

CLASSROOM GAMES

MAKING MONEY

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Abstract: This paper describes a classroom exercise in which students are engaged in the process of money creation, via a circle of loans and deposits. This exercise provides an interactive framework that facilitates discussions of monetary policy and the banking system. In particular, going through the sequence of financial operations gives students a concrete mental image of the money creation process, enabling them to evaluate the effects of relaxing standard assumptions.

Keywords: monetary policy, experimental economics, classroom experiments.

INTRODUCTION

A crucial part of the discussion of monetary policy in an introductory economics class is the role that banks play in the creation of money. Following an initial injection of reserves by the central bank, commercial banks are the vehicle through which money is created. Students frequently find this process mysterious or even suspect after the traditional classroom presentation of the multiple expansion of deposits. As an alternative, students can be involved in the money-creation process through a simple classroom exercise in which they take on the roles of a banker, depositors, and borrowers.

The primary objective of the exercise is to demonstrate how an initial injection of reserves (in this case, by open market operations) leads to a multiple increase in deposits.¹ It may also be used to initiate discussion of the bank's role as a financial intermediary, the importance of

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¹ The details of open market operations, and the motivation for using monetary policy tools, can be addressed in subsequent classes.

depositors' confidence in a bank's solvency, and the role of the central bank in regulating the banking system. This exercise can be referred to later, when the Federal Reserve's monetary policy tools are taught.² The money creation exercise can also be used as a review in intermediate macroeconomics and money and banking classes. In an introductory class, it should follow an introduction to the U.S. banking system. In particular, fractional reserve banking and the associated terms (required reserve ratio, required reserves, actual reserves, excess reserves, and M1) should be defined. This exercise involves about twenty students, and those seated nearby usually pay attention; the benefits will be diminished in classes larger than fifty students.

PROCEDURES

A limited amount of preparation must be done before class begins. Each student should receive a copy of the instructions provided in the appendix; these will fit on two sides of a single sheet of paper.³ In addition to copying the student instruction page, you will need to prepare classroom dollars, government securities, and personal checks. For these, you can use ten index cards (or pieces of paper) marked "\$20," ten cards marked "\$20 Government Security," and ten to twenty index cards to serve as personal checks.

Before beginning the exercise, it is useful to provide a bit of historical perspective on the origins of fractional reserve banking. As noted in Case and Fair (1996), gold was often used as the medium of exchange. Goldsmiths provided receipts for deposits, and soon these receipts began to circulate instead of gold. Because depositors withdrew gold infrequently, the goldsmiths realized they could make loans (and earn interest) by issuing receipts that did not correspond to new gold deposits. This was not a problem unless too many people came in to withdraw gold at the same time. This example illustrates why the money supply may be greater than the reserves available to back up deposits.

At the beginning of class, recruit three volunteers to serve as the banker, the bank record

² This basic setup can be supplemented later in the course to allow for several banks and for private investors with heterogeneous opportunities. These modifications allow the endogenous determination of interest rates and bond prices, and a discussion of the inverse relationship between the two. This will be a topic of a future column.

³ The appendix also contains a step-by-step summary of the preparations and procedures for use by the instructor.

keeper, and the individual record keeper. Next, distribute the government securities to other students, and read the instructions aloud. Two assumptions are emphasized: all money is deposited in the bank (none is held as cash), and all excess reserves are loaned out.⁴ As indicated in the instructions, explain that you are the central banker, and that you regulate the banking system. Publicly inform the banker of the required reserve ratio (20 percent works well). Explain that all reserves are held in the form of "vault cash" (cash held by the bank that is not in circulation). For simplicity, the bank begins with no money in deposits (and thus no loans or reserves). It should be pointed out that the initial money supply (deposits + cash held by the public) is zero. Some of these concepts may need to be reviewed briefly, and students should be encouraged to ask questions as they arise. Answers to some questions may be postponed until after the exercise.

To start the exercise, announce that (as the central bank) you wish to purchase government securities from students in the amount of \$100, and that you will pay for them in classroom dollars. In our experience, it is never a problem to find students who wish to sell their securities, and you can purchase from the first five who volunteer to do so. Remind students that all cash is deposited in the bank. The individual record-keeper should publicly record the deposit by listing the student's name and deposit amount on a new row on the blackboard. The banker should give each depositor several blank checks when a deposit is made.

In addition to the individual record keeper, a second student should keep track of the bank's balance sheet. Some elaboration will prove helpful when recording the deposit on the bank's balance sheet. That deposits increase to \$100 will be obvious to most students, but they may need to be reminded that classroom dollars held by the bank are the bank's reserves. The bank record keeper should record the change in reserves and deposits on the bank's balance sheet. Next, ask what has been the initial change in the money supply. The answer sometimes given is \$200, which is incorrect because the money supply is the sum of deposits and cash held *outside* of the bank. The instructor should summarize the discussion at this point by recording the money supply and reserves on the chalkboard.

⁴ Neither of these is crucial in terms of the descriptive quality of the results. Part of the post-exercise discussion should focus on what would be the effect of relaxing each of these assumptions.

Given this initial injection of reserves, the banker will be able to increase loans. A series of leading questions will guide the banker (and the class) through the banker's lending decision.

1. What percentage of deposits must you hold in reserves? (20 percent)
2. What amount of reserves must you hold? ($.20 \times \$100 = \20)
3. How much do you currently hold in reserves? (\$100)
4. What is the amount of your excess reserves? ($\$100 - \$20 = \$80$)
5. How much may you legally loan out? (\$80)

The banker should find one (or more) volunteers and loan out a total of \$80. For the first round of borrowing it may be helpful to give classroom dollars to the borrowers and record the decrease in reserves and increase in loans. In later rounds, it is quicker to have a loan show up directly as an increase in deposits without using classroom dollars. A frequent source of confusion is about how reserves change in response to a change in loans and deposits. This is because students confuse reserves (vault cash) with "money." A little bit of drama helps to alleviate much of this confusion. Have the banker hold up the classroom dollars that are held as reserves and publicly count them at each stage in the recording process.

The classroom dollars must be re-deposited with the bank, with these deposits recorded on the individual account records and on the bank's balance sheet. As before, the instructor should record the current level of reserves (\$100) and the money supply (\$180), noting that reserves have not changed but the money supply has increased by \$80. It is typical for at least one student to say that reserves have also increased by \$80 (for a total of \$180 in reserves). Ask the banker to count the amount held as vault cash to show that reserves are still \$100.

Students frequently find it suspicious that deposits can increase without an equal increase in reserves. Ask why this is possible, prompting them with a reminder about the fractional reserve requirement if necessary. A specific example may also help. A student has no trouble writing a check at the grocery store because the store cares only whether you have that amount in your account, not whether the bank has enough vault cash to cover all deposits. Conclude the discussion by telling them that it is the fact that the government permits banks to loan out a fraction of their deposits, because only a small percentage are withdrawn at any given time, that makes this possible, profitable, and legal. Another question that often arises at this point is what happens if one or more of the depositors wish to withdraw their money. This is best left until

the end of the exercise.

It is not necessary to repeat this procedure for many rounds, but at least one additional round in which $.20 \times \$180 = \36 must be held as reserves and the remaining \$64 is loaned out and redeposited can be conducted and recorded. Calculate the total money supply ($\$100 + \$80 + \$64 = \244) and the amount of reserves in the system (\$100). Point out that the increases in the money supply (and deposits) are smaller at each stage, and ask why this is the case. A series of leading questions may help focus students on the proper intuition. Is the amount of reserves in the system changing in response to the changes in deposits? What is happening to deposits? As deposits increase, with a required reserve ratio of 20 percent, what happens to required reserves? As required reserves increase, and with no change in actual reserves, what happens to excess reserves?

Once students grasp that the excess reserves available to be loaned out decrease at each stage in the procedure, they quickly observe that this process must eventually end. At this point the standard discussion of the maximum deposit expansion can be used to show that deposits (and the money supply) will increase by a total of \$500. Verify that when this happens the bank will hold no excess reserves and no more can be loaned out. Record the additional changes (an increase in loans and deposits of \$256) on the bank's balance sheet, and pick a student to receive the loan. Some students may question why it was necessary to go through the iterative process, because the initial injection of \$100 can support up to \$500 in deposits. This is a natural place to mention the effect of having more than one bank or the uncertainty about how much of a loan will be redeposited in one's own bank.

Although a number of questions arise during this part of the exercise, students typically understand the creation of money by banks more easily than how the money supply decreases. A second example will help to alleviate this confusion. Explain that the central bank has now decided to sell government securities in the amount of \$40. Find a volunteer (among those who have deposits with the bank) to buy the securities from you. Have the student write a check for \$40 to the central bank, and then give it to the banker to receive payment.

The payment will be recorded on the student's account record as a decrease in deposits. When recording this on the bank's balance sheet, some elaboration in the first stage of the process should be used. The banker must give you \$40 from the bank's reserves, which may be

placed in the central bank's "vault" (a file folder works well). This amount must be subtracted from the bank's reserves, and deposits decrease by \$40 as well. Record the new level of reserves (\$60) and the money supply (\$460) on the chalkboard.

The five questions used to assist the banker with lending decisions in the previous example may be used again to show that required reserves ($.20 \times \$460 = \92) exceed actual reserves (\$60) by \$32. The banker should then be instructed to "call in loans" in the amount of \$32 by choosing a borrower to write the banker a check for this amount. The borrower's and bank's account records will reflect a decrease in loans and deposits of \$32. Calculate the new level of the money supply ($\$500 - \$40 - \$32 = \428) and of reserves (\$60). It should be noted that the money supply has decreased by \$32, but there has been no change in the level of bank reserves.

Students frequently question the act of calling in a loan. Point out that in reality borrowers make payments on loans daily, and this money is typically loaned out again to others. Calling in a loan is equivalent to a borrower making a loan payment, and the money being retained by the bank.

As before, the decrease in deposits is not enough to reduce required reserves to the level of actual reserves, so additional loans must be called in. Students should notice that the decrease in loans (and deposits) at each stage is getting smaller. The standard classroom discussion may then be used to show that the eventual change in the money supply is -\$200. Verify that when this happens actual reserves are equal to required reserves. The appendix contains a summary of these procedures.

CLASS DISCUSSION

This exercise typically lasts less than 30 minutes, leaving time for additional discussion. A good jump-off point is to have the banker summarize the bank's role in the creation of money following an initial injection of reserves by the central bank. Ask the class to differentiate between the roles played by the central bank (which makes the initial injection) and the bank (which makes the loans, causing a multiple increase in deposits).

Now that the students have a more vivid picture of the money creation process, they are better able to analyze changes in the standard assumptions. They should be able to see that the

assumption of a single bank simplifies the record-keeping but has no effect on the actual change in the money supply. Students should be encouraged to determine for themselves the effect of relaxing the other assumptions. Again, leading questions may help. Ask a student what would have happened if, in the first step, one of the five students who received \$20 for a security had held this as cash. Show that deposits (and reserves) would have increased by just \$80, with required reserves of \$16, and excess reserves of only \$64. Because this is exactly what happened in the first example (after the initial \$100 deposit), they will observe that the money supply would have increased by \$400 instead of \$500.

This is a good time to bring up the effect of a depositor making a withdrawal from a bank. The similarity between this and the situation in which the central bank sells a security may be noted. Point out that this is not a problem unless more people decide to withdraw their money than may be supported by the bank's reserves. This can lead to a discussion of the central bank's role in stabilizing the banking system and the importance of the required reserve ratio.

Next consider the effect of allowing the bank to hold excess reserves. Students should notice that the amount loaned out at each stage will decrease, which must result in a smaller increase in deposits (and the money supply).

It can help future lessons to discuss the effect of a change in the required reserve ratio. Use the bank's balance sheet to show how loans and deposits would change in response to such a change. This will come up again when monetary policy is presented, but students typically have better intuition about these effects immediately following the exercise.

FURTHER READING

We are not aware of any experimental studies of the money creation process, but there are a number of papers that examine the functions of money. McCabe (1989) reports an experiment with a fiat money in which its value becomes unstable because of the finite horizon. Brown (1996) and Duffy and Ochs (1996) implement versions of a Kiyotaki and Wright (1989) exchange economy in which one or more commodities are used as a medium of exchange. There are also several working papers in which money is a key element in macroeconomics experiments: Lian and Plott (1993), Evans, Honkapohja, and Marimon (1995), and Hey and di Cagno (1996).

APPENDIX: INSTRUCTIONS

This is an exercise demonstrating the role U.S. banks play in the creation of money. There will be an opportunity for many of you to play roles in this exercise. The banker has been given a folder that will serve as the vault, and will be responsible for managing deposits and making loans. Record keepers will assist the banker by recording deposits, loans, and repayments on the blackboard. There will be an Individual Record Keeper and a Bank Record Keeper. In addition to these people, a number of you have been given government securities. You will have an opportunity to sell your securities and deposit the money you receive in the bank. Others will have the chance to borrow money from the banker. I am the central banker, and I regulate this banking system. There are several rules that will be enforced:

1. The required reserve ratio (the percentage of deposits that the bank must hold as reserves) is 20 percent.
2. The bank holds no excess reserves. All excess reserves are loaned out.
3. All money must be deposited in the bank (none may be held as cash).

Some reminders:

1. Money Supply (M1) = demand deposits
+ cash held outside of banks
+ travelers' checks and other checkable deposits.

In this example, the money supply equals demand deposits because all cash must be deposited, and there are no travelers' checks or other checkable deposits.

2. Reserves = bank deposits with the central bank + cash held by the bank. So cash held by the public is part of the money supply, while cash held by the bank is considered "reserves." Money that the central bank has in its own account is not part of reserves or the money supply.

(Recruit volunteers to serve as banker, bank record keeper, and individual record keeper.)

Instructions for the Banker: The banker manages all deposit and lending activity. When a deposit is made, the banker must compute the reserve requirement on deposits (0.20 x the total amount of deposits) and loan out any excess reserves (the difference between total reserves and required reserves). For example, if \$100 is deposited in the bank, required reserves are: .20 x \$100 = \$20. The remaining \$80 must be loaned out.

Instructions for the Individual Record Keepers: You will keep the records of individual's deposits and loans on the blackboard. They will appear as:

Name	Demand Deposits	Loans
Tim	\$20	\$20
John	\$20	\$0

Each entry can be adjusted as additional deposits and loans are made or withdrawn.

Instructions for the Bank's Record Keeper: You will be provided with a balance sheet, such as the one below:

Bank's Balance Sheet

Assets	Liabilities
Reserves	Deposits
Loans	

Any change to the bank's level of deposits, loans or reserves should be recorded. For example, if a \$100 deposit is made, an entry of +100 should be recorded under deposits. A corresponding change must always be made on the other side of the balance sheet (so that it balances). If the deposits came from actual cash being deposited, the reserves would also show an entry of +\$100.

Sequence of Events: As the central banker, I will offer to purchase \$100 in government securities from you, and pay for them with classroom dollars. Any money received must be deposited in the bank. The banker will calculate required reserves and then loan out any excess reserves. The money received from the loan must be deposited back into the bank, and then the process will be repeated.

After the money creation process has ended: I will now offer to sell \$40 in government securities to someone who has at least \$40 in deposits with the bank. In exchange for a check, I will give you the government securities. I will then cash the check with the bank, and receive \$40 of the bank's reserves to honor this check, which I will put into my own central bank vault. The banker will then calculate the required reserves, and must "call in loans" in the amount of the shortfall. This process will then be repeated.

For the Instructor:

1. Before class, prepare government securities (ten \$20 securities), cash (ten \$20 bills), checks (twenty). It may be helpful to have a transparency prepared that can be used by the banker to determine how much money must be loaned out (or called back in). Bring two file folders to class: one will serve as the bank's vault and the other as the central bank's vault.
2. As students enter the classroom, give out the government securities.
3. Read the instructions.
4. Recruit 3 students: one banker, and 2 record keepers.
5. Offer to purchase securities from 5 students; pay these students with classroom dollars.
6. Prompt these students to deposit their money with the banker, who will give them checks in exchange for their deposits. Instruct the individual record keeper to record each deposit.
7. After all deposits have been made, the bank's balance sheet must be updated on the chalkboard. Deposits have increased by \$100. Have the banker count these reserves (\$100); this should be recorded on the balance sheet. Instruct the banker to put these reserves in the "vault."
8. On the chalkboard record the change in the money supply (\$100) and in reserves (\$100).
9. Assist the banker in calculating required reserves, excess reserves, and loan amount. Instruct the banker to loan out the (\$80) of excess reserves to a student volunteer(s).
10. Repeat steps (6) - (9). Demonstrate that in step (8) the money supply has increased by another \$80, but reserves have not changed. Have the banker publicly count the reserves if necessary.
11. Show that the money multiplier predicts an eventual \$500 increase in deposits:
$$\Delta M^s = (\text{initial injection}) \times (1/\text{required reserve ratio}) = \$100 \times 1/.2$$
Verify that when deposits equal \$500, with a required reserve ratio of 0.2 that there are no excess reserves (required reserves = $.20 \times \$500 = \$100 =$ actual reserves).
12. Update the bank's balance sheet, noting the increases in deposits required to make total deposits equal to \$500, and the increase in loans required to make the total amount of loans equal to \$400. Record the remaining loans on a student's account record.
13. Offer to sell two \$20 securities to one student with at least this much cash on deposit.

14. Have the student write a check for this amount, and cash it with the bank. Take \$40 from the bank's reserves and put it in the Central Bank's Vault. Record this transaction on the student's account record and the bank's balance sheet.
15. Note the change in the money supply (-\$40) and the change in reserves (-\$40). Show that total reserves are now \$60.
16. Have the banker calculate the shortage of reserves, and call in loans. When a student's loan is called in the student must write a check to the banker. This is recorded on the individual's account record and on the bank's balance sheet.
17. Repeat this process as necessary to clear up any questions.
18. As in (11), show that the final change in the money supply will be \$200. Verify that when deposits equal \$300, with a required reserve ratio of twenty percent, there are no excess reserves (required reserves = $.20 \times \$300 = \$60 =$ actual reserves).

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