

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

**FIN 637: Finance and the Sustainable Enterprise
Winter A, 2012, 2.25 Credits
Monday/Wednesday, 10:20 am – 12:40 pm, R1240**

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Office Hours: M/W 1:30 – 3:00 pm.

IMPORTANT NOTES:

- (1) Please read the course outline 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.
- (2) Past students have found **Valuation (F615)** very useful; it is therefore a prerequisite.
- (3) We will also use concepts taught in **Options & Futures [F580]**, but from a very different perspective. I will cover this material in class. I would nevertheless recommend that you take F580 as well, at least concurrently.
- (4) Finally, it will help you a lot to have decent Excel skills. This is a great opportunity to learn, or brush up on, your Excel skills. Online Excel modules are available for purchase to help you learn this material. Instructions to purchase these modules are available on the CTools website.

COURSE DESCRIPTION

Albert Einstein: Everything should be made as simple as possible, but not simpler.

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 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. Most, if not all, of business education does not prepare managers and leaders for an inherently ambiguous and uncertain multidisciplinary world. 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 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. It so turns out that sustainability is largely about the future, and the future is unknown and unpredictable. Therefore, there is the need to train ourselves to think using frameworks that are suited to deal with uncertainty.

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. The focus will be entirely on environmental issues; and I have recently developed another course on finance and social issues titled Impact Investing.

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. Again, the reason for such an approach is simple: firms operate within a large context. Educating business leaders that have a holistic understanding of the effects of projects and firms on society is arguably key to ensuring sustainability.

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; 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.

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, Peter Fritz, Michael Hartley, Bharathwajan Iyengar, Qin Lei, Mark Michelin, Trip O'Shea, 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 seven years ago. I am very happy that Jason Kotter, a PhD colleague of mine, has graciously 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 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 under the **Syllabus Link**, a **Cases folder** containing all information about the cases (except the copyrighted cases), a **Miscellaneous folder** with guidelines and samples of case write-ups to help you prepare your assignments and other pertinent information.

Groups

Most, if not all, your work will be done in groups. So please form your own groups of size four or five. Any unattached individuals are given the option of joining any group with less than five members. You should have your groups formed by the end of the first day of class. Once your group is formed, please post a list of your group members to CTools under the *Forums/Groups List* link. If you are unable to find a group, you may post your name in *Forums/Looking for Group* link; this may facilitate the process. In forming your groups, I strongly encourage you all to team up with people with diverse talents and backgrounds and, most importantly, different beliefs about the real world. Most of the learning will occur in the teams, and most learning occurs when there is a rich and diverse set of thoughts and talents at the table.

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 five 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 will be 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. To determine 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 **FIVE** 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.**

To help you prepare your assignments, I have provided some Guidelines and two samples in the Miscellaneous folder. The basic approach is identical to what I follow in the Valuation course.

In-Class Presentations (30%): 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-to-five 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.

Group Participation Grades

To help deal with free-rider issues, at the end of the class every member of a group will be asked to submit a participation grade for every *other* member of the group. These grades should reflect the overall contribution—both in terms of quality and quantity—of team members to the productivity of the group. Your feedback will be used to allocate group credit across the various group members.

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

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.

Monday, January 9, 2012

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?

Wednesday, January 11, 2012

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, 2nd Edition* [P].

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

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

“Why Maximize Value?” (2010) [P]. This is a recent McKinsey publication.

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 ongoing 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?

Wednesday, January 18, 2012

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. In the past, I have presented a review of all valuation methods contained in a note prepared by the finance department (see below). Last

year, I decided that the review may be best conducted by analyzing a classic case that provides us the opportunity to apply all the valuation techniques we have covered in Valuation, F615. It worked very well. Please recognize that the goal is to make sure that we all understand, and can apply, standard valuation methods in a challenging context. The case we will analyze is the most famous leverage buyout in history; while it is rich and challenging, it is not about sustainability. It, in fact, is a classic example of how unsustainable some mega deals can be.

Main Topic: Valuation – CASE: RJR Nabisco. [SUBMISSION REQUIRED.]

Purpose: To do a valuation exercise that helps us all revisit valuation concepts and apply them in a challenging context; the most famous LBO ever.

Reading:

“RJR Nabisco”[P].

All Exhibits are also available in electronic form on CTools in the “Cases” folder.

“Valuation-A Primer”[N]. This note contains all the valuation methods used in finance. You may skip the international finance applications covered in the later part of the note.

Questions:

1. Using both the APV and the WACC methodologies, determine the value of RJR Nabisco under:
 - (a) The pre-bid operating strategy;
 - (b) The Management Group’s operating strategy;
 - (c) KKR’s operating strategy.[Hint: The WACC method needs to be adjusted for the changing capital structure, D/E ratio, implied by the strategies.]
2. What accounts for any differences in the values of the three operating strategies?

MODULE II: 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 CO₂ 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.

Monday, January 23, 2012

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 are also available in electronic form on CTools in the “Cases” folder.

“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 τ 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.

Wednesday, January 25, 2012

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 CO₂ 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 the “Cases” 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].

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. I will therefore request one of you, or a team, to make a presentation on the economics of externalities in the first half of the class.

Monday, January 30, 2012

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 are also available in electronic form on CTools in the “Cases” 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 to low sulfur in 1996 and then install scrubbers ready for 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.]

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. This is because sustainability is inherently about the long-term future that is inherently unknown. Most tools taught at even top business schools and used by sophisticated companies are inherently static in nature and particularly ill-suited to projects, and especially long-term strategies, that are inherently dynamic in nature. We are fortunate that we have the real options approach, an advanced and powerful framework and a decision-making tool, to address some of the more serious challenges faced by us.

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. I will cover the concepts of Option Pricing that are the fundamental basis to using real options; but this coverage will depend on the proportion of class that has had Options and Futures already.

Wednesday, February 1, 2012

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.*

Monday, February 6, 2012

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 are also available in electronic form on CTools in the “Cases” 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).

Wednesday, February 8, 2012

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 similar) examples. Both examples reflect situations that are common in the real world, but the standard NPV approach typically used can lead to suboptimal choices. These are also cases where the Black-Scholes model is not applicable, and we will therefore be able to hone our skills at using the more flexible binomial model. The first application is to evaluate the entire strategy of a company; this company is pursuing a sustainable, environmentally-friendly, vision that is understandably fraught with uncertainty. 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] [**Submission Required**].

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. Like the strategy case, this “project” is inherently a series of “projects.”

Reading:

“Xylene’s Basement”[P] [**Submission Required**].

All Exhibits also available in electronic form on CTools in the “Cases” 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?

Monday-Wednesday, February 13 & 15, 2012

Since this “capstone case” will require a fair amount of time and effort, we will devote an entire week to it. Monday will be a “preparation” session, followed by Wednesday when the chosen team will make a detailed presentation.

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 are also available in electronic form on CTools in the “Cases” 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). But to keep the analysis focused, **assume that political reasons prevent Southern from purchasing low sulfur coal.**

Helpful Simplifying Assumptions:

You basically need to do three analyses:

- (a) Do nothing the entire period. This is the same as Case A1 from the previous assignment, except to simplify comparisons you can assume you are at the end of 1994 already.
- (b) Assume you are forced to install a scrubber right away. This is the same as Case A2 because a fair amount of analysis given to congress assumed that, and

will continue to do so. This is just a slight redo of what you already did last time. You have to basically imagine that it takes no time at all to build the scrubber at a cost of \$800m by the end of 1994.

- (c) The dynamic/real options analysis that allows you to postpone installing the scrubber as long it makes sense to do so.

ADVICE: Modify the spreadsheet that I gave you on Southern to start in 1994 to execute your analysis; it will help. You will notice that I not only ignored revenues because they are not incremental, but I also ignored costs of production that are NOT incremental. This will help. This will help you execute (a) and (b) easily and then set up and execute (c) as well.

Simplifying Assumptions:

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

For analyses (a) and (b):

- (1) *Decision point, 1995.* Do all your analysis as if you are at the end of 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 AND you can depreciate right away.
- (3) The discount rate is 10%.
- (4) The allowance price starts at \$250 in 1995 and increases at 10% a year till 2010 and then remains at that level. This is so that you can use the earlier spreadsheets.

For analysis of (c):

- (5) *The price of scrubber increases at 10% per year.* This assumption is realistic and actually makes the flexibility option unattractive.
- (6) *Risk-free rate.* Assume a risk-free rate of 5%.
- (7) *Changes in Allowance Prices.* This is the toughest part; hence I will make your life easy. Assume that it starts at \$250 in 1995; 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.
- (8) *Irreversibility of Investment.* For tractability and simplicity, assume that you cannot reverse/undo your choice of installing a scrubber. 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.

- (9) *Sensitivity Analyses*. It is always good to conduct some sensitivity analyses; 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 risk-free rates; and (c) 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.

Extra Reading:

“Acid Rain Progress Report” EPA, 2007 [P].

Monday, February 20, 2012

Main Topic: Carbon Markets and Trading

Purpose: The last session is devoted to learning about carbon markets, emissions trading, and related issues that all countries and companies are already confronting, or will confront. This area is evolving very rapidly, and this class is just an introduction. To make you think about real-world practical issues, this session also has a simulation exercise that helps you understand the issues involved with carbon trading.

Reading:

CASES - “Carbon Trading Simulation.” [To be distributed in class.]

“The Political Economy of Carbon Trading”[P].

The main agenda for this session is for you to learn about carbon trading in a simulation setting. The case involves five different parties who will trade with each other. Cases describing your roles and the information available to you will be distributed a couple of days before the session, but we will form the trading teams of 5 during class, with each member in a team playing their pre-assigned different roles in the trading exercise. Trading will then occur during the session, following which we will debrief and discuss the main issues that arose in real time. It will be a productive and fun way to end the course. Attendance is mandatory because ideally all teams will benefit from having five members trading with each other. You are strongly encouraged to review the background article because it will help you understand general aspects of the carbon trading and much more.