

The Modern Banking System

Andre R. Neveu

September 18, 2019

Money, Debt, & Credit

Money is an abstract concept, closely linked to the notions of wealth, income, credit, and debt. While most people closely associate money with paper currency issued by governments, it is a much broader social and political construct. As a social construct, money functions as it does—facilitating exchange, measuring value, and storing value—because people agree that it exists. As a political construct, states authorize their money for the payment of taxes and require it to be accepted in payment for debts. In this sense, nations can be considered as the protectors of the debts between occupants of politically delineated boundaries. Money serves several functions. It is a medium of exchange; a unit of account; and a store of value. Money is also a standard of deferred payment.

As a **medium of exchange**, money is not the thing that is consumed in the process of trade but rather a *symbol* of agreed upon value. When a person sells their time to an employer, they are usually paid in money and not tangible consumption goods. The purpose of money in this instance is for the worker to ultimately use it in the future for their own consumption. Thus, there is an implicit agreement upon the value of the goods being exchanged (e.g., labor for time). Money also serves as a **unit of account**; in that it is how value is measured. In this way, money serves as standard of measurement. Thus, value of objects or actions can be measured and compared to one another. This is much the same as measuring height, weight, or speed. To serve as a **store of value**, money must retain most of its value over time. If one knew that money had no value at some point in the future, there would be no reason to accept it for exchange today. The store of value represents in some ways the trust that we place in one another when exchanging real things with each other over time.¹ Currency issuing nations mandate the terms of payment of taxes, as well as the repayment of debts between a state and its people. Money also serves as a **standard of deferred payment**. A deferred payment happens when the time of purchase occurs separately from the time of payment. Money serves

¹**Real** variables would include things that can be measured objectively, like hiring someone to mow my lawn. The labor it takes to mow the lawn is *real*, as is the machine (i.e., physical capital) used to cut the lawn. The amount of a given currency paid to the worker or to buy the mower is a **nominal** variable since it is just representing relative value.

as the standard with which we value these payments (or debts). Since money represents a standard in inter-temporal commitment (e.g., goods or services are consumed today, but paid for next year), it serves as the object through which our debts and credits are settled with a state or in private transaction.

Money can be used to measure both stock and flow variables. **Stock variables**—like wealth—are measured at a given point in time. Below, **balance sheets** represent a typical way of measuring wealth (i.e., net worth) for individuals or capital (i.e., net equity) for companies. **Flow variables**—like income—are measured over a set length of time. Income might be paid as \$1,000 per week, or \$50,000 per year. Cash flow or income statements are common ways of measuring flow variables.

Debt is a stock concept, representing the sum total of obligations owed to others at a given point in time. For example, you might have \$1,200 in accumulated debt at one point in time. **Deficits** or **surpluses** are flow concepts represented as the difference between income and expenditures over a set length of time. If you have \$500 a week in income, and \$600 in expenses, the result is a \$100 per-week deficit. In this example, after one week, debt would rise from \$1,200 to \$1,300 as the \$100 deficit is realized. Debts are the accumulated sum of all previous deficits and surpluses. It should be noted that debts do not need to be denominated in terms of an official state-issued currency. You could be in debt to a friend to “give a ride”, “move a couch” or “buy a drink” without resorting to dollars or contracts. However, in the U.S., debt is generally measured in dollars. Debt is often inappropriately vilified, when the true concern might be that a person or entity has taken on *too much* debt. It might be better to think of debts as symbolizing promises of future *real* activity. It is common that some person or entity takes on more future real obligations than they might be able to deliver. In this case, when the time comes to collect on an earlier promise which cannot be fulfilled, both the debtor and creditor might renegotiate the terms of repayment.² In most circumstances, debts are repaid. In this way, debt represents the social and community ties that take place over time. It is worth noting that whenever there is a delay in completing a transaction, debts are created. It is nearly impossible to think of a world in which debt does not exist or one where it is outlawed. Hence, debt and money represent a special kind of social contract.

As is explained below, people and banks can create money out of thin air. Today, when an obligation which spans time is entered into between two parties, this debt is measured using money. In this way, a \$10 bill represents future *real* activity that someone will do for you. Cash, somewhat counterintuitively, is a symbol of debt. If you read a U.S. Federal Reserve Note (U.S. paper money) it says on the front, that “This note is legal tender for all debts, public and private.” To the person holding physical or electronic cash, it means either you

²Social and political norms can help arbitrate the renegotiation under certain circumstances like death. Suppose a person owes their bank \$1,000, but passes away suddenly. The bank might try to recoup their losses by taking over ownership of the person's house or car.

can repay your debts with it, or you can unlock real activity from someone else by getting them to do something for you. A wealthy individual—like Mark Zuckerberg—holds a great deal of influence over what other people will be doing in the future.

Wealth and Balance Sheets

With the concepts of money, debt, and credit introduced, an example can be developed. Imagine that Logan owns several assets. Let's say he has \$1,000 in a checking account, \$60 in cash, a computer he values at \$800, a phone valued at \$500, and a bike worth \$300. These values are what he *thinks* he can sell these to someone else for. We measure the object's **liquidity** as the *speed you can turn an asset into cash, without significant loss in value*. Cash and deposits are generally the most liquid assets, since there is minimal risk that it is not worth exactly what you think it is (e.g., \$100 can be sold for \$100). However, a computer, phone, or bike might not sell right away (or ever) at the values you estimate.

We then examine Logan's **liabilities**, or obligations to others. If he owes \$1,000 to his credit card company, and has \$3,000 in student loans, he has promised to repay those amounts—likely with interest—at some point in the future. We define **wealth** as the difference between your total asset value and total liabilities. This difference is called wealth or **net worth** for individuals and **capital** or **net equity** for firms and banks. A **balance sheet** equates total asset value (usually shown on the left-hand side) with total liabilities plus net worth (usually both shown on the right-hand side).

$$\text{Assets} = \text{Liabilities} + \text{Net Worth}$$

Using these values for the things Logan owns (\$2,660) and debts he owes to others (\$4,000), he would have a net worth of -\$1,340. We need to emphasize that net worth is the item on our balance sheet that *balances* the right-hand and left-hand side of Table 1.

Table 1: Logan's Household Balance Sheet

Assets		Liabilities + Net Worth	
Cash	\$60	Credit Card	\$1,000
Deposits	\$1,000	Student Loan	\$3,000
Computer	\$800		
Phone	\$500		
Bike	\$300	Net Worth	-\$1,340
Total	\$2,660	Total	\$2,660

Having negative wealth does not mean Logan is bankrupt, but it does mean he could not *liquidate* his assets and fully repay his debts. He might be in this

situation because he is borrowing money to get an education, investing in his own human capital. He might do this because he expects this human capital investment will pay for itself through additional future earnings, earnings that exceed the amount being borrowed today. Recall, it is only when real promises are unfulfillable that borrowers are in danger of declaring bankruptcy. This arrangement—borrowing money to go to school—is usually a good deal for both the borrower and the lender.

To understand bankruptcy, Logan’s cash flow must be considered, as it will show how his wealth is changing over time. Let’s assume Logan has an income of \$2,000 per month, with rent of \$800 per month, interest payments of \$50 per month, and other expenses (electricity, cell phone, food, and interest costs on his debt) of \$1,000 per month.³ This leaves a surplus of \$150, which we will assume Logan uses \$50 to pay down his credit card debt, \$50 to pay down his student loan debt, and keeps \$50 to add to his checking account.⁴ We write out all the changes to the balance sheet in what is called a **T-account** which is used to keep track of all the transactions in Table 2.⁵ Notice that the entire \$150 set aside by Logan to repay debt and increase his checking account balance goes towards increasing his net worth. Some of this occurs through adding to his assets, and some occurs through reducing his liabilities.

Table 2: Logan’s Household T-Account for One Month

Assets		Liabilities + Net Worth	
Deposits	+\$50	Credit Card	−\$50
		Student Loan	−\$50
		Net Worth	+\$150
Total	+\$50	Total	+\$50

Our new balance sheet for Logan is visible in Table 3, where we can see the changes from our previous balance sheet as described in our T-account.

Table 3: Logan’s Updated Balance Sheet

Assets		Liabilities + Net Worth	
Cash	\$60	Credit Card	\$950
Deposits	\$1,050	Student Loan	\$2,950
Computer	\$800		
Phone	\$500		
Bike	\$300	Net Worth	−\$1,190
Total	\$2,710	Total	\$2,710

³Note that each of these are flow variables and are comparable since they are measured over the same length of time.

⁴For the ease of exposition, interest payments have been combined with all other expenses, and the \$50 per month represents principal repayment.

⁵T-accounts are the flow counterpart of balance sheets, and themselves must balance. When combining a T-account with a starting balance sheet, the changes shown in a T-account will lead you to the updated balance sheet.

Banks and Money Creation

Banks can be described using balance sheets and T-accounts in much the same way as we described Logan's personal finances before. Banks are different though in that they are profit-seeking institutions, looking to make money for their investors (i.e., equity holders or shareholders). Interest payments are one form of income for banks, which can lead to bank profits. Banks can also make other profitable investments, such as by buying assets that can be sold for more money than they were purchased for. Interest payments and interest rates are normally described in *nominal* terms. Nominal here just reflects how much more money needs to be repaid in the future and does not dictate how much in additional *real* goods and services are paid by the borrower. Above, we combined interest payments with all other expenses. A person like Logan who owes \$3,000 to a bank for his student loans, with an 11% annual interest rate, repaid over four years would have to make regular monthly payments of \$77.50, where at first the principal repayment is \$50 and the remaining \$27.50 is interest.⁶ Over the course of the loan, Logan pays \$3,722, which is \$722 in interest, on top of the \$3,000 of principal. At no point does Logan make a big \$3,000 payment, but he instead makes many smaller monthly payments. The same type of calculation would be used for his monthly credit card payments.

Businesses like banks start with capital (i.e., equity or net worth). We start with a group of investors who are opening Jupiter Bank. The owners want to pool some of their financial resources to incorporate as a bank and make a profit. Let's imagine a group of 50 investors who each contribute a \$1,000 cash investment, for a total of \$50,000 as in Table 4. The bank starts with a pool of \$50,000 cash and equal ownership.

Table 4: Jupiter Bank-Balance Sheet

Assets		Liabilities + Net Worth	
Cash	\$50,000		
		Capital	\$50,000
Total	\$50,000	Total	\$50,000

As investors, we might think that a big pile of cash is not going generate much of a return. We would be right. If prices rise over time due to inflation, the investors' money buys fewer real goods each year. Investors want their assets to grow over time so that they have greater wealth and can buy more real goods. Thus, the bank owners decide to hire managers who will take some calculated risks on their behalf. To operate as a bank, depositors are needed, and loans would be made. To attract business from people like Logan, the newly founded bank might offer higher interest rates on their deposits than other banks. Let's suppose they offer a 3% annual return on deposits to Logan, along with a host

⁶The \$3,000 is the principal on the loan, the 5% represents the interest rate, and the four years represents the term to maturity. The \$77.50 figure is found by using an amortization calculator like those found at <https://www.amortization-calc.com/loan-calculator/>.

of other benefits like debit cards, and online banking.

Logan’s deposit is a liability to Jupiter, as the bank now owes money to its depositor, Logan. The changes are reflected in a T-account (Table 5) and the new balance sheet (Table 6).

Table 5: Jupiter Bank: T-Account After Logan’s Deposit

Assets		Liabilities + Net Worth	
Cash	+\$1,050	Deposits	+\$1,050
Total	+\$1,050	Total	+\$1,050

Table 6: Jupiter Bank: Balance Sheet after Logan’s Deposit

Assets		Liabilities + Net Worth	
Cash	\$51,050	Deposits	\$1,050
		Capital	\$50,000
Total	\$51,050	Total	\$51,050

Reserves

At this point, we will take a closer look at the assets held by Jupiter and give them a new name. What Jupiter had on hand as “cash” is called “reserves” in banking terminology. The cash is still there, it just has a different name. Banking regulators—like the Federal Reserve in the U.S.—set up **reserve requirements** which determine *a percentage of deposits that must be held at the bank in the form of cash or on their account with the Fed*. Reserve requirements apply only to deposit accounts, and in the U.S. system banks must maintain a percentage of deposits—on average—over a two-week maintenance period.

Banks can hold **excess reserves** which are just the amount greater than what they are required to hold. Both required and excess reserves are the primary source of liquidity in the banking system. When banks need to meet withdrawals or move money around to other banks, they do it with reserves. Banks generally hold some reserves in the form of **vault cash**, which is physical currency stored in the bank. Other reserve funds are held electronically on the bank’s **reserve account with the Fed**. The Fed acts as a “bank for banks” helping banks transfer money between each other, and they can create reserves out of thin air using a computer keystroke. As is shown below, reserves move with transactions and banks will often borrow them from each other for various reasons. The reserve requirement for this banking system is set at 10%. With this reserve requirement, the balance sheet can be rewritten, as in Table 7.

At this point, Jupiter Bank’s managers decide to purchase some U.S. government bonds (i.e., Treasuries). The return on U.S. Treasuries is low compared to other assets, reflecting the fact that there is very little risk that they will not be repaid. There is also a very liquid market for Treasuries, and it is easy

Table 7: Jupiter Bank: Reclassifying Assets from Table 6

Assets		Liabilities + Net Worth	
Required Reserves	\$105	Deposits	\$1,050
Excess Reserves	\$50,945	Capital	\$50,000
Total	\$51,050	Total	\$51,050

to turn them into cash quickly. They are also a good source of **collateral**—an asset pledged by a borrower to a lender, which can be taken and sold if the borrower cannot repay their loan. Good collateral might come in handy if this bank needs to borrow cash. In Table 8, we show that Jupiter takes \$20,000 of its cash (i.e., reserves) and uses it to buy some government bonds. These changes are represented in the new balance sheet (Table 9)

Table 8: Jupiter Bank: T-Account Due to Securities Purchase

Assets		Liabilities + Net Worth	
Excess Reserves	−\$20,000		
Securities	+\$20,000		
Total	+\$0	Total	+\$0

Table 9: Jupiter Bank: Balance Sheet after Security Purchase

Assets		Liabilities + Net Worth	
Required Reserves	\$105	Deposits	\$1,050
Excess Reserves	\$30,945		
Securities	\$20,000	Capital	\$50,000
Total	\$51,050	Total	\$51,050

Starting from Table 9, Jupiter’s managers want to make some loans. The interest and fees on the loans made will allow them to pay interest to depositors, finance their operations, and create a profit for the shareholders. Let’s assume a potential customer named Olivia wants to borrow \$20,000 to finance a new climbing gym she plans to open. When they make her this loan, she agrees to deposit the funds back with Jupiter bank so that she can use the money later. Taking the money they have on hand as reserves, Jupiter creates a loan to Olivia. This transaction is reflected in Table 10. Notice the process involves turning reserves into a loan. This is like taking \$20,000 cash and giving it to Olivia, who promises to repay \$20,000 with interest. She then takes the cash to the teller who takes it and credits her deposit account. Now, think of the deposit as a new transaction. Of the \$20,000 that Olivia deposits, 10% or \$2,000 is considered required reserves and the remaining \$18,000 is excess reserves. A more realistic example would be to imagine *electronic claims* to money moving back and forth instead of paper money. In this case, Jupiter would never have even had the cash on hand.

Jupiter’s new balance sheet in Table 11 has increased by \$20,000 on both sides, just as the T-account described. Note that the bank makes money and

Table 10: Jupiter Bank: T-Account Due to New Loan to Olivia and Her Redeposit

Assets		Liabilities + Net Worth	
Excess Reserves	−\$20,000	Deposits	+\$20,000
Loan	+\$20,000		
Required Reserves	+\$2,000		
Excess Reserves	+\$18,000		
Total	+\$20,000	Total	+\$20,000

Table 11: Jupiter Bank: Balance Sheet after Olivia Loan & Deposit

Assets		Liabilities + Net Worth	
Required Reserves	\$2,105	Deposits	\$21,050
Excess Reserves	\$28,945		
Securities	\$20,000		
Loans	\$20,000	Capital	\$50,000
Total	\$71,050	Total	\$71,050

loans out of thin air. The loan is an obligation, and while there is a risk that Olivia will not repay, the bankers are willing to take this risk in order to make a profit. Earning a profit relies upon Olivia fulfilling her end of the deal and doing the real work in the future necessary to repay her loan.

Now, imagine that Olivia takes \$1,000 and uses her debit card connected to her deposit account to buy materials for her gym. This moves money out of her deposit account, and a corresponding amount of reserves must go with it. Note, that of the \$1,000 being moved out of the bank, 10% (or \$100) is required reserves, and the remaining 90% (or \$900) is excess reserves. The required reserve rate (10% here) is always used to find the required reserves in a balance sheet or T-account (Tables 12 and 13).

Table 12: Jupiter Bank: T-Account Due to Olivia's Debit Card Use

Assets		Liabilities + Net Worth	
Required Reserves	−\$100	Deposits	−\$1,000
Excess Reserves	−\$900		
Total	−\$1,000	Total	−\$1,000

Table 13: Jupiter Bank: Balance Sheet after Olivia Uses Debit Card

Assets		Liabilities + Net Worth	
Required Reserves	\$2,005	Deposits	\$20,050
Excess Reserves	\$28,045		
Securities	\$20,000		
Loans	\$20,000	Capital	\$50,000
Total	\$70,050	Total	\$70,050

Capital Requirements & Lending

Banks make loans to create profit and pay for the expenses of running their business. Below, we describe why regulators like the Federal Reserve in the U.S. want to ensure that banks have enough capital on hand in the event that some of the banks risky investments do not pan out. The Federal Reserve does this using **capital requirements** which mandates banks to have a **capital ratio** that is at least a certain percentage of risky loans. Capital ratios are complicated in practice, but for illustrative purposes the capital requirement is set at 10% of loans. In Table 13, the total amount of loans of \$20,000, and 10% of this would be \$2,000. The bank, with \$50,000 in capital is well above its requirement. Jupiter's managers are free to make more loans if they wish. They are also meeting their reserve requirement in Table 13 with \$30,050 in reserves for \$20,050 in deposits. With deposits of \$20,050, they are required to have \$2,005 in reserves. Reserves above the required amount, \$28,045 in this case, are excess reserves.

Both the reserve and capital ratio requirements are important in practice. The reserve requirement exists to ensure that banks have sufficient liquidity to meet withdrawals, and capital requirements exist to ensure that banks remain **solvent** in the event of losses. An **insolvent** bank would be one who could not liquidate all of their assets and repay their liabilities.

Let's imagine that Jupiter makes a new \$30,000 loan to Emma who wants to start a cupcake shop. Emma plans to redeposit this loan in the bank. At the moment the loan is made, the bank does not have enough in excess reserves (since $\$28,045 < \$30,000$), and making the loan would leave them with only a portion of the reserves they are required to have. However, because Emma redeposits the money at Jupiter, there is no shortfall in required reserves. You should notice that in this situation, the total amount of reserves between Table 13 and 15 is unchanged. It is only the portion that is considered to be required that has changed. In the next section, we discuss what happens if Emma were to write a large check using the newly created deposits just placed in her account.

Table 14: Jupiter Bank: T-Account Due to New Loan to Emma and Her Re-deposit

Assets		Liabilities + Net Worth	
Excess Reserves	−\$30,000	Deposits	+\$30,000
Loan	+\$30,000		
Required Reserves	+\$3,000		
Excess Reserves	+\$27,000		
Total	+\$30,000	Total	+\$30,000

Table 15: Jupiter Bank: Balance Sheet after Emma's Loan & Redeposit

Assets		Liabilities + Net Worth	
Required Reserves	\$5,005	Deposits	\$50,050
Excess Reserves	\$25,045		
Securities	\$20,000		
Loans	\$50,000	Capital	\$50,000
Total	\$100,050	Total	\$100,050

Federal Funds Loans

Let's suppose that Emma wants to hire Cupcake Startup Inc. to help her get a cupcake shop up and running. Emma writes a check for \$30,000 on her account, paid to Cupcake Startup Inc., who has an account at a different bank (Europa Bank in Table 17). When Emma pays Cupcake Startup Inc., money is transferred from one bank to another. Europa Bank's reserves and deposits increase by the amount that they fall at Jupiter Bank.

Now, a question is whether Jupiter is still meeting its reserve requirements. In Table 18, because of the changes described in Table 16, excess reserves are negative. Negative excess reserves indicate a shortfall in reserves. In this case, it can be viewed as total reserves being \$50, with a shortfall of reserves of \$1,955. What should the bank do, given that they are short of their liquidity requirement?

Table 16: Jupiter Bank: T-Account Due to Emma's Check Writing

Assets		Liabilities + Net Worth	
Required Reserves	−\$3,000	Deposits	−\$30,000
Excess Reserves	−\$27,000		
Total	−\$30,000	Total	−\$30,000

Table 17: Europa Bank: T-Account (Cupcake Startup Inc.'s Bank)

Assets		Liabilities + Net Worth	
Required Reserves	+\$3,000	Deposits	+\$30,000
Excess Reserves	+\$27,000		
Total	+\$30,000	Total	+\$30,000

Jupiter could choose to borrow the funds from another bank on the overnight market. Since Jupiter needs to pay for the funds that they borrow, we will assume that they borrow the smallest amount that they need, or \$1,955. Since they need 10% of \$20,050, or \$2,005, but already have \$50, they only need to borrow \$1,955. These loans between banks are for terms as short as one night, and banks like Jupiter who are borrowing pay the federal funds rate (or close to it) for this money. Jupiter's borrowing can be seen in the new balance sheet in Table 20, which has grown by the amount of the interbank loan. One feature of

the federal funds rate market is that the loans are not collateralized, meaning the bank is borrowing reserves from another bank on the promise that the loan will be repaid. If banks cannot get a federal funds market loan, they are often able to post assets (like government securities) as collateral and borrow money at similar rates.

Table 18: Jupiter Bank: Balance Sheet after Emma’s Check is Cashed

Assets		Liabilities + Net Worth	
Required Reserves	\$2,005	Deposits	\$20,050
Excess Reserves	−\$1,955		
Securities	\$20,000		
Loans	\$50,000	Capital	\$50,000
Total	\$70,050	Total	\$70,050

Table 19: Jupiter Bank: T-Account Due to Interbank Loan

Assets		Liabilities + Net Worth	
Excess Reserves	+\$1,955	Interbank Loan	+\$1,955
Total	+\$1,955	Total	+\$1,955

Table 20: Jupiter Bank: Balance Sheet after Interbank Loan

Assets		Liabilities + Net Worth	
Required Reserves	\$2,005	Deposits	\$20,050
Excess Reserves	\$0	Interbank Loan	\$1,955
Securities	\$20,000		
Loans	\$50,000	Capital	\$50,000
Total	\$72,005	Total	\$72,005

A key feature of the interbank loan market is that banks do not have to hold reserves against these funds. Thus, it is a way banks can meet their requirements without having to maintain additional reserves. As long as there are excess reserves somewhere in the system, and other banks believe the borrowing bank is likely to repay, banks have access to necessary funds. If there is a shortfall in reserves—because many banks are trying to borrow—the Fed can “inject” liquidity into the system by creating reserves which they can use to temporarily purchase assets from a bank. They would generally do this when they observe the federal funds rate—the overnight cost of borrowing—is rising above their preferred target federal funds rate. The **target federal funds rate** is the most important interest rate set by the **Federal Open Market Committee** during their meetings, which occur every six weeks.⁷ The Federal Reserve Open Market Desk purchases securities from the banking system or general public, using reserves that it creates out of thin air. These reserves are usually

⁷The FOMC can decide to change rates in between meetings, but this is rare and usually only in response to very severe shocks. The last time the FOMC changed interest rates in between meetings was in early 2008.

electronic, but the Fed can direct the Treasury to print paper currency that could also be used as reserves. We assume here in Table 21 and 22 that the Fed buys \$10,000 of bonds directly from Jupiter—even if this is an unlikely real-world scenario.⁸

Table 21: Jupiter Bank: T-Account Due to Open Market Sale of Securities

Assets		Liabilities + Net Worth	
Securities	−\$10,000		
Excess Reserves	+\$10,000		
Total	+\$0	Total	+\$0

Table 22: Jupiter Bank: Balance Sheet after Open Market Sale of Securities

Assets		Liabilities + Net Worth	
Required Reserves	\$2,005	Deposits	\$20,050
Excess Reserves	\$10,000	Interbank Loan	\$1,955
Securities	\$10,000		
Loans	\$50,000	Capital	\$50,000
Total	\$72,005	Total	\$72,005

In this scenario the Fed is fulfilling its role as the *lender of last resort* and ultimate source of liquidity to the system. If the system is *illiquid* then the creation of credit for borrowers like Olivia and Emma might slow down more than anticipated. Credit plays a very important role in our economy, as it helps finance firm operations, and helps smooth consumption by households who otherwise receive lumpy payments.

Following the Fed’s purchase of bonds from Jupiter, we observe that Jupiter can make more loans and still meet its capital and reserve requirements. With \$50,000 in capital, they can make up to \$500,000 in loans, since \$50,000 is 10% of \$500,000 and 10% is our capital requirement. Also, with \$12,005 in reserves, they would be able to have \$120,050 in deposits—since \$12,005 is 10% of \$120,050 and 10% is our reserve requirement. The bank is not constrained by either requirement. Also note that since Jupiter has access to the overnight market for reserves that they could increase lending and borrow the reserves necessary to meet any requirement. It is worth reiterating that the job of the bank is to make a profit, and holding onto reserves is not particularly rewarding—although this has changed a bit in recent years as banks now get paid interest for holding reserves with the Fed. Let’s next presume that the managers of Jupiter target a level of \$150,000 in loans, which are made to customers who redeposit their money back into the bank. Jupiter’s balance sheet is now shown in Table 23.

⁸Notice that the Fed is effectively using newly created money to bid up the price of bonds that are for sale on the open market. This would lead to an increase in the price, and a decline in the interest rate. In our example here, this is what the Fed is trying to accomplish. When interest rates are rising away from the Fed’s target federal funds rate, they inject liquidity to ease the upward pressure. If interest rates are falling below their target, their goal is to extract liquidity, lowering prices and raising interest rates.

Table 23: Jupiter Bank: Balance Sheet after Increasing Loan Portfolio

Assets		Liabilities + Net Worth	
Required Reserves	\$12,005	Deposits	\$120,050
Excess Reserves	\$0	Interbank Loan	\$1,955
Securities	\$10,000		
Loans	\$150,000	Capital	\$50,000
Total	\$172,005	Total	\$172,005

To reach the target level of loans of \$150,000, Jupiter would have had to have made \$100,000 in additional loans. This is 10-times the excess reserves in Table 22. With these additional loans, let's see if the bank is meeting its capital and reserve requirements. The bank has exactly 10% of its deposits held as reserves, so it is meeting that requirement. As for capital, the bank has \$150,000 in loans, and needs to have 10% (or \$15,000) in capital. The bank has \$50,000, well over \$15,000 in capital required, so the bank is also meeting its capital requirement.

Recall that the act of a bank lending comes with a degree of risk, the risk being that the borrower will not repay the loan. Thus, when banks lend people money to buy homes, they usually require the purchaser to post the house as collateral to the loan as well as put a cash “down payment” towards the purchase price. Historically, this down payment was 20% of the purchase price, so a \$100,000 apartment would require the buyer pay \$20,000 in cash up front. The bank would provide the other \$80,000 in the form of a mortgage. If the borrower loses their job or cannot come up with their mortgage payments, they are **foreclosed** on by the bank. In foreclosure, the bank seizes the apartment and can resell it to recoup their losses. Since banks do not typically like to own homes, they will often try to sell these homes as fast as possible, likely selling it for less than it might otherwise be worth. In this situation, the bank would face losses on the value of their assets, since they **write-down** or reduce the value of their loan portfolio.

In Table 24, we presume that Jupiter faces losses of \$10,000 on its loans. This might be because the bank lent a client money who ran up a balance on a credit card which they were unable repay and went into bankruptcy. In our balance sheet in Table 25, Jupiter's loans and capital decline together. The bank still owes its depositors their money back, and their reserves are not available to reflect losses. The owners of the bank suffer these losses, and the bank's overall balance sheet shrinks.

Table 24: Jupiter Bank: T-Account Due to \$10,000 Write-down on Loan Portfolio

Assets		Liabilities + Net Worth	
Loans	−\$10,000	Capital	−\$10,000
Total	−\$10,000	Total	−\$10,000

Table 25: Jupiter Bank: Balance Sheet after \$10,000 Write-down on Loan Portfolio

Assets		Liabilities + Net Worth	
Required Reserves	\$12,005	Deposits	\$120,050
Excess Reserves	\$0	Interbank Loan	\$1,955
Securities	\$10,000		
Loans	\$140,000	Capital	\$40,000
Total	\$162,005	Total	\$162,005

Taking this a step further, now assume that Jupiter has made a lot of bad loans, so many in fact that they lose another \$45,000 in value (Table 26). The new balance sheet would show a negative value for net worth in Table 27. At this point, Jupiter is insolvent, meaning it cannot liquidate its assets and repay its creditors. The Federal Deposit Insurance Corporation (FDIC) exists to intervene in these circumstances. The FDIC makes depositors whole and makes up for the shortfall in capital at a loss to the FDIC insurance fund. Banks like Jupiter are members of the FDIC and pay periodic insurance premiums to help ensure the solvency of the banking system.

Table 26: Jupiter Bank: T-Account Due to \$45,000 Write-down on Loan Portfolio

Assets		Liabilities + Net Worth	
Loans	−\$45,000	Capital	−\$45,000
Total	−\$45,000	Total	−\$45,000

Table 27: Jupiter Bank: Balance Sheet after \$45,000 Write-down on Loan Portfolio

Assets		Liabilities + Net Worth	
Required Reserves	\$12,005	Deposits	\$120,050
Excess Reserves	\$0	Interbank Loan	\$1,955
Securities	\$10,000		
Loans	\$95,000	Capital	−\$5,000
Total	\$117,005	Total	\$117,005

The FDIC usually tries to intervene well before the bank is insolvent, and usually tries to help arrange for another firm to buy the failing firm. Another bank might want to buy access to Jupiter’s depositors, their remaining loan portfolio, or the physical locations and employees.

Capital v. Reserve Constrained Banking

Regulation of both capital and liquidity play an important role in banking. Here we examine another fictional bank—Callisto Bank—to discuss the role for regulation. First, we examine the **debt-to-equity ratio**, which is calculated as the total amount of liabilities—or debt—to the total amount of capital. In

Table 28, Callisto Bank has a debt-to-equity ratio of \$210,000 to \$15,000, which is 14-to-1. This is also sometimes referred to as the banks' **leverage ratio**, since it represents the amount of borrowed money that the bank is using relative to their own capital. Highly leveraged banks are taking more risk, since if the bank's assets decline in value, the losses are amplified by this amount. Next, a **capital ratio** is found by taking the total of all risky loans, \$120,000, and comparing that to total capital of \$15,000, yielding an 8-to-1 ratio.⁹ This is the same thing as having 12.5% of loans held as capital. If we continue using the 10% requirement from earlier, then this bank is meeting its capital requirement. With \$200,000 in deposits, and \$30,000 in total reserves, the bank is also well above its reserve requirement with a 15% ratio.

Table 28: Callisto Bank: Balance Sheet

Assets		Liabilities + Net Worth	
Required Reserves	\$20,000	Deposits	\$200,000
Excess Reserves	\$10,000	Interbank Loan	\$10,000
Securities	\$75,000		
Loans	\$120,000	Capital	\$15,000
Total	\$225,000	Total	\$225,000

So, our question is to see how much lending this bank could do and still meet both statutory requirements. With existing reserves, the bank could support deposits of up to \$300,000, since \$30,000 of reserves divided by the reserve requirement of 10% (or 0.10) would be \$300,000 (Table 29). The new balance sheet would have an increase of \$100,000 on each side since the \$10,000 of excess reserves would be categorized as required reserves after the increase in deposits.¹⁰

Table 29: Callisto Bank: Balance Sheet with Proposed Loan Expansion Based on Reserve Requirement

Assets		Liabilities + Net Worth	
Required Reserves	\$30,000	Deposits	\$300,000
Excess Reserves	\$0	Interbank Loan	\$10,000
Securities	\$75,000		
Loans	\$220,000	Capital	\$15,000
Total	\$325,000	Total	\$325,000

If we check the capital requirement, we would see that the bank is holding loans that place it at more risk than regulators would prefer. Callisto's capital ratio is only at 6.8% (\$15,000/\$220,000), below its 10% requirement of \$22,000. Callisto should not be making loans in this amount. In this case, we say they are **capital constrained** but not **liquidity constrained**. If Callisto wanted to increase lending while still meeting their capital requirement, they could increase lending from \$120,000 in Table 30 to \$150,000 (which is \$15,000 divided

⁹ We are assuming here that the debt issued by the bank only takes the form of loans, and equity only comes in the form of capital.

¹⁰ Note again, we are assuming all loans created are immediately held as deposits.

by the capital requirement of 10%). The balance sheet would grow by \$30,000. Banks like Callisto might be able to borrow more reserves on the overnight market and increase their lending by much more than the amounts mentioned here. Banks face other regulations, but the role played by capital is very important to understanding the financial crisis in the late 2000s.

Table 30: Callisto Bank: Balance Sheet with Proposed Loan Expansion Based on Capital Requirement

Assets		Liabilities + Net Worth	
Required Reserves	\$23,000	Deposits	\$230,000
Excess Reserves	\$7,000	Interbank Loan	\$10,000
Securities	\$75,000		
Loans	\$150,000	Capital	\$15,000
Total	\$255,000	Total	\$255,000

Table 30 is more representative of the modern system, where banking operations are more constrained by access to capital and capital requirements than reserve or liquidity requirements. After the 2008 Financial Crisis, the Federal Reserve increased reserves in the system by nearly \$4 trillion. This increase spurred fears of an overwhelming increase in lending, but those predictions failed to understand that banks were already constrained by capital requirements and a lack of demand for new lending. Following the housing crisis which started in 2006, bank capital had been decimated. Banks were not necessarily eager to go out and make lots of new loans just because they were given the reserves to do so. Instead, they faced much tighter oversight of their capital when many banks were facing a crisis of solvency. The Fed can only do so much when banks face solvency issues, since that is left to the FDIC who does not typically help recapitalize banks. Banks were left to raise capital on their own and were under pressure to find investors who would be willing to give banks money in exchange for ownership stakes in now undercapitalized banks. In 2008, the **Troubled Asset Relief Program** or TARP authorized the government purchase of an ownership stake in financial institutions that were deemed systemically important. These institutions were effectively nationalized as the government took a large controlling stake in the banks. The government did not overwhelmingly restrict the banking operations of these institutions, although TARP did come with some additional oversight responsibility.

Federal Reserve Tools/Instruments, Targets, and Goals

There is a distinction between the Federal Reserve's tools (or instruments), targets, and goals. The main tools used by the Federal Reserve are the:

- Open Market Operations: The Fed's purchase (sale) of bonds intended to increase (decrease) reserves in the federal funds market.

- Interest on Reserves: Starting in October 2008, the Fed began paying banks for holding reserves. There are separate rates paid for required and excess reserves (although they have been set equal to each other since the program's inception)
- Reserve Requirements: The percentage of deposits that must be held in the form of the bank's reserves.
- Balance Sheet Operations: When the Fed increases the size (quantitative) or quality (qualitative) of its own balance sheet.
- Discount Rate: The cost of borrowing reserves directly from the Federal Reserve. This is nearly identical to how the interbank loans work, except the reserves are coming from outside the private sector and the loans are collateralized. There is also an increase in reserves through a discount rate loan.

The Fed's targets are the intermediate things the Fed is trying to change which might influence economic activity like consumption or investment. Some examples of targets are the:

- Federal Funds Rate: The Fed sets a target rate in this market by providing sufficient liquidity to push lending conditions towards their preferable state.
- Long-term Interest Rates: The Fed might choose to also try to manipulate longer-term interest rates to affect behavior in other markets.
- Money Supply: The Fed could try to target the total supply of money, in the form of deposits and currency (i.e., $M1$) or the broader $M2$ money supply ($M1 + MMMF + Savings + Time deposits$).¹¹

Ultimately, the Federal Reserve is trying to reach its goals of:

- Full Employment: interpreted as unemployment at or near the natural rate of unemployment
- Stable Prices: interpreted as a stable and low rate of inflation at or near 2%.

The Fed is free to change its instruments, and form its own targets, but the goals are more rigid since they are mandated by Congress. By law, the Fed's job is to maintain full employment and stable prices, but they are free to interpret what this means. So, there is some flexibility here, where rather than focus on keeping prices constant they have chosen to instead try to keep inflation steady (which is the rate of change in prices).

¹¹Savings accounts or money-market deposit accounts (*MMDA*) are less liquid than checking. Money market mutual funds (*MMMF*) are another less-liquid alternative to deposits. Finally, small-denominated time deposits or certificate of deposit (*CDs*) are investments that can be liquidated with a small penalty.

An Aside on Sweeps

There is one other regulatory complication which has made the U.S. banking system less reserve constrained and more subject to capital constraints. Take the example of Callisto Bank again, who now instead of having interbank loans, has savings deposits from its customers in the amount of \$10,000. This bank could make loans under its capital requirement (up to \$150,000 as seen in Table 31), but they do not have any reserves to make the—say \$5,000—loan they would like to. What the bank can do is reclassify some of its deposits as savings. They do this, because savings accounts are not subject to reserve requirements.¹²

Table 31: Callisto Bank: Balance Sheet

Assets		Liabilities + Net Worth	
Required Reserves	\$20,000	Deposits	\$200,000
Excess Reserves	\$0	Savings	\$10,000
Securities	\$75,000		
Loans	\$130,000	Capital	\$15,000
Total	\$225,000	Total	\$225,000

The changes to the balance sheet must lead to an increase in excess reserves of \$5,000, which we can get by switching \$50,000 out of their deposits and into savings as in Tables 32 and 33.

Table 32: Callisto Bank: T-Account

Assets		Liabilities + Net Worth	
		Deposits	−\$50,000
		Savings	+\$50,000
Required Reserves	−\$5,000		
Excess Reserves	+\$5,000		
Total	\$0	Total	\$0

Table 33: Callisto Bank: Balance Sheet After Sweeps

Assets		Liabilities + Net Worth	
Required Reserves	\$15,000	Deposits	\$150,000
Excess Reserves	\$5,000	Savings	\$60,000
Securities	\$75,000		
Loans	\$130,000	Capital	\$15,000
Total	\$225,000	Total	\$225,000

The size of the balance sheet does not change, and total reserves do not change, just how their money is categorized. The loan gets created in Table 34, and the final balance sheet is shown below in Table 35.

Banks can *sweep* deposits into non-reserve-requiring savings accounts for the purpose of reducing their need to hold reserves, and so that the bank can

¹²Technically, sweeps are not savings accounts, but this simplification is made to make it clear that your deposits are still relatively liquid.

Table 34: Callisto Bank: T-Account Due to New \$5,000 Loan and Redeposit

Assets		Liabilities + Net Worth	
Excess Reserves	−\$5,000	Deposits	+\$5,000
Loans	+\$5,000		
Required Reserves	+\$500		
Excess Reserves	+\$4,500		
Total	+\$5,000	Total	+\$5,000

Table 35: Callisto Bank: Balance Sheet After \$5,000 Loan and Redeposit

Assets		Liabilities + Net Worth	
Required Reserves	\$15,500	Deposits	\$155,000
Excess Reserves	\$4,500	Savings	\$60,000
Securities	\$75,000		
Loans	\$135,000	Capital	\$15,000
Total	\$230,000	Total	\$230,000

purchase assets that offer depositors a higher rate of return. In the years after banks were allowed to do this in the early 1980s, bank reserves fell to approximately 7% of total deposits prior to the financial crisis in 2008. Prior to 2008, there were only about \$45 billion in reserves in the entire banking system, and about \$30 billion being vault cash. This meant there were only about \$15 billion in reserve balances with the Fed, and \$2 billion in excess reserves. These reserves supported checkable deposits of approximately \$600 billion in checkable deposits in 2008.