This paper considers a loan market subject to \textit{adverse selection}. It shows that a small increase in the riskless interest rate or a small increase in some borrowers’ perceived risk can lead to a financial collapse. It is one of many examples in which information asymmetries can lead to market failure.

I. Assumptions

A.1 This is a single-period model. There are many (a continuum of) risk-neutral entrepreneurs (potential borrowers), each having a project that requires 1 unit of initial investment and pays a random end-of-period payment that has an expected value of $R$. The probability that a given borrower will be able to fully repay a loan at the end of the period is $P$. With probability $1 - P$ the borrower repays zero. $P$ and $R$ vary across the population of entrepreneurs, and the probability density is given by $f(P, R)$.

A.2 A competitive, risk-neutral lender (a bank) can invest in a safe asset paying a certain future payment of $\rho$. The lender can also make loans to the previously described entrepreneurs. However, information is asymmetric. The lender cannot distinguish the individual characteristics ($P, R$) of a given entrepreneur, though each entrepreneur knows his own characteristics. Thus, the lender must charge the same loan rate, $r$, for each borrower.

II. Loan Market Equilibrium

A given entrepreneur will choose to borrow at the loan rate $r$ if the expected return to undertaking the project exceeds his expected payment on the loan. In other words, the entrepreneur will borrow if $R > P r$, and not borrow if $R \leq P r$. Note that while a socially efficient project is defined as $R > \rho$, in general we can have entrepreneurs having socially inefficient projects.
but choosing to borrow \((R > P r \text{ but } R < \rho)\) or entrepreneurs having socially efficient projects but choosing not to borrow \((R < P r \text{ but } R > \rho)\). These inefficiencies are a result of the unobservability of entrepreneurs’ characteristics which require that the interest rate on all loans be the same.

Define \(\Pi\) as the average probability of repayment for those entrepreneurs who choose to borrow. Thus, \(\Pi(r)\) is the conditional expectation of \(P\) for those who choose to borrow when the lender sets the loan rate at \(r\).

\[
\Pi(r) = E[P | R > Pr].
\]

This is a well-defined function of \(r\) for any population density \(f(P, R)\). In general, without knowing the exact form of \(f(P, R)\), one cannot say how \(\Pi(r)\) varies as \(r\) increases. However, in the special case that \(R\) is the same across entrepreneurs, but \(P\) differs, then \(\Pi(r)\) is decreasing in \(r\). In this case, entrepreneurs with the highest \(P\) choose not to borrow as \(r\) rises. Thus, we might expect that \(\Pi(r)\) is decreasing in \(r\), that is, raising \(r\) results in a pool of higher risk borrowers.

Equilibrium implies that the competitive risk-neutral lender has expected profits from making loans equal to the return from investing in safe assets. Hence, we have the equilibrium condition

\[
r \Pi(r) = \rho.
\]

It may be helpful to consider equilibrium in the loan market with the aid of a graph of equations (1) and (2) in \(\Pi, r\) space.

The conditional expected probability of borrower repayment, equation (1), is labeled \(BB\) and we have assumed that this is a downward-sloping function of \(r\). The lender’s zero profit condition, equation (2), is labeled \(LL\). Given \(r \Pi = \rho\), a constant, this is a hyperbola in \(\Pi, r\) space.

As one can see from Figure A, there may be multiple equilibria. However, the higher loan rate, \(r_y\), at point \(y\) is likely to be an unstable market equilibrium. This is because a bank could charge a break-even, below market interest rate of \(r_x\) and attract all of the borrowers previously
borrowing at rate $r_y$. Hence, the intersection at $x$ where the interest rate is lowest is the only stable equilibrium.

For certain parameter values, it is also possible that no equilibrium will exist. This is represented in Figure B. In this case, for all possible loan rates, $r$, we have $r \Pi(r) < \rho$. In this situation, the lender invests only in the riskless asset. This can be thought of as a “collapsed” credit market.

### III. An Example

Assume the special case in which $R$ is the same for all entrepreneurs and known by the lender. However, $P$ varies across entrepreneurs, is uniformly distributed between zero and one, and is unobserved by the lender.

Note that since $R$ is the same for all entrepreneurs, either all projects are socially efficient ($R \geq \rho$) or socially inefficient ($R < \rho$). Thus, for this example, if an equilibrium exists ($r \Pi(r) = \rho$), then all lending will be for socially efficient projects, that is, it must be that $R > \rho$. Why? Since entrepreneurs borrow iff $R > Pr$, averaging over all borrowers implies $R > \Pi r$. Since $\Pi r = \rho$, we know $R > \rho$.

Further, one can show that for this example, when $R \geq 2\rho$, all entrepreneurs have their
projects funded. Note that for any $P \leq 1$, all entrepreneurs choose to borrow when $R \geq r$. In this case, since $P$ is uniformly distributed over $(0, 1)$ this implies $\Pi = 1/2$. Thus the lender’s equilibrium condition is $r \Pi = \rho$ or $r/2 = \rho$, which means that $r = 2\rho$. Thus $R \geq r = 2\rho$ is a sufficient condition for all projects to be funded by the loan market.

In contrast, consider what happens when $2\rho > R > \rho$. Note that we again require $r \Pi = \rho$ for the lender to break even. If $r \leq R$, $\Pi = 1/2$ but $r \Pi = r/2 < \rho$ since $r \leq R < 2\rho$ so the lender cannot possibly break even when $r \leq R$. If instead, $r > R$, then given the uniform distribution of $P$, $\Pi = R/2r$ and some entrepreneurs (those with high $P$ such that $rP > R$) choose not to borrow. Since we must have $r \Pi = \rho$ for lending to exist, $rR/2r = R/2$. But by assumption, $R/2 < \rho$, so that $r \Pi = R/2 < \rho$ when $r > R$. Thus, no $r$ exists for which making loans is profitable when $2\rho > R > \rho$.

Hence, we have a severe discontinuity at $R = 2\rho$. If $R > 2\rho$, all entrepreneurs’ projects are funded, but if $R < 2\rho$, no entrepreneur’s project is funded.

**IV. Financial Collapse**

**An increase in the riskless rate:**

For the general cases illustrated by Figures A and B above, consider the effect of an increase in the risk-free return, $\rho$, that leaves the distribution of the risky entrepreneurs’ projects, $f(P, R)$, unchanged. For example, this might be the result of restrictive monetary policy, perhaps to defend the country’s exchange rate. From equation (2) we see that this shifts the $LL$ curve up and to the right. If an equilibrium continues to exist, this results in an increase in the loan rate, $r$, and the amount of borrowing declines.

It is possible that an increase in $\rho$ shifts the $LL$ curve such that it no longer intersects the $BB$ curve. This event could be interpreted as a financial collapse of the credit market. A case in point is the example in the previous section. We saw that when $R > 2\rho$, all projects were funded. A slight rise in $\rho$ such that now $R < 2\rho$, would result in no projects being funded. Hence, a small rise in $\rho$ could result in a large change in loan volume, even though borrowers’ risk distribution is continuous. Thus, unlike the standard IS-LM model where a small rise in $\rho$ produces a small fall in output, here a small rise in $\rho$ could produce a very large decline in investment demand and a very large decline in output, in spite of the fact that investments
continue to be socially productive. Mankiw argues that this could provide justification for certain government subsidized loan programs.

**An increase in the perceived risk of some entrepreneurs:**

Assuming that the loan market currently exists (as in Figure A), suppose that for any given loan interest rate, $r$, $\Pi(r)$ is now perceived to be lower. This has the effect of shifting the $BB$ curve in Figures A and B down and to the left. It is possible that even with a small increase in perceived risk, there will now be no intersection between the $BB$ and $LL$ curves, so that the loan market again collapses.

Lenders no longer make loans to entrepreneurs but choose to invest only in the riskless asset. This phenomenon could be interpreted as a “flight to quality,” a common characteristic of a financial crisis.

Perhaps this model is especially realistic when there is a sudden, unexpected shock to asset values (the collapse of a speculative bubble?) that leaves lenders uncertain regarding the collateral (repayment capacities) of entrepreneurs (potential borrowers). Thus, until lenders can learn (produce information regarding) the changed repayment abilities of entrepreneurs, loan markets collapse. This framework could justify the central bank acting as a (temporary) lender of last resort to the private sector.