Economics of Banking
Lecture 13

April 2021

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Economics of looting

Model over $t = 0, 1, 2$.

At $t = 0$: Initial capital $W_0$, liabilities $L_0$.

Used to and purchase assets $A = W_0 + L_0$. By capital regulation: $W_0 \geq cA_0$.

Assets give payments $\rho_1(A)$ at $t = 1$ and $\rho_2(A)$ at $t = 2$.

At $t = 1$, dividends $\Delta_1$ are paid out.

After the payment of dividends, the liabilities are

$$L_1 = (1 + r_1)L_0 - \rho_1(A) + \Delta_1.$$

At $t = 2$, business can be finished after receipt if $\rho_2(A)$.

The liabilities are

$$(1 + r_2)L_1 = (1 + r_2)[(1 + r_1)L_0 - \rho_1(A) + \Delta_1],$$

and Net worth is value of assets minus value of liabilities

With full liability: Solve (at $t = 2$).

$$V^* = \max_{A, \Delta_1} \frac{\rho_2(A) - (1 + r_2)[(1 + r_1)L_0 - \rho_1(A) + \Delta_1]}{1 + r_2} + \Delta_1$$

$$= \max_{A} \frac{\rho_2(A)}{1 + r_2} + \rho_1(A) - (1 + r_1)L_0$$

subject to

$$0 \leq cA_0 \leq W_0.$$
Strategic default

With **limited liability**: Government imposes an upper bound $M(A)$ on dividend at $t = 1$:

Now the problem is:

$$E = \max_{A, \Delta_1, \Delta_2} \left[ \frac{\Delta_2}{1 + r_2} + \Delta_1 \right]$$

under the constraints

$$0 \leq cA_0 \leq W_0, \Delta_1 \leq M(A),$$

$$\Delta_2 \leq \max\{0, \rho_2(A) - (1 + r_2)[(1 + r_1)L_0 - \rho_1(A) + \Delta_1]\};$$

($E$ is the value of the equity)

The general result

Let $M^*$ be maximum of $M(A)$ given that $0 \leq cA_0 \leq W_0$.

**Theorem**

(1) If $M^* \leq V^*$, then the thrift chooses $A$ so as to maximize the true value.

(2) If $M^* > V^*$, then the thrift chooses $A$ so as to maximize $M(A)$, it pays dividends $M^*$ in period 1 and defaults in period 2.
Bankruptcy for profit

Example

“Riding the yield curve”

The firm acquires a bond with maturity at $t = 2$ for borrowed money. Yearly interest payment on loan $r_L$ given by

$$(1 + r_L) + (1 + r_2)r_L = (1 + r_1)(1 + r_2)$$

so that $r_L \sim (r_1 + r_2)/2$.

Assume $r_2 > r_L > r_1$:

First year interest $r_1 > r_L$ paid out as dividend. Second year: $r_2 > r_L$ and default!

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The undervalued option

Pavlov-Wachter model

A simple mortgage loan model

Investment project: Outcome $y_h > 1$ with probability $\pi$, otherwise $y_l < 1$.

Banks’ profit:

$\pi R_L + (1 - \pi)y_l - \pi R = \pi (R_L - (1 - \pi)(R - y_l) - \pi R = 0$

Define $\nu = (1 - \pi)(R - y_l)$: value of option on property with strike price $R$ at $t = 1$.

Then

$$R_L = \frac{\nu}{\pi} + R$$

The option given to the borrower is a cost for the lender.
Consequences

If banks neglect the cost of the option: $R_L \to R$

Loan rates do not reflect true cost $\to$ oversupply of (unsafe) credit!

But why do banks neglect the implicit option?

Bank managers may be
- myopic (wrong perception of possible downturn)
- compete for total assets rather than maximal expected profits

Evergreening

Investments:

<table>
<thead>
<tr>
<th>Time</th>
<th>0</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast</td>
<td>1</td>
<td>→</td>
<td>Y</td>
</tr>
<tr>
<td>Slow</td>
<td>1</td>
<td>→</td>
<td>Y − 1</td>
</tr>
<tr>
<td>Very slow</td>
<td>1</td>
<td>→</td>
<td>→</td>
</tr>
</tbody>
</table>

Bank is funded at interest rate $r$.

Probability of success:

| If monitored | 1 |
| If not monitored | $p$ |

Monitoring cost $m$
Saving the bank after failed engagement

Suppose the bank chooses not to monitor a slow investment

Borrower defaults with probability $1 - p$

If net gains $p(r_L - r)$ are smaller than losses $(1 - p)(1 + r)$ and revealed, the regulator closes the bank.

Instead: Carry on (pretending that the investment is very slow), profits at $t = 2$ are $p(1 + r_L)^2 - (1 + r)^2$. If

$$p(1 + r_L)^2 - (1 + r)^2 > (1 - p)(1 + r) - p(r_L - r)$$

then the bank survives.
If $m > (1 - p)(1 + r_L)^2$ then not monitoring is better than monitoring!

Technology of money laundering

- Placement: legal organisations
- Layering: many transactions between individuals
- Integration: sales as legitimate transactions
Crying wolf: A simple model

Two agents: Bank and Government.

Bank observes transaction: prior probability \( \alpha \) (say = 0.1) of ML

ML has cost \( h \) to society

ML can be prosecuted, reduces \( h \) by a percentage \( \rho (=0.8) \).

Bank may monitor transaction at cost \( m (=0.02) \), receives a signal \( \sigma \in \{0, 1\} \). Probabilities are

<table>
<thead>
<tr>
<th>Money laundering</th>
<th>Legal transaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \sigma = 0 )</td>
<td>( 1 - \delta )</td>
</tr>
<tr>
<td>( \sigma = 1 )</td>
<td>( \delta )</td>
</tr>
</tbody>
</table>

Here: \( \delta = 3/4 \).

Result of observation

We can compute posterior probability of ML:

\[
\beta_0 = P[ML | \sigma = 0] = \frac{0.1 \cdot 0.75}{0.1 \cdot 0.25 + 0.9 \cdot 0.25} = 0.04 \\
\beta_1 = P[ML | \sigma = 1] = \frac{0.1 \cdot 0.75}{0.1 \cdot 0.75 + 0.9 \cdot 0.25} = 0.25
\]

Bank reports if received signal. Reporting has a cost \( c (=0.01) \)

Government also exerts effort \( I (= \text{probability of verifying ML}) \) at cost \( \frac{1}{2} I^2 \). \( I_0 \) if no report and \( I_1 \) if report.

Fine \( F (=10) \) to bank if government discovers an unreported ML
The Monitoring and Reporting Game

Bank chooses a policy \((M, T)\)

\(M \in \{0, 1\}\) for monitoring, \(T \in \{0, 1\}\) for reporting when signal is \(\geq T\).

Let \(q_{1T} (q_{0T})\) be the probability of ML (no ML) given monitoring and reporting.

Then \(q_{01} = \beta_0 = 0.04, q_{11} = \beta_1 = 0.25\).

If \(T = 0\), then reporting is uninformative, so that \(q_{10} = q_{00} = \alpha = 0.1\).

We also use probability \(p_T\) of reporting \(T, p_1 = 0.1 \cdot 0.75 + 0.9 \cdot 0.25 = 0.3\)

Social welfare

For society, \(F\) is a transfer between agents and doesn’t matter

Bank chooses \((1, 1)\).

Marginal gain from effort should equal marginal cost:

\[
\begin{align*}
\text{No report} & \quad \text{Report} \\
I_0^* &= q_{01}\rho = 0.03 & I_1^* &= q_{11}\rho = 0.2
\end{align*}
\]

But can this optimum be sustained?
Setting the fine

Yes if the fine $F$ can be determined so that

(a) Expected cost for bank not smaller if $M = 0$,

$$\alpha l_0^* F \geq (1 - p_1)q_0 l_0^* F + p_1 c + m,$$

or

$$F \geq \frac{p_1 c + m}{\alpha - (1 - p_1)q_0 l_0^*} = 5.65$$

(b) Expected cost should not increase if the bank monitors but reports at all signals,

$$c + m \geq (1 - p_1)q_0 l_0^* F + p_1 c + m,$$

or

$$F \leq \frac{(1 - p_1)c}{(1 - p_1)q_0 l_0^*} = 9.8.$$
How to formalize operational losses

Peaks over threshold: Outlays larger than usual

The basic indicator approach:
Since the bank has to carry out business even without knowing in detail where the losses due to operational risk are most likely to occur, it can act according to rules of prudent behavior: Banks must set aside capital

\[
C_t = \frac{1}{\sum_{i=1}^{3} 1\{Y_{t-i} > 0\}} \sum_{i=1}^{3} \alpha \max\{Y_{t-i}, 0\},
\]

where:
- \( Y_{t-i} \) is gross income in year \( t - i \),
- \( 1_A \) is the indicator function of \( A \)
- \( \alpha \) is set to 15%.
### The standardized approach

Bank activities are divided into 8 distinct business lines, and for each:

\[
C_t^S = \frac{1}{3} \sum_{i=1}^{3} \max \left\{ \sum_{j=1}^{8} \beta_j Y_{t-i}^j, 0 \right\}
\]

<table>
<thead>
<tr>
<th>Business lines</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 corporate finance</td>
<td>18</td>
</tr>
<tr>
<td>2 trading &amp; sales</td>
<td>18</td>
</tr>
<tr>
<td>3 retail banking</td>
<td>12</td>
</tr>
<tr>
<td>4 commercial banking</td>
<td>15</td>
</tr>
<tr>
<td>5 payment &amp; settlement</td>
<td>18</td>
</tr>
<tr>
<td>6 agency services</td>
<td>15</td>
</tr>
<tr>
<td>7 asset management</td>
<td>12</td>
</tr>
<tr>
<td>8 retail brokerage</td>
<td>12</td>
</tr>
</tbody>
</table>

### Advanced management approaches I

Three different methods for calculating the capital charges:

*The internal measurement approach I:* For the 56 business-event combinations, find

(i) The exposure indicator, \( EI \)

(ii) Probability of event, \( PE \)

(iii) Loss given the event, \( LGE \).

\[
K = \sum_{j=1}^{8} \sum_{k=1}^{7} \gamma_{jk} \times EI_{jk} \times PE_{jk} \times LGE_{jk}.
\]
**Advanced management approaches II**

*The scorecard approach*: Initial operational risk capital modified on the basis of scorecards. Capital charge is

\[ K = \sum_{j=1}^{8} K_j^0 \times R_j. \]

where \( R_j \) is the risk score that rescales the initial capital charge.

*The loss distribution approach* estimates the loss severity and frequency distributions and finds \( \text{VaR}_{jk} \). Then

\[ K = \sum_{j=1}^{8} \sum_{k=1}^{7} \text{VaR}_{jk}. \]