



HARVARD Kennedy School
JOHN F. KENNEDY SCHOOL OF GOVERNMENT

API 148

Advanced Risk Management and Infrastructure Finance

SYLLABUS

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Akash Deep

HARVARD Kennedy School
API-148, Fall 2009
Advanced Risk Management and Infrastructure Finance

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Office Hours:	Monday or Wednesday afternoons (sign-up outside L-213)
Lectures	Monday and Wednesday, 10:10 to 11:30 AM in L-280
Review sessions	Friday, 8:40 to 10:00 AM in L-332
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COURSE DESCRIPTION

This course presents an advanced treatment of the theory of financial risk management and its applications in infrastructure finance. The theory presents tools for pricing of currency, commodity and interest rate derivatives, dynamic and long-term hedging, measuring credit risk, credit enhancement and hedging, and evaluating risk exposure. Applications, discussed in the form of cases, will cover issues related to project finance, public private partnerships for infrastructure, project cash flows, capital structure, development impact, cost of capital, infrastructure funds, valuation of brownfield and greenfield projects, risk allocation, and structured finance.

AUDIENCE

The class is primarily intended for students who wish to acquire a better understanding of risk management and its application to infrastructure finance. The primary vehicle for motivation, analysis and discussion will be cases about the development, valuation, financing and management of infrastructure projects. The course will also benefit those who wish to deepen their knowledge about the instruments and techniques of risk management and corporate finance.

PREREQUISITE

It will be assumed that students will have taken a basic course in finance (e.g. API-141 or an equivalent introductory course in finance). Students must be familiar with basic mathematical and statistical techniques, and comfortable with using spreadsheets for analysis.

Students with concerns about their background are welcome to speak to the instructor.

REQUIREMENTS

The course must be taken for credit. Auditors will not be allowed.

Attendance and participation

The course uses the case method extensively. The case method relies on two prerequisites:

- A careful reading of the case, as well as the other assigned readings, and answering of the study questions *before* coming to class.
- An alert, inquisitive and participative presence during the case discussion.

To facilitate this, the classroom will have assigned seating and attendance will count for part of the grade. Laptops, mobile phones and other electronic devices cannot be used in the class.

Assignments

Students will be asked to complete several assignments that are designed to illustrate, reinforce and test the concepts and cases discussed in class. Students are strongly encouraged to do the analysis and discussion work related to these assignments in small groups. However, the writing and submission has to be individual.

Final exam

Students will be required to appear for a final exam at the end of the course that will be based on material that is assumed as a prerequisite as well as that covered in the course.

GRADING

- Attendance and class participation: 20%
- Assignments: 20%
- Final exam: 60%

MATERIALS

Readings and cases are available for purchase in the form of course packets from the Course Materials Office at the Harvard Kennedy School. Some of the material may be available online to be accessed from the course web page. The course packet is also available for reference at the Harvard Kennedy School Library.

Note: You are required to do the readings for the first day of class, September 2, in advance. These are in the first reading packet, available for purchase at the Course Materials Office, or for reference at the library at the Harvard Kennedy School. The first reading packet covers the readings for the first four class sessions.

BOOKS

There is no required textbook for the course.

However, there are various books that can be recommended for the material that will be covered in the course. These can be split into three broad domains:

Risk management and derivatives:

- Hull, John C., 2005, *Options, Futures, and Other Derivatives*, 6th edition, Prentice Hall.
- Stulz, René M., 2003, *Risk Management and Derivatives*, South-Western.
- Fabozzi, Frank, J., Henry A. Davis and Moorad Choudhry, 2006, *Introduction to Structured Finance*, Wiley.

Infrastructure finance:

- Yescombe, E. R., 2007, *Public-Private Partnerships: Principles of Policy and Finance*, Elsevier.
- Finnerty, John D., 2007, *Project Financing: Asset-Based Financial Engineering*, 2nd edition, Wiley.
- Grimsey, Darrin, and Mervyn Lewis, 2005, *The Economics of Public Private Partnerships*, The International Library of Critical Writings in Economics, Edward Elgar.
- Yescombe, E. R., 2002, *Principles of Project Finance*, Academic Press.
- Esty, Benjamin C., 2003, *Modern Project Finance: A Casebook*, Wiley.

Finance:

- Copeland, Thomas E., J. Fred Weston and Kuldeep Shastri, 2005, *Financial Theory and Corporate Policy*, 4th edition, Addison-Wesley.
- Luenberger, David G., 1997, *Investment Science*, Oxford University Press.

In addition, and especially if you want to review background concepts that will be assumed for this class, you might find it useful to consult selected chapters from the following texts:

- Bodie, Zvi, Alex Kane and Alan Marcus, 2008, *Essentials of Investments*, 7th edition, McGraw-Hill Irwin.
- Brealey, Richard and Stewart Myers, 2008, *Principles of Corporate Finance*, 9th edition, McGraw-Hill Irwin.
- Ross, Stephen, Jeffrey Jaffe, and Randolph Westerfield, 2008, *Corporate Finance*, 8th edition, McGraw-Hill Irwin.

Copies of all these books are on reserve at KSG library.

TOPICS AT A GLANCE

Day	Date	Topic	Assignment
		<i>Introduction</i>	
Wed	Sep 2	Infrastructure finance	
Wed	Sep 9	The theory and relevance of risk management	
		<i>Structure</i>	
Mon	Sep 14	Project finance: Managing political risk (<i>Petrolera Zuata</i>)	1
Wed	Sep 16	How risky is project finance: Measuring credit risk statistically (<i>Basel II</i>)	
Mon	Sep 21	Sculpting cash flows: Capital structure for risk management (<i>Poland A2 Motorway</i>)	2
Wed	Sep 23	Leverage: Measuring credit risk structurally (<i>Lecture</i>)	
Mon	Sep 28	Capital structure for governance: The role of residual risk (<i>Glas Cymru</i>)	3
Wed	Sep 30	Leasing: Adjusting structure for changing risk (<i>Barracuda & Caratinga oil project</i>)	
		<i>Value</i>	
Mon	Oct 5	Valuing development impact: Social and private value (<i>Nghe An Tate & Lyle</i>)	4
Wed	Oct 7	Valuation techniques and the cost of capital (<i>Lecture</i>)	
Wed	Oct 14	Valuation for regulation: Market risk (<i>Transener</i>)	
Mon	Oct 19	Valuation for privatization: Country risk (<i>The Sale of Rio Light</i>)	5
Wed	Oct 21	Valuation for financing: Leverage risk (<i>Texas High Speed Rail</i>)	
		<i>Risk</i>	
Mon	Oct 26	Hedging long term risks (<i>Lecture</i>)	6
Wed	Oct 28	Review of fixed income and arbitrage-pricing methods	
Mon	Nov 2	Credit derivatives: Pricing credit risk (<i>First American Bank</i>)	7
Wed	Nov 4	Financing municipal infrastructure: Credit enhancement (<i>TNUDF</i>)	
Mon	Nov 9	Guest lecture: Thomas H. Green, Infrastructure Finance, Citigroup	
Mon	Nov 16	Long-term contracts: The "optimal" hedge (<i>Metallgesellschaft</i>)	8
Wed	Nov 18	Risk allocation (<i>Sutton Bridge Power Station</i>)	
		<i>Structure, value and risk: public, private, or PPP?</i>	
Fri	Nov 20	Infrastructure funds: Pooling risk (<i>Extra class</i>)	
Mon	Nov 23	The Public Sector Comparator: Value for Money? (<i>Partnerships Victoria</i>)	9
Wed	Nov 25	Valuing risk transfer (<i>Partnerships Victoria</i>)	
Mon	Nov 30	Review of infrastructure finance	
Wed	Dec 2	Review of risk management	
Mon	Dec 14	Final exam (morning)	

INTRODUCTION

Infrastructure finance

- Grimsey, Darrin and Mervyn K. Lewis, 2004, "The revolution in infrastructure", in *Public Private Partnerships: The Worldwide Revolution in Infrastructure Provision and Project Finance*, Edward Elgar, pp. 19-40, and 250-262 (References).
- Deep, Akash, 2001, "A Firm Foundation for Project Finance", in James Pickford (Ed.) *Mastering Risk, Concepts I*, 2001, Prentice Hall.

The theory and relevance of risk management

- Stulz, René M., 2003, "Investors and Risk Management" (Chapter 2) and "Creating Value with Risk Management" (Chapter 3) in *Risk Management and Derivatives*, South-Western, pp 21-76.
- Roll, Richard, 1994, "What every CFO Should Know About Scientific Progress in Financial Economics", *Financial Management*, 23 (2), Summer, 69-75.

STRUCTURE

Project finance: Managing political risk

- Brealey, Richard, et al, 1996, "Using Project Finance to Fund Infrastructure Investments", *Journal of Applied Corporate Finance*, Volume 9, No. 3.
- Case: *Petrolera Zuata Petrozuata C.A.*, Harvard Business School Case 9-299-012
Petrozuata is a proposed \$2.5 billion oil-field development project in Venezuela. The case is set in 1997 as the project sponsors, Conoco, Inc. and PDVSA (Venezuela's national oil company), are planning to meet with various development agencies and rating agencies regarding the proposed financial structure. The sponsors hope to raise a portion of the \$1.5 billion debt in the capital markets, which will require an investment-grade rating. The key questions are how to structure and finance the project.
- Project / infrastructure finance glossary
<http://www.people.hbs.edu/besty/projfinportal/glossary.htm>

How risky is project finance: Measuring credit risk statistically

- Hull, John C., 2005, "Credit risk", Chapter 20 in *Options, Futures, and Other Derivatives*, 6th edition, Prentice Hall (up to section 20.5).
- Case: *Basel II: Assessing the Default and Loss Characteristics of Project Finance Loans*, Harvard Business School Case 9-203-035.
In June 1999, the Basel Committee on Banking Supervision announced plans to revise the capital standards for banks. The Basel Committee believed that project loans were significantly riskier than corporate loans and, therefore, warranted higher capital charges under the new proposal (known as Basel II). Bankers, fearing that higher capital charges would damage project lending by lowering profits and driving borrowers to nonbank competitors, formed a consortium to oppose the proposal by studying the actual default and loss characteristics of their combined portfolios of project loans. The study showed that project loans were not riskier than corporate loans. Armed with this data, the consortium sent a letter to the Basel Committee in August 2002 trying to convince them to lower the proposed capital charges on project finance loans.

Sculpting cash flows: Capital structure for risk management

- Harvin, Doug, et al, 2006, "Tailored Debt Structures: a Better Fit for Uncertain Cash Flows", Fitch Ratings Special Report.
- Case: *Poland's A2 Motorway*, Harvard Business School Case 9-202-030
Autostrada Wielkopolska S.A. (AWSA), a consortium of 18 firms, has won a concession to build and operate Poland's first private toll road. In June 2000, AWSA's chief financial officer is preparing for a meeting with the projects' lead bankers to discuss concerns they have regarding the traffic forecasts and revenue projections. Based on their concerns, the bankers are asking the sponsors to inject a sizeable amount of additional equity into the deal. This request presents a serious problem for AWSA because the concession is scheduled to expire in six weeks if financing has not closed and because he has very few options available to address the problem.

Leverage: Measuring credit risk structurally

- Hull, John C., 2005, "Credit risk", Chapter 20 in *Options, Futures, and Other Derivatives*, 6th edition, Prentice Hall. (Section 20.6 onwards)

Capital structure for governance: The role of residual risk

- Case: *Glas Cymru and the Debate over Nonprofits*, KSG case 1810.0
The unusual financial structure of Glas Cymru has made it a controversial one. Instead of shareholders, the company was controlled by a group "members". Based on this structure, it had launched a successful "people's bid" to acquire Welsh Water two years earlier and run it on a non-profit making basis. Instead of paying dividends to shareholders, cash surpluses would be shared with customers.

Leasing: Adjusting structure for changing risk

- Fowkes, David, Nasir Kahn, 2000, Don Armstrong, "Leasing in project financing", *Journal of Project Finance*, Vol. 6, Issue 1 (Spring)
- Case: *The Barracuda & Caratinga Oil Project Financing*, KSG case (draft)
In July 1998, Petrobras awarded Deutsche Bank, Merrill Lynch and two Japanese trading firms the mandate to structure a long-term financing for the development of the Barracuda & Caratinga Oil Fields. The financing proposal envisaged debt in an amount of \$2.5 billion from a combination of sources including capital markets and syndicated bank loans. However, the Russian debt crisis of August 1998 triggered financial turmoil across international financial markets and the capital market option had to be dropped. As some team members walked away from the mandate, the remaining ones, together with Petrobras, devised an innovative project structure, and explored alternative sources of financing. They approached a variety of lenders from across the globe that included commercial and investments banks, as well as Brazil's BNDES and the Japan Bank for International Cooperation. But in the already reeling Latin American lending market, the Real devaluation of January 1999 dealt a blow that threatened to dry up the availability of funds from the bank syndicate market as Brazil's country risk shot up, driving lenders and investors away.

VALUE

Valuing development impact: Social and private value

- Gomez-Ibanez, Jose, *Note on the Differences Between Social Benefit-Cost Analysis, Financial, and Regional Income Analyses*.
- Case: *Nghe An Tate & Lyle Sugar Company*, Harvard Business School Case 9-202-054
The International Finance Corp. (IFC) was considering lending up to \$45 million to finance a \$90 million sugar mill in northern Vietnam in 1998. Its main concerns were whether the plant was commercially viable and whether it had support from the government. The IFC also needed to assess the project's developmental impact. It only supported projects that contributed to sustainable development, and one of the key determinants of sustainability was the degree to which the project was "fair" to all parties involved. Thus, the IFC needed to assess not only the private returns, but also the social returns as measured by the project's economic rate of return (ERR). To do so, it would have to consider the various groups affected by the project and, where possible, quantify the impact on them.

Valuation techniques and the cost of capital

- Brealey, Richard and Stewart Myers, 2003, "Financing and Valuation", Chapter 19, *Principles of Corporate Finance*, 7th edition, McGraw-Hill Irwin.
- Sabal, Jaime, 2004, The Discount Rate in Emerging Markets: A Guide, *Journal of Applied Corporate Finance*, Volume 16, No. 2-3.

Valuation for regulation: Market risk

- Alexander, Ian and Timothy Irwin, 1996, "Price Caps, Rate-of-Return Regulation, and the Cost of Capital", *Public Policy for the Private Sector*, Issue 87.
- Case: *Transener (B): The First Tariff Review*, Kennedy School of Government Case Program. Case No. 1636.0.
Transener, the private firm forged from a formerly public corporation in 1993 to operate Argentina's national high-voltage transmission grid, had been consistently profitable and had embarked on a major expansion program. But as the case unfolds in 1998, there are clouds on Transener's horizon. ENRE, Argentina's national electricity regulatory agency, is reviewing the tariffs that Transener can charge for transporting electricity. ENRE regulates the tariffs on the grounds that the high voltage transmission system is a natural monopoly. Transener's initial tariffs had been set before the company's sale in 1993, and are to be reviewed every 5 years, starting in 1998. ENRE has begun Transener's first review by proposing a schedule of tariffs that would substantially reduce Transener's future revenues.

Valuation for privatization: Country risk

- Estrada, Javier, 2007, Discount Rates in Emerging Markets, *Journal of Applied Corporate Finance*, Volume 19, No. 2.
- Lessard, Donald R., 1996, "Incorporating Country Risk in the Valuation of Offshore Projects", *Journal of Applied Corporate Finance*.
- Godfrey, Stephen and Ramon Espinosa, 1996, "A Practical Approach to Calculating Costs of Equity for Investments in Emerging Markets", *Journal of Applied Corporate Finance*.
- Case: *The Privatization of Light – Servicos de Eletricidade, SA: Preparing the Terms of Sale*, Kennedy School of Government Case 1540.0.
In early March 1996, the response from possible bidders for the largest electricity distribution company in Rio de Janeiro had been hostile. Within a few weeks, the company, Servicos de Eletricidade, S.A, was to be auctioned in a much awaited and publicized bid. But investors had

been very critical of several aspects of the structure of the sale, particularly the minimum asking price. If the sale went forward under its current structure and conditions, there was a serious chance that it would be a failure. On the one hand, there was enormous political pressure for the sale to take place as soon as possible without any significant changes to the conditions of sale. Many saw the future of the entire Brazilian privatization program as hinging on the success of this auction.

Valuation for financing: Leverage risk

- Case: *Texas High-Speed Rail Corp.*, Harvard Business School Case 9-293-072. The finance director of the Texas High-Speed Rail Corp. (THSRC) is considering modifications to the financing program designed to support the development, construction, and operations of THSRC's planned high-speed rail system. The current plan achieves many objectives, including raising \$6.5 billion from private sources, but a few problems remain to be addressed. These include temporary over-funding, unutilized tax losses, and certain important contingencies.

RISK

Hedging long term risks

- Hull, John C., 2005, "Hedging strategies using futures", Chapter 3 in *Options, Futures, and Other Derivatives*, 6th edition, Prentice Hall.
- Hull, John C., 2005, "Swaps", Chapter 7 in *Options, Futures, and Other Derivatives*, 6th edition, Prentice Hall.

Review of fixed income and arbitrage-pricing methods

- Varian, Hal, 1987, "The Arbitrage Principle in Financial Economics", *Journal of Economic Perspectives*, Fall.
- Jorion, Philippe, 1997, "Fixed-income toolkit", Chapter 6, *Value at Risk*, McGraw Hill.

Credit derivatives: Pricing credit risk

- Hull, John C., 2005, "Credit risk", Chapter 20 in *Options, Futures, and Other Derivatives*, 6th edition, Prentice Hall. (Section 20.6 onwards)
- Case: *First American Bank: credit default swaps*, Harvard Business School Case 9-203-033.
Charles Bank International is interested in making a \$50 million loan to a client. The motivation for the loan is not the fees or return that the bank expects to earn. Instead, this is a major client and the bank wishes to make the loan to keep the client's business. The problem is that Charles bank has already holds \$100 million in loans to this client and the additional \$50 million would exceed its exposure limit with respect to a single client. How could the bank prevent the possibility of damaging an existing client relationship without violating its internal lending statutes?

Financing municipal infrastructure: Credit enhancement

- Matsukawa and Habeck, 2007, "Recent trends in risk mitigation instruments for infrastructure finance", *Gridlines*. (<http://www.ppiaf.org/Gridlines/20RskMgmt.pdf>)
- Case: *Tamil Nadu Urban Development Fund, KSG case (draft)*
The second phase of the Tamil Nadu Urban Development Project (TNUDP II) project had come to a close in March 2005, and the World Bank was actively considering the sanction of a repeater program, TNUDP III. The most innovative component of the plan had been the Tamil Nadu Urban

Development Fund (TNUDF), one of the first efforts in the developing world to establish public-private collaboration in the funding and management of a local urban infrastructure intermediary. The “backbone” of TNUDF had been the \$80 million line of credit provided by the World Bank. TNUDF III proposed a similar but slightly smaller fund to be supported by \$110 million of World Bank credit. In its Country Strategy for India (2004), the World Bank had described its objective as: “... to support the urban reform agenda...improve governance, incentives and financing capacities of urban local governments... encourage improvements in local finances and revenue mobilization making cities less dependent on state and central flows and enabling them to gradually access sustainable forms of finance; and facilitate private sector participation.” Supported by urban reform at the national level, TNUDF had contributed to these objectives. But the recent experience of the fund had also raised concerns about its performance, suitability and sustainability.

Long-term contracts: The “optimal” hedge

- Culp, Christopher and Miller, Merton, 1995, “Metallgesellschaft and the economics of synthetic storage”, *Journal of Applied Corporate Finance*, Winter.
“To avoid being ambushed, top managers and directors of those firms need not become derivatives experts ... but they must understand the essential logic behind their firm’s marketing and hedging strategies and the long term commitments needed to make the programs work. Otherwise, their firms may encounter not the classic gambler’s ruin problem ...but an insidious new phenomenon of the derivatives age: an economically sound hedging program may be liquidated prematurely because highly visible rollover costs and temporary cash drains might be construed by top management as gambling losses. Perhaps we might call this new phenomenon ‘hedger’s ruin’.” (Extract from article)

Risk Allocation

- Beidleman, Carl R., Donna Fletcher and David Veshosky, “On Allocating Risk: The Essence of Project Finance,” *Sloan Management Review*, Spring 1990
- Case: *The Sutton Bridge Power Station Project*, Kennedy School of Government Case Program.
In May 1997, a £280 million (\$454 million) debt issue backed by utility bill revenue was expected out of London for the Sutton Bridge Power Station. With only 13% equity, the sponsors would spend about \$300 million to construct the station that was expected to start generation in March 1999. But financiers of the Sutton Bridge Power project were planning to seek 25-year financing for the project in summer of 1997, almost two years before the completion of construction. With all of its inherent risks, financial managers responsible for structuring the issue were concerned about stretching the U.K investor’s appetite for risk to its limit. A dollar tranche, to tap the more sophisticated market for project debt in the United States, was being considered but this would expose the already risky project to exchange rate risk.

STRUCTURE, VALUE AND RISK: PUBLIC, PRIVATE OR PPP?

Infrastructure Funds: pooling risk

- Orr, Ryan J. 2007, "The rise of infra funds," *Project Finance International*, 13 June.
- McLean, Bethany, 2007, Would You Buy a Bridge from This Man? *Fortune*, October 2.
- Lawrence, Martin and Stapledon, Geoffrey, 2008, "Infrastructure Funds: Managing, Financing and Accounting In Whose Interests?", *RiskMetrics Group* (April)

The Public Sector Comparator: Value for money?

- Engel, Eduardo , Ronald Fischer and Alexander Galetovic, 2008, "Public-Private Partnerships: When and How", Working paper, Yale University. (Read pages 1-28 only)
- Case: *Partnerships Victoria*, Kennedy School of Government Case 1822.0
The government of the State of Victoria in Australia has been a pioneer in using the private sector to provide public infrastructure through "public-private partnerships" (PPPs). Under PPP programs the government contracts with a private company not just to build a facility but to operate it over its expected life, as well. PPPs are used for "social" infrastructure such as courthouses and hospitals as well as for "economic" infrastructure such as toll roads or public transport. The Department of Treasury required that agencies pursuing a PPP demonstrate that the PPP would save money compared to traditional procurement options. But critics argued that the Treasury's guidelines for such cost comparisons were flawed. The debate raised issues about how to compare the risks assumed by the government under different procurement options and how the differences in risks should be reflected in the discount rates.

Valuing risk transfer

- Grout, Paul A, 1997, "The economics of the private finance initiative", *Oxford Review of Economic Policy*, Volume 13, Number 4.

Review of infrastructure finance

- Miller, Roger, and Donald Lessard, 2001, "Understanding and managing risks in large engineering projects", *International Journal of Project Management*, Vol. 19, pp 437-443.
-