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ECONOMIC INSTRUCTION

A Classroom Experiment on Banking

Mary Mathewes Kassis, Denise Hazlett, and Jolanda E. Ygosse Battisti

This classroom experiment uses double oral auction credit markets to illustrate the role of banks as financial intermediaries. The experiment demonstrates how risk affects market interest rates in the presence of asymmetric information. It provides fodder for a discussion of the moral-hazard problem of deposit insurance and its impact on depositor and bank behavior. The basic experiment can be extended to include the effect of political risk on credit markets. The experiment can be used in principles, intermediate macroeconomics, or money and banking courses with 8–75 students. It takes 50–75 minutes to run, depending on class size, and requires no computers.

Keywords *asymmetric information, bank, classroom experiment, double oral auction*

JEL codes *A22, A23, G21*

This article describes how to run and debrief a classroom experiment on the economic role of banks. Participating in this experiment gives students hands-on experience with some of the banking principles taught in courses on macroeconomics and money and banking. Because most students are already familiar with using banks, this experiment is designed to inspire students to think more broadly about the banking system. It introduces students to the concept of banks as intermediaries that channel funds from savers to borrowers. The experiment demonstrates the problem of asymmetric information when borrowers (firms) go directly to households for financing. It shows the benefits of indirect finance when banks use their expertise in risk assessment to overcome the asymmetric information problem. In addition, the experiment provides a concrete example of the role of deposit insurance and the relationship between risk and interest rates. An extension of the basic experiment adds political risk.[1]

Mary Mathewes Kassis is an associate professor of economics at the University of West Georgia (e-mail: mkassis@westga.edu). Denise Hazlett is a professor of economics at Whitman College and the corresponding author (e-mail: hazlett@whitman.edu). Jolanda E. Ygosse Battisti is an assistant professor of economics at the São Paulo School of Business Administration of Getulio Vargas Foundation (e-mail: jolanda.ygosse.battisti@fgv.br).

This experiment is based on one designed with the help of Judith Brenneke, Cynthia Hill, and Richard Schiming at the 2005 Workshop on Classroom Experiments funded by the National Science Foundation.

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The experiment uses double oral auction credit markets with students taking the roles of bankers, households, and firms. A firm has the opportunity to undertake an investment project with a specified probability of success and rate of return. A firm has no funds of its own. In order to undertake its project the firm would need to borrow. A household begins each period with a cash endowment that it can lend either to a firm or to a bank, at an interest rate it negotiates, or spend on personal purchases that bring it satisfaction but no financial return. A bank attempts to borrow from households and lend to firms. A bank has no funds of its own. It would have to borrow from households in order to lend to firms. Banks have deposit insurance, so households cannot lose any funds they lend to banks.

The experiment consists of multiple market periods. At the beginning of every period, each firm randomly draws a project. There are three kinds of projects: high-risk, medium-risk and low-risk projects. Because banks have expertise in evaluating the riskiness of projects, banks observe what kind of project each firm draws. Because households have no such expertise, they do not observe what kind of project any firm draws. After all of the firms have drawn projects, loan negotiations begin between households, banks, and firms. Once the players finish negotiating their loans, the instructor randomly determines whether each project succeeded or failed.

RUNNING THE EXPERIMENT

In a principles-level course, we typically run the experiment before discussing the economic role of banks. The experiment thereby introduces banks as financial intermediaries and provides a common background for discussing asymmetric information, diversification, and deposit insurance. We have run this experiment with as few as 8 students and as many as 51. It could be run with a class as large as 75 students. For classes up to about 20 students, the experiment can be run in 50 minutes. Larger classes, or those with students who have never before participated in a double-auction experiment, will require as much as 75 minutes. Having an assistant help with passing out materials and recording the loans on the board speeds the process.

On the day of the experiment, the instructor makes sure that there is enough open space in the room for students to use it as a trading floor and for them to move from the trading floor to the board to report their results. Right before the experiment starts, the instructor makes a final count of the participating students, in order to assign the appropriate ratio of households, firms, and banks. The instructor should create approximately twice as many households as firms because each firm needs $10,000 to undertake its project, and each household has an endowment of $5,000. The instructor assigns 1 student to represent a household or firm and 2 to represent a bank. Assigning 2 students per bank provides enough staffing for the bank to simultaneously negotiate with households for deposits and with firms for loans. In large classes, we recommend having at least three banks. In very small classes, there can be as few as two banks, each staffed by 1 student.[2]

After determining the number of households, firms, and banks, the instructor has each student randomly draw a slip establishing the student's role in the experiment. To prevent confusion, it works best to identify firms by using letters (Firm A, Firm B, etc.) and households by using numbers (Household 1, Household 2, etc.). Banks are identified by name, such as First Bank, Second Bank, etc. The slip for a firm or bank simply states its identifying letter or name. The slip for a household states the household's identifying number and also the lowest interest rate that

household would be willing to accept to lend its funds. If the household does not get an offer of at least this interest rate, it would rather use the funds for personal purchases. The instructor tells households that these reservation interest rates are private information that no one else would know, so a household should not share this information with a firm, bank, or another household. These reservation rates range from 3% to 5%.

To speed the negotiating and recording process, the instructor gives students identifying nametags, for example, Firm B, Household 4, or Second Bank. An instructor with access to mesh practice jerseys could distribute them in three colors to help students distinguish at a glance a household, firm, or bank. The jerseys give the trading floor a festive, competitive atmosphere. After assigning roles, the instructor passes out the instructions and distributes the student record-keeping sheets. Appendices 1–3 show the basic format of the record-keeping sheets. These sheets describe the process of calculating profits and allow students to keep track of their results.[3]

The instructions for running the experiment appear in appendix 4. The instructor reads the instructions aloud, while encouraging students to ask questions. The instructor then begins period 1 by giving each household a $5,000 money card. Colored index cards work well here. Next, firms come one-by-one to the front of the room to draw their projects.

To prepare for the drawing of projects, the instructor has put slips in a hat, one per firm, with roughly one-third labeled "H" (for the high-risk project), one-third labeled "M" (for the medium-risk project), and one-third labeled "L" (for the low-risk project). To keep things simple, the distribution of project types stays the same across periods. Thus the instructor reclaims the slips after firms have made their draws, and reuses them in the next period. The instructor and the bankers stand at the front of the room observing each project drawn by a firm. The other firms and the households sit where they cannot observe the draw.

The instructor gives each bank a sheet as in table 1 to help it keep track of which type of project each firm drew that period. The instructor also uses one of these sheets to keep track of the draws. Each firm makes an individual note of what project it drew. However, in keeping with the information asymmetry, a firm has no official record of its project's type. In particular, a firm that tries to convince a household that it has a low-risk project cannot prove that claim.

From the instructions, everyone knows the probability of success for each of the three types of projects and the return if that type succeeds. If a project does not succeed, all of the funds put into it are lost. The projects have fairly low probabilities of success, making it likely that in each period some of the projects will fail.[4]

TABLE 1
Bank's Record of Project Return and Risk for each Firm, for a Class with 4 Firms

Period: _____ ID Letter of the Firm Drawing this Project	Project's Risk	Rate of Return on the Firm's Project if Successful
	High risk (50% chance of success)	124%
	High risk (50% chance of success)	124%
	Medium risk (70% chance of success)	60%
	Low risk (80% chance of success)	40%

Note: With 4 firms, the authors recommend having two high-risk projects.

Each bank establishes a location at the edge of the trading floor as a base from which to conduct negotiations. Firms and households interested in borrowing from or lending to a bank can go to the bank's location to negotiate. One or both of the bank representatives also can move around the floor to conduct negotiations.

After all the firms have drawn their projects for that period, the instructor opens the trading floor. Students will mingle, making offers to borrow or lend at an interest rate they specify. To get $10,000 to finance its project, a firm could borrow $10,000 from one of the banks, $5,000 from each of two banks, $5,000 from each of two households, or $5,000 from a bank and $5,000 from a household. For simplicity, households may not split their funds into multiple loans. So all loans from households to either a firm or a bank must be for exactly $5,000. Because a bank has no funds of its own, it borrows from households the funds that it lends to firms.

After a household makes a loan, it gives its $5,000 money card to the firm or bank to which it lent. The student representing the household then comes to the front of the room to report the loan information to the instructor. The household reports the interest rate on the loan, the household ID number and the identity of the borrower (either the firm's letter ID or the bank's name). The instructor records this information on the board for all to see. When a bank lends to a firm, it gives the firm either one or two money cards, depending on whether the loan was for $5,000 or $10,000. The firm that borrowed from a bank comes to the front of the room to report the loan information for the instructor to record on the board. The firm reports the amount lent, the firm's ID letter, the name of the bank, and the interest rate. A firm that has borrowed only $5,000 so far would continue looking for another household or bank to lend it the rest of the funds. Households who choose to use their $5,000 for personal consumption will give their $5,000 money card to the instructor.

After all students have finished negotiating and reporting their loans, the instructor closes the trading floor. The instructor then goes to each firm that borrowed enough to finance its project. The instructor asks each such firm to hold up its two money cards to verify that it obtained the full $10,000 financing. If the firm only borrowed $5,000, it cannot undertake the project and immediately gives the money card back to the household or bank from which it borrowed. If the firm has obtained the full $10,000, the instructor rolls a 10-sided die (or draws playing cards) to determine whether that project succeeds. Low-risk projects succeed on a roll of 1–8 and fail on a roll of 9 or 10. Medium-risk projects succeed on a roll of 1–7 and fail on a roll of 8–10. High-risk projects succeed on a roll of 1–5 and fail on a roll of 6–10.

If a firm's project succeeds, the firm will have the funds to pay back its loans, and it will earn a profit from the difference between the project's rate of return and the interest rate it paid on the loan. If a firm's project fails, the firm gets nothing from the project, but it still owes the funds it borrowed plus the interest on the loan. For each loan a bank makes on a project that succeeds, the bank earns a profit equal to the difference between the interest rate the firm paid on the loan and the interest rate the bank paid on deposits. For each loan that a bank makes on a project that fails, it loses the amount of the loan plus the interest that it owed depositors on those funds.[5] Households' returns on loans they make to banks are guaranteed by deposit insurance, so deposits always pay the interest promised. On a loan that a household makes to a firm for a project that succeeds, the household earns a profit equal to the interest on the loan. For a loan to a firm on a project that fails, the household loses the amount of the loan.[6]

After the instructor determines the success or failure of the projects, students calculate their profits for that period and record them on their record-keeping sheets. Some students may have

trouble calculating their profits at the end of the first period, so the instructor should circulate to provide assistance to those having difficulties. It also helps if the instructor reminds students to consult the examples of profit calculations in the instructions.

The first period takes the longest to run, because students are still getting comfortable with their roles. After everyone has finished recording his or her profits, the instructor will announce the start of a new period. For simplicity, each period is independent, so nothing that happened in the past will carry over to this new period. The instructor again gives each household a $5,000 money card, which the household may lend or use for personal consumption. Each household has the same reservation value it had before. Each firm will randomly draw a new project that would require borrowing $10,000 to undertake.

The instructor should plan to run the experiment for at least three periods, as it generally takes that much repetition for a pattern to emerge in the results. Typically there is an increase in interest rates charged to firms by households between the first and second periods, as households become more comfortable negotiating with firms. Students learn more about the market, as they see the period 1 results posted on the board, informing them of the interest rates negotiated by the other participants. Calculating their profits for period 1 also seems to help students understand the impact of the interest rates they negotiated. The dramatic losses that some households suffer in period 1 drive home the risk any household runs in directly financing a project. Seeing those failures sometimes inspires households to take their funds to the bank in subsequent periods or to require higher interest rates on loans to firms.

CREDIT MARKET CONDITIONS

Credit market conditions depend on the ratio of households to firms. With a ratio of two households per firm, each project could potentially get financed. A higher ratio results in an excess supply of funds, making fairly low interest rates more likely. A lower ratio results in tighter credit conditions, making higher interest rates more likely. In a class with 40 students, the instructor could distribute the roles as follows: three banks, each composed of two students, 10 firms and 24 households. This distribution, with its fairly high ratio of households to firms, results in excess funds in each market period. These excess funds reduce the likelihood of firms feeling perpetually frustrated by an inability to borrow. The trade-off is that banks may become frustrated if they find themselves unable to lend all of the funds they borrowed from households. The situation reverses if the instructor chooses a lower ratio of households to firms, generating tighter credit conditions. These results reflect the way actual credit market conditions depend on the ratio of lenders to borrowers. The authors sometimes run the experiment with a slight excess supply of funds, other times with a slight shortage of funds, and other times with a ratio of exactly 2 households per firm. All three situations are realistic, so the authors suggest instructors use whichever ratio they prefer.

PAYOFFS

The payoffs in the experiment may be hypothetical, or the instructor could choose to provide actual payoffs to encourage some friendly competition among students. We use different approaches. One author typically offers all students 5 bonus points on the final exam for participating in the

experiment and awards an additional 2 bonus points to each of the most profitable household, firm, and bank, from a period randomly selected after the experiment ends. Providing payoffs for only one period keeps up the spirits of those who have made losses in past periods, and who therefore suspect that they cannot possibly have the highest cumulative profits. Another author generally runs the experiment with hypothetical payoffs, although she sometimes provides candy payoffs to everyone, based on their profits in one period randomly selected after the experiment ends. Another author typically makes a cash payoff, or awards extra credit, to the highest cumulative earners in each role.

PATTERNS IN THE RESULTS

The experimental results depend on whether students in the various roles tend to be risk-prone, risk-neutral, or risk-averse. The number of project failures in the first period also seems to matter, as does the form the payoffs take. For instance, one author finds that when she uses grades for payoffs, her students display more risk aversion than when she uses money. Given the various ways group dynamics might play out, there is no particular pattern of results that instructors should expect. However, we have observed the following general trends across many of the sessions in which we have run the experiment:

1. Interest rates charged by households to firms tend to get pushed up after households gain some experience (i.e., after a period or two), to rates that are at least equal to but usually higher than the rates households can get at the banks. Households' willingness to accept lower interest rates on deposits than they could earn lending to firms shows that households find the deposit insurance guarantee valuable.
2. Banks generally lend at significantly different rates for projects of different risk profiles, showing that banks make good use of the information advantage they have over households.
3. Over the course of the experiment, high-risk projects tend to be financed increasingly by direct loans from households.

DISCUSSION DEBRIEFING

One approach to debriefing the experiment is to follow up during the next class period with a discussion that introduces the topic of banks. To start the discussion, the instructor defines banks as financial intermediaries in the credit market. Students are then asked to think back to the roles in the experiment and describe how banks were the middlemen in the transactions. Students typically note that the households who chose not to spend their money on consumption purchases were savers and that the firms were borrowers, which makes banks the intermediaries between savers and borrowers.

The instructor then turns the discussion to how financial intermediaries benefit the economy. The instructor asks the students who represented households to describe how they evaluated the risk of a firm's project when they were negotiating a loan with a firm. Students generally say that they took the firm's word for its risk level or that they did not really know how to evaluate risk.

The instructor then asks the students who had the role of firms if they always told households their true risk level. The answers to this question vary. Usually some students will admit that if they had high-risk projects they did not tell the truth (or at least had the incentive not to tell the truth). Other students have commented that they could not prove to households the true risk level of their projects because the instructor kept the risk slip that they drew. The instructor notes that because firms had more information than households about the true risk of their projects, there was a situation of asymmetric information in the credit market. The instructor asks the students whether banks had the same asymmetric information problem that households had. The students typically are quick to reply that banks did not have this problem because they were able to observe the type of project each firm drew. This response leads to a discussion of how banks have more expertise in evaluating a borrower's creditworthiness, making them better able to deal with the problem of asymmetric information. The relationship between risk and interest rates is also considered as the instructor leads students to discuss why they would want to charge firms with riskier projects a higher rate than firms with lower-risk projects.

Next, the instructor turns the discussion to the topic of diversification. The instructor asks the students who had represented households whether they would have liked to have had the option of splitting their funds between firms. Students usually comment that if they could have split their funds they would not have necessarily lost everything when the firm they lent to undertook a project that failed. Discussion is then focused on how banks have a greater ability to reduce risk through diversification, so that if one of their loans failed, the bank would not lose everything. The instructor explains that banks essentially take depositors' funds and lend them out to many different borrowers in a way that would not be possible for a single household.

Finally the discussion turns to the topic of deposit insurance. The instructor asks students about the risk to households who lent to banks. Students typically reply that there was no risk because bank deposits were insured. We recall that deposit insurance was a Depression-era reform designed to prevent bank runs. We then discuss some of the issues associated with the moral-hazard problem of deposit insurance. In particular, because deposits are insured, households are not concerned about whether a bank is making risky loans with their deposits. Banks therefore do not have to offer households high interest rates on the deposits used to finance risky projects. Banks can, however, *charge* a high rate to finance a risky project, generating a wide interest rate spread on the loan. By making depositors complacent, thereby reducing the bank stockholders' cost of risky lending decisions, deposit insurance encourages banks to make more risky loans than they otherwise would. This discussion is very interesting to students who often have never considered the potential negative consequences of deposit insurance.

ALTERNATIVE DEBRIEFING: A LABORATORY REPORT ASSIGNMENT BEFORE DISCUSSION

Instructors could assign a laboratory report in which students analyze the experimental results before the class debriefing. An example laboratory report assignment is available from the authors on request. The experimental results described in that assignment and discussed here come from a course on principles of macroeconomics with 22 students. There were two banks, six firms and

12 households, and the payoffs were hypothetical. When students turned in their reports the week following the experiment, the class held a discussion of their findings. Students found that the average interest rate firms paid households rose from 11% in the first period to 17% and 20% in the second and third periods. The number of these direct loans gradually increased over the three periods. The composition of the loans changed, too, as firms with the riskier projects increasingly used direct household financing to avoid the high rates charged by banks. On average, across the three periods, banks charged 18%, 22%, and 39% for the low-, medium-, and high-risk projects respectively. Households, not content with the 6% to 7% average rates banks paid on deposits, became increasingly open to negotiating with the firms. That negotiation usually started with the firm making a claim about the riskiness of its project. Sometimes households believed these claims. Some firms could support their claim of low (or medium) risk, by pointing to the fact that a bank had given them a low (or moderate) rate to finance half of their project. The interest rate for that loan was written on the blackboard, so the firm could literally point it out to a household. In part because of this free-riding on the bank's expertise in evaluating risk, students concluded that households in general charged lower rates to firms with less risky projects. On average, across the three periods, firms with low-, medium-, and high-risk projects paid households 14%, 14%, and 19% respectively.[7]

The class with the laboratory report assignment also answered a question about the experiment on the final exam five weeks later. The question simply asked students to describe what they learned from the banking experiment. Sample answers from three students appear below:

Sample Student Answer 1 follows:

In the banking experiment, we learned about savings and the risks associated therein. Each firm had a project that would produce a return based on the risk level of the project. The riskier the project the greater the potential return, but also the greater chance to fail. The households could either invest (macroeconomically speaking, this is saving) directly in a firm or in a bank. The banks gave a much lower return rate, but the deposit was federally assured, so there was no chance of losing money, while if you invested in a firm and its project failed, you would lose all of the investment. Therefore, if the households wanted to maximize returns they went to the firms, and to minimize risk they went to a bank.

The banks were knowledgeable about the risk level of the firms' projects and could make loans accordingly. Therefore, the firms were able to get much better (ie lower) rates from the uninformed households.

Sample Student Answer 2 follows:

To be specific and relevant to the current economic situation, I learned to try and make large profits it is a good idea to bring projects to those who know the least about your project. It is easy to confuse and sell a project to an investor at incredible interest rates if they lack the knowledge to evaluate the project themselves.

Conversely, I learned that as a household or one with little apraising [sic] expertise it is a good idea to research and be smart with where you invest.

Sample Student Answer 3 follows:

This experiment was all about risk. In this experiment the firms were trying to finance projects of various risks via households and/or bank investment. Overall there appeared to be a relative willingness to take the risk on the part of the household. I attribute this to the fact that it was not

real money we were dealing with, thus, it was easy to take the risk because it didn't actually pose any threat to our wellbeing. This was the most important lesson because it helped explain part of the current economic crisis. Part of this happened through the originate to distribute loans which were in fact very risky, but because they were distributed few cared about the risk because they made their profits, or it was no skin off their back when they failed. Thus, it is important to keep the risk as real and tangible as possible by keeping everyone's skin in the game.

A POLITICAL RISK VARIATION OF THE EXPERIMENT

One of the authors runs a variation of the experiment that helps students understand how important political stability is for credit markets. The situation comes from an experience in 1990 in Brazil. The day after his inauguration, President Fernando Collor de Mello froze all savings deposits over an amount equivalent to US$1300. A sharp drop in economic activity followed his surprise move.

After running several periods without political risk, the instructor announces that in the next period, a household's access to its bank deposits will depend on the outcome of an election that takes place at the end of the period. The instructor puts a number of different names in a hat, one of which is Candidate X, who will partially freeze households' bank deposits if elected. The instructor announces that if X wins, all households who deposited their funds in a bank will get only half of their funds back, plus half the accrued interest. After all students have made their lending decisions and before throwing the die for each project, the instructor asks one of the students to determine the election outcome by drawing a name from the hat.[8]

As expected, the author found that some households who in the previous periods had settled into lending their funds to banks now stopped lending altogether. Instead, they spent their funds on personal purchases. With fewer deposits in the banks, the number of projects financed typically dropped sharply.

Recall that households can lend their funds to firms, lend them to banks, or spend them on personal purchases. For simplicity, households have no other options in the experiment. In the debriefing, the instructor draws attention to those households who, in the face of political risk, chose to stop depositing in a bank and to consume instead. The instructor asks what options these households would have liked for their funds, other than consumption. Students typically remark that they would have liked to be able to put their funds in safe assets, such as real estate or investments abroad. This response leads to a discussion of how important political stability is to ensure that financial intermediation by banks works smoothly. It also illustrates the economic importance of well-functioning credit markets.

CONCLUSIONS

This experiment provides a concrete and memorable demonstration of the economic role of banks. It can be used to promote class discussion on asymmetric information, diversification, and the relationship between risk and interest rates. It also illustrates some of the issues associated with the moral-hazard problem of deposit insurance. The experiment is fun and can inspire even normally quiet students to participate in class. Students get excited about the game and will cheer and groan as a roll of the die determines the success or failure of their project. After participating

in the experiment, students have a rich background for a discussion of credit markets in general and the economic role of banks in particular.

NOTES

1. Other classroom experiments involving banks include Hester's (1991) computerized simulation of bank portfolio management, Cameron's (1997) and Laury and Holt's (2000) money creation exercises, Hazlett's (2003) federal funds market experiment, and Balkenborg, Kaplan, and Miller's (2011) bank run experiment.
2. In the class with 8 students, there were two banks (represented by 1 student each), two firms and four households. In this case, two banks seemed to generate adequate competition, whereas one bank would not.
3. A fuller version of this article with the complete materials for running the experiment is available from the authors upon request.
4. Note that to a risk-neutral firm, undertaking each of the projects looks equally attractive, because the projects have the same expected return. [The low-risk project's expected return is $(0.8)(0.4) + (0.2)(-1)$, the medium-risk project's expected return is $(0.7)(0.6) + (0.3)(-1)$, and the high-risk project's expected return is $(0.5)(1.24) + (0.5)(-1)$, all of which equal 0.12.] However, a risk-neutral lender would not see these projects as equally attractive. For instance, a risk-neutral lender who was offered the same interest rate for funding a high- or medium-risk project (say, 20%) would find the medium-risk project to be the better deal. With the medium-risk project, the lender has a 7/10 chance of collecting the 20%. With the high-risk project, the lender has only a 5/10 chance of collecting the 20%. In the event of project failure, the lender is equally poorly off with either project; he or she loses everything lent. A risk-neutral lender therefore wants a higher interest rate for the riskier project to offset the lower likelihood of repayment.
5. We assume that the loans a bank makes in this experiment are part of its larger overall operations. So when a bank suffers a loss on a particular loan, we do not assume that loss drives the bank into insolvency. A bank that financed a failed project therefore ends that period assuming it will have to pay back depositors, rather than closing down and having the deposit insurance fund repay its depositors.
6. In the case where a firm's project fails, the firm defaults on the loan because it does not have the funds to make the payment on time. This default (i.e., failure to make timely payment) does not mean the loan obligation is canceled. The firm ends the period still owing the funds. In the real world, the future resolution of this default situation would be a legal issue. However, that resolution is outside the scope of this experiment. Because of the uncertainty of any future repayment, the households and/or banks that lent to this firm end the period by considering the loan a loss.
7. In their laboratory reports, most students described a 35% household-to-firm loan in period 2 as an outlier and omitted it from their calculations. That omission made their calculation of the average rate on household funding of low-risk projects 11% over the course of the three periods. They then reported that, on average, across the three periods, firms with low-, medium-, and high-risk projects paid households 11%, 14%, and 19%, respectively. Students emphasized in their written analyses and in the follow-up discussion their conviction that they had experienced a market where households had some, but not perfect, ability to distinguish the riskiness of projects. They cited two sources of that ability: that firms sometimes told the truth, and that in the cases where a firm had already gotten half of its financing from a bank, households could see the rate the bank had charged. Students also noted that firms did sometimes lie about the riskiness of their projects.
8. Alternatively, limiting the number of presidential candidates to two, the instructor can ask 1 of the students to flip a coin to determine whether Candidate X won the election.

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APPENDIX 1: HOUSEHOLD RECORD-KEEPING SHEET

Name: _____ Household ID: _____

Period	Amount available to Lend	Loaned to	Interest Rate on Loan	Interest Income on Loan to Bank, or on Loan to Firm if Project Succeeds = $5,000 × (interest on loan)	Loss of $ 5,000 on Loan to Firm Firm if Project Fails
1	$5,000	. . .	. . .	. . .	. . .

Note: Student record-keeping sheets would have a row to record data for each period of the experiment.

APPENDIX 2: FIRM RECORD-KEEPING SHEET

Name: _____ Firm ID: _____

						If Project Succeeds		**If Project Fails**
Period	Project Risk Type	Loan Amount	Borrowed from	Interest Rate on Loan (i)	Rate of Return on Project (R)	Average Interest Rate on Loans (average i)	Profit = ($10,000) × (R − average i)	Loss = − $10,000 − [($10,000) × (average i)]
1	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
		. . .	. . .	. . .				

Note: Student record-keeping sheets would have a row to record data for each period of the experiment.

APPENDIX 3: BANK PROFIT/LOSS RECORD-KEEPING SHEET

Name: _____ Bank ID: _____

Bank Profit/Loss Record

Period 1

Deposits		Loans				
Household ID	Interest Rate paid on $5,000 Deposit	Firm ID	Loan Amount	Interest Rate Received	Profit if Project Succeeds = (loan amount) × (interest rate received − average interest rate paid on deposits)	Loss if Project Fails = − (loan amount) − [(loan amount) × (average interest rate paid on deposits)]
. . .						
	. . .	. . .	. . .	. . .	. . .	. . .
. . .						
	. . .					
Average Interest Rate Paid on Deposits:					Total Profit from Successful Projects:	Total Losses from Failed Projects:
	. . .				. . .	. . .

Total Profits from Successful Projects _____

Minus Total Losses from Failed Projects _____

Minus (total deposits not loaned out) × (average interest rate paid on deposits) _____

Total Profit or Loss this Period _____

Notes: A separate bank profit/loss record-keeping sheet is required for each period of the experiment. Each record-keeping sheet would have enough rows to record all potential deposits and loans that period.

APPENDIX 4: INSTRUCTIONS FOR THE BASIC EXPERIMENT

You are about to participate in an experiment involving borrowing and lending. The experiment will consist of a series of market periods. Your record-keeping sheet tells you whether you represent a firm, a household, or a bank.

Firms

Let's consider those of you who represent firms. Each of you will have a risky investment project that you may undertake, if households or banks lend you the funds to finance it. There are three kinds of projects: high-risk, medium-risk, and low-risk. The table below shows the probability of success for each type of project, and the return the project provides if successful. If a project does not succeed, all the funds put into it are lost.

Each of you representing a firm will randomly and secretly draw one of these three kinds of projects at the beginning of the period, before negotiating for loans to finance the project. In each period, there is an approximately equal number of each type of project. All of the banks will know what kind of project you drew, because banks have expertise in evaluating the riskiness of firms'

APPENDIX 4 (CONTINUED)

TABLE 2
Types of Projects and Rates of Return

Type of Project	Project's Probability of Success	Project's Rate of Return if Successful
High-risk	50% chance	124% return
Medium-risk	70% chance	60% return
Low-risk	80% chance	40% return

projects. Households have no such expertise, so they will not know what kind of project you drew. Undertaking your project requires $10,000 in financing. Each household can lend $5,000. So, you could finance your project by borrowing $5,000 from each of two households. Alternatively, you could borrow $10,000 from one of the banks. Or, you could borrow $5,000 each from two banks, or $5,000 from a bank and $5,000 from a household. For each loan, you want to pay as low an interest rate as possible. You should never pay more than your project's rate of return, or you would be guaranteed to make a loss. If you do not borrow to finance your project, you earn zero profits that period.

Let's consider what happens if you borrow $10,000. After you negotiate your financing, the instructor will roll a 10-sided die to determine whether your project succeeds. If your project is low-risk, it succeeds on a roll of 1–8, and fails on a roll of 9 or 10. If your project is medium-risk, it succeeds on a roll of 1–7 and fails on a roll of 8–10. If your project is high-risk, it succeeds on a roll of 1–5 and fails on a roll of 6–10. If your project succeeds, you will have the funds to pay back the loans, plus you earn a profit equal to $10,000 times the difference between your project's rate of return and the average interest rate you paid for the loans.

For example, suppose you drew a low-risk project, so your project's rate of return if successful is 40%. Suppose you obtained a $5,000 loan at 8.5% and a $5,000 loan at 9.5% (an average interest rate of 9%).

*If your project **succeeds**, your profit equals ($10,000) × (0.40–0.09) = $3,100.*

*If your project **fails**, you would owe the $10,000 you borrowed, plus the interest due on the loans, so your loss would be −$10,900.*

At the end of a period, if you borrowed only $5,000, you would not have enough funds to undertake your project, so you would give the $5,000 back to the household or bank who lent it to you.

Banks

Let's consider those of you who represent banks. Banks attempt to borrow money from households and then lend these funds to firms, so that the firms can undertake their projects. Banks have no funds of their own, so they must borrow funds from households before they can make any loans to firms. Banks do have deposit insurance, so households cannot lose any money they lend to banks. When each firm draws its investment project, all of the banks will observe which kind of project each firm drew. Banks will not share this information with households or with other firms. Banks would like to pay as *low* an interest rate as possible on the *funds they borrow* from households; and earn as *high* an interest rate as possible on the *funds they lend* to firms. A bank can borrow from as many households as it can convince to lend to it, but it must borrow all of a household's $5,000. It cannot borrow fractions of $5,000. A bank can lend to as many different firms as it can convince to borrow from it. A bank can lend either the full $10,000 that a firm needs to finance its project, or it can lend

APPENDIX 4 (CONTINUED)

$5,000, and the firm can attempt to get financing for the other $5,000 from another bank, or directly from a household. For any funds a bank borrows from households but does not lend to firms, the bank owes the promised interest to the households, so that amount of interest is subtracted from the bank's profits.

In each period, a bank calculates its profit as follows: For each loan that it makes on a project that **succeeds**, the bank's profit equals the amount it lent times the difference between the interest rate received on the loan and the interest rate paid to obtain the funds from households.

For example, suppose you borrowed from three households, paying 5.5%, 4.9% and 4.6% on these three loans of $5,000 each. You pay an average interest rate of (5.5% + 4.9% + 4.6%) ÷ 3 = 15% ÷ 3 = 5%. Suppose you made a $10,000 loan at 10% interest to finance firm C's low-risk project, which succeeded. You made a $5,000 loan at 21% interest to partially finance Firm A's high-risk project, which also succeeded. Your profit that period would be ($10,000)×(0.10–0.05) + ($5,000)×(0.21–0.05) = $500 + $800 = $1,300.

For each loan that it makes on a project that **fails,** the bank gets no repayment from the firm. However, the bank must still repay the amount it borrowed from households, plus the interest it promised them.

For example, suppose you borrowed from four households at an average interest rate of 5.2%. Suppose you made a $10,000 loan at 8.4% interest to finance firm D's low-risk project, which failed. You made a $10,000 loan at 14.5% interest to finance firm E's medium-risk project, which succeeded. You would make a loss that period equal to −($10,000 + $10,000×0.052) + ($10,000)×(0.145–0.052) = −$10,520 + $930 = −$9,590.

Note that banks will be concerned about the riskiness of the projects the firms will be financing. In particular, lower-risk projects will have a greater likelihood of succeeding, in which case the bank actually gets repaid. On a lower-risk project, the bank might therefore charge a lower interest rate than it does on a higher-risk project.

Households

Let's consider those of you who represent households. You start each period with $5,000. You may choose to either (1) lend the funds to a firm so that the firm can finance its project, or (2) use those funds for personal purchases, such as family travel, which would bring you happiness but no financial return, or (3) lend the funds to a bank. You must put all of your $5,000 into only *one* of these three options. Your private information slip gives you information about your willingness to lend your funds. If you do not get an offer of at least the interest rate listed on your slip, you would rather use your funds for personal purchases. Your profit on a loan to a firm for a project that succeeds is the interest that you earn on the $5,000 loan. However, if the project fails, you lose your $5,000. Your profit on a loan to a bank is guaranteed by deposit insurance, so your profit on that loan would be $5,000 times the interest rate you negotiated with the bank.

For example, suppose you made a $5,000 loan to firm C at an 8.5% interest rate.

*If C's project **succeeds**, your gain for that period would be ($5,000 × 0.085) = $425.*

*If C's project **fails**, you would lose your $5,000.*

If instead you made a $5,000 loan to a bank at a 4.5% interest rate, then your profit would be guaranteed to be ($5,000 × 0.045) = $225.

When making a loan, you prefer to get a high interest rate over a low interest rate, if all else is equal. Also, at any particular interest rate, you would prefer to make a loan to a firm with a *less* risky project over a loan to a firm with a *more* risky project, because the less risky project has a greater likelihood of succeeding, so that you actually get repaid. So, if you make a riskier loan, you would want a higher interest rate to compensate you for that risk. Note that loans to firms are always riskier

APPENDIX 4 (CONTINUED)

than loans to banks. Banks have the deposit insurance guarantee, whereas any firm's project might fail and leave you with nothing.

Negotiating Loans

A period begins with the instructor passing out one card representing $5,000 to each household. Then, each of the firms randomly draws a project, while the banks observe these draws. Next, households, banks and firms negotiate loans via a double oral auction. They will mingle, making offers to borrow or offers to lend at interest rates they specify. After a household makes a loan, they will give their money card to the firm or bank to which they made the loan. The person representing the household will then come to the front of the room to report that loan contract to the instructor. The household will report the interest rate on the loan, the household's ID number, and the identity of the borrower (which would be either the firm's ID letter or the bank's name). The instructor will record this information on the board for all to see, and then the household will sit down and wait for the period to end. When a bank lends to a firm, it will give the firm one or two money cards, depending on the size of the loan. After a bank lends to a firm, the firm will come to the front of the room to report the information on that loan contract for the instructor to record and all to see. The firm will report the amount lent, the interest rate, the firm's ID letter, and the name of the bank. A firm that has borrowed only $5,000 so far would continue looking for another household or bank to lend to it. Households who choose to use their $5,000 for personal consumption will give their money card to the instructor.

Once everyone is done negotiating and reporting all of their loans, the instructor will close the loan market. If a firm was only able to borrow $5,000, it will immediately return the $5,000 to the household or bank that lent it. The household or bank would not earn any interest on that loan. Then, the instructor will go individually to each firm that got financing for its project, and roll the die to determine whether that project succeeds. Next, everyone will calculate their profits for that period, and record them on their record-keeping sheets. Once everyone has finished recording their profits, the instructor will announce the start of a new period, in which everything begins anew. Nothing that happened in the past will carry over to this new period. Each household will again receive a $5,000 money card, which it may lend or use for personal purchases. Each firm will again randomly draw a risky project that would cost $10,000 to finance. The distribution of project risk will be the same for each period.