How Costly is External Financing?
Evidence from a Structural Estimation

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The Effects of Costly External Finance on Investment

• Still, after all of these years, an important, and unresolved, question

  – If corporate financing did not affect real activity, we would not care about corporate finance in the first place.

• We propose a new method, based on estimating a structural model, of gauging the effects of external finance constraints on investment.
The Cost of External Funds

- Nobody disagrees that external funds are more costly than internal.

- Open question: the magnitude of these costs.
  - Direct institutional issuance costs.
  - Indirect effects on real decisions.

- Open question: source of the financial frictions.
Which Firms are Constrained?

- Our model with estimated parameters gives a laboratory in which to examine various indicators of “financially constrained” firms.

- In particular, investment-cash flow sensitivities.
  - Fazzari, Hubbard, and Petersen (1988) claim that investment-cash flow sensitivities are monotonically increasing in the size of financing frictions.
  - This single number can measure the size of financial frictions.
Debate

• Kaplan and Zingales (1997,2000)
  – “There is no strong theoretical reason for investment-cash flow sensitivities to increase monotonically with the degree of financing constraints.”
• FHP-KZ debate based upon the first order conditions from
  – a static model, with
  – one source of outside finance
  – no uncertainty
  – no precautionary saving
  – no debt
  – no taxes
• A reasonable basis for assessing comparative static properties of multiple regression coefficients generated by firms optimizing at multiple margins of choice over time?
The Agenda

• Estimate the costs of external funds.
• Formulate and simulate a dynamic model of finance and investment.
• Broad set of frictions:
  – corporate and personal taxation
  – bankruptcy costs
  – linear-quadratic costs of external equity
• Estimate the model via SMM.
• The estimates answer the question:
  – What magnitude of financing costs “best” explains observed financing and investment patterns?
Related Papers

• Moyen (2004)
  – Less general model; focus on cash-flow sensitivity

• Cooley and Quadrini (2001)
  – Very closely related model; focus on firm growth and industry entry and exit.

• Cooper and Ejarque (2001, 2003)
  – Also use SMM; focus on real, instead of financial, moments.

• Hennessy and Whited (2005)
  – Slightly less general model; focus on capital structure
Preview of Results

- Estimates of external equity costs are higher than previous estimates of underwriting costs.
  - There exist large indirect costs of external equity and corporations are sensitive to these costs.

- Moderate estimates of deadweight default costs.

- Small firms face larger costs than large firms.

- Other indicators of “external finance constraints” vary in their ability to isolate truly constrained firms.

- Cash-flow sensitivity is increasing in deadweight default costs, but decreasing in external equity costs.
Overview of the Model

• Firm with an infinite horizon
• Stochastic production technology and market power
• Exogenous costs of equity issuance
• Exogenous deadweight bankruptcy costs
• Realistic tax environment
• Endogenous real investment decision
• Full range of financing options, endogenously chosen
  – Distributions
  – External equity
  – One-period risky debt
  – Internal savings
• Endogenous default when firm value is zero.
• Endogenously determined risky interest rate
The Model

\( z \pi(k) \equiv zk^\alpha \)  
Profit function reflects constant elasticity demand and constant returns to scale

\( Q(z, z') \)  
Markov transition function

\( b \)  
One period debt, \( b<0 \) implies cash holding

\( \xi(1-\delta)k' \)  
Dead weight loss in default

\( \Lambda(x) = \lambda_0 + \lambda_1 x + \lambda_2 x^2 \)  
Costs of external equity
Taxation

Taxable income: 
\[ y' \equiv \left[ z' \pi(k') - \delta k' - \tilde{r}(k', b', z)b' \right] \]

Corporate income tax: 
\[ T^c(k', b', z, z') \equiv \left[ \tau_c^+ \chi + (1 - \chi)\tau_c^- \right] y' \]

Personal tax on interest: 
\[ \tau_i < \tau_c^+ \]

Personal distribution tax: 
\[ \tau_d(x) \equiv \bar{r}_d \left[ 1 - e^{-\phi x} \right] \]
Net Worth and Default

Net worth:

\[ w(k', b', z, z') \equiv (1 - \delta)k' + z' \pi(k') - \left(T^c\right)' - (1 + \tilde{r})b' \]

In the event of default, the lender extracts a payment, such that the firm is indifferent between continuing and liquidating; i.e., such that firm value is zero. In this case net worth is denoted as \( \underline{w}(z') \).

Revised net worth:

\[ \tilde{w}(k', b', z, z') \equiv \max\{w(k', b', z, z'), \underline{w}(z')\} \]
Bond Pricing

• The endogenous rate of interest on debt

\[ \tilde{r}(k', b', z) \]

• Sets the value of bonds equal to the discounted expected value of

  – Payment in non-default states
  – PLUS
  – Expected payment in default states
Our Empirical Approach

• No closed-form estimating equations from the model.

• We use SMM to estimate underlying parameters.

• “What kind of frictions best explain observed financing patterns?”
Estimation

- Solve the model numerically and use the solution to generate a simulated panel of firms.

- Calculate interesting moments using
  - The simulated panel
  - An actual panel of COMPUSTAT firms

- Parameter estimates minimize the distance between actual data moments and the corresponding moments from the simulated data.
Choice of Moments

• Poor choice of moments can result in large model standard errors
• Basing a choice of moments on the size of standard errors constitutes data mining.
• We choose moments that are a priori informative about the parameters we seek to estimate.
• A moment is informative about an unknown parameter if that moment is sensitive to changes in the parameter.
• The moments need to be easily interpretable.
Full Sample Results

- Cost of issuing equity: $83,410 on the first million dollars of gross proceeds.
- Increasing marginal cost: slope equal to $616 per million.
- Average estimated marginal fee: $86,109 per million.
- Altinkilic and Hansen (2000)
  - Average marginal underwriting fee on equity: $51,488 per million
  - Marginal fee rises at a rate of only $299 per million.
- There exist large indirect costs of external equity.
- Deadweight bankruptcy cost estimates are in line with previous studies.
Identifying Constrained Firms

- Use the model to assess the usual criteria for identifying “constrained” firms
  - Small versus large
  - Dividends versus no dividends
  - A variety of financial constraints indices.
## Excerpt of the Estimation Results

### SMM Parameter Estimates

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Full Sample</th>
<th>Large Firms</th>
<th>Small Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed external equity cost</td>
<td>0.598</td>
<td>0.389</td>
<td>0.951</td>
</tr>
<tr>
<td></td>
<td>(0.233)</td>
<td>(0.302)</td>
<td>(0.495)</td>
</tr>
<tr>
<td>Linear external equity cost</td>
<td>0.091</td>
<td>0.054</td>
<td>0.120</td>
</tr>
<tr>
<td></td>
<td>(0.026)</td>
<td>(0.022)</td>
<td>(0.039)</td>
</tr>
<tr>
<td>Deadweight default cost</td>
<td>0.104</td>
<td>0.084</td>
<td>0.151</td>
</tr>
<tr>
<td></td>
<td>(0.059)</td>
<td>(0.055)</td>
<td>(0.072)</td>
</tr>
<tr>
<td>Production function curvature</td>
<td>0.627</td>
<td>0.577</td>
<td>0.693</td>
</tr>
<tr>
<td></td>
<td>(0.219)</td>
<td>(0.235)</td>
<td>(0.302)</td>
</tr>
<tr>
<td>Shock Variance</td>
<td>0.118</td>
<td>0.086</td>
<td>0.159</td>
</tr>
<tr>
<td></td>
<td>(0.042)</td>
<td>(0.045)</td>
<td>(0.081)</td>
</tr>
<tr>
<td>Overidentifying restrictions</td>
<td>(0.091)</td>
<td>(0.128)</td>
<td>(0.057)</td>
</tr>
</tbody>
</table>

### Observed Moments

<table>
<thead>
<tr>
<th>Moment</th>
<th>Full Sample</th>
<th>Large Firms</th>
<th>Small Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash-to-Assets</td>
<td>0.315</td>
<td>0.248</td>
<td>0.428</td>
</tr>
<tr>
<td>Equity Issuance Incidence</td>
<td>0.179</td>
<td>0.127</td>
<td>0.239</td>
</tr>
<tr>
<td>Leverage</td>
<td>0.120</td>
<td>0.145</td>
<td>0.084</td>
</tr>
<tr>
<td></td>
<td>Investment/ Assets</td>
<td>Tobin's q</td>
<td>Net Debt/ Assets</td>
</tr>
<tr>
<td>---------------------</td>
<td>--------------------</td>
<td>-----------</td>
<td>------------------</td>
</tr>
<tr>
<td><strong>Large Firms</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constrained</td>
<td>0.140</td>
<td>1.592</td>
<td>0.160</td>
</tr>
<tr>
<td>Unconstrained</td>
<td>0.151</td>
<td>1.913</td>
<td>0.178</td>
</tr>
<tr>
<td><strong>Small Firms</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constrained</td>
<td>0.125</td>
<td>2.913</td>
<td>0.061</td>
</tr>
<tr>
<td>Unconstrained</td>
<td>0.159</td>
<td>3.724</td>
<td>0.099</td>
</tr>
</tbody>
</table>
### Sensitivity of Model Moments to Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Curvature</th>
<th>Fixed Issuance Cost</th>
<th>Linear Issuance Cost</th>
<th>Deadweight Cost</th>
<th>Shock Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Equity Issuance/Assets</td>
<td>0.398</td>
<td>-1.155</td>
<td>-0.755</td>
<td>1.361</td>
<td>1.763</td>
</tr>
<tr>
<td>Frequency of Equity Issuance</td>
<td>0.731</td>
<td>-0.817</td>
<td>-0.732</td>
<td>1.394</td>
<td>1.042</td>
</tr>
<tr>
<td>Frequency of Cash Holding</td>
<td>0.341</td>
<td>-0.210</td>
<td>-0.257</td>
<td>0.533</td>
<td>0.700</td>
</tr>
<tr>
<td>Average Net Debt-Assets Ratio</td>
<td>-0.311</td>
<td>0.537</td>
<td>0.105</td>
<td>-1.271</td>
<td>-0.855</td>
</tr>
</tbody>
</table>
CF Sensitivity not a summary statistic for frictions

• Coefficient is increasing in bankruptcy costs.
  – In the face of deadweight default costs, the firm hoards financial assets, thereby rendering it less susceptible to shocks to cash flow. Lower debt also reduces overhang.

• Coefficient decreasing in each cost of external equity.
  – Even conditioning on average q, cash flow is a proxy for investment opportunities, due to concavity of the profit function. When faced with higher costs of external equity, the firm invests less aggressively when hit with a positive cash flow shock.
Take Away Points

• External finance is costly, both directly and indirectly.
• Firms react to these costs by investing suboptimally, relative to a frictionless world.
• Cash flow sensitivity is a poor indicator of the costs of external finance.
• Firm size is a good indicator.
• Other indicators of financially constrained firms vary in their ability to identify constrained firms.