistics also enhances the students' ability to comprehend the material. However, stochastic processes are generally beyond this textbook's scope.

This textbook was borne from my own lecture notes used to teach a course of the same name. Given the relative technical strength of our masters of finance and masters

of quantitative finance students, I was afforded the opportunity to develop lectures with a higher level of mathematical treatment than that which is covered in many textbooks. I cover most of the material in this book in a 36-hour course, but realistically the book should probably be covered in two courses. (Again, our masters students are technically very talented and have taken several pre-requisite courses such as financial economics prior to my course. Hence, this allows me to proceed at a brisk pace.) The results have been rewarding, with the course very well received by students. Many who have subsequently passed CFA examinations have commented on how helpful the course is in pursuing this valuable professional designation.

Intended Market

The book is appropriate for both advanced undergraduate students and graduate students with reasonably strong math skills. The book is also relevant for practitioners looking for tools and techniques to enhance their abilities to tackle new challenges. As previously mentioned, the level of treatment in the textbook is more mathematically rigorous than that of many other financial textbooks. The student with knowledge of multi-variable calculus and probability & statistics will be able to follow derivations of results and will benefit on a more profound level. Nonetheless, even for those who lack this level of mathematical sophistication, the book can still be helpful given its extensive exposition of summary results, detailed explanations and related diagrams.

Key Features

Knowledge regarding valuation of assets is critically important to those who desire to work in the world of finance. It is also invaluable in managing one's own personal wealth. The book offers a sound grounding not only in valuation, but also in its application to assets not included here.

Part I reviews financial basics such as discounting cash flows, future values of cash flows and value additivity. Special cases of the latter are included, such as growing perpetuities and annuities. This part also shows the most common metrics used for historical performance of asset returns.

Part II discusses metrics of risk and how these impact corresponding rewards that investors may expect. Future asset rates of return are modeled via random variables, and investors preferences are modeled via utility functions. Investors optimal frontier of risky asset portfolios is identified, and introduction of a risk-free asset allows identification of

the capital market line. An intuitive development of the security market line is derived, and the market model is introduced. The arbitrage pricing theory is reviewed, and its implementation via detailed numerical examples is shown.

Part III focuses on equity valuation. Financial accounting statements are introduced, and many ratios used to analyze a firm's financial health are reviewed. Relative valuation of a firm's equity is discussed. Several techniques of absolute valuation via discounted cash flows are also covered. The earnings multiplier model, a hybrid of both relative valuation via price-to-earnings ratio and absolute valuation via dividend discount model, is explored in detail.

Part IV examines valuation of fixed-income securities, focusing on fixed coupon bonds. Initially bond pricing is reviewed, breaking down components of value. Various yield metrics are explored. Comparative statics are performed in order to determine the drivers of bond value. These relationships allow subsequent calculation of useful simplified price-yield approximations. Pricing of bonds between coupon dates is subsequently covered in more detail than in other books. Lastly, given a set of benchmark rates such as those of the US Treasury, useful implicit future periodic rates are determined, e.g., spot rates and forward rates.

Part V deals with options. Expiration date payoffs of options, of combinations of options, and of portfolios of securities including options are reviewed. A derivation of put-call spot parity utilizing the critically important no-arbitrage principle is developed. Utilizing a binomial stock pricing model, option valuations via replicating portfolio, via delta hedge, and via risk-neutral valuation are derived. The flexibility of a multi-period binomial model in valuing American options as well as path-dependent options is shown. A sketch of an outline of the development of the Black-Scholes model is presented. Corresponding comparative statics results are performed.

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Many people have played a part in developing this book. In particular, feedback from students, including many talented teaching assistants through the years, has been critical to this book's production. I am particularly grateful to Tiffany Bai, who read the original manuscript in its entirety and provided valuable comments. Other students who have provided particularly useful input include Mona Zhou, Cathy Liu, Ginger Huang, Michael Ma and Hazel Wang.

I'd also like to thank PHBS Dean, professor Wen Hai, for his encouragement and

support in authoring this textbook. Additionally, Annie Jin of PHBS helped coordinate publication, and the staff at Peking University Press was instrumental with its enthusiasm and advice.

About The Author

Koger holds the position of assistant professor at Peking University, Shenzhen, PRC. He received a B.S. in Chemical Engineering from Louisiana State University, where he was a member of Phi Beta Kappa and Phi Kappa Phi honor societies. He received his International MBA from the Darla Moore School of Business at the University of South Carolina, where he graduated 1st of 92 students. He was the only student in his cohort to conclude his studies with a perfect grade point average of 4.0/4.0. Koger received a Ph.D. in finance from Tulane University. Professor Koger also holds a charter from the Institute of Chartered Financial Analysts.

Professor Koger has vast teaching experience. While a Ph.D. student at Tulane, he taught financial management, advanced financial management and managerial accounting at the undergraduate level. At the masters level, he taught corporate financial policy and fixed income analytics.

At Peking University (PKU), Koger currently teaches asset valuation theory, financial modeling, advanced financial modeling and financial modeling in Excel. None of these courses existed prior to his arrival, as he has initiated and developed all these from scratch. He has also taught corporate finance at PKU. Professor Koger has consistently earned some of the highest teaching evaluations at PKU. Furthermore, he has received teaching awards, not only from the PKU HSBC Business School (PHBS), but also at the campus-wide level of PKU Shenzhen.

During his time at PKU, Koger has been invited to teach individual courses at other universities. He has taught fixed income: models and applications at South University of Science and Technology in Shenzhen, China. Koger has instructed financial modeling in multiple summer sessions at Ruhr University, Bochum International Summer Session (BISS) in Bochum, Germany, where he received the highest evaluation of the 16 courses offered during BISS 2015.

Koger has been active in relevant service to PHBS. He was solely responsible for

securing academic partnerships with both the CFA Institute as well as the Global Association of Risk Professionals. Koger has given his time via volunteer review sessions for CFA examinations. At PHBS, he has also served on both the curriculum committee as well as the teaching quality committee. Professor Koger established PHBS first exchange program, that with Tulane University, and subsequently has helped in developing other exchange programs. He has also volunteered his time with lectures of introductory finance at Shenzhen High School (Shenzhen Zhong Xue).

Prior to working in academia, Koger was the general manager of Filtration Group Technical Media, a manufacturer of media for air filters and a former stand-alone division of Filtration Group. Prior to this, he has worked for 15 years for Hoechst A.G. in numerous capacities of increasing responsibility and in several locations, including the USA (Texas, Kentucky, New Jersey, Michigan and South Carolina) and Germany (Bavaria).

Common Variable Definitions

APr	annualized percentage rate of return, compounded $m \frac{\text{periods}}{\text{year}}$
c_0	current European call option premium or price
c_1^u	call value after one period in up state of binomial model
c_1^d	call value after one period in down state of binomial model
C_0	current American call option premium or price
C_T	call option payoff at expiration, date T
C_t	coupon interest payment from a bond received at date t
CF_t	cash flow received at date t
D_0	current value of debt
d_t	dividend per share received at date t
E	earnings, or net income, NI
Eq_0	current value of equity
EAr	effective annualized rate of return, on a discrete basis
EV	enterprise value, or loosely, firm value, V
$E[X]$	expected value of random variable X
F	face value of a bond, received at maturity, date T
FCF_t	free cash flow for period t evaluated at date t
$FCFE_t$	free cash flow to equity holders for period t
FV_t	future value at date t of cash flows received before date t
$f(x)$	probability density function of random variable X at $X = x$
$F(x)$	cumulative probability distribution function of X at $X = x$
g^i	annualized growth rate of entity i, e.g., g^{CF} or g^{Eq}
GMR	geometric mean gross return
GMr	geometric mean rate of return
$h'(x_0)$	derivative of function $h(x)$ with respect to x evaluated at x_0
$h''(x_0)$	second derivative of function $h(x)$ with respect to x at $x = x_0$

IRR	annualized rate implied by cost (price) and future CFs
IV_0	current intrinsic value of cash flows
K	option strike or exercise price
M	market portfolio of all risky assets
NI	net income, or earnings, E
P_0	current price of a security; American put premium
p_0	current European put option premium or price
p_1^d	put value one period in down state of binomial model
p_1^u	put value one period in up state of binomial model
P_T	put option payoff at expiration, date T
PV_0	current (date $t = 0$) present value of future CF(s)
R_t	annualized gross return for period t
r_t	annualized rate of return, or yield, for period t
r^E	annualized rate of return demanded by equity holders
r^D	annualized rate of return demanded by debt holders
r^f	annualized rate demanded by investors of risk-free asset
r^i	annualized rate demanded by investors of asset i
r^m	annualized rate demanded by investors of market portfolio
$s(R^x)$	historical standard deviation of gross return of security x
$s^2(R^x)$	historical variance of gross return of security x
$s(r^x)$	historical standard deviation of rate of return of security x
$s^2(r^x)$	historical variance of rate of return of security x
S_0	current stock price
S_1^d	stock price after one period in down state of binomial model
S_1^u	stock price after one period in up state of binomial model
T	maturity or terminal date of security, or date of final CF
T^C	corporate tax rate
V_t	value at date t of CF, package of CFs, security or firm
w^i	weight of component i in weighted average calculations
$WACC$	weighted average cost of capital
y	yield to maturity, an annualized percentage rate of return
β^x	regression slope coefficient: x returns on market returns
$\sigma(R^x)$	expected standard deviation of return of security x
$\sigma^2(R^x)$	expected variance of return of security x

Brief Contents

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