Solution

The problem here essentially is that the lender does not get to observe the true state of the revenues. It is only the borrower who knows what revenue the project ended up with. This gives rise to a moral hazard problem. The borrower has an incentive to steal when the good state occurs. Why? Simply because the lender will not find out. But, of course, there is a way out – Verify.

The first question to answer is: what kind of loan contract will work for these entrepreneurs with risky projects? In practice, one observes that the contract specifies a fixed interest rate. If the entrepreneur claims that the project has failed, then the lender verifies the claim and seizes the property. Why does lender verify? Because, if the borrower wants to cheat, he/she can lie and claim a bad state even when a good state has occurred. In this way he/she can steal $50 give the lender $80. Verification however costs $10 (this is the idea of costly state verification). If the lender verifies then all he/she can get is $80-10=70 if the borrower spoke the truth. If the borrower lied, then you verify and get your payment of principal ($100) with interest ($10) and thus after verification cost ($10) there is nothing left of the revenues. The point then is that why would borrower lie at all? At the same time, you want to convince yourself that it is the fear of verification that deters borrower from lying.

Now let us answer the parts one by one.

1. The expected value of the project without any information problem is given by

$$E\{\text{revenue}\} - \text{investment}$$

$$= 130 \times 0.8 + 80 \times 0.2 - 100$$

$$= 20$$

2. With information problem, if the good state occurs, the entrepreneur and lender both get to share the total benefits. Out of $120, $110 goes to the lender and the entrepreneur gets to keep the other $10. If the bad state occurs, the lender verifies and gets only $80-$10 = $70. Recalling that $100 is the original investment the expected net social value of the project under information problem is

$$E\{\text{revenue}\} - E\{\text{verification cost}\} - \text{investment}$$

$$= \frac{130 \times 0.8 + 80 \times 0.2}{E\{\text{revenue}\}} - \frac{0.2 \times 10}{E\{\text{verification cost}\}} - \frac{100}{\text{investment}}$$

$$= 18$$

The social value of the project is thus lower under information problem.

3. Your cost of funds is 10%. Suppose the contract specifies a fixed interest rate of $i\%$. But in equilibrium it is only 80% of the time that you will get $i\%$; other times, you will get only $70 and thus lose $100-70 = $30 on this loan. Your loss of $30 on $100 loan means your net return if the project fails is $-30\%$. This is what you will get with a 20% chance. Thus your expected net return is

$$E\{\text{net return}\} = \frac{0.8 \times i}{\text{good state}} + \frac{0.2 \times (-30)}{\text{bad state}}$$

But this must equal 10% if you want to break even. Thus, the equation to solve for $i$ is

$$0.8 \times i + 0.2 \times (-30) = 10$$

or

$$i = \frac{10}{0.8} = 20\%$$

4. These are safe projects. These guys will always return your money back. Otherwise, of course, they will lose if you go to the court. There is no contracting problem here because there is no asymmetric information problem. Everyone knows that the revenues are going to be $120.

5. Now here comes the adverse selection problem in action. Since you do not know who is who, you are going to make the safe guys suffer as well. If the contract again specifies that either you will pay $i\%$ or I will verify your revenues and seize your property, it is only in the case of risky projects that verifying/seizing will occur. Then your expected return is $i\%$ for sure from safe guys, (50% of the population)
while from the risky guys (the remaining 50%) you get \( i \)% with 80% chance but -30% with 20% chance. Your expected return

\[
E \{ \text{net return} \} = 0.5 \times i + 0.5 \times \left( \begin{array}{c}
\text{safe guys} \\
\text{good state} \\
\text{bad state} \\
\text{risky guys}
\end{array} \right)
\]

\[
= 0.5 \times i + 0.5 \times (0.8 \times i + 0.2 \times (-30))
\]

Again, this must equal 10% which leads to the following equation

\[
0.9 \times i - 3 = 10 \quad \text{or} \quad i = 14.44\%
\]

6. At this stage you can see how the information problem (due to adverse selection) hurts the safe guys. If they have to pay 14.44% they get to keep only 5.56%. This may not be worth all the time and effort and they may simply drop out of the market.