

**STEPHEN M. ROSS SCHOOL OF BUSINESS  
ANN ARBOR, MI 48109-1234**

**FIN 637: Finance and the Sustainable Enterprise  
Fall A, 2009, 2.25 Credits  
Tuesday/Thursday, 10:20 am – 12:40 pm, R1220**

**Gautam Kaul**

Office: R5334

E-mail: [kaul@umich.edu](mailto:kaul@umich.edu)

**Office Hours:** M/W 1:30 – 3:00 pm.

**IMPORTANT NOTES:**

- (1) *I have placed this Syllabus on the course web site. Please read it carefully. While I do not intend to scare you away, I do want to emphasize that this is not an easy course. Be prepared to work hard. The syllabus, although still in draft form, will give you a good sense of the nature of the course. The course web site is also ready for your review, though again it is still “work in progress.” Finally, you will receive an email notification when the course materials are available for purchase.*
- (2) *I do not believe in prerequisites, but past students have found **Valuation (F615)** very useful; most have recommended that it should be a prerequisite. I therefore strongly recommend that you should have had Valuation before taking this course.*
- (3) *We will also use concepts taught in **Options & Futures [F580]**, but from a very different perspective. I will cover this material in class.*
- (4) *Finally, it will help you a lot to have decent Excel skills. You may want to (formally or on your own) have all this preparation before you take F637, or you may choose to use this course to force yourself to learn this stuff. If you choose to do the latter, you will need to work harder in a course that is quite demanding to begin with. To give you an opportunity to learn excel skills in advance, I have arranged for you to have access to a new excel preparation module that we are using for the entering MBA1s this year. It is a Harvard program that we have access to for free this year, and MBA1s will be expected to master this self-paced online module **before** they start in Fall. Since this coming trial year is free, access is limited. I had to therefore to request special access for F637 since it is very important for the course. I strongly recommend that you take advantage of this by accessing the **Excel 2007 Simulation Link** toward the bottom of the left panel in the CTools website for the course at:*

<https://ctools.umich.edu/portal/site/528f1bea-a704-4235-8dd5-88a063f303d0>

*Please read the instructions for creating an account. Although the document listing these instructions is geared toward the entering class, you may find it worthwhile. I recommend that you take advantage of this Excel online simulation, but **do not share** access to it with any others. It would be a violation of copyright and resale laws.*

## **COURSE DESCRIPTION**

The past decade has witnessed the emergence of the notion of “sustainable” business in both corporate and academic circles. Although still nebulous, a reasonable characterization of a sustainable enterprise is emerging. In its broadest sense, *a sustainable business is one that achieves an optimal balance between profit and shareholder value, on the one hand, and broader economic, social, and environmental values, on the other.* So, why is there this need for studying a “sustainable” enterprise? This relatively recent, though increasingly visible and important, trend seems to imply that most (or at least a significant fraction of) current businesses are not sustainable. As a result, some business schools offer courses that deal with the strategic, marketing, and policy aspects of sustainable business. We will go a step further and explore the financial aspects unique to sustainability issues confronted by businesses.

I believe this course is the only one of its kind offered at any business school. We therefore are either barking up the wrong tree, or on to something unique and special. Regardless of whether you are interested in sustainability or not, this course may be useful to you because eventually it is about decision-making under uncertainty. It therefore is, by its very nature, a multidisciplinary course, very applied and technical, and will equip you to make reasonable decisions in an increasingly uncertain world.

We will begin the course with a study of the evolution of the modern firm, and explicitly establish the fundamental basis of the well-accepted objective of maximizing shareholder value. The objective of “maximization of shareholder value” has had remarkable success because, apart from being based on the powerful principle of the “invisible hand,” it is relatively easy to implement by rational individuals in a well-functioning competitive market. To fulfill this objective, a corporation simply needs to pursue ideas/projects whose perceived benefits are greater than the perceived costs; or equivalently, firms need to pursue projects that create value on a *net* basis. And the well-developed fields of economics and finance have provided us with sophisticated, yet applicable, valuation frameworks and techniques that help us determine whether an idea is value-creating or not.

This course is based on the assumption that the frameworks provided by economics and finance can, with appropriate modifications, help us understand and deal with the unique issues faced by a sustainable business. Since the issues that challenge the sustainability of the modern enterprise are both varied and complex, this course needs to have a focus. Although this focus is largely on environmental issues, we will also address the social aspects of sustainability. Two of the cases we evaluate in detail are exclusively about social issues, but again from an economics/finance standpoint.

We will address the financial and valuation issues from the perspective of a typical firm, whose objective is to maximize shareholder value, but recognizes and confronts a whole slew of environmental issues with dire real effects. We will critically evaluate the viability of the assumptions and institutions necessary to ensure the success of any

modern firm in achieving its objective of maximizing shareholder, *without adversely affecting broader economic and societal values*. More importantly, we will modify existing economic and financial frameworks in an attempt to evaluate the effects of new and emerging regulatory and strategic environmental issues on the value of projects and firms. This process will make us realize that “business as usual,” at least as we have known it for the past several decades, cannot lead to a sustainable world. We hopefully will also emerge through this experience equipped with a framework and a set of tools that can help us create and manage businesses that can deal with the complex and uncertain world confronting us today. Ultimately, our goal is to evaluate not only the private benefit, but also the social value, created or destroyed by a project and therefore the firm.

Please recognize that although we will attempt to be as open-minded as possible, if only because the issue of sustainability is so multi-faceted and complex, we will largely be looking at issues from an economist’s standpoint. Such a viewpoint is obviously limited, but we hopefully will emerge with both a better understanding of the issues and practical ways of dealing with them.

## **COURSE PEDAGOGY**

There are two unique and important pedagogical features of this course that I would like to highlight. **First, we will have to deal with a lot of ambiguity in this course; yet we must create as much structure as possible to help us seriously confront sustainability issues.** I am used to teaching Finance, which is very structured. Over the past few years I have realized that in this course both I, and you, will need to deal with nebulous and open-ended issues. And this starts with the very concept of sustainability. We must nevertheless strive to make the course as analytical and numbers-oriented as possible because eventually that is the only way (that I know of) to make a coherent case for or against any issue. If we fail to achieve a healthy balance between the philosophical and analytical issues involved, I will consider the course to have fallen short on one of its major goals. If, on the other hand, we can develop the ability to adopt an analytical mindset in the context of nebulous issues, I am positive that we will be much better equipped not only to frame the issues but also to try and confront them in a rigorous manner.

**The second unique feature of this course (at least for me) is its pedagogy.** While we will rely heavily on the emerging literature at the intersection of ecological economics, traditional economics, and modern finance, we need to learn and create a lot of new material. There is a dearth of quality material that is simultaneously rigorous and applied in nature. Over the years, I want to use this course as a platform for not only framing and addressing important sustainability-related issues, but also for collecting and creating materials that contain rich examples and analyses of these issues. This probably is the most challenging goal that I have set for myself, and your help will be greatly appreciated. I am happy to report that we together have had a fair amount of success in creating teaching materials that we use in the course.

**This course is therefore an experiment in co-creation.** We already have benefited tremendously from the contributions of past students, especially David Azari, Nicholas Cucinelli, Justin Felt, David Foley, Michael Hartley, Qin Lei, Mark Michelin, Diviya

Sharma, and Kari Walworth. Special thanks are due to Nick; without his conviction and persistence this course would not have been created. He worked tirelessly with me over an entire year to create both the structure and the content of the first offering of the course five years ago. I am very happy that Mark Michelin has agreed to help us all this year by serving as the Teaching Assistant for this course.

Thanks to the feedback of past students, and my own evolving take on things, the course has changed dramatically over the past few years. It has increased from 1.50 to 2.25 credits, with more emphasis on analytical issues and number crunching. We have added at least a half a dozen cases to the schedule. I would like to thank Professors Benjamin Esty and Forest Reinhardt of the Harvard Business School for their advice in identifying and obtaining cases that would be appropriate for this course.

My sincere hope is that this is your most conceptually and technically demanding and practically useful course at RSB. I would be really thrilled if you can come to appreciate how business can be used to make the world a better place. It is very important however to recognize that tough problems require rigorous and thought-provoking approaches; and this course therefore has to be difficult.

## **ADMINISTRATIVE DETAILS**

### **Required Materials:**

The materials for the course are divided into two parts. The first set contains copyright articles and cases that you are **required** to purchase. *All materials in this packet are marked with a **P** in the attached class schedule. These materials are organized according to the sessions of the course.* The second set of materials is a set of notes on standard and real options approaches to valuation, the economics of the environment, etc. These notes again will form the basis of several class discussions, but you will be responsible for printing them. *The Notes are marked with an **N** in the attached class schedule and will be made available in the Notes folder under the Resources Link in the CTools website for the course.* There is no text book for this course, though I do refer to some books that may be useful to you. The CTools web site also has a copy of this syllabus, and has other folders containing Assignments, Miscellaneous information, etc.

## **EVALUATION**

Each class will be facilitated by either me or one of you (typically working with your team). The teams will be formed at the beginning of the course, with no more than four students in each of them. There is a set of pre-assigned reading material and/or cases for each week. You must be well-prepared for class because your participation is key to the success of this course.

The grades for this course will be based on the following main components:

**Class Participation (30%):** This course belongs to all of us. The quality of discussion in class will be the main indicator of the effectiveness and success of the course. Hence, there is a 30% weight on “general” class participation, which does not include any required formal presentations. As part of the process of determining your class participation scores, I will request each one of you to formally evaluate the participation of all your colleagues.

**Assignment Submissions (40%):** There will be an assignment for each class, and I expect all of you to be prepared to discuss and/or make presentations of your work. I will however require you to submit **FOUR** of these assignments for grading. These Assignments have been indicated in the detailed schedule presented in this syllabus. ***All assignments need to be submitted electronically using the Assignment Link on CTools before the start of class. Please submit only one assignment per team. Also bring one hard copy per team to the class.***

**In-Class Presentations (30%):** Your team will have at least one major opportunity to lead an in-class discussion. Depending on the eventual size of the class, we will have one to two teams making presentations on a particular day. While you have the freedom to choose the format of your presentation, you will have to demonstrate mastery of an important concept and/or application that is scheduled to be covered in the course. The presentation will typically include your analysis of one of the cases we will be covering in class. It will give you the opportunity to introduce the class to new insight(s) and analysis pertinent to the general area of sustainability and finance. You will also be graded on your ability to handle questions from your colleagues. As part of this process, I will also ask each member of a team to evaluate all the other members.

As you can see, almost all the work will be done in teams/groups. Each team will be comprised of four students; with a mix of people with different skills. In keeping with the exploratory spirit of the course, I expect you to conduct research that goes beyond the articles/materials provided in the syllabus.

## **HONOR CODE**

Personal integrity and professionalism are fundamental values of the Ross Business School community. This course will be conducted in strict conformity with the Academic Honor Code. The Code and related procedures can be found at [www.bus.umich.edu/Academics/Resources/communityvalues.htm](http://www.bus.umich.edu/Academics/Resources/communityvalues.htm)

The site also contains comprehensive information on how to be sure that you have not plagiarized the work of others. Claimed ignorance of the Code and related information appearing on the site will be viewed as irrelevant should a violation take place. Non-Ross Business School students taking the course should also familiarize themselves with the Code as they will be subject to the Code as well while in this course.

## **STUDENTS WITH DISABILITIES**

If you need an accommodation for a disability, please let me know at your earliest convenience. Some aspects of the course, the assignments, and the in-class activities

may be modified to facilitate your participation and progress. As soon as you make the instructor aware of your needs, we can work with the Office of Services for Students with Disabilities to help us determine appropriate accommodations. I will treat information you provide as private and confidential.

## **BACKGROUND READING FOR THE COURSE**

I encourage you to read the articles listed below at your earliest convenience to understand some important set of issues that lie at the heart of sustainability. Even if you have already read these articles before, please review them again. Approach each article with an open mind, and do not worry too much about the relation between the various issues discussed in them and sustainability as you understand it. As the course evolves, you will develop a sense of the links between the issues discussed in them. All articles (including excerpts from the last book) are available in the course packet.

Ronald Coase, "The Problem of Social Cost," Journal of Law and Economics (October 1960). Read pp. 1-19, 42-44[P].

Garrett Hardin, "Tragedy of the Commons," Science (1968)[P]. Read entire article.

Alfred E. Kahn, "The tyranny of small decisions: market failures, imperfections, and the limits of economics," Kylos (1966)[P]. Read entire article.

Aldo Leopold, excerpts from A Sand County Almanac, with Essays on Conservation from Round River, (1966). Read pp. 137-141, 188-190, and 237-246 [P]. [This book is a classic you will have to purchase, and read it when you have the time.]

## **CLASS SCHEDULE**

### **MODULE I: FUNDAMENTALS**

In the first major module of the course, we will address some fundamental concepts related to sustainability, the role of the modern corporation, and the theory and practice of finance. The discussions will start off at a conceptual level, but we will move quickly to detailed valuation exercises.

### **Tuesday, September 8, 2009**

#### **Course Description, Expectations and Administration (including formation of teams).**

We will spend a fair amount of time on the first day developing an understanding of what the course is all about, getting to know each other and forming teams.

#### **Main Topic: Sustainability**

**Purpose:** To grapple with the complex concept of Sustainability. We will attempt to arrive at as clear an understanding of sustainability as possible, to guide us through

this course and beyond. From a conceptual standpoint, this is probably the most terrifying and exciting class! The readings are only supposed to start us thinking about the issues.

### **Reading:**

Robert Solow, "Sustainability: An Economist's Perspective," (1991)[P].

Robert Solow, "An Almost Practical Step Toward Sustainability," (1992)[P].

### **Questions:**

Please consider the following questions, and any others that come to mind, as you carefully read through the assigned articles.

- 1) How is sustainability defined by Solow?
- 2) What are the distinctive features of this definition?
- 3) In the second article, Solow suggests a way to account for the depletion of our natural capital. Even if we could correctly alter the measurement of our national product, how will it help the goal of achieving sustainability?
- 4) How would you define and measure sustainability for the world? In what way(s) is your view different from Solow's?

## **Thursday, September 10, 2009**

### **Main Topic I: The Role of the Modern Firm**

**Purpose:** To understand the main objectives of the modern corporation, as they have evolved in the U.S. and increasingly in the rest of the world. More importantly, you must consider the ramifications of what you read for sustainability as defined above.

The readings below are the introductory chapters of the most popular book on Valuation. Although there is some overlap, reading all of them will give you a very good sense of both the issues and the evolution of thought (albeit, largely in the U.S.) on this important matter.

### **Reading:**

The following three articles, published in the *McKinsey Quarterly*, will help you develop an understanding of the role of the modern corporation.

"Why Value Value?" (1994). This is the first chapter of the McKinsey book, *Valuation: Measuring and Managing the Value of Companies, 2<sup>nd</sup> Edition*)[P].

"Why Value Value?" (2000). This is the first chapter of the McKinsey book, *Valuation: Measuring and Managing the Value of Companies, 3<sup>rd</sup> Edition*)[P].

“Why Maximize Value?” (2005). This is the first chapter of the McKinsey book, *Valuation: Measuring and Managing the Value of Companies, 4<sup>th</sup> Edition*)[P].

### **Questions:**

Please consider the following questions, and any others that come to mind, as you carefully read through the assigned articles.

- 1) What is the main objective of the modern corporation?
- 2) What assumptions are necessary to achieve this objective?
- 3) What are the benefits and costs to society of having an economy comprised of private corporations? [Think of the message of the movie “The Corporation.”]
- 4) Do you observe any change in the flavor of the articles over the years?
- 5) Is a world populated with such firms sustainable?
- 6) Can you relate all of this to the recent financial crisis? Remember, the goal is not to just have a knee-jerk response, positive or negative, but to think through whether or not our corporate structure can lead to both good and bad outcomes.

### **Main Topic II: The Role of Discounting**

**Purpose:** To understand the basis of interest, time value of money, and discounting, and how it is relevant for sustainability. This is one of the crucial links between finance and sustainability, and therefore we really need to develop a deep understanding of the issues involved; regardless of whether we come to an agreement about what is the right thing to do!

### **Reading:**

Irving Fisher, “Theory of Interest”, (1930), pp. 1 – 117)[P].

This is a **Classic!** It forms the foundation of modern finance. Ironically, the “father” of discounting also developed a definition of “income” that is the most sustainability friendly! *This is a long document, so read the following pages carefully (browse thru the rest quickly): 1-7, 23-28, 30-46, 63-74, 77-85, & 93-100.*

“Deep Discounting,” Economist, (1999)[P]. *Read carefully.*

“Copenhagen Consensus: Putting the World to Rights,” Economist, (2004)[P]. *Read carefully.*

“Rich versus Poor: Environmental Footprint,” Berkeley Media Relations, 2008 [P]. *Read carefully.*

### **Questions:**

Please consider the following questions, and any others that come to mind, as you carefully read through the assigned articles.

- 1) What are the sources of the (typically positive) interest rate?
- 2) Read pages 97-100 very carefully to understand how the two main sources can interact with each other. Can you envision circumstances under which the interest rate could be zero or even negative?
- 3) Now consider the *Economist* (1999) article: critically evaluate it with specific emphasis on the argument in the third paragraph.
- 4) Now consider the *Economist* (2004) article. The article seems to reflect a paradox: The Copenhagen consensus placed global warming and climate change at the bottom of the list of the priorities. What criterion was used to evaluate the different “projects?” Critically, evaluate the rankings; especially the placement of all Climate Change “projects.” Why were all of them rated as “bad” projects? Is the problem with finance/economics or with financial economists?
- 5) Having thought about all the above issues, do you think that a positive interest rate is inherently inconsistent with sustainability?
- 6) How does the information in the Berkeley Media Release fit into all of this?

**Tuesday, September 15, 2009**

**Main Topic: Financial Valuation Methods.**

**Purpose:** After struggling with some important and fundamental issues about finance and sustainability, we will now deal with important issues at the firm level. The goal of this class is to bring everyone up to speed on different valuation methods most commonly used in the real world. I will lead the class discussion, and use some notes as background materials, and I will assume that you are on top of all the material covered in the finance core course. However, this is the time when people with strong finance skills, developed by taking the Core and Valuation courses at RSB or elsewhere, should participate actively in class to help the learning process.

**Reading:**

“Valuation-A Primer”[N].

**Questions:**

There are no specific questions for this session, but I strongly recommend that you attempt to solve all the numerical exercises in the note. I know it is a long note, but we need to really develop some basic foundations that are common to us all. This will help you understand the issues and tackle cases that follow. The good news is that you should already have a decent understanding of at least half of the material even if you have not taken any finance electives.

**MODULE II: VALUING SOCIAL ISSUES**

In the second module of the course, we will attempt to develop frameworks for valuing social issues. The frameworks will basically incorporate the effects of a project on all stakeholders and therefore society at large. We will evaluate two very interesting cases

with widespread impact on all parts of the economy. This is however just an exposure to social issues and, my sense is that, this whole area will develop very rapidly over the next decade and, at some point, we will offer an entire course on the valuation of all types of complex social effects of business.

**Thursday, September 17, 2009**

**Main Topic: Traditional Financial Valuation versus Social Valuation - CASE: Nghe An Tate & Lyle Sugar Company (Vietnam). [Submission Required.]**

**Purpose:** The main purpose of this analysis is to understand and measure the private *and* social returns to a large investment in a developing country. A secondary purpose is to introduce you to project financing. Since this case involves some background reading and some new concepts, which need to then be applied to a case, we will devote the entire session on this topic.

**Reading:**

“Nghe An Tate & Lyle Sugar Company (Vietnam)” [P].

**All Exhibits also available in electronic form on CTools in “Case Exhibits” folder.**

**Important Notes:**

You need to understand a framework that needs to be used to understand global sustainability issues. I therefore recommend that you read the following articles carefully before attempting to tackle the case. These articles are neither profound nor exhaustive, but should suffice to make you frame and evaluate the issues. Remember though that the framework presented below is not the only one being used in the real world. The good news though is that this framework is very logical and “fits in” well with our general approach to valuation.

Benjamin C. Esty, Frank J. Lysy & Carrie Ferman, “An Economic Framework for Assessing Development Impact,” (2003)[P].

Benjamin C. Esty & Aldo Sesia Jr., “An Overview of Project Finance – 2004 Update,” (2005)[P].

Finally, if you are interested in this type of analysis and/or development issues, there are two interesting Harvard cases that you may wish to purchase: ***Chad-Cameroon Pipeline*** and the ***International Rivers Network***. Please read these cases at your leisure to understand the complexity and richness of all the issues involved in the development of large-scale projects across the world (and particularly in the developing world). I know that these cases are covered in some other courses, but not in a quantitative manner.

**Questions:**

- 1) How attractive is the project from the sponsor’s perspective? What are the major sources of risk facing the project? [Assume that the appropriate real, risk-

adjusted discount rate is 10%, the inflation rate is 3%, and the nominal discount rate is 13.3%.]

- 2) Are farmers likely to convert to cane?
- 3) Will the government support the project? Who will be affected by the project, and how large are the costs and benefits to each group?
- 4) Would you, as IFC management, finance the project? How compelling are the social returns?

## **Tuesday, September 22, 2009**

**Main Topic: Valuing a “Social” Enterprise.** This is another session on the valuation of an enterprise from both a financial and a social lens. This is a real case of a company evaluated by Acumen as a potential investee.

### **Reading:**

“Acumen Fund: Valuing a Social Venture” [P].

**All Exhibits are also available in electronic form on CTools in “Case Exhibits” folder.**

### **Background**

Acumen Fund is a non-profit global venture fund that uses entrepreneurial approaches to solve the problems of global poverty. The company seeks to prove that small amounts of philanthropic capital, combined with large doses of business acumen, can build thriving enterprises that serve vast numbers of the poor. Acumen’s investments focus on delivering affordable, critical goods and services – like health, water, housing and energy – through innovative, market-oriented approaches. Acumen Fund’s investment process is fairly typical of a venture capital fund: portfolio teams work with entrepreneurs to understand their business model, map out the opportunity and plan for growth and social impact.

This case is designed to provide an overview of the social venture investing process, with a focus on the valuation of the social enterprise and the structuring of the terms to create a fair and commercially viable investment. While the numbers in the case have been changed to prevent disclosure of the investee’s real operating economics, and the term sheet has been redacted, the content of the case is otherwise virtually identical to the presentation made to the Acumen Fund investment committee in September 2006.

Before analyzing all the issues/questions raised below, please also review the following materials:

“Acumen Fund: How to Make the Greatest Impact?” [P]. This is a background case describes the creation and mission of Acumen, and how it operates.

“BACO-Measuring Social Return”[P]. This piece describes the BACO methodology used by Acumen for measuring social impact of a project.

“BACO-Concept Paper”**[P]**. This is another working document on BACO prepared by Acumen.

## Questions

- 1) What is the opportunity provided by ZHL? Is this opportunity consistent with Acumen Fund’s mission?
- 2) What are the major opportunities and risks inherent to this potential investment?
- 3) What is ZHL worth? If you were Acumen Fund, what valuation would you present to your investment committee? How did you arrive at that valuation? Be prepared to discuss your:
  - a. Methodology for arriving at the valuation
  - b. Choice of discount rate and rationale
  - c. Terminal value assumptions.
- 4) What terms would you offer above and beyond the valuation? Review the term sheet. If the oldest person in your study group’s birthday is an odd number, your team will assume the role of the Acumen Fund investment committee. Conversely, even number birthday teams should play the role of the ZHL promoters.

Please review the term sheet from the Acumen Fund or ZHL perspective, and come prepared with a completed term sheet (valuation, dividend, etc.). Feel free to add additional clauses, strike any terms, etc. I will ask two teams to come forward and “negotiate” the deal in front of the class.

- 5) Evaluate the BACO methodology developed by Acumen, and the specific BACO analysis conducted for ZHL. How would you incorporate the social value, if any, created by this investment? Although some numbers would help, I am primarily looking for methodological methods/approaches that are distinct from BACO.
- 6) Finally, reflect on the entire Acumen Fund investment process. What information was helpful in making the decision? What information was missing?

## **MODULE III: CLASSIC SUSTAINABILITY ISSUES**

By now we hopefully realize that sustainability requires that we, *at a minimum*, operate efficiently. That, in turn, means that we maximize value of all activities at a minimum cost, where both value and costs include private *and* social effects. Markets fail because they are not designed to maximize/minimize the social value/costs. We will kick off this module with the classic “tree-cutting” problem, to understand how many of the fundamental problems with our current way of doing business. However, since this course is using environmental issues as the main backdrop, the rest of this module (and course) is based on the experience of the U.S. in confronting the Acid Rain problem. The module has the advantage of being very topical and relevant for us as we confront the bigger problem of global climate change. We will of course also get exposed to current issues peculiar to CO<sub>2</sub> emissions, but the conceptual framework developed for dealing with the acid rain problem will be the same that is needed to understand and tackle the, albeit much bigger, problem of climate change.

**Thursday, September 24, 2009**

**Main Topic: Sustainability Valuation – CASE: Tree Values. [Submission Required.]**

**Purpose:** To do a valuation exercise directly related to sustainability. This is a case about the valuation of a natural resource, a forest, both from the standard and a new perspective. We will first do a hypothetical analysis, followed by a more detailed analysis based on data provided in the case. We will then further expand the scope of the case by considering the value of preserving natural capital. Here, after conducting an interesting modeling exercise, we will critically evaluating a detailed analysis presented in Science based on Madagascar rain forests.

This session is quite important to the course as it covers both financial techniques and sustainability issues. It also provides you a great opportunity to apply your Excel skills.

**Reading:**

“Tree Values” [P].

**All Exhibits also available in electronic form on CTools in “Case Exhibits” folder.**

Read “Economic Incentives for Rain Forest Conservation Across Scales” Science (2000)[P].

**(Hypothetical) Questions:**

*The classic result in finance/economics of when to “harvest” suggests that we should let trees grow till the rate of growth in value is greater than the discount rate (or the opportunity cost of capital). Please think through this and use the percentage change from one point to the next as the “IRR” of postponing the harvest. **Use both this well-accepted IRR approach and the maximize NPV approach to answer all questions below.***

1. Consider a 50-year old tree that is 10” in DBH and grows one inch in DBH every five years. Assume that the cost of capital is 6.50% per year and there is no change in grade for the hypothetical tree. When would you recommend cutting this tree? What if it takes ten years to grow one inch in DBH? If you now recommend different times to cut the tree, explain why you reach different conclusions.
2. Consider the same problem as above, except that the tree now increases one grade with each 2” growth in DBH and the price per MBF also grows at the rate of 2% per year in real terms. How would your recommendation change?
3. Assume that you are faced with this problem today, how would you go about determining the cost of capital? Conduct a cost of capital analysis and redo questions (1) and (2) above. How does your analysis change, if at all?

*[This last part requires you to do an analysis based on real world data that is not provided in the case. It can be really fun! You can find the relevant data in many different places, as your group members who have done Valuation should be able to confirm.]*

### **(Real) Questions**

4. If Mr. Smith simply lets his trees grow, would they increase in value? When would you recommend cutting the trees if they are simply left to grow? Assume that the trees grow at a rate of 1" in DBH every ten years. The relevant cost of capital for Mr. Smith is 6.50% per year, and all the trees have to be cut at the same time. Half of the trees were 12" in DBH and the other half 14" in DBH. The 12" trees were 100% grade 4, and the 14" trees were 40% grade 4 and 60% grade 3. The increase of tree grade occurs after each 2" DBH growth and up to 20" DBH, according to the probability distribution in Exhibit 3. The BF/tree grows at 10% per inch for DBH larger than 24".
5. If Mr. Smith decides to manage his forest from now on, how would this affect its value? Assume that half the trees are thinned and that the remaining trees grow at the rate of 2" in DBH every ten years. Also assume that a forester's management costs are offset by the value of the thinned trees. What forest management strategy, if any, would you recommend to Mr. Smith? Does this strategy change if the cost of capital is 7.50% instead?
6. So far, we have considered the decision over one harvesting cycle. All trees are currently 50 years old and new trees are planted at the end of each harvesting cycle. Assume that history repeats itself for an infinite number of times and the present value of harvesting proceeds is identical at each harvesting cycle. How would you recommend differently?
7. Built upon the assumptions made above, we further assume that there is significant biodiversity value of owning the forest such as the flood control value, the value of recreational activities and the value of developing medicine from the forest. Mr. Smith just agreed with an outside contractor who will deliver the biodiversity value (BDV) at the end of each growth cycle on the basis of  $BDV = \tau\theta\sqrt{age}$ , where  $\tau$  is the thinning fraction of trees,  $\theta = 500$  is the value factor, and  $age$  is the tree age. The biodiversity value will be lost forever upon even a single harvest. When do you recommend cutting the trees? What if  $\theta = 10000$ ?
8. Read the Science (2000) article titled "Economic Incentives for Rain Forest Conservation Across Scales" carefully and critique the financial analysis and think of the main insights that can be gleaned from the analysis.

**Tuesday, September 29, 2009**

**Main Topic: Externalities - CASE: Controlling Acid Rain.**

**Purpose:** The previous case exposed you to the *positive* externality of biodiversity, which unfortunately is not valued by any individual company/person because most of the benefits are borne by society at large. Hence, we all do not pursue activities that have large public good! Not surprisingly, however, most of sustainability issues that are of immediate and dire importance are due to the fact that we do pursue activities with private net benefit, but they often come with large *negative* externalities. This case provides a “macro/big picture” view of the problem of externalities. We will try and understand how basic cost-benefit analysis can be used to analyze environmental problems created by large externalities and how can it help formulate government policy. This is a real world case of the benefit-cost analysis and legislation related to acid rain. Its applicability has re-emerged, and with a vengeance, given the climate change (and CO<sub>2</sub> emissions) crisis. The nature of the current problem is admittedly much more complicated and harmful, but we can learn a lot from the acid rain “experience.”

We will use this case to learn about externalities and, since many of you may not be familiar with the issues, I have provided a note prepared by Michael Hartley. As always, however, please familiarize yourself with the materials and attempt to address the issues brought up in the case. Also, please follow the progress of climate change policies in the U.S. and the rest of the world. I do provide you some important information about our current crisis, but we do not have the time to discuss all the details. Our focus, I believe rightly, is to develop tools and frameworks that will help us understand and deal with the main issues. Fortunately, the lessons from the acid-rain experience are well-suited for this purpose.

**Reading:**

“Controlling Acid Rain” [P].

**All Exhibits also available in electronic form on CTools in “Case Exhibits” folder.**

**Questions:**

Conduct a cost-benefit analysis of controlling acid rain with the information given in the case.

To make your analysis and class discussion interesting, and to be impartial in doing so, imagine that you are an aide to a senator or representative whose constituents’ interests are **not** directly affected by acid rain. Please come prepared to the class to recommend how your boss should vote on the Waxman-Sikorski bill and why. In developing your recommendation, you may want to consider the following issues (and any others you can think of):

- 1) What are the costs of acid rain control?
- 2) What are the benefits of acid rain control? What are the principal sources of uncertainty in forecasting these benefits?

- 3) Did the NAPAP study evaluate the appropriate benefits of control and place the correct dollar values on those benefits?
- 4) Based on the current information, what controls on acid rain would you recommend?
- 5) Is future research (e.g., the next phases of NAPAP) likely to resolve the uncertainties?

### **Important Notes:**

This case requires some understanding of the theory of externalities and cost-benefit analysis. Apart from assuming that you have read the background readings listed on p. 6 of this syllabus, I am assuming that many of you would have been exposed to this in an economics class. If not, any standard textbook on environmental economics or natural resources will be sufficient for our purposes.

As a resource, you may want to review the following note:

“Externalities – A Primer”**[N]**.

The role of externalities, and therefore the need for public policy, is even more critical for greenhouse gases. I strongly encourage you to follow the news on this issue. The following resource may be a useful place to start:

“An Introduction to Global Warming Impacts” Climate Progress, Blog Archive, 2009**[P]**.

“Pathways to a Low Carbon Economy” McKinsey, 2009**[P]**.

Finally, please recognize that we do not have the time to cover all concepts in detail, largely because sustainability issues are too complex. So please do the conceptual reading and then address the case. I recommend this strongly because ***this case is the most nebulous and frustrating one in the course***. Regardless, that does not diminish its real world importance in any way. While I would like you to struggle through the conceptual issue while doing the case, I recognize that there is value from bringing everybody up-to-speed on some essentials.

### **Thursday, October 1, 2009**

#### **Main Topic I: Externalities – Role of Policy Costs CASE – Southern Company (A & B). [Submission Required.]**

**Purpose:** The main purpose of this case is to use financial tools *to figure out the “least cost” way for a particular firm to comply with the new regulation* contained in the Amendment to the Clean Air Act of 1990. This can be done based on just case (A). But we also want to understand the implications of the regulatory complexities of Clean Air Act compliance planning for electric utilities. Case (B) forces such a discussion and has excellent background material on regulation. I strongly recommend that you read both cases carefully.

This session is very important to the course because we will attempt to understand how a firm should operate given inevitable government regulation. Even more importantly this session will introduce us to a case that we will tackle twice: first using traditional valuation techniques (today) and then using advanced valuation techniques (later in the course). It again provides you a great opportunity to apply your Excel skills.

**Reading:**

“Southern Company (A & B)”[P].

**All Exhibits of Southern (A) also available in electronic form on CTools in “Case Exhibits” folder.**

**Questions:**

**Main question:** What is Southern Company’s “least cost” alternative? In answering this question, you should *evaluate the following alternatives*:

- A1** Do nothing in the entire period
- A2** Install scrubbers that are ready to operate starting 1995
- A3** Switch into using the low-sulfur coals starting 1996
- A4** Install scrubbers that are ready to operate starting 2000
- A5** Switch into using the low-sulfur coals starting 2000
- A6** Switch into using the low-sulfur coals between 1996 and 1999 and install scrubbers that are ready to operate starting 2000

**Note:** It is not economical to install scrubbers and use the low-sulfur coals.

In evaluating the alternatives, conduct two important sensitivity analyses:

- (1) Conduct a sensitivity analysis using alternative starting prices of the allowances in 1995.
- (2) Do not take the 10% discount rate given in the case as “the truth.” Do your present value calculations twice: (a) first using 10%, and (b) using a discount rate (or cost of capital) for the company based on your own calculation/estimation based on real data from the internet or wherever. You may assume that there is no tax-advantage to debt and that the probability of bankruptcy is close to zero. Since you may have trouble getting data at the time the case was written, you should feel free to calculate the cost of capital using even post-1992 data. Remember that although it is the process that is important; but, in the case of the discount rate, so is the magnitude.

### **Important Notes:**

This case again will require some understanding of the background of the economics of pollution control, and the strengths and weaknesses of different policy options. While our “Externalities” note will be of use again, the following reading will be useful as well:

Tom Tietenberg, Environmental and Natural Resource Economics (2003), Chapters 15 & 17. [This book, or a similar one, should be available in the Kresge and/or Graduate Libraries.]

“Global Climate Change and Emissions Trading” [P].

### **Optional Reading:**

It is also important to understand that the actions of the government can affect multiple parties, including those seemingly unrelated to the issue at hand. In this context, please read the following case as well (it also includes a good description of the acid rain problem):

“Burlington Northern, Inc. (A)” [P]. The acid rain problem here is approached from the perspective of a railroad whose principal product is the transportation of low-sulfur coal. Executives of Burlington Northern understand that their product’s competitive position depends, in part, on the form of acid rain legislation that is passed by the Congress. [You do **NOT** need to analyze this case; just read it to understand the issues.]

## **MODULE III: THE REAL OPTIONS FRAMEWORK**

The goal of this module is to understand the real option framework, with an eye toward its applicability to sustainability issues. This is the most intellectually and practically demanding topic that is surprisingly applicable to most issues related to sustainability. It is also the most advanced and powerful decision-making tool finance has to offer. We will, therefore, spend some time understanding the framework, gain a deeper feel for this approach by doing multiple applications, and then conduct a complicated analysis to re-evaluate the compliance strategy of Southern Company (A). Students who have a thorough understanding of option pricing, because they have taken the Options and Futures course at RSB or elsewhere, should take this opportunity to help the class develop a keen appreciation of the content. Almost equally importantly, you should also take this opportunity to develop and demonstrate your Excel skills.

**Tuesday, October 6, 2009**

**Main Topic: Real Options - The Framework for Valuing Flexibility**

**Purpose:** To understand the fundamental underpinnings of the real options framework.

## **Reading:**

“Introducing a Hybrid: An Example”[N]. I have adapted this example from a “case” dating back to the early 80s about a company faced with the decision to introduce a PC. It is applicable to any corporate decision made under a lot of uncertainty. It is supposed to excite your imagination about the potential value of the Real Option Framework. *Read this carefully and think about the issues.*

“Electric Plant”[N]. This is another generic example of how NPV analysis is deficient and a real options approach is appropriate in an uncertain world. *Read this carefully and try and “solve” the various parts.*

“Option Pricing – A Primer”[N]. *This is a note that we will cover in detail in class, after we have motivated the need for the real options framework.*

“Note on Basic Option Properties” (2005)[P]. *This is an article that is similar to the first part of the note we will cover in class.*

“Note on Option Valuation” (2005)[P]. *This is an article that is similar to the second part of the note we will cover in class.*

Burton A Weisbrod, “Collective-Consumption Services of Individual-Consumption Goods,” (1964)[P]. *This is a very nice piece on option value in the context of conservation.*

## **Thursday, October 8, 2009**

### **Main Topic: Real Options - The Framework for Valuing Flexibility (Cont.)**

**Purpose:** To continue to develop our understanding of the fundamental underpinnings of the real options framework. This class will be divided into two parts:

**Main Topic I:** A continuation of Option Pricing Principles.

**Main Topic II:** A classic application, virtually identical to the Hybrid Example, that uses the Black-Scholes model to value staged investments. The assignment for this part includes a thorough review and presentation of a conceptual piece with a full application. The assignment also includes evaluating the same example and the Hybrid example, using the Binomial model.

Read the article carefully, keeping the questions listed below in mind. Also, note that you will need to revisit the Hybrid example.

## **Reading:**

“Investment Opportunities as Real Options: Getting Started on the Numbers” HBR (98)[P].

**All Exhibits in the article are also available in electronic form on CTools in “Case Exhibits” folder.**

“Introducing a Hybrid: An Example”[N].

**Questions:**

1. Please be prepared to present and explain the theoretical framework developed in the article.
2. Also, be prepared to present and explain the entire application presented in the article.
3. Discuss the main pitfalls in applying the Black-Scholes model to real projects.
4. Now use the Binomial model to determine the values of the options embedded in both cases (the example in the article and the Hybrid case).

**Tuesday, October 13, 2009****Main Topic I: Real Options Applications – Using Real Option Analysis to Value a Strategy.**

Real Options Analysis (ROA) is both science and art. We will use this session to gain an appreciation of ROA and its applicability by considering two very powerful and different examples. The first application is to evaluate the entire strategy of a company that is pursuing a sustainable, environmentally-friendly, vision. This example is pertinent for any company dealing with sustainability and the inherent uncertainty that is part and parcel of this space.

**Reading:**

“GreenTech”[N].

**Main Topic II: Real Options Applications – Xylene’s Basement**

Although this case is about a chemical plant/project, we will conduct a real options analysis that is applicable to many sustainability issues because it involves multiple stages of a project, and the success of a specific stage is dependent on the success of all previous stages. This project should be valued using a real options approach, where you explicitly consider it as a series of sequential options. The value of any one option depends on the exercise of the previous one(s).

**Reading:**

“Xylene’s Basement”[P].

**All Exhibits also available in electronic form on CTools in “Case Exhibits” folder.**

**Questions:**

1. Consider the NPV analysis of the plant presented in Exhibit 4 of the case. Although you should not redo this analysis, make sure you understand the assumptions underlying the analysis, listed in Exhibit 5, and the execution. How would you conduct the analysis in Pakistani rupees? What information would you need to do so? Attempt to acquire this information under the assumption that you are doing this analysis today and redo the analysis in rupees. What is the NPV of the project in rupees, in pounds?

2. What do you learn from the sensitivity analysis conducted to obtain the distribution of the NPV in Exhibit 8?
3. Try and figure out how the volatility of returns was determined in Exhibit 9? Should the prices or spreads drive the model?
4. Build the underlying binomial tree and perform the real options analysis using risk-neutral probabilities. The tree itself is not very difficult to create because there are very few periods to consider. The real options analysis is not easy; not in terms of number-crunching, but in terms of the thought process involved. Remember that Xylene's Basement involves a compound sequential option, with three separate options. [Hint: In conducting the ROA you will need to work backwards (as usual), but you will have to assume that all previous options have been exercised.]
5. Suppose the standard deviation of expected annual return from the project is 35%, how would your entire analysis get affected?

**Tuesday, October 20, 2009 [Last Class]\***

**[\*Since this case will require a fair amount of time and effort, we will postpone the last Thursday's class to the following Tuesday. I will of course make sure to convene the class at a time suitable to all of us.]**

**Main Topic: Cost of Compliance - Real Options - CASE: Southern Company (A)[P](Revisited). [Submission Required.]**

**Purpose:** The main purpose of this analysis is the same as the first time we did this case: to use financial tools *to figure out the "least cost" way for a particular firm to comply with the new regulation* contained in the Amendment to the Clean Air Act of 1990. This can be done based on just case (A). In this analysis I expect you to use the Real Options Framework to re-examine how flexibility inherent in a market-based regulatory system, versus a command-and-control system, helps reduce implementations costs. This is a tough case, both conceptually and practically, and we will spend a lot of time on it.

**Reading:**

"Southern Company (A)" [P].

**All Exhibits of Southern (A) also available in electronic form on CTools in "Case Exhibits" folder.**

**Questions:**

**Main Question:** What is Southern Company's "least cost" alternative? In answering this question, you should allow the option to introduce the scrubbers in any year (starting in 1995).

**Helpful Simplifying Assumptions:**

To simplify your analysis, you may make the following assumptions (and/or others that you can justify):

- (1) *Decision point, 1995.* Do all your analysis as if you are in 1995.
- (2) *There is no time-to-build.* This implies that you can buy the scrubber for ~\$800 million and start using it right away (that is, you do not need three years to build the equipment). The depreciation schedule is the same as in the original case/analysis. Arbitrarily assume there is no investment in the last year.
- (3) *The price of scrubber increases at 10% per year.* This assumption is realistic and actually makes the flexibility option unattractive.
- (4) *Risk-free rate.* Assume a risk-free rate of 5%.
- (5) *Allowance Prices.* This is the toughest part; hence I will make your life easy. Assume that it starts at \$250; and also that  $u = 1.35$  and  $d = 0.74$ . [Note: Consistent with typical usage in many books, these are “gross” and equivalent to  $(1 + u)$  and  $(1 + d)$ .] This, along with the risk-free rate, will give you risk-neutral probabilities of ~0.50. At each node, start with the price you project and assume that there is a 10% increase every year after that till 2010 (as you did in the static PV analysis).
- (6) *Conduct the Real Options Analysis.* This is the tough part. Once you have the tree for the allowance price, you will need to recognize that you have multiple options in the future. For tractability and simplicity, assume that you cannot reverse/undo your choice of installing a scrubber or switching to low sulfur. For example, if you do install a scrubber, you will stick with this decision till the end of the decision horizon; that is, you will not uninstall it in the future, nor will you switch to low sulfur.
- (7) *Sensitivity Analyses.* It is always good to conduct some sensitivity analysis; and you may therefore build-in an ability to do so in your Excel model. Some important sensitivity analyses to conduct may be to (a) allow the up and down movements to be different from the 1.34 and 0.74 provided to you; (b) use different discount rates from the 10% rate used at each node; (c) use different risk-free rates; and (d) create a table that lists the present values of all alternatives as a function of the allowance price in 1995; use increments of \$50 to do this. If you write a macro, these sensitivity analyses should not be a problem.

This case will demonstrate how allowing flexibility in the regulatory framework should lead to significant reduction in the costs of compliance. You may want to review an important article in this context; an EPA Report on the acid rain regulation experiment.

### **Extra Reading:**

EPA: Acid Rain Progress Report (2007)[P].