Mankiw Chap 4: The Monetary System

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Abstract

These are NOTES and an Outline for my Intermediate Macroeconomics lectures. This chapter covers the basics of money, T-accounts and the monetary system, base money, bank capital and leverage, and basic money multipliers.

1 What Is Money?

Q: Why do we have money?
A: Fundamentally it is a social institution evolved to make transactions more efficient by overcoming the "double coincidence of wants" problem.

1.1 Functions of Money

1. store of value
2. unit of account
3. medium of exchange

1.2 Types of Money

1. commodity money
2. commodity-backed money
3. fiat money

2 Banks, the Monetary System and Reserves

The most basic measure of "money" or the "money supply" (M) is currency (C) plus demand deposits (D):

$$M = C + D \tag{2.1}$$

2.1 100-Percent Reserves

If there were no banks, then there would be no demand deposits, so

$$M = C + (D = 0) \rightarrow M = C \tag{2.2}$$

Now introduce banks, but suppose they don't lend out any money that depositors leave with them. In this case, we say 100% of deposits are kept as reserves.

Firstbank's Balance Sheet with 100% Reserves

Assets	Liabilities
Reserves $1,000	Deposits $1,000

If banks hold 100 percent of deposits in reserves, the banking system does not affect the supply of money.

2.2 Fractional Reserves

Now suppose banks lend out a portion of their deposits.

Firstbank's Balance Sheet with Fractional Reserves

Assets		Liabilities	
Reserves	\$200	Deposits	\$1,000
Loans	\$800		

We've assumed a reserve-to-deposit ratio of 20% here. Notice that the loan of \$800 goes to another person so it gets counted again in the money supply as either currency (if it's in their pocket) or as demand deposit, if they deposit it in their bank. If they deposit the money, then a fraction gets help and the rest gets lent out again, adding even more to the money supply. In this way a fractional reserve banking system "creates" money.

If we let rr denote the reserve-deposit ratio, then the amount of money that the original \$1,000 creates is

$$\begin{aligned} M &= [1 + (1 - rr) + (1 - rr)^2 + (1 - rr)^3 + ...] \times \$1,000 \\ M &= \left(\frac{1}{rr}\right) \times \$1,000 \end{aligned} \tag{2.3}$$

2.3 Bank Capital, Leverage, and Capital Requirements

Opening a bank requires some capital. This is called "bank capital" or "bank owner's equity". A more realistic balance sheet looks more like this

Assets		Liabilities and Owner's Equity	
Reserves	\$200	Deposits	\$750
Loans	\$500	Debt	\$200
Securities	\$300	Capital (owner's equity)	\$50

This bank has used "leverage" which is the use of borrowed money to supplement existing funds for the purpose of investment.

The "leverage ratio" is the ratio of the bank's total assets (left side of the balance sheet) to bank capital (i.e., owner's equity above). In this example, the leverage ratio is \$1,000/\$50 or 20.

Leverage Ratio = 20 means that for every dollar of capital that the bank owners have contributed, the bank has \$20 of assets and, thus, \$19 of deposits and debts.

THE PROBLEM: Leverage plus specific legal institution mean that, in bad times, a bank can lose a lot of capital quickly. In this example, if the bank's assets fall 5 percent, then the total asset value declines from \$1,000 to \$950.

Legally, depositors and debt holders have the legal right to be paid first, so the value of the owner's equity falls to zero. In this case, it means a 5% decline in assets depletes 100% of the bank's capital.

When markets see the value of a bank's capital go to zero, they often panic and rising concern that depositors won't get paid can drive a bank run.

REGULATION: Banking regulations have tried to remedy this solution by implementing a number of things

1. **deposit insurance** so depositors are guaranteed to get their money back

2. **capital requirements** to ensure banks don't over-leverage. And, the type of capital matters. If a bank holds more "safe" assets like US gov bonds, then regulators require the banks to put in less capital. But "safe" is relative. US gov backed "mortgage-backed securities" were deemed extremely safe until the housing crisis collapsed our financial system. Now we call them "toxic assets".

3 Central Banks and the Money Supply

The Federal Reserve, the US "Central Bank", determines the supply of money in the USA (although money is technically printed by the US treasury). In the end, however, three factors come into play to determine the actual amount of money in the economy:

1. the Fed's decision about how many dollars to create
2. banks' decisions about how much of their deposits to hold as reserves versus how much they lend out
3. households' decisions about how much of their money to hold as currency versus deposit in a bank

Our basic monetary system model has **3 exogenous variables**

1. **monetary base, B,** $B = C + R$ is the total number of dollars held by the public as currency C and by the banks as reserves R. R is directly controlled by the Central Bank.
2. **reserve-dposit ratio, rr,** is the fraction of deposits that banks hold in reserves. It is determined by bank business decisions and the Central Bank's (or other regulators') reserve requirements. Note: $rr = R/D$
3. **currency-deposit ratio, cr,** which is the amount of curency C that people hold as a fraction of their holdings of demand deposits, D, and it reflects household preferences. Note: $cr = C/D$

MODEL GOAL This model allows us to consider how Central Bank policy and the choices of the individual agents (banks and households) in an economy interact to determine the overall money supply in an economy.

Begin with our basic relations:

$$M = C + D \tag{3.1}$$

$$B = C + R \tag{3.2}$$

Solve for the money supply as a function of our three exogenous variables:

$$\frac{M}{B} = \frac{C + D}{C + R} \tag{3.3}$$

$$\frac{M}{B} = \frac{C + D}{C + R}\frac{D}{D} \rightarrow \frac{M}{B} = \frac{C/D + 1}{C/D + R/D}$$

Since $rr = R/D$ and $cr = C/D$ we can write

$$\frac{M}{B} = \frac{C/D + 1}{C/D + R/D}$$

As

$$M = \frac{cd + 1}{cd + rr} \times B$$

The above expression makes everything explicit, but we often simplify it by referring to the first expression as the **money multiplier**:

$$m = \frac{cd + 1}{cd + rr}$$

So, we can write the final relationship as

$$M = m \times B \tag{3.4}$$

Because the monetary base, B has a multiplied effect on the money supply, the monetary base is also often called **high-powered money**.

EXAMPLE:

If $rr = 0.1$ and $cr = 0.8$, then what is the money multiplier? Suppose the monetary base is \$800 billion. What is the money supply in this economy?

Solution:

$$m = \frac{0.8 + 1}{0.8 + 0.1} = 2.0$$

and

$$M = m \times B = 2 \times \$800 \text{ billion} = \$1,600 \text{ billion}$$

Exploring the **model**:

1. The Central Bank **increases the monetary base:**$\uparrow B \rightarrow \uparrow M^s$
2. The Regulatory Authority **increases the required resere-deposit ratio:** $\uparrow rr \rightarrow \downarrow M^s$
3. Households decide to **hold more currency:** $\uparrow cr \rightarrow \downarrow M^s$

Some open-ended thoughts:

1. The news reports that banks are failing and the money supply is declining. Consumers believe the reports.
   - What happens in this model?
   - Were consumers right to believe the reports?
   - From all of the above, did the Fed do anything to cause and potentially justify this panic?
2. Suppose the Fed decides to stimulate the economy by dramatically increasing base money.
   - All else equal would this increase the money supply?
   - What if simultaneously the bank regulators decide the securities banks hold are toxic so banks should hold more reserves?

4 The Process of Monetary Policy in the USA

The US Central Bank, the Federal Reserve, has basically two major policy tools it uses to conduct Monetary Policy:

1. Changing Base Money
2. Determining Reserves - technically here the US Fed both sets the required reserve level (the min amount a bank must hold) and pays interest to banks on their reserve holding (which they hold with the US Fed) to allow the Fed to encourage/discourage banks from holding more reserves than are required.

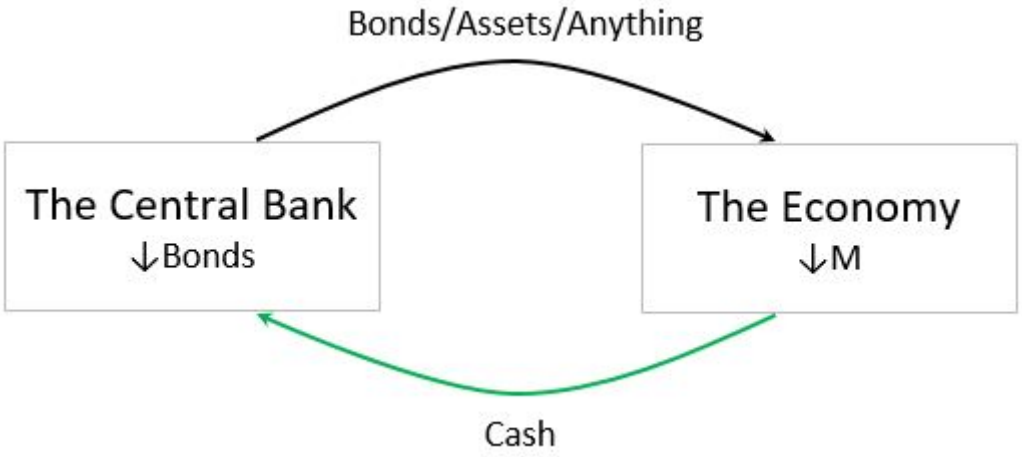
Open Market Operations

The US Fed changes the monetary base by conducting an open market operation. Since the theory of how this works in any country, we'll cover it generally without all the institutional details of the USA. In short, the Central Bank is NOT considered a part of "the economy" when calculating the money supply. When we calculated the money supply, we said it was

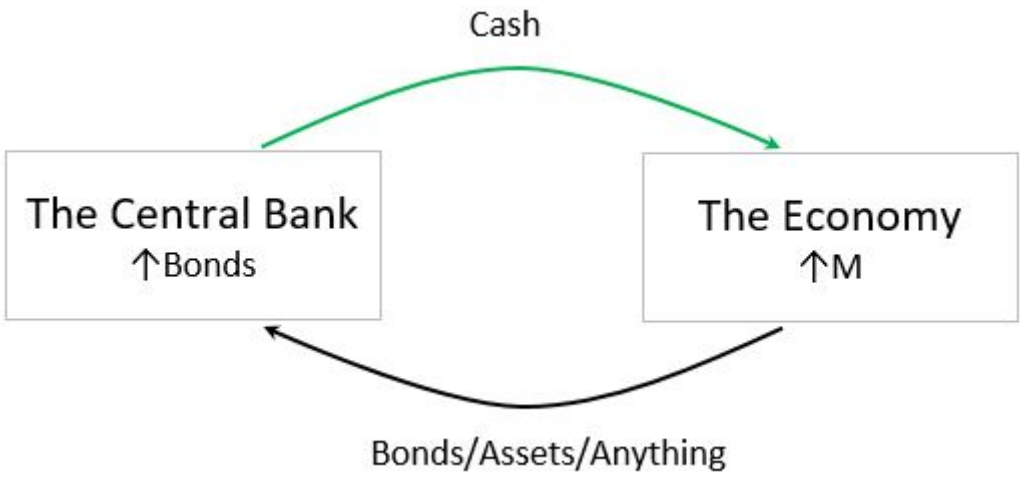
$$M = C + D$$

Neither C nor D are "owned" by the Fed. Even the monetary base, $B = C + R$, is independent of the Fed. Technically R is held in a Fed account, but they are owned by the banks, not the Fed. So none of the parts of the money supply in an economy are part of the Fed itself. So we can think of the FED, really any Central Bank, as being outside "the economy" for the purposes of conducting monetary policy.

When the Central Bank buys something, it must buy it from a private person in the economy. Like any other actor in a market, in the USA, the Fed pays USD to buy something. This means the Fed acquires "a good" or "service" which is then no longer part of "the economy" and the private agent in the economy now holds more USD which might initially be Currency, but today is more likely immediately a Demand Deposit. So, this increases the money supply. This sort of action is called an **Open Market Operation** and traditionally the US Fed only bought US Treasuries (i.e., US government bonds) but they can buy anything and during times of crisis buy all sorts of things from toxic assets to mortgages and in other countries (like Hungary for example) Central Banks have bought art, castles, universities, etc.



When the Central Bank sells something, the opposite process occurs. In a free society it can only sell something if private individuals are willing and able to buy it. That is, it must sell in a market at the going market rate. This means the Fed decreases its holding of "a good" or "service" which is now part of "the economy" and the private agent in the economy now holds *less USD*. So, this decreases the money supply. This sort of action is called an **Open Market Operation** and traditionally the US Fed only sold US Treasuries (i.e., US government bonds) but technically they can sell anything.



4.1 Managing Reserves

Today there are many ways the Fed manages reserves. In general, the Fed can just require banks to hold a certain percentage of their deposits in the form of reserves (versus lending them out), which is what happens when they set the **reserve requirements**. Alternatively they can lend banks reserves. In times of crisis, if banks are suddenly running out of reserves and people panic because they worry the banks won't be able to give them their deposits bank, the Fed can act as the **lender of last resort** and in the USA we have **Federal Deposit Insurance** which means people will get their deposits back either directly from banks, from banks via the Fed as lender of last resort, or from the US Federal Government via the FDIC (the "C" is for Corp.). This structure was put in place to ease people's minds and prevent bank runs, banking panics and avoid banking crises in general. (Note: These have been around for decades before the banking panic and crisis of 2008-2009.)

Ways the Fed manages reserves:

1. **discount window:** banks can borrow from the Fed via its "discount window" through which the Fed lends to banks at a **"discount rate",** i^d. $\downarrow i^d \rightarrow\downarrow$ cost of borrowoing reserves $\rightarrow\uparrow R \rightarrow\downarrow M^s$
2. **Term Auction Facility:** This was a unique facility established temporarily during the 2008-2009 financial crisis. The Fed set a quantity of funds it wanted to lend and it let banks bid for the funds.
    - NOTE: In both the above cases, the Fed uses the "market for reserves" to conduct it's policy. On one side of this market is the Fed and on the other side of the market are banks. One interesting difference in these two lending facilities is that in the first case (discount window) the Fed determines the market price (the "discount rate") and stands ready to buy or sell as much as the market needs to maintain that constant rate. In this case, the Fed sets the price and lets the market determine the quantity. In the second case, the Fed determines the quantity and lets the market determine the price.
3. **sets reserve requirements:** $\uparrow rr \rightarrow\downarrow m \rightarrow\downarrow M^s$
4. **pays interest on reserves:** increasing the interest on reserves increases the reserve to deposit ratio, thereby lowering the money multiplier and lowering the money supply. $\uparrow i^{reserves} \rightarrow\uparrow$ return on holding reserves $\rightarrow\uparrow R \rightarrow\downarrow M^s$

5 The Monetary Bases and the Great Depression

The "Great Depression" is now widely believed to have been caused in part by bad monetary policy. The Federal Reserve System had only been created in 1913 and began operating in 1914. It did not

seem to have a good understanding or practice of how to manage monetary policy yet. It's challenge with monetary policy during the Great Depression is of both historical interest and also provides an insight into the challenges any monetary policy faces and, additionally, helps explain the Fed's policy actions during the more recent Financial Crisis of 2008-2009.

In August 1929 business activity reached its peak and began to slow. Of course, even today this would be slow to be identified in the data but in 1929 this peak and slowdown was even slower to reveal itself to policy makers. Two months later as businesses continued to slow and markets began to reflect this new reality, there was a stock market crash in October 1929.

	August 1929	**March 1933**	%Δ
Money Supply, M	26.5	19	-0.28
Currency, C	3.9	5.5	0.41
Demand deposits, D	22.6	13.5	-0.40
Monetary Base, B	7.1	8.4	0.18
Currency, C	3.9	5.5	0.41
Reserves, R	3.2	2.9	-0.09
Money Multiplier, m	3.7	2.3	-0.38
Reserve-deposit ratio, rr	0.14	0.21	0.50
Currency-deposit ratio, cr	0.17	0.41	1.41
$M = m \times B$	26.27	19.32	-0.26
$\hat{M} = \hat{m} + \hat{B}$			-.20
$\hat{M} = \hat{m} + \hat{B} + \hat{m} \times \hat{B}$			-.265

The Fed believed it was increasing the money supply during the Depression because it was increasing base money. What it didn't realize at the time was that the money multiplier was falling by more than they were increasing the base, hence the actual money supply was falling. (Note: If $M = m \times B$ then $\hat{M} = \hat{m} + \hat{B}$.)This contraction of the money supply drove the economy into a deeper recession.

6 The Monetary Bases and the Financial Crisis of 2008-2009

When the financial crisis hit in 2008, the Fed was determined not to repeat it's mistakes made during the Great Depression. By chance, the Fed Chairman, Ben Bernanke, happened to be a leading scholar on the topic of the Great Depression. As a result, he knew well that the multiplier would likely fall and need to be closely considered. And he knew that if the Fed didn't throw everything it had at increasing the money supply, it would unwittingly make the recession worse than it already was.

During the financial crisis of 2008-2009, the Fed bought large quantities of assets from banks that the Fed viewed as "toxic", like mortgage-backed securities. The idea was in part that, if the Fed bought these, banks would hold fewer bad assets and would be out of danger and willing to lend money (and investors would invest in them and depositors wouldn't worry about their deposits, etc.). Also this would inject massive amounts of base money into the banking system and hopefully increase the money supply, hence adding monetary stimulus to the economy.

Bernanke's insights were right. The money multiplier dropped during the crisis but he pumped way more base money into the system than the amount by which the multipliers declined and was able to increase the money supply to help stimulate the economy.

	%Δ2007 to 2014
Money Supply, M1	100%
Money Supply, M2	50%
Monetary Base, B	400%
Money Multiplier, $\hat{m}1 = \hat{M}1 - \hat{B}$	-300 %
Money Multiplier, $\hat{m}2 = \hat{M}2 - \hat{B}$	-350 %

Whether this massive monetary stimulus prevented the Great Recession from turning into a Great Depression is still an open question and the topic of much research.

Note: Source of last tables is Mankiw's textbook, pp. 98-99.