1 Model

• Inside equity and moral hazard
• Banks as monitors
• General equilibrium implications of capital shocks

1.1 Entrepreneurs

• Entrepreneurs need $I$ at $t = 0$ to create a project
• (2nd part of the paper looks at a version with variable investment scale)
• A project yields $y$ or $0$ at $t = 1$
• Different entrepreneurs have different endowments at $t = 0$. Distribution $G(A)$
• The probability of success depends on whether the entrepreneur exert effort.
• Two possible effort levels lead to probabilities $p_H$ and $p_L$. $\Delta p = p_H - p_L$
• Entrepreneur has two ways of exerting low effort: going to Bahamas and going to the office but spending all day reading a Book
• Bahamas gives him a utility $B$, a book gives him utility $b < B$; both lead to $p_L$. Effort gives him zero utility
• Entrepreneurs only consume in period 1 and are risk neutral
1.2 Consumers

- Consumers have unlimited endowments at $t = 0$ and preferences are

$$u = c_0 + \frac{1}{R}c_1$$

- Later we relax this to make $\frac{u_{cm}}{u_{c1}}$ and thus the interest rate endogenous.

- Consumers cannot observe the entrepreneurs’ effort levels.

1.3 Banks

- Banks have an endowment of $K$.

- They have the ability to observe whether the entrepreneur is in Bahamas or at the office, but not whether he is working or reading a book.

  - Simpler to assume something slightly stronger: they can prevent the entrepreneur from going to Bahamas.

- Checking up on the entrepreneur has a cost of $c$.

- Consumers cannot observe whether the bank has checked up on the entrepreneur.

1.4 To make things interesting

Assume

$$p_H y - \gamma I - c > 0 > p_L y + \gamma I + B$$

2 Possible contracts

2.1 Direct finance

- Consumers lend $I - A$ to entrepreneurs.

- Entrepreneurs promise to repay $d_c$ if the project succeeds, keeping $d_c$ for themselves.

- Entrepreneurs promise to exert high effort.

- Participation constraint for consumer:

$$p_H d_c \geq R (I - A)$$
• Participation constraint for the entrepreneur

\[ p_H d_e \geq RA \]

(because we have assumed positive NPV, this will be satisfied if the consumer’s participation constraint holds with equality, so we don’t worry about it)

• Incentive compatibility constraint for entrepreneur:

\[ p_H d_e \geq p_L d_e + B \]

\[ \Rightarrow d_e \geq \frac{B}{\Delta p} \]

• Resource constraint

\[ d_c + d_e = y \]

• Combining constraints:

\[ p_H \left( y - \frac{B}{\Delta p} \right) \geq R (I - A) \]

\[ A \geq I - \frac{p_H}{R} \left( y - \frac{B}{\Delta p} \right) = \bar{A} (R) \] (1)

• There is a minimum level of \( t = 0 \) endowment that entrepreneurs need to have in order to be able to carry out the project with direct finance from consumers

• Note that there is no guarantee that \( RHS > 0 \). For instance, if \( y \) is very large, the entrepreneur can satisfy the consumer’s participation constraint and still have a sufficient stake in the outcome to exert effort, even if he put in no money

• What matter is not how much money the entrepreneur put in, but how much he expects to get out.

• As in Bernanke and Gertler [1989], the wealth of entrepreneurs is important for determining outcomes

2.2 Indirect finance

• Consumers lend \( I - I_b - A \) to entrepreneurs

• Banks lend \( I_b \) to entrepreneurs

• Entrepreneurs promise to repay \( d_c \) to consumers and \( d_b \) to the bank if the project succeeds, keeping \( d_e \) for themselves
• The entrepreneur promises to exert high effort
• The bank promises to monitor the entrepreneur
• Participation constraint for consumers

\[ p_H d_e \geq R (I - I_b - A) \]

• Participation constraint for bankers

\[ p_H d_b - c \geq R_b I_b \]
\[ \Rightarrow I_b \leq \frac{p_H d_b - c}{R_b} \]

• \( R_b \) is the rate of return on the bankers’ capital. We will have to solve for it in general equilibrium, but for the individual contract we take it as given.\(^1\)

• Note that because the banker could always just lend to consumers

\[ R_b \geq R \]

• \( I_b \) is the maximum amount that you can get the banker to lend to the entrepreneur in exchange for a promise of \( d_b \)

• Again we assume that because the whole thing is positive NPV, the entrepreneur’s participation constraint does not bind

• Incentive compatibility for entrepreneurs

\[ p_H d_e \geq p_L d_e + b \]
\[ \Rightarrow d_e \geq \frac{b}{\Delta p} \]

• This is weaker than \( d_e \geq R \frac{b}{\Delta p} \). Assume that the stronger condition does not hold, so if the bankers does not monitor, the entrepreneur goes to Bahamas

• Incentive compatibility for bankers

\[ p_H d_b - c \geq p_L d_b \]
\[ d_b \geq \frac{c}{\Delta p} \]

\(^1\)The original paper equates has this as \( p_H d_b \geq R_b I_b \). Somehow it is defining the return on capital separately from the monitoring cost. It doesn’t make much sense to me. Ultimatley, I think it doesn’t matter for the conclusions.
• Resource constraint

\[ d_c + d_b + d_e = y \]

• Combining constraints, we can solve for how much the entrepreneur will ask the banker to contribute to the project:\(^2\)

\[ I_b(R_b) = \frac{p_H \frac{c}{\Delta p} - c}{R_b} = \frac{p_L}{\Delta p R_b} c \]

• What is the meaning of \( I_b(R_b) \)?

  – For incentive reasons, you need to give banks a stake in the outcome
  – Given limited liability, this means that the bank has to get a positive expected dividend from the project
  – Since you are going to give the bank a positive dividend anyway, why not ask them to put in some money up front?

• How much money does the entrepreneur need to have in order to do the project? From the consumer’s participation constraint:

\[
p_H \left( y - \frac{c}{\Delta p} - \frac{b}{\Delta p} \right) \geq R \left( I - I_b(R_b) - A \right)
\]

\[
A \geq I - I_b(R_b) - \frac{p_H}{R} \left( y - \frac{b + c}{\Delta p} \right)
\]

\[
= I - \frac{p_L}{\Delta p R_b} c - \frac{p_H}{R} \left( y - \frac{b + c}{\Delta p} \right)
\]

\[
= I - \frac{p_H}{R} \left( y - \frac{b + c}{\Delta p} - \frac{p_L}{p_H R_b} c \right) \equiv \bar{A}(R, R_b)
\]

• How does \( \bar{A}(R) \) compare to \( \bar{A}(R, R_b) \)? Does the presence of the bank let poorer entrepreneurs carry out projects that they otherwise wouldn’t?

• Suppose \( R_b \to \infty \). Then \( I_b(R_b) \to 0 \) so

\[
\bar{A}(R, R_b) \to I - \frac{p_H}{R} \left( y - \frac{b + c}{\Delta p} \right)
\]

which is less than \( \bar{A}(R) \) iff

\[ b + c \leq B \]

\(^2\)The original paper has \( p_H \) rather than \( p_L \) in the numerator, from carrying the earlier mistake/weird way of defining the return on capital
If \( b + c \leq B \) the banks can help even if they put in no money. Otherwise they only help if they put in money.

- Suppose \( R_b = R \). Then

\[
\underline{A}(R, R_b) = I - \frac{p_H}{R} \left( \frac{b + c - \frac{p_L}{p_H} c}{\Delta p} \right)
\]

- Is monitoring socially useful in this case? Only if

\[
b + c - \frac{p_L}{p_H} c < B
\]

\[
c \Delta p < p_H [B - b]
\]

which we assume is the case.

- Banks can be interpreted as certifiers or intermediaries.

### 2.3 General Equilibrium

- Suppose (3) doesn’t hold and (4) does

- Suppose that \( R_b > R \).

- Then

\[
\underline{A}(R, R_b) < \bar{A}(R)
\]

- Entrepreneurs with \( A < \underline{A}(R, R_b) \) will not do projects

- Entrepreneurs with \( A \in [\underline{A}(R, R_b), \bar{A}(R)] \) will get some money from the bank and some from consumers

- Entrepreneurs with \( A > \bar{A}(R) \) will borrow directly from consumers (or not at all if \( A \) is very large)

- Demand for bank loans is given by

\[
D_b (R, R_b) = I_b (R_b) \left[ G (\bar{A}(R)) - G (\underline{A}(R, R_b)) \right]
\]

- Equilibrium requires

\[
K = D_b (R, R_b)
\]
• Demand for loans from consumers is

\[ D_c(R, R_b) = \int_{A(R, R_b)}^{A(R)} [I - I_b(R_b) - A] dG(A) + \int_{A(R)}^{\infty} [I - A] dG(A) \]

(note that this includes that if \( A > I \) the entrepreneur lends his surplus)

• If consumers have concave preferences, we can equate this demand to some supply \( S(R) \)

2.4 Shocks

• Three types of bad shocks:
  
  – Credit crunch: decrease in \( K \)
  
  – Collateral squeeze: decrease in \( \int A dG(A) \)
  
  – Savings squeeze: increase in \( R \) (i.e. shift to the left in supply \( S(R) \))

Proposition 1. Any of these shocks leads to a drop in investment

Proof.

• Suppose \( A \) goes down (which is required for higher investment, assuming the shock does nothing weird to the shape of the distribution \( G \))

• An increase in investment would require more loans from consumers.

• If \( S(R) \) is upward-sloping, this would imply higher interest rates

• But higher interest rates mean that the threshold \( \bar{A} \) becomes higher

• Lower \( A \) and higher \( \bar{A} \) mean that more firms are getting bank loans

• So each bank loan must be smaller

• Which means that \( R_b \) increases

• But higher \( R \) and \( R_b \) imply higher \( A \): a contradiction

\[ \square \]

• The marginal, bank-dependent firms, lose financing

• Effect on interest rates depends on shape of \( G \)
3 Variant with variable investment scale

- Now choose scale $I$
- Private benefits and monitoring costs linear in $I$
- Assume that entrepreneur uses bank and that $R_b > R$
- Program

$$\max_{I,d_b,d_c} p_H y I - p_H d_b - p_H d_c$$
$$A + I_b + I_c = I$$
$$p_H d_b - c I \geq R_b I_b$$
$$p_H d_c \geq RI_c$$
$$d_b \geq \frac{c I}{\Delta p}$$
$$d_c \geq \frac{b I}{\Delta p}$$
$$d_e + d_b + d_c = y I$$

- All constraints will bind, so

$$A + \frac{p_H d_b - c I}{R_b} + \frac{p_H d_c}{R} = I$$
$$A + \frac{p_H d_b - c I}{R_b} + \frac{p_H [y I - d_e - d_b]}{R} = I$$
$$A + \frac{p_H c I}{\Delta p} - \frac{c I}{\Delta p} + \frac{p_H [y I - \frac{b I}{\Delta p} - \frac{c I}{\Delta p}]}{R} = I$$
$$1 - \frac{p_L c}{\Delta p R_b} - \frac{p_H [y - \frac{b + c}{\Delta p}]}{R} \right] I = A$$
$$1 - \frac{p_H}{R} \left[ y - \frac{b + c}{\Delta p} \frac{p_L R R_b c}{\Delta p} \right] I = A$$

(5)

3.1 General Equilibrium

- The return on loans that consumers will obtain is

$$R = \frac{p_H d_c}{I_c} = \frac{p_H I \left[ y - \frac{b + c}{\Delta p} \right]}{I_c}$$

(6)
• Let $R(I_c)$ be the inverse supply function for loans from consumers.

• Market-clearing therefore requires

\[ R(I_c) I_c = p_H I \left[ y - \frac{b + c}{\Delta p} \right] \]  

(7)

• The return that banks will obtain is

\[ R_b = p_H d_b - cI \frac{b}{I_b} = \frac{p_L c I}{\Delta p I_b} \]

• Market clearing therefore requires

\[ R_b = \frac{p_L c I}{\Delta p K} \]  

(8)

• Note that once we impose (8), (5) reduces to

\[ \left[ 1 - \frac{p_H \left( y - \frac{b + c}{\Delta p} \right)}{R} \right] I = A + K \]  

(9)

so investment depends only on the sum of firm and bank capital, and not on each separately.

3.2 Shocks

• Credit crunch: decrease in $K$

1. From (8), $R_b$ increases
2. Since $I_c$ falls, $R$ decreases
3. $\frac{K}{K+I_c}$ decreases
4. $\frac{A}{I}$ increases

• Collateral squeeze: decrease in $A$

1. From (8), $R_b$ decreases
2. Since $I_c$ falls, $R$ decreases
3. $\frac{K}{K+I_c}$ increases
4. $\frac{A}{I}$ decreases
• Savings squeeze: increase in $R$ (i.e. shift to the left in supply $S(R)$

1. $R$ increases
2. From (8), $R_b$ decreases
3. $\frac{K}{K+I}$ increases
4. $\frac{A}{T}$ increases

• Different kinds of shocks have different effects on
  
  – bank interest rates
  – direct interest rates
  – (therefore spreads)
  – the proportion of investment that is financed by banks
  – overall leverage

  even though they all lead to lower investment

References
