

BUS 35131
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FINANCIAL ENGINEERING: CASES IN FINANCIAL RISK MANAGEMENT

Course Overview

The 2007 – 2009 financial crisis highlighted once again the importance of financial risk management, not only by financial institutions, but by corporations more generally. A hot discussion resurfaced on the usefulness of popular risk measures, such as Value-at-Risk, as well as of derivative securities as proper instruments to hedge corporate financial risk. As the financial world becomes increasingly more complex and the opportunities offered by derivative instruments increase, so do the potential risks from their misunderstanding and misuse. As the global derivatives market keeps increasing – it reached \$592 trillion (notional) in December 2008, a 40% increase over its value in December 2006 – it is as important as ever to be able to exploit the opportunities offered by derivative instruments, not only for proper corporate risk management, but even to gain a strategic advantage once risk management solutions are integrated with the long term corporate goals.

This course uses the case method to study the fundamentals of corporate financial risk management. The course has two main objectives. The first is to cover techniques to identify, measure, and manage corporate financial risk, as modern financial markets and regulation require. Specifically, topics of discussion will include dynamic hedging and portfolio replication, the development of Value-at-Risk and Expected Shortfall, the management of exchange rate risk, interest rate risk, credit risk and operation risk. We learn the pros and cons of many derivative securities, from standard futures and options, to the more advanced credit default swaps (CDS) and collateralized debt obligations (CDOs), as they have become main stream securities. The second main objective is to build a framework to integrate financial risk management solutions with long-term corporate strategy. We will discuss cases where the use of financial engineering was vital for the success of a business strategy. Typical applications in this case include privatizations, mergers and acquisitions, and financing strategies, among others.

This course is at the same level of analytical complexity as Investments (35100) and Financial Instruments (35100), which are strict prerequisites. Cases draw from many industries and different times, including in particular the 2007 – 2009 crisis.

Required Material

- a) A packet of cases and readings.

- b) Rene' M. Stulz, *Risk Management and Derivatives*, South Western, 2003, ISBN 0 538 – 86101 – 0;

Optional Material

The following books are all excellent, and cover the material from different perspectives. The two books on financial risk management (Jorion and Smithson) are two classic books written by leading experts. I found both of them very useful.

(A) Financial Risk Management

- a) Jorion P. *Value at Risk*, 2nd Edition, Irwin, 2000, ISBN 0-07-135502-2.
- b) Smithson C.W., *Managing Financial Risk*, McGraw Hill, 1998, ISBN 0-07-059354-X;

(B) Derivatives

- c) John C. Hull, *Options, Futures and Other Derivatives*, 6th Edition, Prentice Hall, 2006, ISBN 0-13-149908-4;
- d) Robert L. McDonald, *Derivative Markets (2nd Edition)*, Addison Wesley, 2005, ISBN 032128030X;

(C) Fixed Income

- e) Pietro Veronesi. *Fixed Income Securities: Valuation, Risk, and Risk Management*, Wiley, ISBN 978-0-470-10910-6
- f) Sundaresan S. *Fixed Income Markets and Their Derivatives*, Academic Press, 3rd Ed., 2009, ISBN 978-0123704719
- g) Tuckman B. *Fixed Income Securities*, John Wiley and Sons, 2nd Ed, 2002, ISBN 0-471-06322-3.

Administrative Notes

Office hours: Open door policy with the following caveats:

- 1) I will set up an electronic board on my web site (<http://gsbwww.uchicago.edu/fac/pietro.veronesi/teaching>) where I will post frequently asked questions and their answers. Please, check the board before asking me questions, since the answer could already be there.

- 2) Try to ask your questions by e-mail first. In many cases the answer can easily be given by e-mail, and you can expect it within a reasonable time. I will also post the question and the answer on the electronic board. (Of course, I won't disclose who asked the question.)
- 3) If you expect you need a long meeting, please try to arrange a mutually convenient meeting-time with me first.

Teaching Assistant: Mark Hendricks is the teaching assistant for this course. The TA will lead the review sessions (see below) and will be available for questions as well.

Administrative Assistant: Gwen Tillman, HPC507, Phone: 773 702 0053, email: gwen.tillman@ChicagoBooth.edu

Course Outline

The course begins with a **review of the “building blocks” of financial risk management**. We will discuss basic derivative instruments and standard hedging techniques by looking at two interesting episodes in the financial engineering history: the portfolio insurance business during the market crash of 1987 and the collapse (and ensuing debate) of Metallgesellschaft. As a further application of basic derivative instruments and as an occasion to discuss what are the economic motivations for hedging financial risk, we will then examine the hedging strategies of “American Barrick Resource Corporation,” in the gold mining industry.

The course proceeds to explore the techniques to **identify, measure, and hedge the exposure to financial price risk**. We will start by studying the concept of Value at Risk (VaR) and Expected Shortfall (ES) – widely used measures of financial risk exposure – and discussing various issues related to implementation and interpretation. We will apply these measures in almost all cases that we will study in the rest of the course. In order to illustrate the use of VaR and ES in a relatively simple, albeit important environment, we will concentrate the first application to **exchange rate risk**. Specifically, in the case “*Credit General SA*” we will evaluate the risk of a particular FX position and the alternative strategies that can be undertaken in order to shed the risk in that particular occasion. We will then evaluate the use of VaR methodology in a non-financial corporation, by going through the case “*Aspen Technology Inc.*”

We will then also talk about the **modeling interest rate exposure**. Since this is not a course on fixed income securities, the course will concentrate more on the methodology than on the development of term structure models (the latter are extensively discussed in Bus35130 for the interested student). In this course we will only review a simple model and explore how it can be used to manage interest rate risk. We will apply these techniques to study the interest rate hedging program implemented by the mortgage giant *Freddie Mac*, a case study that also opens the door to the discussion of the 2007 – 2009 crisis. Similarly, we will also talk about **liquidity risk** by studying the case of *Long Term Capital Management*.

The course will then focus on **credit risk exposure and credit derivatives**: we will first see how VaR can be used to measure credit risk as well as market risk. We will then study how firms practically deal with credit risk, and we delve on credit derivatives, by studying the case of *Enron Corporation: Credit Sensitive Notes*, the first ever synthetic CDO with the *JP Morgan BISTRO Trust*, and the 2006 – 2009 credit crisis leading to the bailout of giant insurance company AIG with the case *AIG – Blame for the Bailout*.

In the last three weeks we will discuss **strategic risk management**, which involves the application of financial risk management to support and promote the primary business activity of a company. We will discuss several cases: we will analyze how financial engineering can be used (1) to successfully promote the privatization of a big state owned firm, such as *Rhone Poulenc*; (2) to monetize positions in illiquid securities, such as internet stocks, and obtain a tax benefit from it (*Times Mirror's PEPS*); (3) to support M&A activity ("*MW Petroleum Corporation*"); (4) to meet financing needs contingent on some events (*Chephalon*); (5) to increase capacity but retain flexibility in the power supply market ("*Tennessee Valley Authority*").

Requirements

Prerequisite for this course is Bus35100. Working knowledge of spreadsheet programs, such as Excel, is also required. I will make available Excel files for the discussion of selected cases.

Course Procedures

You can expect this course to be quite time-consuming: over the course of the quarter we will discuss about 14 cases. Therefore you should forecast to prepare 2 cases per week for about 4 out of the 10 weeks of course. Class time will also be devoted to cover concepts important to prepare subsequent cases, such as Value-at-Risk, Monte-Carlo simulation methods, yield curve risk assessment, the pricing of interest rate derivatives, credit risk management etc.

Note that there is a first-class assignment detailed in the reading packet.

For each case, I will assign study questions to guide your own preparation for the class discussion. Before the class begins, you will have to hand in a two-page **memorandum** covering the main points of the case. Each memorandum has to be typed and double spaced. Write each memorandum as if you were giving a recommendation to the major decision-maker of the case (unless differently stated in the actual assignment). The limit of 2 pages is for the typed part only. You can attach as many pages of calculations as you like. A memorandum will be given credit if it is handed in and no credit if it is not. Initially, therefore, I will not grade them. However, I will use the memoranda to

determine the final grades for those students who are on the border of an A or B, the border of a B or C, or the border of a C, D, or F.

I will also assign about six “technical” **homeworks**: these contain exercises that are closely related to the cases to be discussed in class. The main purpose of these homeworks is to give students the opportunity to revise/learn techniques of risk management abstracting from the details of the case. As the memoranda, homeworks must be handed in at the beginning of class. These assignments will be graded and returned to you. Their solutions will be discussed in the review sessions.

You are encouraged, but not required, to meet in groups to work on the cases and hand in group memoranda and homeworks. However, a **maximum of 4 people can be in the same group**. When you work in a group, make sure the memorandum and the homework contains all the names of the people in the group. **Memoranda and homeworks won't be accepted after the class has met.**

Because of the nature of this course (and its grading criteria), it is extremely important that you attend every class, arrive on time and be prepared to participate. **Please, bring your name cards to each class.**

I will not hand out “solutions” to the case analysis after the class has discussed the case. This is because there are usually no absolute right answers. The best cases are deliberately written to be ambiguous. While there are no right answers, there are good arguments and bad arguments. This course is designed to help you learn to distinguish between sensible and senseless arguments. Handing out “solutions” would reduce the ambiguity in the cases and partially defeat the purpose of doing cases. Handouts also tend to circulate which is a problem when I teach the case in another quarter.

Review Sessions

Weekly review sessions are held throughout the course. In the review sessions, the course teaching assistant will give reviews of background material, go through the homework exercises and provide additional clarifications for the material covered in class. Time and location of the review sessions is to be announced. Even though I strongly encourage you to attend them, these review sessions are for your own benefit only and are not mandatory.

Grading

Grading will be based on class participation, the short memoranda, technical homeworks and a final examination.

Class participation: Class participation will count for 30% of the final grade. I will judge your performance based both on the quality and the quantity of your comments.

Specifically, for each class I will assign 0 if you do not talk, 1 if you say something OK, 2 or 3 if the comment is good or excellent (3s are rare). I will also give -1 for silly comments (5 seconds of thinking are required before talking). Because so much of the learning in this course occurs in the classroom, it is very important that you attend every class. Low class participation combined with several absences can lead to a failing grade. The first 4 meetings will also have a slightly lower weight in the final computation of the class participation grade to allow everyone to get up to speed.

Memoranda/Homeworks: The memoranda and homework will count for 20% of the final grade (with equal weight). The memoranda will have greater importance for those students on the A- / B+, B- / C+ etc. borders. The technical homeworks will be graded and returned to you.

Final: The final examination will count for 50% of the final grade. The final examination will be an **individual** take home case analysis. You will have approximately four or five days to work on the case.

Honor Code

Students in my class are required to adhere to the standards of conduct in the GSB Honor Code and the Chicago Booth Standards of Scholarship. The Chicago Booth Honor Code also require students to sign the following Chicago Booth Honor Code pledge. "I pledge my honor that I have not violated the Honor Code during this examination," on every examination, as well as on the term project.

Class Schedule

Please, note the following class schedule is preliminary and could be subject to slight modifications.

A. The Building Blocks of Risk Management Systems

Class 1(A) Review of Options, Futures and Optimal Hedging

- Readings:
- (1) Teaching Notes #1 and #2 (skim).
 - (2) Either Hull Ch.: 2 (skim), 3 (esp. 3.5), 9.1, 9.4, 11, 13 (esp. 13.8), 14.4. or Stulz: Ch. 5 (skim), Ch.: 11 (esp. up to 11.2.1 included) and Ch .12 (Black Scholes model).
 - (3) Rubinstein M. and H.E. Leland “Replicating Options with Positions in Stock and Cash” (in packet)

Class 1(B) Portfolio Insurance and Dynamic Replication

Case Study: Leland O'Brien Rubinstein Associate Inc.: Portfolio Insurance
(HBS Case # 9-294-061)

Homework #0 (pre-assigned) due.

Homework # 1 assigned. Due at the beginning of class 2.

Class 2(A) A First Look at Cross-Hedging and Basis Risk

Case Study: The Collapse of Metallgesellschaft (Edwards F.R. and Canter M.S.
"The Collapse of Metallgesellschaft: Unhedgeable Risk, Poor
Hedging, or Just Bad Luck?")

Readings: Note on Crude Oil and Crude Oil Derivatives Markets (HBS Note
N9-295-053)

Class 2(B) A Closer Look at Optimal Hedging Techniques

Readings: (1) Teaching Notes #2
 (2) Stulz: Ch. 6 (esp. up to 6.3)

Homework #1 due. Homework #2 assigned. Due at the beginning of class 3.

B. Identifying, Measuring and Hedging the Exposure to Financial Price Risk

Class 3 (A) The Rationale for Financial Risk Management

Case Study: American Barrick Resource Corporation: Managing Gold Price
Risk (HBS Case # 9-293-128)

Readings: (1) Tufano, "Why Manage Risk?" (HBS Note # 9-294-107)
 (2) Stulz: Ch. 3.

Class 3 (B) Introduction to Value-at-Risk and Expected Shortfall

Readings: (1) Teaching Notes #3
 (2) Stulz: Ch. 4 (esp. up 4.1.2), Ch. 13 (esp. up to 13.2.2)

- (3) Additional (optional) material is in Hull Ch. 18 and Jorion Ch. 5.1, 7.2, 8, 9, 12.1.
- (3) Basle Committee on Banking Supervision “Overview of the Amendment to the Capital Accord to Incorporate Market Risks” (in packet)

Homework #2 due.

Homework #3 assigned. Due at the beginning of class 4.

Class 4(A) The Use of Value-at-Risk in a Financial Institution

Case Study: Credit General, SA (HBS Case # 9-296-011)

C. Modeling Interest Rate Exposure

Class 4(B) Yield-Curve Risk and the Pricing of Interest Rate Derivatives

- Readings:
- (1) Teaching Notes #4
 - (2) Stulz: Ch. 9 (esp. 9.3 and 9.4.1, 9.4.2)
 - (3) Additional (optional) material is in Jorion: Ch. 11.4,
Hull: Ch. 28 (esp. 28.3) and Sundaresan: Ch. 6, Ch 9.

Homework #3 due.

Homework #4 assigned. Due at the beginning of class 5.

Class 5(A) Interest-Rate Risk Management

Case Study: Risk at Freddie Mac (Case # F-270, Stanford)

Class 5(B) Risk Management in a Non-Financial Institution

Case Study: Aspen Technology, Inc.: Currency Hedging Review (HBS Case # 9-296-027)

- Readings:
- Stulz: Ch. 4.1.3, 4.1.4, 4.2.1, 4.2.2.
 - Lewent and Kearney “Identifying, Measuring and Hedging Currency Risk at Merck” (in packet)

Homework #4 due.

Overview of the New Basel Capital Accord (in packet)

Class 8(A) Credit Risk Management and the 2007 – 2008 Crisis

Case Study: AIG – Blame for the Bailout (Stanford Case # A -203)

Readings: Gary Gorton: The Panic of 2007
Pietro Veronesi and Luigi Zingales: Paulson’s Gift

E. Strategic Risk Management: The Creative Use of Financial Engineering

Class 8(B) Creating Incentives with FE

Case Study: The Privatization of Rhone-Poulenc, 1993 (HBS Case # 9-295-049)

Class 9(A) Tax Risk, Illiquid Securities and FE

Case Study: Times Mirror Company PEPS Proposal Review (HBS Case # 9-296-089)

Reading: Financial Engineering and Tax Risk: The case of Times Mirror PEPS

Class 9(B) FE to support M&A

Case Study: MW Petroleum Corporation (B) (HBS Case # 9-295-045)

Class 10(A) FE to meet Financing Needs: Taking FRM Seriously

Case Study: Cephalon, Inc. (HBS Case # 9-298-116)

Class 10(B) New Opportunities for FE: Options on Power Electricity

Case Study: Tennessee Valley Authority: Option Purchase Agreements (HBS Case # 9-296-038)