Start-Up Costs and the Capital Structure of Young Firms

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Motivation

- **Young firms are key to the dynamism of the economy**
  - Large share of employment, important contributor to innovation
  - Numerous policies encourage firm creation / entrepreneurship
  - → Understanding the financial constraints they face is critical

- Leading theories: **Frictions are stronger for new firms**
  - More information asymmetries due to shorter business history
  - Hard to raise external finance → Lower leverage and debt maturity
  - Firms escape from constraints as they age

- State of empirical work: **Capital structure usually unobserved**
  - Compustat firms: Age almost always measured as age since IPO
  - Robb & Robinson (2012): Survey of US firms → Reliance on debt
Motivation: An empirical puzzle

Leverage and maturity both decrease with firm age
- Not driven by selection w.r.t. default → Holds with firm fixed effects
- A priori inconsistent with financial constraints being tighter
This paper

- **Theory:** Start-up costs as key determinant of capital structure
  - Simple model based on Holmstrom and Tirole (1997)
  - Novel cross-sectional and time-series predictions on start-up costs

- **Empirics:** New stylized facts consistent with the model
  - Rich data on young firms: Balance sheets + New loans
  - Pooled sample: Both leverage and debt maturity decrease with age
  - Across industries: High start-up costs → Higher leverage & maturity
  - Within industries: Lower profitability → Longer-maturity debt
  - Selection: Low net worth → Hinders creation of high-cost firms

- **Diff-in-diff identification:** Real effects of start-up costs
  - Experiment: Failure of Dexia (lender to municipalities) in 2008
  - Treated banks reduce maturity of new corporate loans
  - Firms with high start-up costs are hurt differentially more
  - → New source of heterogeneity in transmission of banking shocks
Model – Setup

- $t \in \{0, 1, 2\}$
- **Continuum of industries** $i$ with start-up cost $I \geq 0$ over $[I, \bar{I}]$
- Within industries, **continuum of entrepreneurs** $a$
  - With resources $A \geq 0$ over $[A, \bar{A}]$
  - Each needs $D = \max\{I - A, 0\}$ to start a project
  - Lenders have opportunity cost of funds $r > 0$
- **Project cash flows**: Safe $e$ at $t = 1$, risky verifiable at $t = 2$
  - $R > 0$ with prob. $p$, 0 with prob. $1 - p$
- **Entrepreneur is subject to moral hazard**
  - With effort: $p = p_H$, no private benefit
  - Without effort: $p = p_L < p_H$, but private benefit $B \geq 0$
  - Project viable only if effort: $e + p_H R > I(1 + r) > e + p_L R + B$
- **Timing**: Effort decision taken at date 1, after $e$ is realized
  - Intuition: Long-term projects require efforts to be exerted throughout
Model – External financing

- **Loan contract**: Share cash flows at dates 1 and 2
  - Cash flows to lender: $L_1$ and $L_2$
  - Cash flows to entrepreneur: $W_1$ and $W_2$

- **Lenders are perfectly competitive**: Zero profit on expectation
  - Participation constraint binds: $L_1 + p_H L_2 = D(1 + r)$, given effort

- **Incentive compatibility**: Give rents to induce effort
  
  \[ W_1 + p_H W_2 \geq W_1 + p_L W_2 + B, \]

  - This limits income that can be pledged to lenders at date 1
  - Date-1 pledgeable income: $p_H (R - B/\Delta p)$ with $\Delta p = p_H - p_L$

- **Loan feasibility while preserving incentives**
  
  \[ L_1 + p_H (R - \frac{B}{\Delta p}) \geq D(1 + r). \]
Model – External financing

- **Access to financing**
  - Only entrepreneurs with resources $A \geq A^*(I, r)$ get funding
  
  \[ A^*(I, r) = I - \frac{L_1}{1 + r} - \frac{p_H}{1 + r}(R - \frac{B}{\Delta p}) \]

  - Low resources $A \rightarrow$ Large debt $D \rightarrow$ Undermines effort
  - Selection: Higher share of funded projects in low cost industries

- **Debt repayment schedule**
  - $A^*(I, r)$ is decreasing in $L_1 \rightarrow$ Repay as much as possible at date 1
  
  \[ L_1 = \min\{e, D\} \quad \text{and} \quad L_2 = \max\{D - e, 0\}. \]

  - Early payments minimize later moral hazard $\rightarrow$ Get more from effort

- **Relation to Holmstrom & Tirole (1997)**
  - Heterogeneity in fixed costs across industries
  - One additional period to model debt maturity
Testable predictions from the model

■ **H1:** Across industries: Higher start-up costs $\rightarrow$ Longer maturity
  ■ Conditional on obtaining financing
  ■ Higher financing need $D$ for given $e$ $\rightarrow$ $L_2/L_1$ higher
  ■ Corollary: Higher start-up costs $\rightarrow$ Higher leverage

■ **H2:** Within industries: Lower profitability $\rightarrow$ Longer maturity
  ■ Conditional on obtaining financing
  ■ Higher $D$ relative to $e$ $\rightarrow$ $L_2/L_1$ higher

■ **H3:** Loan supply shock: Higher start-up cost $\rightarrow$ No more entry
  ■ Requires solving for equilibrium $r$ given supply function $S(r)$
  ■ Higher interest rate raises threshold for firm entry
Data on French firms

- **Balance sheet and income statements from all firms** (*Diane*)
  - Random 20% of all firms created in France over 2006-2016
  - Exclude self-employment (one-person firms)
  - Detailed information on debt structure, including maturity

- **Detailed data on new loans to firms** (*M-Contran*)
  - Proprietary dataset by the Banque de France
  - All loans granted by random sample of bank branches, every quarter
  - All loan terms, including detailed maturity (in months)
  - → Can study maturity of new loans, not just outstanding maturities
Measurement of start-up costs

- **Measurement of start-up costs at 3-digit industry level**
  - Sample of non-financial firms with age 0 or 1 year
  - For each firm \( f \), measure start-up investment as
    \[
    INV_f = \frac{1}{2} \sum_{t=0}^{t=1} [PPE_{ft} + IA_{ft}]
    \]
  - \( PPE \): property, plant & equipment, \( IA \): intangible assets
  - For each industry, compute median across firms (if at least 15 firms)

- **Large heterogeneity consistent with intuition**
  - High costs: Mostly industrial (e.g., manufacture of concrete)
  - Low costs: Mostly services (e.g., translation and interpretation)
Stylized facts

- **Leverage and maturity decrease with age**
  - Robust to focusing on new loans only
  - Driven by financial debt (mostly from banks), not payables
  - Hard to explain with other theories
Stylized facts

Breakdown consistent with start-up costs being key
Stylized facts

- Maturity of total debt (in months)
- Av. loan maturity at issuance (months)
- Firm age buckets
  - High start-up costs
  - Mid start-up costs
  - Low start-up costs

Similar fact in sample of new loans
Cross-industry tests

- **H1**: Across industries: **Higher start-up costs → Longer maturity**

\[ Y_{ijt} = \beta_0 \cdot \text{Age}_{it} + \beta_1 \cdot \text{Age}_{it} \cdot \text{MidCost}_{ij} + \beta_2 \cdot \text{Age}_{it} \cdot \text{HighCost}_{ij} + \gamma_3 \cdot \text{Controls}_{it} + \nu_i + \lambda_t + \epsilon_{ijt} \]

- \( Y_{ijt} \): Maturity/Leverage of firm \( i \) in industry \( j \) in year \( t \)
- \( \text{MidCost}_{ij}, \text{MidCost}_{ij} \): Based on terciles of cost distribution
- Controls: Size, Tangible, Total debt
- Firm fixed effects → Address concerns on selection w.r.t. age

- **Same regression at loan-level with loan controls**
  - Fixed vs. floating, regulated loan dummy, etc.
### Cross-industry tests

<table>
<thead>
<tr>
<th></th>
<th>Bank debt / Assets</th>
<th>Maturity of total debt</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td>-0.010*** -0.015***-0.004*** -0.005***</td>
<td>-0.030*** -0.047*** -0.022*** -0.034***</td>
</tr>
<tr>
<td></td>
<td>(0.000) (0.000) (0.000) (0.000)</td>
<td>(0.001) (0.002) (0.002) (0.002)</td>
</tr>
<tr>
<td><strong>Age-MidCost</strong></td>
<td>-0.002*** -0.000</td>
<td>0.011*** 0.010***</td>
</tr>
<tr>
<td></td>
<td>(0.000) (0.000)</td>
<td>(0.002) (0.002)</td>
</tr>
<tr>
<td><strong>Age-HighCost</strong></td>
<td>-0.026*** -0.015***</td>
<td>-0.077*** -0.047***</td>
</tr>
<tr>
<td></td>
<td>(0.000) (0.000)</td>
<td>(0.002) (0.002)</td>
</tr>
<tr>
<td><strong>Size</strong></td>
<td>0.021***</td>
<td>0.143***</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.005)</td>
</tr>
<tr>
<td><strong>Tang./Assets</strong></td>
<td>0.294***</td>
<td>0.995***</td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.029)</td>
</tr>
<tr>
<td><strong>Debt/Assets</strong></td>
<td>0.294***</td>
<td>0.596***</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.013)</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.022 0.073 0.118 0.388</td>
<td>0.007 0.032 0.060 0.173</td>
</tr>
<tr>
<td>Firm FE</td>
<td>No Yes Yes Yes</td>
<td>No Yes Yes Yes</td>
</tr>
<tr>
<td>Year FE</td>
<td>Yes Yes Yes Yes</td>
<td>Yes Yes Yes Yes</td>
</tr>
<tr>
<td>N. Obs</td>
<td>656,432 656,432 656,432 355,431</td>
<td>255,950 255,950 255,950 240,945</td>
</tr>
</tbody>
</table>

- Evidence consistent with the model
- Similar results when focusing on new loans
Within-industry tests

- **H2**: Within industries: **Lower profitability → Longer maturity**

\[
Maturity_{ijt} = \sum_{s=0}^{10} \beta_s \cdot \frac{EBITDA}{Assets} \cdot 1(Age = s) + \phi_j + \mu_s + \lambda_t + \epsilon_{ijt},
\]

- \(1(Age = s)\): Equals 1 when firm has age \(s\)
- EBITDA/Assets is equivalent of \(e\) in the model
- Same regression estimated on new loans (with loan controls)

**Predictions**

- Coefficients \(\beta_s\) are generally negative → Against common intuition
- \(\beta_s\) converges to zero as age increases (move away from constraint)
## Within-industry tests

<table>
<thead>
<tr>
<th></th>
<th>Maturity of total debt</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-0.317*** -0.137***</td>
</tr>
<tr>
<td></td>
<td>(0.031) (0.012)</td>
</tr>
<tr>
<td>EBITDA / Assets</td>
<td></td>
</tr>
<tr>
<td>EBITDA / Assets · Age 0</td>
<td>-0.245*** -0.313***</td>
</tr>
<tr>
<td></td>
<td>(0.031) (0.030)</td>
</tr>
<tr>
<td>EBITDA / Assets · Age 1</td>
<td>-0.197*** -0.214***</td>
</tr>
<tr>
<td></td>
<td>(0.021) (0.021)</td>
</tr>
<tr>
<td>EBITDA / Assets · Age 2</td>
<td>-0.067*** -0.084***</td>
</tr>
<tr>
<td></td>
<td>(0.021) (0.021)</td>
</tr>
<tr>
<td>EBITDA / Assets · Age 3</td>
<td>-0.087*** -0.070***</td>
</tr>
<tr>
<td></td>
<td>(0.022) (0.022)</td>
</tr>
<tr>
<td>...</td>
<td></td>
</tr>
<tr>
<td>EBITDA / Assets · Age 9</td>
<td>-0.087 -0.060</td>
</tr>
<tr>
<td></td>
<td>(0.070) (0.070)</td>
</tr>
<tr>
<td>EBITDA / Assets · Age 10</td>
<td>-0.038 -0.017</td>
</tr>
<tr>
<td></td>
<td>(0.082) (0.078)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>0.796 0.803 0.803 0.810</th>
</tr>
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<tbody>
<tr>
<td>$R^2$</td>
<td></td>
</tr>
<tr>
<td>Firm age</td>
<td>&lt;1y All All All</td>
</tr>
<tr>
<td>Industry FE</td>
<td>Yes Yes Yes No</td>
</tr>
<tr>
<td>Age FE</td>
<td>No Yes Yes No</td>
</tr>
<tr>
<td>Industry·Age FE</td>
<td>No No No Yes</td>
</tr>
<tr>
<td>Year FE</td>
<td>Yes Yes Yes Yes</td>
</tr>
<tr>
<td>N. Obs</td>
<td>17,672 224,006 224,006 224,006</td>
</tr>
</tbody>
</table>
Alternative explanations

- **Alternative 1:** Higher pledgeability in high-cost industries
  - Pledgeability can explain *levels* of leverage and debt maturity
  - ... but not *changes* with firm age
  - Results are robust to controlling for firm-level pledgeability
  - Results equally strong when only intangible assets as fixed cost

- **Alternative 2:** Maturity matching
  - High-cost firms may have longer-maturity assets
  - This can explains differences in *levels* but not *changes*
  - High-cost firms borrow at “short” maturities after a few years
Real effects of start-up costs

- **H3**: Loan supply shock: Higher start-up cost $\rightarrow$ No more entry

- **Ideal experiment**: Credit shock $\rightarrow$ Banks reduce maturity of loans
  - Expect heterogeneous effects across high and low-cost industries

- **Quasi-natural experiment**: Credit supply following Dexia failure
  - Specialized in lending to public entities in France ($\approx 40\%$)
  - Failure in 2008 due to losses unrelated to public lending
  - Identify municipalities heavily exposed to Dexia
  - Treated banks: Top 50% of share of loans to exposed municipalities

- **Rationale for diff-in-diff**
  - Treated banks more likely to lend to municipalities post-shock
  - Loans to municipalities have long maturities
  - Banks face limits in terms of asset duration
  - $\rightarrow$ Constrains maturity of new loans to firms
The Dexia experiment – Exogeneity

- **Failure of Dexia is unrelated to local conditions**
  - Subprime losses + Monoline credit insurer in US

- **Confounding factors (Lehman failure) unlikely to matter**
  - Construction of treatments builds from local level
  - Dexia was present throughout France (no regional dominance)
  - Unlikely that Lehman shock affects these exact same municipalities

- **Assumptions required for the Dexia shock to transmit**
  - Municipalities turn to existing lenders when Dexia fails
  - Banks accommodate these loans to municipalities → Good deals
  - Banks face regulatory/risk management constraints
The Dexia experiment

Credit to municipalities by type of bank

- **Treated banks lend significantly more to municipalities**
  - Specifically after 2008
  - In contrast with (arguably) parallel trends before

*Capital Structure of Young Firms*
Municipalities borrow with larger maturities than firms

Based on maturity of new loans issued
- Treated banks reduce maturity of new loans to firms
  - Specifically after 2008
  - In contrast with (arguably) parallel trends before
  - Maturities converge again after shock is absorbed ($\approx$ 2014)
### Maturity of new loans

<table>
<thead>
<tr>
<th></th>
<th>All</th>
<th>Low Cost</th>
<th>High Cost</th>
<th>All</th>
<th>Low Cost</th>
<th>High Cost</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[1.222]</td>
<td>[1.397]</td>
<td>[1.282]</td>
<td>[1.418]</td>
<td>[1.326]</td>
<td>[1.565]</td>
<td>[1.594]</td>
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<tr>
<td>Treated bank X High Cost</td>
<td>0.908</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[1.279]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post X High Cost</td>
<td>0.288</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.577]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treated bank X Post X High Cost</td>
<td>-1.878*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[1.130]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
- Treated banks reduce loan maturity after the shock
- ... and significantly more in high start-up cost industries
- Sample: All firms with age ≤ 20 years
Difference-in-differences estimates

<table>
<thead>
<tr>
<th></th>
<th>Size(T+2)</th>
<th>Tang./A (T+2)</th>
<th>EBITDA/A (T+2)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low Cost</td>
<td>High Cost</td>
<td>Low Cost</td>
</tr>
<tr>
<td>Treated bank X Post</td>
<td>0.007</td>
<td>-0.001</td>
<td>0.004</td>
</tr>
<tr>
<td></td>
<td>[0.014]</td>
<td>[0.012]</td>
<td>[0.003]</td>
</tr>
<tr>
<td>Quarter FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Bank FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Sector FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Firm controls</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Observations</td>
<td>20,598</td>
<td>23,104</td>
<td>20,380</td>
</tr>
<tr>
<td>Adj. R2</td>
<td>0.97</td>
<td>0.98</td>
<td>0.76</td>
</tr>
</tbody>
</table>

- **Treated firms have lower tangibles and EBITDA after 2 years**
  - ... but only in high cost industries
  - ... estimated in sample of firms with age ≤ 3 years
  - No significant difference in terms of size
For future work

- **Key prediction is on the selection of firms created**
  - Expect entry in high-cost industries to be disproportionately low

- **Test:** **Define treatment at geographical level**
  - Treated area: where municipalities were highly borrowing from Dexia
  - Diff-in-diff requires data on firm creation at the local level
  - Requires access to other data sources: In progress
Conclusion and implications

Main takeaway: **Start-up costs are key to understand new firms**
- They explain otherwise puzzling features of capital structure
- ... both across and within industries
- They are a source of heterogeneity in response to banking shocks

Implication 1: **Design of policies to foster firm creation**
- One cannot assume that all firms start equally small
- Potential “threshold effects” in policies supporting young firms?

Implication 2: **Understanding recoveries**
- Shocks hit high-cost industries differentially more
- Selection of new firms into these industries is also strongest
- Persistent changes in industry composition following crises?
Appendix
Sources of debt financing

- **Bank debt / Assets**
- **Debt from equityholders / Assets**
- **Payables / Assets**

- **Aggregate patterns driven by financial debt**
  - Among financial debt, mostly by bank debt
Firms are growing with age

- Conditional on survival