Finance Education for the Public Sector

Deborah Lucas
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MIT
“… I found myself awkwardly defending the federal fisc from both on- and off-balance sheet attacks … With each new topic I confronted, I tried to engage my counterparts in the language of finance, risk and exposure but found myself treated as if I were speaking a foreign language completely unrecognizable to the indigenous population…”

“I compared the federal government to “a gigantic insurance company (with a side line business in national defense and homeland security) which does its accounting on a cash basis – only counting premiums and payouts as they go in and out the door.” For good measure, I noted: ‘An insurance company with cash accounting is not really an insurance company at all. It is an accident waiting to happen.’”

– Peter Fisher, former Under Secretary of Treasury for Domestic Finance and Managing Director, Fixed Income, BlackRock
Main themes

1. Financial education for policymakers is essential, but often lacking

2. Such education is critical because of the central role of governments in allocating financial resources and risk

3. Current government accounting rules, which inform policy, are at odds with the logic of financial economics

4. A combination of better education for policymakers, and public accounting reforms, would have high social dividends

5. The new MIT Center for Finance and Policy aims to address these and related issues through education and research initiatives
Academics often study governments as regulators of financial institutions.
But relatively little work has been done on governments as major financial institutions in their own right...
Governments as financial institutions

- Governments are the world’s largest financial institutions
- As such, they have first-order effects on the distribution of risk and the allocation of capital in the world economy
- To do that job right, public sector managers face the same fundamental issues as their private sector counterparts…
  - What is the cost of capital?
  - How should financial activities be accounted for?
  - How to ensure the institutions are well-managed?
  - What are the systemic/macroeconomic implications?
  - Are gov’t financial products well-designed?
    - e.g., conforming mortgages and student loans
    - Consumer protection and behavioral finance
    - Systemic risk
    - Pricing
Governments as financial institutions

• How big are they?
  – Enormous

• What is the right way for them to think about their cost of capital?
  – The same way as large firms in the private sector

• How do governments think about their cost of capital in practice?
  – As their own borrowing rates

• How much does it matter that they underestimate their cost of capital?
  – It matters a lot, both quantitatively and for the distortions it creates
U.S. federal direct and guaranteed loans topped $2.3 trillion in 2010, and by 2013 exceeded $3 trillion.

**Figure 1: Total Non-Emergency Federal Loans Outstanding (Direct and Guaranteed) by Category: 1998-2010**

Source: Budget of the U.S. Government, Analytical Perspectives, FY2001-2012, as reported in Uncle Sam in Pinstripes, by Douglas Elliott.
Including the mortgages held or guaranteed by Fannie Mae and Freddie Mac brings the total to over $8 trillion.

Figure 2: Total Federal Loans and GSE Obligations Outstanding (Direct and Guarantees): 1998-2010

Largest federal credit activities

- Excludes the Federal Reserves emergency lending facilities
- Excludes federal health/life/P&C insurance/gov’t pensions

Federally-Backed Credit Outstanding, 2010
($000s)
Largest financial institutions

Assets or Insured Obligations ($000s)

- Federal Government
- Bank of America
- JPMorgan Chase
- Citigroup
- Wells Fargo
- Goldman Sachs
Outstanding Government-Guaranteed Bonds and Debt of Government-Related Enterprises, OECD Countries (percent of GDP)

(Excludes contingent guarantees and national credit programs)

Source: IMF 2012 Fiscal Monitor
Assessing costs and benefits

• The government’s **risk exposure is enormous**, but **most of the time** the **realized costs** will turn out to be **small**

• That situation is a source of systemic risk

• Focus of research discussed here is on cost measurement, although **benefit evaluation is also important**
What is the right way for governments to think about their cost of capital?

Answer: The same way as large firms do in the private sector
Robust principles from finance theory

• The cost of capital is **related** to the undiversifiable market risk (β) of the project financed
• The cost of capital is **not related** to the proportion of debt and equity used to finance the project
  – This is a first approximation—taxes, etc. also affect cost

• Key relations:

\[
E(r_A) = r_f + \beta_A (r_f - E(r_m))
= \frac{D}{V} E(r_D) + \frac{E}{V} E(r_E)
\]

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$D$</td>
<td>Debt</td>
</tr>
<tr>
<td>$E$</td>
<td>Equity</td>
</tr>
<tr>
<td>$V$</td>
<td>$D + E$</td>
</tr>
<tr>
<td>$E(R_A)$</td>
<td>expected return on firm assets</td>
</tr>
<tr>
<td>$E(R_E)$</td>
<td>expected return on firm equity</td>
</tr>
<tr>
<td>$E(R_D)$</td>
<td>expected return on firm debt</td>
</tr>
<tr>
<td>$R_f$</td>
<td>risk-free rate</td>
</tr>
<tr>
<td>$E(r_m)$</td>
<td>expected return on market portfolio</td>
</tr>
<tr>
<td>$\beta_A$</td>
<td>beta of firm assets</td>
</tr>
</tbody>
</table>
Robust principles from finance theory

• A key relation as seen on a balance sheet:
  \[ E(r_A) = \frac{D}{V} E(r_D) + \frac{E}{V} E(r_E) \]

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Assets</td>
<td>Debt</td>
</tr>
<tr>
<td>Financial Assets</td>
<td>Equity</td>
</tr>
</tbody>
</table>

\[ D = \text{Debt} \]
\[ E = \text{Equity} \]
\[ V = D + E \]
\[ E(R_A) = \text{expected return on firm assets} \]
\[ E(R_E) = \text{expected return on firm equity} \]
\[ E(R_D) = \text{expected return on firm debt} \]
\[ r_f = \text{risk-free rate} \]
\[ E(r_m) = \text{expected return on market portfolio} \]
\[ \beta_A = \text{beta of firm assets} \]

• Firms make an economic profit when realized returns exceed the required return on assets
Robust principles from finance theory

- Financial guarantees are a type of “put option”
  - A put option gives the holder the right but not the obligation to sell a specified object at a preset price

- Put options concentrate market risk on the issuer
  - E.g., loan guarantees are equivalent to a highly levered position by the option writer in the stock of the guaranteed firm
  - Governments are big issuers of credit guarantees

- Financial guarantees can be valued using an options-pricing approach
  - E.g., variations of Black-Scholes-Merton formula
Those robust principles also logically apply to government investments

- Importantly, the cost of capital for a risky government investment is higher than the interest rate it pays on its debt.

- **Example:** The government makes a risky loan to finance an investment in new electrical generation.
  - Principal is $100 million
  - Interest rate charged is 3%
  - Government borrowing rate is 2%
Why a government’s cost of capital exceeds its borrowing rate

- Initial notional government balance sheet after loan is made:

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risky loan $100m</td>
<td>Treasury Debt $100m</td>
</tr>
</tbody>
</table>
Why a government’s cost of capital exceeds its borrowing rate

- Notional balance sheet at end of the year if the loan pays off in full:

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash $103m</td>
<td>Government Debt $102m</td>
</tr>
</tbody>
</table>

“Profit” of $1 million
Why a government’s cost of capital exceeds its borrowing rate

- Notional balance sheet at end of the year if the loan defaults and recovery is only $73m:

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash $73m</td>
<td>Government Debt $102m</td>
</tr>
<tr>
<td></td>
<td>Taxpayers -$29m</td>
</tr>
</tbody>
</table>

- Government borrowing costs are only low because of taxpayer backing.

- **Taxpayers and the public are *de facto* equity holders in government investments**—they absorb any gains or losses.

- The government’s cost of capital is a weighted average of the cost of debt and equity (as for a private sector firm).
  - It depends on the priced risks of the project, not on how it is funded.
How do governments think about their cost of capital in practice?

Answer: As their own borrowing rate
How gov’ts assess their cost of capital in practice

• Governments almost always treat their cost of capital as their own borrowing rates
  – National, local, multilateral financial institutions, and government firms

• Profits defined as accounting profits rather than economic profits
  – **Accounting profits** are positive if expenses including interest costs are less than revenues
  – **Economic profits** are positive if expenses including a fair return to equity and interest costs are less than revenues
  – Often accounting profits are positive but economic profits are negative

• **Consequently, government subsidies to capital often are unrecognized in budgetary accounts and financial statements**
A few words on accounting

- How does the reporting about the cost of government credit support compare to that for publicly-traded financial companies?
  - Both have similar financial statements
  - Publicly-traded companies have observable stock price changes
  - Governments have observable budgetary costs

- The information revealed for public and private entities is similar only when budgetary costs are reported on a fair value basis
  - Budgetary costs on a fair value basis are in principle the same as the stock price change upon announcement of a new investment
    - Stock price changes by the NPV of the investment; fair value budgetary effect is the NPV of the investment

- In practice, most governments budget on a cash basis and ignore the ex ante cost of financial guarantees
How much does it matter that governments understate their cost of capital?

Answer: It matters a lot, both quantitatively and for the distortions it creates
Quantitative examples

- Examples illustrate:
  - Methods that can be used to infer government capital costs
  - Size and implications of cost understatement

- We’ll look at several examples:
  - Tennessee Valley Authority (TVA)
  - Fannie Mae and Freddie Mac
  - European Stability Mechanism (ESM)

Cost of capital for TVA

- TVA is the largest wholesale supplier of electricity in the U.S., supplying about 1/6 of total electrical power
  - It is wholly owned by the U.S. federal government
  - Its assets include coal-fired, nuclear and hydroelectric generators and an extensive transmission system.
- It funds new investments with debt issues and retained earnings
- Historically it has taken large losses
- Nevertheless, it is rated AAA and able to borrow at low rates because of the implicit backing of the federal government
Cost of capital for TVA

- Simple weighted-average cost-of-capital (WACC) approach can be used to estimate capital costs

- **Step 1**: Infer required return on TVA assets from returns on similar private electrical utilities, using the CAPM

- **Step 2**: Compare implied financing cost to reported cost of debt financing. Difference is understatement of capital costs.
## Table 1: Calculation of Unrecognized Capital Cost Subsidies to TVA

<table>
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</tr>
</thead>
<tbody>
<tr>
<td>Interest Expenses¹</td>
<td>$1,273</td>
<td>$1,305</td>
<td>$1,294</td>
<td>$1,272</td>
<td>$1,376</td>
</tr>
<tr>
<td>Book Assets¹</td>
<td>$47,334</td>
<td>$46,393</td>
<td>$42,753</td>
<td>$40,017</td>
<td>$37,137</td>
</tr>
<tr>
<td>Total Debt¹</td>
<td>$25,078</td>
<td>$24,431</td>
<td>$23,424</td>
<td>$22,640</td>
<td>$22,619</td>
</tr>
<tr>
<td>Borrowing cost</td>
<td>5.08%</td>
<td>5.34%</td>
<td>5.52%</td>
<td>5.62%</td>
<td>6.08%</td>
</tr>
<tr>
<td>Risk Free Rate (3 month t-bill)</td>
<td>0.03%</td>
<td>0.15%</td>
<td>0.06%</td>
<td>0.13%</td>
<td>2.75%</td>
</tr>
<tr>
<td>Market risk premium</td>
<td>6.50%</td>
<td>6.50%</td>
<td>6.50%</td>
<td>6.50%</td>
<td>6.50%</td>
</tr>
<tr>
<td>Asset Beta²</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>Required Return on Assets³</td>
<td>3.93%</td>
<td>4.05%</td>
<td>3.96%</td>
<td>4.03%</td>
<td>6.60%</td>
</tr>
<tr>
<td>Unrecognized capital subsidy⁴</td>
<td>$587</td>
<td>$574</td>
<td>$399</td>
<td>$341</td>
<td>$1,094</td>
</tr>
</tbody>
</table>

All dollar amounts are in millions
Cost of capital for TVA

• Consequences:
  – TVA managers think of the firm as profitable when it isn’t
  – Underpricing of electricity
  – History of over-investment
Fannie Mae and Freddie Mac

- Projected costs under three different budgetary treatments tell very different stories
- The answer matters for the debate over what to do with them.

Table 1.

<table>
<thead>
<tr>
<th>Projections of Mandatory Outlays for Fannie Mae and Freddie Mac Under Alternative Budgetary Treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td>(By fiscal year, in billions of dollars)</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>FCRA</td>
</tr>
<tr>
<td>Fair Value</td>
</tr>
<tr>
<td>Cash</td>
</tr>
</tbody>
</table>

Source: Congressional Budget Office.
Note: Numbers do not add up to totals because of rounding.
Fannie Mae and Freddie Mac

• Fair value approach reduces barriers to privatization
  – Under naïve accrual or cash accounting turning F&F into a government agency would show continuing profits for government; under fair value it would show costs
  – Under naïve accrual accounting liquidating the GSE portfolio at market prices would show losses; under fair value it would be largely neutral

• Inconsistent accounting across federal programs causes other problems
  – Budgetary gains from steering borrowers to more subsidized FHA mortgage guarantees instead of to F&F
Cost of Callable Capital for the EFSF/ESM

- The EFSF was created in May 2010 to respond to Eurozone crisis
- A rescue mechanism with the mandate of safeguarding financial stability by providing financial assistance to euro area Member States
  - ESM is the permanent version
- Authority to issue bonds backed by member capital and callable capital
  - Bonds are rated AA+ because of the EUR 620 billion callable capital
- Governments recognize no cost of the call exposure until losses are realized
- Callable capital can be valued using a generalized options-pricing approach (this time including jumps) following Lucas & McDonald 2010
- Cost of committed callable capital over 20 years for EFSF/ESM estimated to be EUR 20 to 80 billion to member countries
Cost of Callable Capital for the EFSF/ESM

- Methodology (in brief)
  - “Risk-neutral” Monte Carlo valuation model
  - Risky assets evolve stochastically
    - A jump process indicates occurrence of infrequent crisis state
    - Asset volatility process can be time- and state varying; tricky to calibrate
  - Liabilities increase by the amount of new loans made in a crisis
  - Capital is called when the ratio of liabilities-to-equity exceeds a trigger threshold
    - The amount called is set to restore target liability-to-equity ratio
    - New capital is invested in safe liquid assets
  - Cost of callable capital is present value of model-predicted call amounts, averaged over 20,000 Monte Carlo runs over 20 years
Cost of Callable Capital for the EFSF/ESM

Figure 1: Distribution EFSF/ESM cost
5,000 trials of 20 years
base case parameters, EUR millions
Summary

• Governments are the world’s largest financial institutions
• Understatement of their capital costs has significant adverse consequences
  – Overinvestment and capital misallocation
  – Over-reliance on credit support relative to other types of assistance (such as grants), whose costs are measured more fully
  – Reduced transparency
    • Unrecognized subsidies
    • Underreporting of the size of the public sector
    • Unrecognized aggregate financial risk in the world economy
  – Encourages a buildup of financial risk by governments, which if realized could hinder their capacity to respond to future adverse shocks
• Financial education for policymakers, and accounting reform to provide more accurate information, would be a big step toward addressing those problems.
The MIT Center for Finance and Policy (CFP)

- Broad mission is to produce and disseminate:
  - **Original and timely research** at intersection of finance and policy that will lead to improved decision-making by policymakers and regulators
  - **Innovative educational materials** and curricula that will make financial education relevant and accessible to students of public policy, employees of public institutions, and policymakers
What will be the CFP’s focus and structure?

• **Research** will cover three main content areas
  – Evaluation and management of *government financial institutions*
    • e.g., government loans and guarantees, state pensions, sovereign wealth funds
  – **Regulation** of financial markets and institutions
    • e.g., evaluation of proposed rule changes, development of methods to identify emerging risks
  – Measurement and control of *systemic risk*
    • e.g., forensics on causes of crashes
    • Consortium for Systemic Risk Analytics
What will be the CFP’s focus and structure?

- **Educational Initiatives**
  - Distinguished speaker series on MIT campus
  - Policy-related projects for action learning classes
  - SIP/IAP special classes
  - Training for graduate students interested in financial research with a policy focus
  - Development of executive education programs for policymakers
  - Development of EdX course on finance for policy makers
  - Website with resources for multiple audiences
  - Working papers and briefs
  - Topical conferences that bring together academics, industry leaders, and policymakers
What will be the CFP’s focus and structure?

• **Non-partisan and analytics-based**

• **Interdisciplinary approach**
  – Managed by finance group faculty (but key players will include faculty and students across MIT)
    • computer science, economics, political science, engineering, accounting

• **Management**
  – Key finance faculty: Deborah Lucas (director); Robert Merton, Andrew Lo, Andrei Kirilenko (co-directors)

• **Governance**
  – Advisory board of MIT faculty, industry and public sector leaders

• **Fellows and visiting scholars**
  – Will contribute to the CFP’s work and serve as ambassadors to their respective communities
Pioneers of Finance For Over 40 Years

- Black-Scholes-Merton derivative pricing model
- Modigliani-Miller theorems on corporate financing and valuation
- Cox-Ingersoll-Ross model of the term structure of interest rates
Thank you!