Money Supply

ECON 40364: Monetary Theory & Policy

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Readings

- Friedman Ch. 1, Ch. 2 (sections "Mystery of Money" and "The Supply of Money")
- Mishkin Ch. 3
- Mishkin Ch. 14
- GLS Ch. 31
- Rendahl and Freund

What is Money?

- Money is something that is accepted as payment for goods or services or in the repayment of debts
- Friedman: "Money is whatever is generally accepted in exchange for goods and services – accepted not as an object to be consumed but as an object that represents a temporary abode of purchasing power to be used for buying still other goods and services."
- Something has value as a medium of exchange because people think other people will accept that thing in exchange for goods and services

Stock vs. Flow

- Properly understood, money is a stock concept – something you accumulate and can carry across time (balance sheet). Not a flow concept (income statement)
- An asset is a claim on current and/or future resource/financial flows that you own; a liability is a claim against you on current and/or future resource/financial flows
- For the holder of money, it is an asset. For the issuer, it is a liability
- Money can be publicly or privately created. Most money is privately created
- It is backed by something – something tangible (e.g. precious metals) or intangible (e.g. full faith and credit)
- What is (and isn't) money is increasingly less clear

Functions of Money

- Three functions of money:
  1. Medium of exchange
  2. Unit of account
  3. Store of value
- Any asset can serve as a store of value (e.g. house, land, stocks, bonds), but most assets do not perform the first two roles of money
- Unit of account is important (particularly in a diverse economy), though anything could serve as a unit of account
- Medium of exchange role is the most important role of money:
  - Eliminates need for barter, reduces transactions costs associated with exchange, and allows for greater specialization
  - Even when currencies have failed (e.g. Wiemar Republic), people resort to alternative monies (e.g. cigarettes) before engaging directly in barter

Liquidity

- As a store of value, money tends to be crummy relative to other assets like stocks and houses, which offer some expected return over time
- Why then do people hold money? Because they value liquidity
- One popular definition of liquidity: ease with which an asset can be converted into a medium of exchange (i.e. money)
- Money is the most liquid asset because it is the medium of exchange
- If you held all your wealth in housing, and you wanted to buy a car, you would have to sell (liquidate) the house, which may not be easy to do, may take a while, and may involve selling at a discount if you must do it quickly

Liquidity (continued)

- Need to take a somewhat nuanced interpretation of "ease with which asset can be converted into a medium of exchange"
- We will use term "cash" to refer to physical currency *or* demand deposits which can be used in exchange
- Shares of stock are nearly perfectly liquid in that I can easily convert them to cash quickly . . .
- . . . but maybe not at the price I expect
- Example: I have $1000, and I don't need to spend it today. I *might* need to spend it tomorrow (or the day after)
  - I could store cash (either in currency under my mattress or in a checking account), or I could buy Apple stock (AAPL)
  - If I store $1000 in cash, I will have $1000 in cash when I need it
  - If I buy $1000 in Apple, I can get cash when I need it, but I'm uncertain as to how much cash (i.e. price could go up or down)

Liquidity (continued)

- In addition to market liquidity, by which we mean the actual ease of selling an asset without affecting its market price, one might also measure an asset's liquidity by how much that asset's price fluctuates
- The (nominal) value of money doesn't fluctuate – one dollar in cash today gives you one dollar with certainty tomorrow. Money is a special asset because it "trades at par" (par = face value)
- Not true for other assets like stocks, real estate
- So-called near monies are assets that are very nearly as liquid as cash with either small transactions cost of liquidating them or small price uncertainty:
  - Money market funds
  - Non-transactions deposits (savings accounts, time deposits)
  - Government bonds with short time to maturity

The Island of Stone Money

- In Ch. 1, Friedman discusses the monetary system of the island of Uap
- Their currency was *fei* – large stone wheels
- People freely accepted these *fei* in exchange for goods and services, even without actually taking physical possession of them
- Seems crazy, but you and I do this all the time
  - e.g. I write you a check, my bank transfers funds from my account to your bank account
  - We never take physical possession of anything (though we have the right to)
- In some deep sense, monetary systems rest on a fiction
  - True particularly for fiat money
  - But true even for commodity-based money

Evolution of Money and Payments

- Commodity-based money: money made up of precious metals or other commodities
  - Difficult to carry around, potentially difficult to divide, price may fluctuate if precious metal or commodity has consumption value independent of medium of exchange role (i.e. not really perfectly liquid)
- Currency: pieces of paper or coins that are accepted as medium of exchange. May be "backed" by some commodity (e.g. government guarantees conversion of paper into gold)
  - Problems: easily stolen, difficult to track, and difficult to transport
- Checks: instructions for holder of your money (a bank) to transfer money to another person or institution. Eliminates need to carry currency around
  - Problems: processing of checks and transfer is potentially costly, people may not accept checks if they doubt soundness of your financial institution
- Electronic payment and e-money: like checks, but transfer happens instantaneously with a complete record (e.g. debit card)

Fiat Money

- Prior to 1971, every major currency had been linked directly or indirectly to a commodity
  - No more
- Fiat money is currency, checks, and/or electronic entries that are not backed by any commodity or precious metal
- In other words, fiat money is not "convertible"
- It is only backed by the "full faith and credit"
- Fiat money has no "fundamental" value – it is only valuable because people accept it in exchange. For this reason, sometimes people say fiat money is a "bubble"
- Advantages: easily divisible, can be fully electronic, value does not fluctuate due to demand and supply of a commodity, easy for government to change quantity
- Potential problems: maybe too easy for government to manipulate quantity. Precarious in the sense of being a bubble – only has value because people believe it does

Measures of the Money Supply

- Most basic definition of the money supply is "currency in circulation," C. Also called "M0"
- Obviously currency isn't the only thing that can be used in exchange – checks can as well
- M1: currency in circulation plus demand deposits (money held in checking accounts), plus travelers checks, plus "other" checkable deposits (interest-bearing checking accounts). Again, think of this as "cash"
- M2: M1 + savings deposits and money market deposit accounts, small time deposits (e.g. CDs), and money market accounts (i.e. M1 plus "near monies")
- Descending order of liquidity – M2 includes less liquid assets than M1
- M3 (discontinued) includes M2 plus "large" time deposits, institutional money market funds, and short term repurchase agreements

TABLE 1 Measures of the Monetary Aggregates

	Value as of August 18, 2014, ($ billions)
M1 = Currency	1,206.1
+ Traveler's checks	3.3
+ Demand deposits	1,089.9
+ Other checkable deposits	477.4
Total M1	2,776.7
M2 = M1	
+ Small-denomination time deposits	533.0
+ Savings deposits and money market deposit accounts	7,338.2
+ Money market mutual fund shares (retail)	642.5
Total M2	11,290.4

Source: http://www.federalreserve.gov/releases/h6/hist.

Money Supply

- We often think of the central bank (e.g. the Federal Reserve) as setting the money supply
- This is not quite accurate, though in normal times it is not a bad approximation
- Why? Money supply includes privately-created assets
- Can't even perfectly control M0: central bank can print more currency, but cannot ensure it stays in circulation – i.e. it could be deposited in a bank
  - Reserves: currency not in circulation ("vault cash") plus bank deposits at the central bank
- Central bank also cannot prevent banks from creating deposits, which we think of as constituting money in terms of M1
- The money supply is jointly set by three actors:
  1. Central bank
  2. Commercial banks
  3. Depositors

T-Accounts

- In thinking about the money creation process, it is useful to use T-Accounts, which are tabular depictions of an institution's balance sheet
- A balance sheet shows the assets and liabilities of an institution
- Asset: a piece of property, note, or electronic entry that is valuable and entitles the holder to some payout (e.g. stock, bond, cash)
- Liability: a liability is an obligation that requires the holder to pay at some point in the future as a result of some past transaction
- For example, if I make you a loan, the loan is an asset to me (it's a piece of paper that says you have to pay me back), but a liability for you
- Equity (or sometimes "net worth") is the difference between the values of assets and liabilities. If you liquidated all assets and paid off all liabilities, how much money would you be left with

Example T-Account for a Homeowner

Assets		Liabilities + Equity	
Value of Home	\$100,000	Mortgage	\$80,000
Checking account	\$10,000	Student loans	\$50,000
Stocks	\$50,000	Credit card debt	\$10,000
		Equity	\$20,000

- Equity is just the difference between total value of assets and total value of liabilities for an agent (household, firm, etc.)
- In an aggregate sense, household equity is equal to the total value of non-financial assets, what we call capital
- Financial assets (stocks, bonds, deposits) are just contractual claims – one person's asset is another's liability, and hence these are not net assets (capital) in an aggregate sense

Balance Sheet for the Fed

Assets	Liabilities
Securities	Currency in circulation
Loans	Reserves

- Monetary liabilities are not really liabilities in the formal sense – these are IOUs to be paid off with other IOUs
- Monetary liabilities of the Fed: monetary base (currency plus reserves)
- It can freely create these liabilities, and hence controls the monetary base
- Reserves: deposits banks hold at the Fed plus currency in bank vaults
- Securities: holdings of US government bonds and private sector stocks and bonds
- Loans: loans made to financial institutions
- Don't worry about equity – Fed is "owned" by Treasury and remits profits

Balance Sheet for the Banking System as a Whole

Assets	Liabilities
Loans	Demand deposits
Securities	Savings deposits
Reserves	Borrowings
	Equity

- Loans are assets for banks because they are IOUs that promise the bank back its money
- Deposits are liabilities: banks have to pay out cash on demand
- Reserves: vault cash and deposits at central bank
- Borrowings: loans bank has taken out from Fed or other institution

The Monetary Base

- The monetary base is the sum of currency in circulation plus reserves:

$$MB = C + R$$

- The Fed can affect the base through open market operations and loans to financial institutions
- The split between currency and reserves is determined by the public's desire to hold cash versus deposits – central bank cannot perfectly control split between C and R, but can control MB
- An open market operation involves the purchase (or sale) of securities (typically short term government securities like Treasury Bills)
- Open market operations create (or eliminate) monetary liabilities and alter the asset composition of the banking system

Open Market Purchase

- Suppose that the Fed decides to purchase \$100 of securities from the banking system
- To do this, the Fed simply creates reserves – it credits the banking system with reserves in exchange for the securities
- For the Fed:

Assets		Liabilities	
Securities	+\$100	Reserves	+\$100

- For the banking system as a whole:

Assets		Liabilities
Securities	-\$100	
Reserves	+\$100	

- An open market purchase increases reserves (and hence the monetary base), while a sale does the opposite
- In a sense, what is special about a central bank is that it can expand or contract the size of its balance sheet arbitrarily
- Private sector cannot do this on its own

Loans to Financial Institutions

- Commercial banks can borrow directly from the Fed through the discount window or other lending facilities
- Suppose the Fed loans the banking system \$100. Fed balance sheet:

Assets		Liabilities	
Loans	+\$100	Reserves	+\$100

- Banking system balance sheet:

Assets		Liabilities	
Reserves	+\$100	Borrowings	+\$100

Currency Withdrawal

- The Fed cannot directly control reserves
- Suppose that depositors want to withdraw $100
- Banking system has to meet this withdrawal demand by drawing down reserves

Assets		Liabilities	
Reserves	-$100	Deposits	-$100

- Withdrawals reduce reserves, but increase currency in circulation, leaving monetary base unaffected
- Hence, Fed can control MB, but not C or R directly

Borrowed vs. Non-Borrowed Reserves

- Even though the Fed can completely control open market operations, there is some uncertainty about loans to financial institutions
- It is therefore convenient to split the monetary base into two components: the non-borrowed monetary base and borrowed reserves:

$$MB = MB_n + BR$$

- Where MB_n is the non-borrowed monetary base and BR is borrowed reserves (e.g. discount loans)
- Because the Fed has complete control of MB_n through open market operations, it can always adjust MB_n given fluctuations in BR to hit a target MB
- We therefore think of the Fed as directly controlling the monetary base
- But what about the money supply?

From Monetary Base to Money Supply

- The Fed can directly control the monetary base
- But what about the money supply?
- For these purposes, think of the money supply as currency in circulation plus demand deposits (so M1)
- There exists a relationship between the monetary base and the money supply, but it is not directly controlled by the Fed

Multiple Deposit Creation

- In a "fractional reserve" banking system, banks do not hold the total value of deposits in reserves
- The Fed stipulates by law a minimum fraction of total outstanding deposits that commercial banks must hold
- Call this the required reserve ratio, or *rr*
- Suppose, for simplicity, that banks do not hold any "excess reserves" (reserves in excess of what is required by the Fed)

A Hypothetical Bank Balance Sheet

- Suppose a bank, call it Bank A, has the following balance sheet:

Assets		Liabilities
Loans	\$1000	Deposits \$1000
Securities	\$100	
Reserves	\$100	

- Assume that $rr = 0.1$. So deposits are a multiple of reserves. Bank equity in this example is \$200. The bank makes money (return on equity) by earning returns on its loans and securities. Reserves (i.e. cash in vault) earn nothing (at least traditionally, before payment of interest on reserves in last decade) and hence do not create equity in a dynamic sense.

Open Market Operation

- Suppose that the Fed purchases \$100 of securities from the bank. Balance sheet goes from:

Assets		Liabilities
Loans	\$1000	Deposits \$1000
Securities	\$100	
Reserves	\$100	

to:

Assets		Liabilities	
Loans	\$1000	Deposits	\$1000
Securities	\$0 (-\$100)		
Reserves	\$200 (+\$100)		

- The direct effect of the open market operation is to alter the composition of assets at a bank
- The central bank has expanded the size of its balance sheet by creating reserves

Excess Reserves

- Now the bank is holding 20 percent of its deposits as reserves. This is more than $rr = 0.1$
- Reserves don't make money. Loans or securities do
- Suppose bank makes a loan for \$100 (equal to the value of the excess reserves)
- When it does this, it just creates a deposit for the person getting a loan. The bank creates a liability (deposit) at same time it creates an asset (loan) (without affecting equity). Can do this because of fractional reserve requirement
- New balance sheet:

Assets		Liabilities	
Loans	\$1100 (+\$100)	Deposits	\$1100 (+\$100)
Securities	\$0		
Reserves	\$200		

- A bank can expand the size of its balance (by creating liabilities) whenever it has excess reserves

Ex Nihilo

- Does Bank A create money "out of thin air"?
- No
- In this example, what allows it to create deposits is that it holds (excess) reserves
- Even if there were not an explicit reserve requirement, other parties wouldn't accept checks from Bank A if it wasn't known that Bank A had reserves (or more generally solid backing assets)
- So the bank creates money, but it isn't out of thin air (Freund and Rendahl)

Bank B

- Suppose that Bank B has an initial balance sheet that looks just like Bank A's, but Bank B didn't sell securities to the Fed
- Initial balance sheet:

Assets		Liabilities	
Loans	\$1000	Deposits	\$1000
Securities	\$100		
Reserves	\$100		

- The person getting the loan from Bank A isn't getting a loan to keep deposits with bank A. He/she is getting the loan to buy something
- Suppose that person uses the \$100 deposit and buys something, and the seller then deposits the \$100 in Bank B

New Balance Sheets for Banks A and B

- Bank A:

Assets		Liabilities	
Loans	\$1100	Deposits	\$1000 (-\$100)
Securities	\$0		
Reserves	\$100 (-\$100)		

- Bank B:

Assets		Liabilities	
Loans	\$1000	Deposits	\$1100 (+\$100)
Securities	\$100		
Reserves	\$200 (+\$100)		

- Bank A is back to its reserve requirement
- Now bank B is holding reserves equal to 0.1818 of deposits, in excess of $rr = 0.1$
- Bank B will not want to sit on these excess reserves

Bank B Makes Loans

- Suppose that Bank B makes a loan for \$90, equal to its excess reserves:

Assets		Liabilities	
Loans	\$1090 (+\$90)	Deposits	\$1190 (+\$90)
Securities	\$100		
Reserves	\$200		

- The deposits created for Bank B will only temporarily be there. The borrower will deposit them in another bank, call it Bank C, and Bank B's balance sheet will revert to:

Assets		Liabilities	
Loans	\$1090	Deposits	\$1100 (-\$90)
Securities	\$100		
Reserves	\$110 (-\$90)		

Bank C

- Initial balance sheet looks like all the others:

Assets		Liabilities	
Loans	\$1000	Deposits	\$1000
Securities	\$100		
Reserves	\$100		

- After getting the deposit, its balance sheet will be:

Assets		Liabilities	
Loans	\$1000	Deposits	\$1090 (+\$90)
Securities	\$100		
Reserves	\$190 (+\$90)		

- But now Bank C is sitting on \$81 in excess reserves. It will want to loan it out

Bank C Makes Loans

- Suppose that Bank C makes a loan for \$81, equal to its excess reserves:

Assets		Liabilities	
Loans	\$1081 (+\$81)	Deposits	\$1171 (+\$81)
Securities	\$100		
Reserves	\$190		

- The deposits created for Bank C will only temporarily be there. The borrower will deposit them in another bank, call it Bank D, and Bank C's balance sheet will revert to:

Assets		Liabilities	
Loans	\$1081	Deposits	\$1090 (-\$81)
Securities	\$100		
Reserves	\$109 (-\$81)		

Multiple Deposit Creation

- The open market operation increases (excess) reserves for Bank A
- Bank A then makes a loan, which generates \$100 additional deposits for Bank B
- Bank B then makes a loan, which generates \$90 additional deposits for Bank C
- Bank C then makes a loan, which generates \$81 additional deposits for Bank D
- And so on!
- Total change in deposits for a \$1 open market purchase:

$$\Delta D = 1 + (1 - rr) + (1 - rr)^2 + (1 - rr)^3 + \ldots$$

- This simplifies to an expression called the "simple deposit multiplier":

$$\Delta D = \frac{1}{rr}$$

Deposit Creation and the Money Supply

- Recall that we are thinking of the money supply as M1: currency in circulation plus deposits
- An open market purchase of \$100 increases deposits by $\frac{1}{rr} \times \$100$ with no effect on currency in circulation
- Hence, the change in the money supply is $\frac{1}{rr}$ times the change in reserves, or more generally times the change in the monetary base:

$$\Delta M = \frac{1}{rr} \Delta MB$$

- We could call the money multiplier the simple deposit multiplier:

$$mm = \frac{1}{rr}$$

- Then we have a relationship between the monetary base and the money supply:

$$M = mm \times MB$$

The Simple Model is too Simple

- The simple model assumes the following:
  1. Banks hold no excess reserves: they either make loans or buy securities to just satisfy the reserve requirement
  2. Lenders who get loans deposit the entirety of the loan in a bank – there is no currency holding
- Holding excess reserves or currency outside of a bank will "slow down" multiple deposit creation and lower the money multiplier

A More General Model

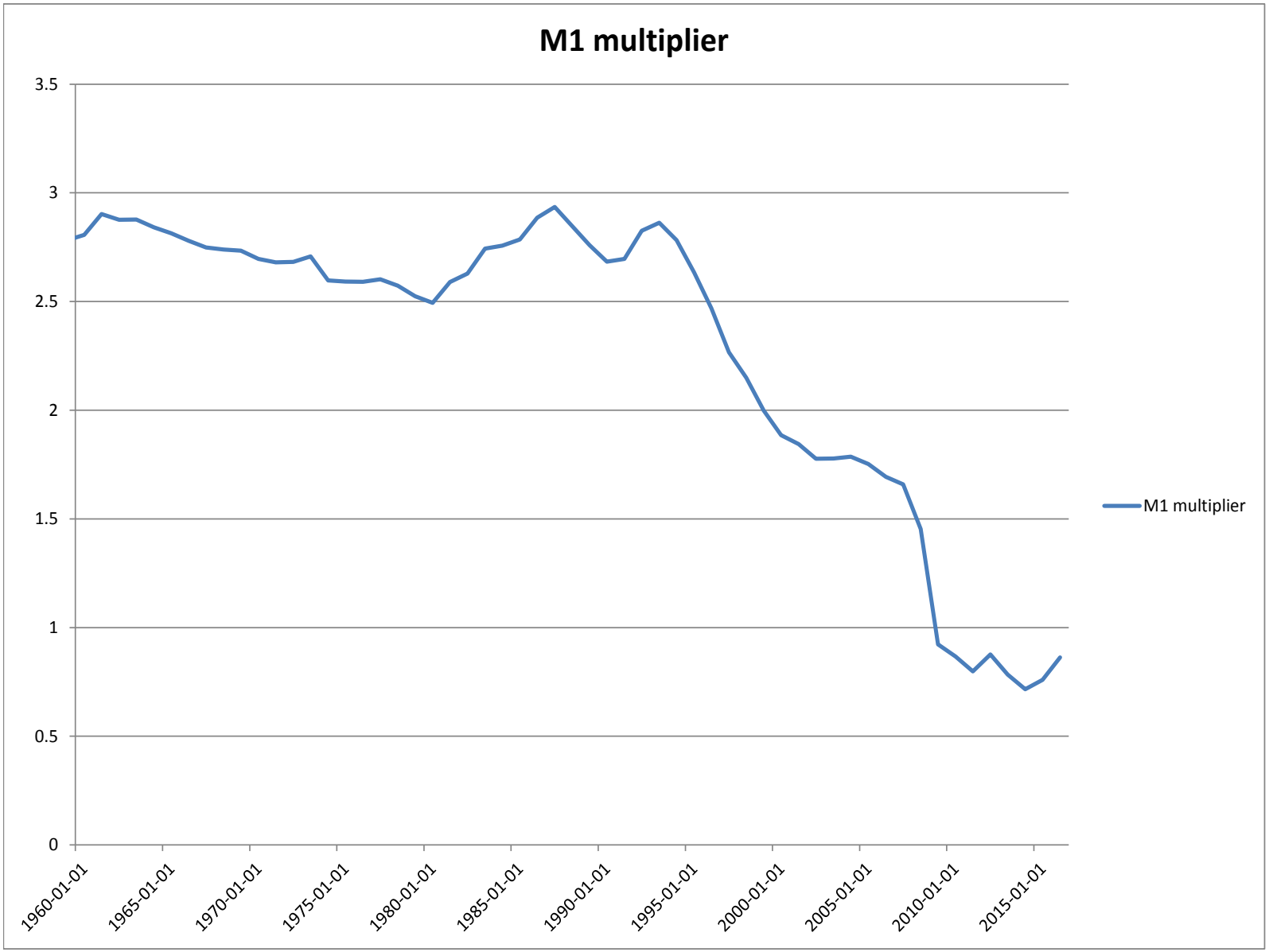
- Let $c = \frac{C}{D}$ be the desired currency to deposit ratio and $e = \frac{ER}{D}$ be the excess reserve ratio held by banks. $rr = \frac{RR}{D}$ is the required reserve ratio, which the central bank can set. Total reserves, $R = ER + RR$
- Recall $MB = C + R$ and $M = C + D$
- Can derive an expression:

$$M = mm \times MB$$

- Where:

$$mm = \frac{1 + c}{rr + e + c}$$

- If $c = e = 0$, this reduces to simple multiplier


M1 multiplier
3.5
3
2.5
2
1.5
1
0.5
0
1960-01-01
1965-01-01
1970-01-01
1975-01-01
1980-01-01
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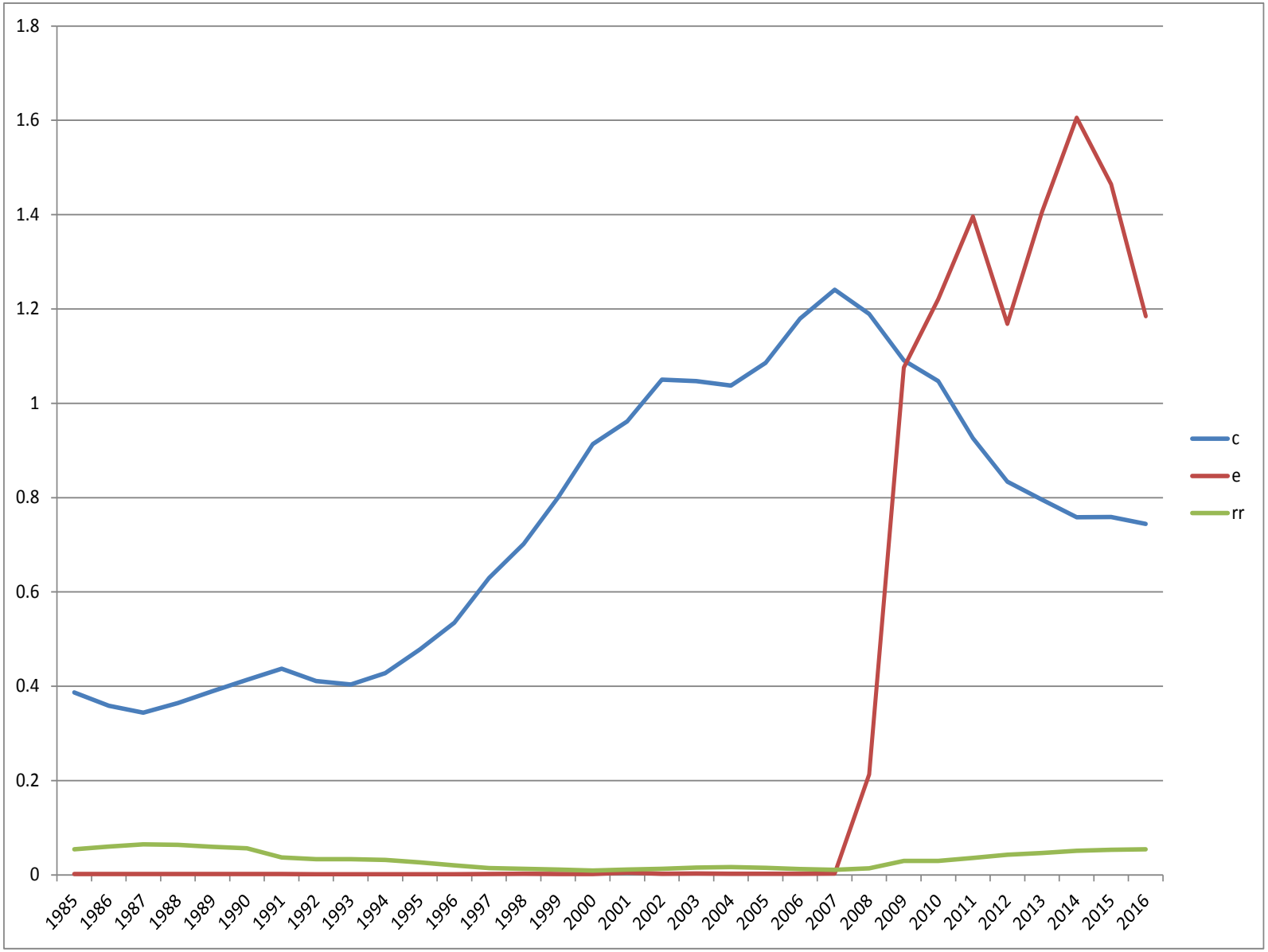
M1 multiplier


1.8
1.6
1.4
1.2
1
0.8
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1985
1986
1987
1988
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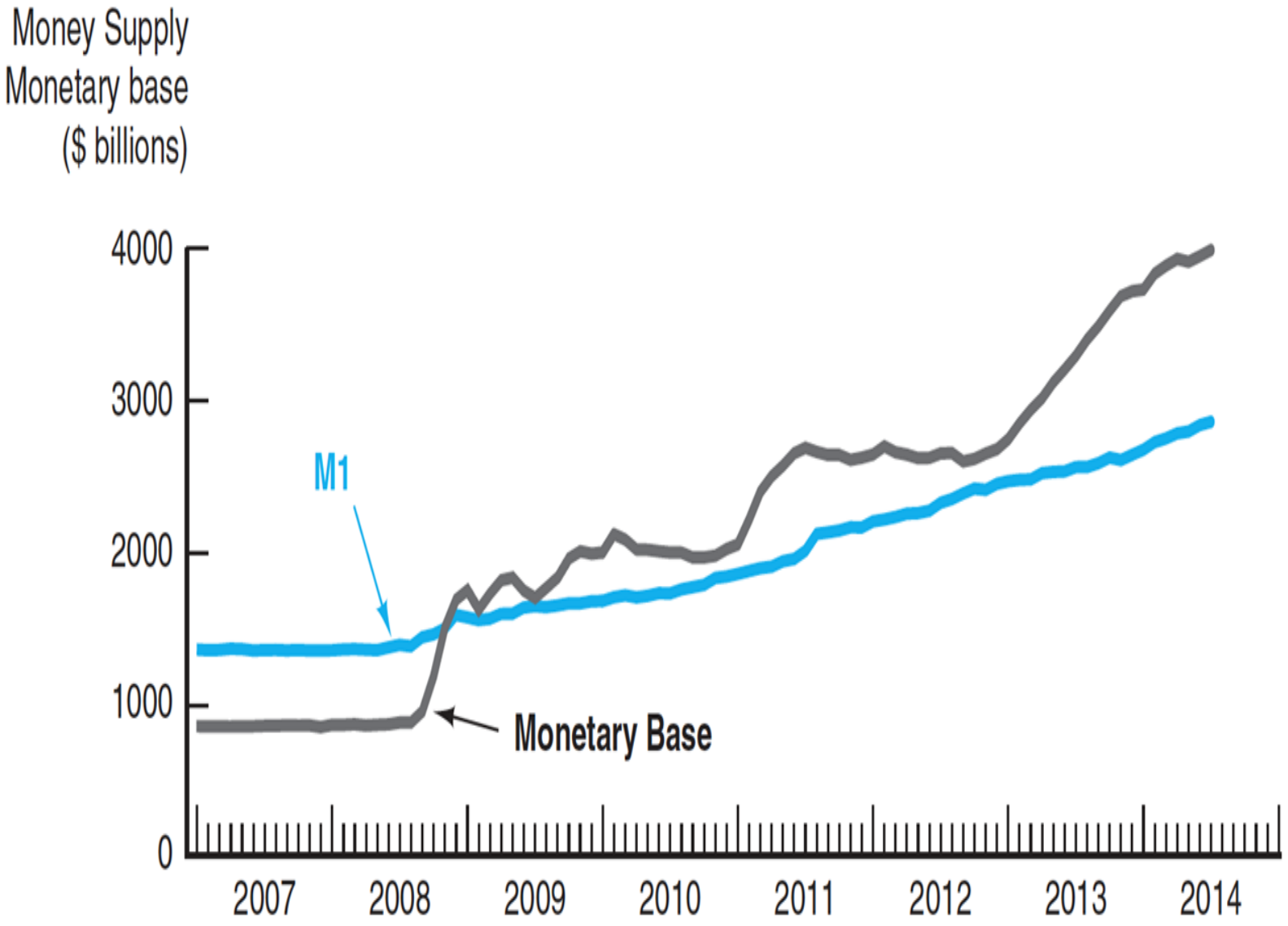
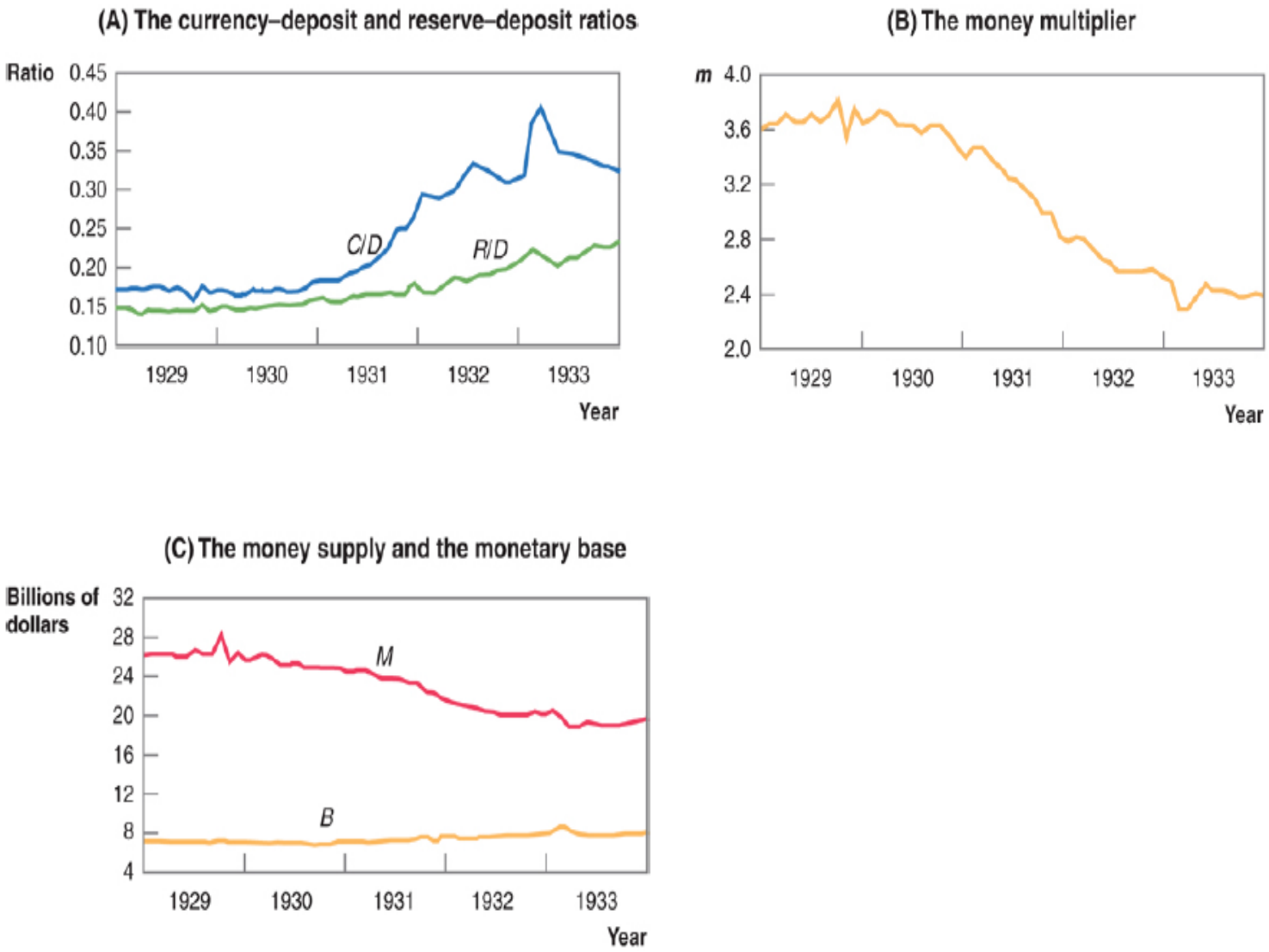
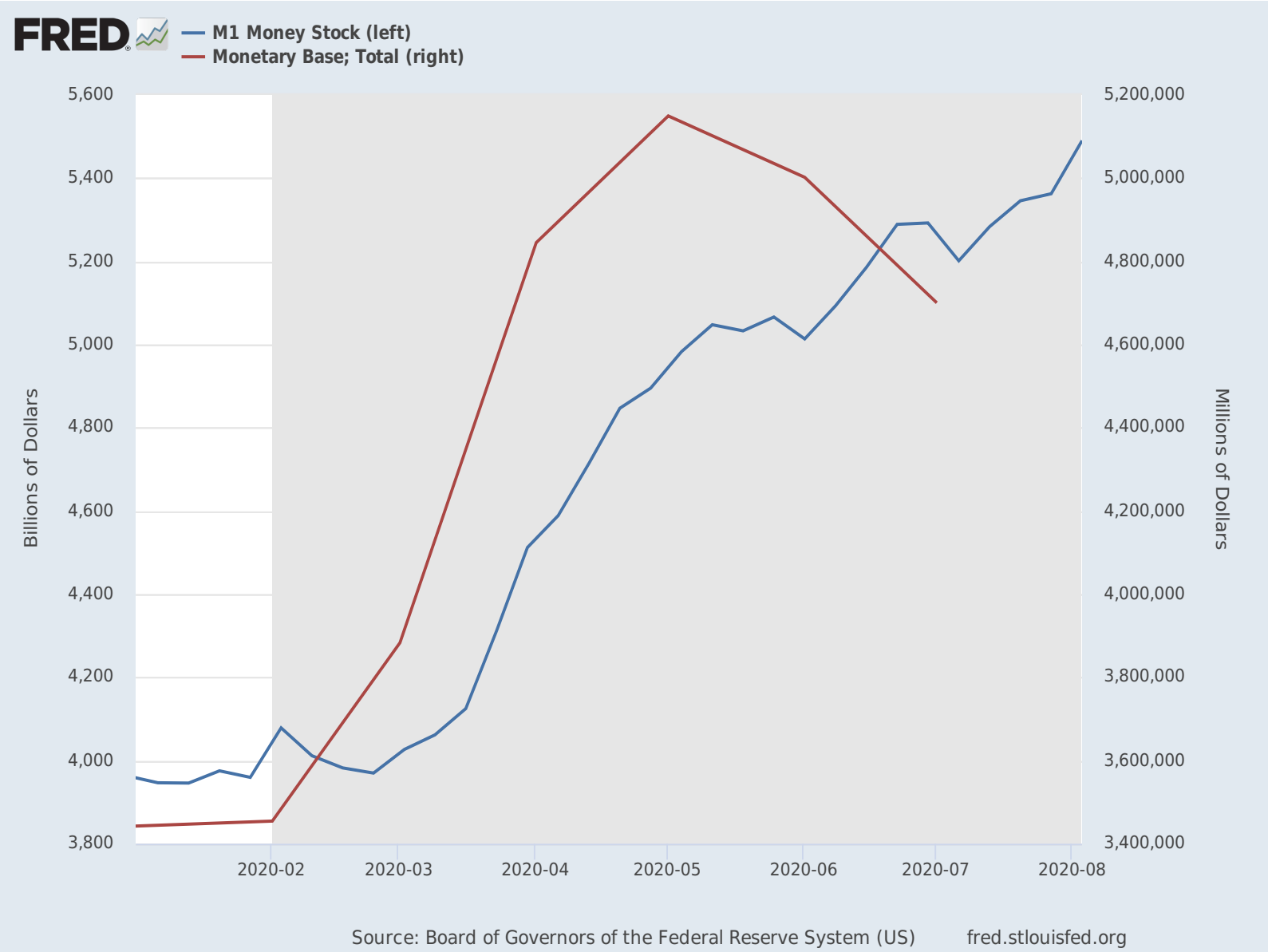
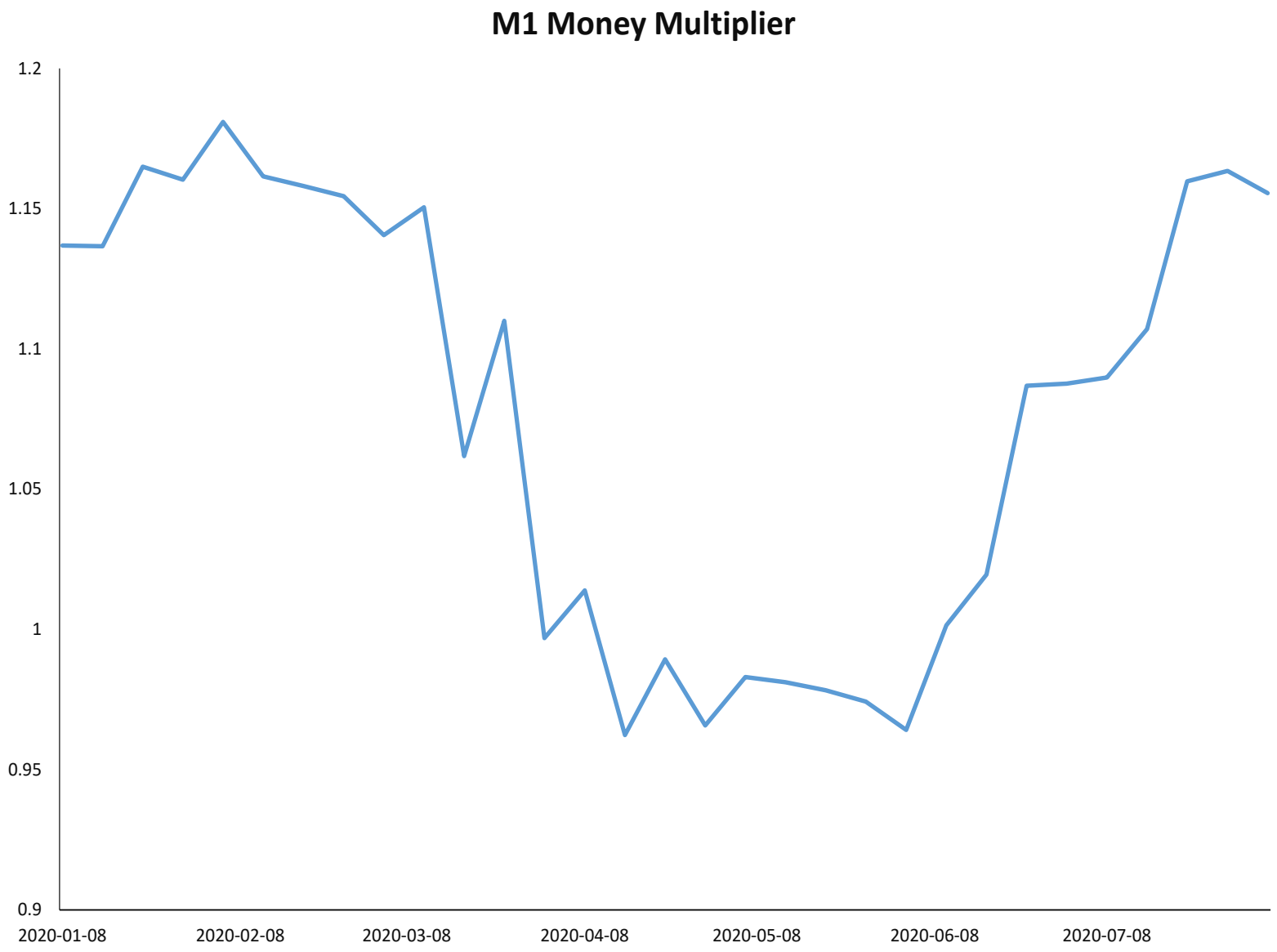

Money Supply
Monetary base
($ billions)
4000
3000
2000
1000
0
M1
Monetary Base
2007
2008
2009
2010
2011
2012
2013
2014


(A) The currency–deposit and reserve–deposit ratios
Ratio
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
C/D
R/D
1929
1930
1931
1932
1933
Year
(B) The money multiplier
m
4.0
3.6
3.2
2.8
2.4
2.0
1929
1930
1931
1932
1933
Year
(C) The money supply and the monetary base
Billions of dollars
32
28
24
20
16
12
8
4
M
B
1929
1930
1931
1932
1933
Year

Monetary Aggregates During COVID-19



Money Multiplier During COVID-19



What Can a Central Bank Control?

- The Fed can control the monetary base, MB, and the required reserve ratio, rr
- It cannot influence currency holdings, c, or excess reserves, e
- In "normal" times c and e are pretty stable, so the Fed can control M pretty well
- In extreme circumstances, not so:
  - In Great Depression, currency holdings shot up (bank runs) and the money multiplier fell. The Fed did not adjust the base much, so the money supply fell
  - In Great Recession, excess reserves went up. The Fed massively raised the monetary base, but because of the decline in the money multiplier, this had only limited effect on the money supply