API 148
*Advanced Risk Management and Infrastructure Finance*

**SYLLABUS**
August 28, 2017

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Office Hours: Tuesday and/or Thursday afternoons (sign-up outside Littauer-213)

Lectures Tuesday and Thursday, 10:15am to 11:30am in Littauer-280
Review sessions Friday, 11:45am to 1:00pm in Belfer-400 (Land)

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COURSE DESCRIPTION

The course presents an advanced treatment of the theory of financial risk management and its application to infrastructure finance. The theory presented in the course covers the topics of economic and financial rate of return, measurement of risk exposure, cost of funds, capital structure, valuation methods, dynamic hedging using futures and swaps, and credit risk models and derivatives. Applications, discussed mostly in the form of infrastructure cases, will examine issues related to project finance, public-private partnerships, project appraisal and valuation, risk allocation, debt management, commodity, interest-rate and currency risk hedging, credit enhancement, regulation and privatization.

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.

Assignments

Students will be asked to complete 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. Some assignments will need to be submitted individually while others must be submitted in groups.

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: 30%
- Assignments: 20%
- Final exam: 50%

MATERIALS

Readings and cases are available online on the Canvas site for this course. Non-Harvard students should request a Harvard XID, following instructions on courses.harvard.edu.

Note: You are required to do the readings for the first day of class in advance.
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:


Infrastructure finance:


Finance:


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:


Copies of all these books are on reserve at the HKS library.
## TOPICS AT A GLANCE

<table>
<thead>
<tr>
<th>Date*</th>
<th>Topic</th>
<th>Assignment*</th>
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<tbody>
<tr>
<td>1 Aug 31 (Th)</td>
<td>Infrastructure finance</td>
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<tr>
<td><strong>Structure</strong></td>
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<tr>
<td>2 Sep 5 (Tu)</td>
<td>Project finance: Managing political risk (<em>Petrolera Zuata</em>)</td>
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<td>3 Sep 7 (Th)</td>
<td>The theory and relevance of risk management (Lecture)</td>
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<td>4 Sep 12 (Tu)</td>
<td>Risk allocation: The role of residual risk (<em>Poland A2 Motorway</em>)</td>
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<td>5 Sep 14 (Th)</td>
<td>Sculpting cash flows: Capital structure for risk management (<em>Poland A2 Motorway, session 2</em>)</td>
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<td>6 Sep 19 (Tu)</td>
<td>Leverage: Measuring credit risk structurally (Lecture)</td>
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<td>7 Sep 21 (Th)</td>
<td>How risky is project finance: Measuring credit risk statistically (<em>Basel II</em>)</td>
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<td><strong>Value</strong></td>
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<td>8 Sep 26 (Tu)</td>
<td>Valuation techniques and the cost of capital (Lecture)</td>
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<td>9 Sep 28 (Th)</td>
<td>Valuation for regulation: Market risk (<em>Transener</em>)</td>
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<td>10 Oct 3 (Tu)</td>
<td>Valuation for privatization: Country risk (<em>The Sale of Rio Light</em>)</td>
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<td>11 Oct 5 (Th)</td>
<td>Valuation for financing: Leverage risk (<em>Texas High Speed Rail</em>)</td>
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<td>12 Oct 10 (Tu)</td>
<td>Valuation of development impact: Social and private value (<em>Nghe An Tate &amp; Lyle</em>)</td>
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<td>13 Oct 12 (Th)</td>
<td>Valuation for subsidization (<em>Geothermal Renewal Energy Development in Indonesia</em>)</td>
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<td><strong>Risk</strong></td>
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<td>14 Oct 17 (Tu)</td>
<td>Hedging long-term risks (Lecture)</td>
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<td>15 Oct 19 (Th)</td>
<td>Credit enhancement: Bonds versus bank loans (<em>Project Bond Credit Enhancement</em>)</td>
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<td>16 Oct 24 (Tu)</td>
<td>Swaps: Static hedging of long-term currency risk (<em>Sutton Bridge Power Station</em>)</td>
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<td>17 Oct 26 (Th)</td>
<td>Rolling futures: Dynamic hedging of long-term commodity risk (<em>Metallgesellschaft</em>)</td>
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<td>18 Oct 31 (Tu)</td>
<td>Credit derivatives: Pricing credit risk (<em>First American Bank</em>)</td>
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<td><strong>Structure, value and risk: public, private, or PPP?</strong></td>
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<td>19 Nov 2 (Th)</td>
<td>Defining PPPs: Project, Partners, Process (<em>Completing the Trans-Java Highway</em>)</td>
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<td>20 Nov 7 (Tu)</td>
<td>Public versus private: Seeking value in partnership (<em>Rio de Janeiro Galeão Airport</em>)</td>
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<td>21 Nov 9 (Th)</td>
<td>Governance of PPPs: Infrastructure funds (<em>Miami Port Tunnel: Journey to Meridiam</em>)</td>
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<td>22 Nov 14 (Tu)</td>
<td>The Public Sector Comparator: Ensuring value for money (<em>Partnerships Victoria</em>)</td>
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<td>23 Nov 16 (Th)</td>
<td>The discount rate: Valuing risk transfer (<em>Partnerships Victoria, session 2</em>)</td>
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<td>24 Nov 21 (Tu)</td>
<td>TBD</td>
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<td>25 Nov 28 (Tu)</td>
<td>Review of risk management</td>
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<td>26 Nov 30 (Th)</td>
<td>Review of infrastructure finance</td>
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<td>Dec 6</td>
<td>Final exam (3pm to 6pm)</td>
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* Assignment 1 will be graded, but not for credit. Choose one of Assignments 4a/4b, and one of 5a/5b for credit.
REQUIRED READINGS

You are required to do these readings in advance of the corresponding class session. Case studies should be prepared using the study questions and/or assignments posted on the course page.

INTRODUCTION

Infrastructure finance


STRUCTURE

Project finance: Managing political risk

- Case: Petróleos de Zárate 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

The theory and relevance of risk management


Sculpting cash flows: Capital structure for risk management

- 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.

**Risk allocation: The role of residual risk**

- Case: *Poland’s A2 Motorway*, Harvard Business School Case 9-202-030 (see above)

**Leverage: Measuring credit risk structurally**


**How risky is project finance: Measuring credit risk statistically**

  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.

**VALUE**

Valuation techniques and the cost of capital


**Valuation for regulation: Market risk**

  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 Tansener’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


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, Serviços 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.

Valuation of 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 for subsidization

- Case: *Geothermal Renewal Energy Development in Indonesia*, Harvard Kennedy School (Draft)
  The Corporate Finance Manager at Pertamina, Indonesia’s national oil and gas company, recognized the high investment costs and risks associated with developing greenfield geothermal sites that made geothermal power less competitive for its subsidiary, PGE, than producing electricity from coal. PGE wanted to secure off-take tariffs for electrical power that were commensurate with the higher costs of geothermal development but PLN, the off taker of the electricity, opposed higher tariffs. How could PGE make viable geothermal investments to sell power at a sale price that would be acceptable to PLN? At the same time, the Director for Energy, Mineral Resources and Mining at Indonesia’s Ministry of Planning knew that the World Bank had been encouraging the Government of Indonesia to develop geothermal power projects in order to meet its increasing energy demand in an environmentally responsible way. He wondered how he could convince the World Bank to extend its financial and non-financial support to bridge the gap between PGE and PLN.
RISK

Hedging long term risks

  - Alternatively, you may review this material in: Hull, John C., 2018, “Interest Rates”, Chapter 4 in Options, Futures, and Other Derivatives, 10th edition, Prentice Hall.

Credit derivatives: Pricing credit risk


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?

Credit enhancement: Bonds versus bank loans

- Case: Project Bond Credit Enhancement: The Castor Project, Harvard Kennedy School Case (draft)

Infrastructure investment in Europe has declined significantly in the aftermath of the global financial crisis of 2008. Beleaguered banks subject to tighter capital and liquidity regulation were reluctant to take on risky, long-term debt. Monoline insurance companies that guaranteed the full credit risk of senior lenders to infrastructure projects had collapsed. A large and growing infrastructure gap emerged. The Project Bond Credit Enhancement (PBCE) initiative was launched in 2012 by the European Commission (EC) and the European Investment Bank (EIB) to provide an alternative to financing projects through bank loans or public sector grants in order to close the infrastructure financing gap. In July 2013, the first bonds under this initiative – €1.4 billion of 30-year bonds supported by a liquidity line of €200 million – were issued for the Castor gas storage project in Spain. Credit enhancement had allowed the Castor project to achieve a BBB/BBB+ credit rating, one notch above the sovereign rating of Spain, but below the EIB’s ‘A-’ target. Could PBCE bridge the gap that existed between the significant need for infrastructure investment and the large pool of savings accumulated by institutional investors, especially pension funds? Would PBCE catalyze the emergence bond financing as an attractive alternative to bank loans which had historically been the mainstay of infrastructure finance not only in Europe but around the world?

Swaps: Static hedging of long-term currency risk

- Case: The Sutton Bridge Power Station Project, Harvard Kennedy School Case.

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
Rolling futures: Dynamic hedging of long-term commodity risk

  
  “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)

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

Defining PPPs: Project, Partners, Process

- Case: *Completing the Trans-Java Highway*, World Bank Institute Case (draft)
  
  The Government of Indonesia was keen to develop the Solo-Kertosono highway, which constituted the last 187 kilometers of the 900-kilometre Trans-Java Toll Road that still lacked a signed concession agreement. It felt that comprehensive reforms in the toll road sector as well as specific support provided for this project should have addressed most of the concerns of potential investors, including those related to land acquisition and financial viability. The Government had reinforced its commitment by naming this project one of the ten model projects to be implemented under the new Public Private Partnerships scheme in Indonesia. But the preferred bidder, an Australian construction company called Thiess Contractors, refused to sign a concession agreement until all the issues that it had raised were adequately dealt with.

Governance of PPPs: Infrastructure funds

- Inderst, Georg, 2010, “Infrastructure as an asset class”, *ElB Papers, Volume 15. No. 1*
- Case: *Port of Miami Tunnel: Journey to Meridiam*, Harvard Kennedy School Case (draft)
  
  When Bethany Mclean, a journalist credited with first raising the alarm about Enron’s accounting practices, published the provocatively titled article “Would you Buy a Bridge from this Man?” in 2007, she was referring to not just one seller but an entirely new class of private equity investors called “Infrastructure funds”. Three years earlier, such a fund, pioneered by Macquarie Bank of Australia, had paid the City of Chicago $1.8 billion for a 99-year lease on a 7.8-mile toll road in the city. Infrastructure funds have emerged over the past decade as a distinct and significant funding source for infrastructure projects in many developed and developing countries. It is estimated that over $110 billion of equity infrastructure funds would be present in the market by the end of 2010, of which more than $30 billion would be targeted towards emerging markets. Suitably levered with debt, such funds could channel an additional half a trillion dollars of investments into the infrastructure sector.
The Public Sector Comparator: Ensuring value for money

- Case: *Partnerships Victoria*, Harvard Kennedy School 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.

The discount rate: Valuing risk transfer

- Case: *Partnerships Victoria*, Harvard Kennedy School Case 1822.0 (see above)

Public versus private: Seeking value in partnership

- Case: *Rio de Janeiro Galeão International Airport*, Harvard Kennedy School Case (draft)

On November 22, 2013, the bids for expanding and operating Rio de Janeiro’s Galeão International Airport were made public. All of the five bid amounts surpassed the minimum bid of R$4.8 billion set by the Brazilian government; four of them were more than twice as high. However, the winning consortium, led by Singapore’s Changi Airport and the Brazilian construction giant Odebrecht, “drew gasps of surprise and disbelief” by offering R$19 billion (USD 8.3 billion), almost four times the minimum bid. The bid amount represented part of the payment that the concessionaire – tasked with improving user experience at the airport while accommodating increased traffic – would make to the Brazilian government over the 25-year contract. The concessionaire would also pay five percent of the gross revenue generated.

At this time Galeão Airport was being operated by *Infraero*, the state-owned enterprise that had operated all of Brazil’s commercial airports from 1973 until the first round of airport privatizations in 2011. Brazil’s rapid macroeconomic growth, the upcoming 2014 FIFA World Cup and the 2016 Summer Olympics in Rio all further enhanced the urgency and significance of awarding the concession to improve and expand the airport.

Tomas Anker, Investment Officer at the International Finance Corporation (IFC) São Paulo Office which had commissioned and monitored the studies for the preparation of the concession, walked out of the São Paulo Stock Exchange amazed by the premium the airport had received. What could explain the sky-high bids, and the wide range of financial offers? How could the private sector extract so much more value from the airport than what the public sector could?