Chapter 4: The monetary system: What it is and how it works

Prof. Dr. Georg Stadtmann
stadtmann@europa-uni.de

Chapter 4: Monetary System

- Learning goals

1. 4.1 What is money?
   - Introduction
   - Functions of money
   - Types of money
   - How the quantity of money is controlled
   - How the quantity of money is measured
2. 4.2 The role of *commercial* banks in the monetary system
   - Assumptions so far
   - 100 % reserve banking
   - Fractional reserve banking
   - Bank capital, leverage, and capital requirements
3. 4.3 How central banks influence the money supply?
   - A model of the money supply
   - The instruments of monetary policy
   - Problems in monetary control

Learning goals of chapter 4

After this chapter, you should

a) be able to distinguish important terms, such as monetary base versus money supply.

b) able to explain, how money is created and which factors and agents influence the money creation process

c) able to explain how the central bank can influence the money creation process, but also name some limiting factors which are not under control.

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Introduction

- Fiscal policy: Government decides on G and T.
- Monetary policy: Central bank decides on M
- Government: Elected representatives.
- Central bank: Is set up *by* elected representatives, but allowed to operate independently.

Introduction

- This chapter: Long-run focus on money! (Short run: Chapter 10).
- Central questions:
  - What is money?
  - How do commercial banks affect money supply?
  - How does the central bank control/influence money supply?

Functions of money

- Money is not equal to wealth! Counter example: Stocks!
- Functions of money:
  - Store of value
  - Unit of account
  - Medium of exchange
- Different assets: Is this money?
  - Cigarettes
  - ECU (EU currency BEFORE Euro was introduced).
  - Bitcoin
  - Debit cards
  - Credit cards

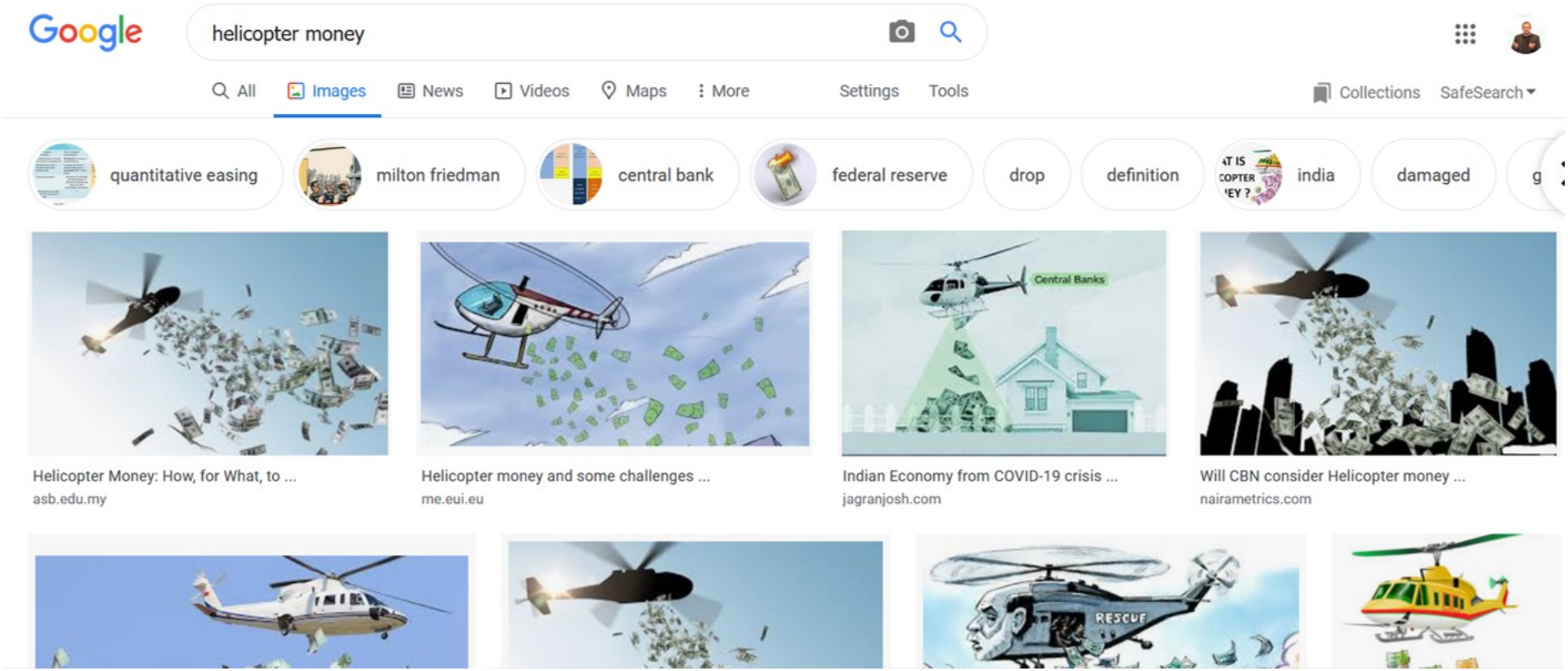
Fiat *versus* commodity money

- Fiat money
  - Money without intrinsic value,
  - established by government decree (or fiat).
- Commodity money
  - Money with some intrinsic value (gold, silver, copper).

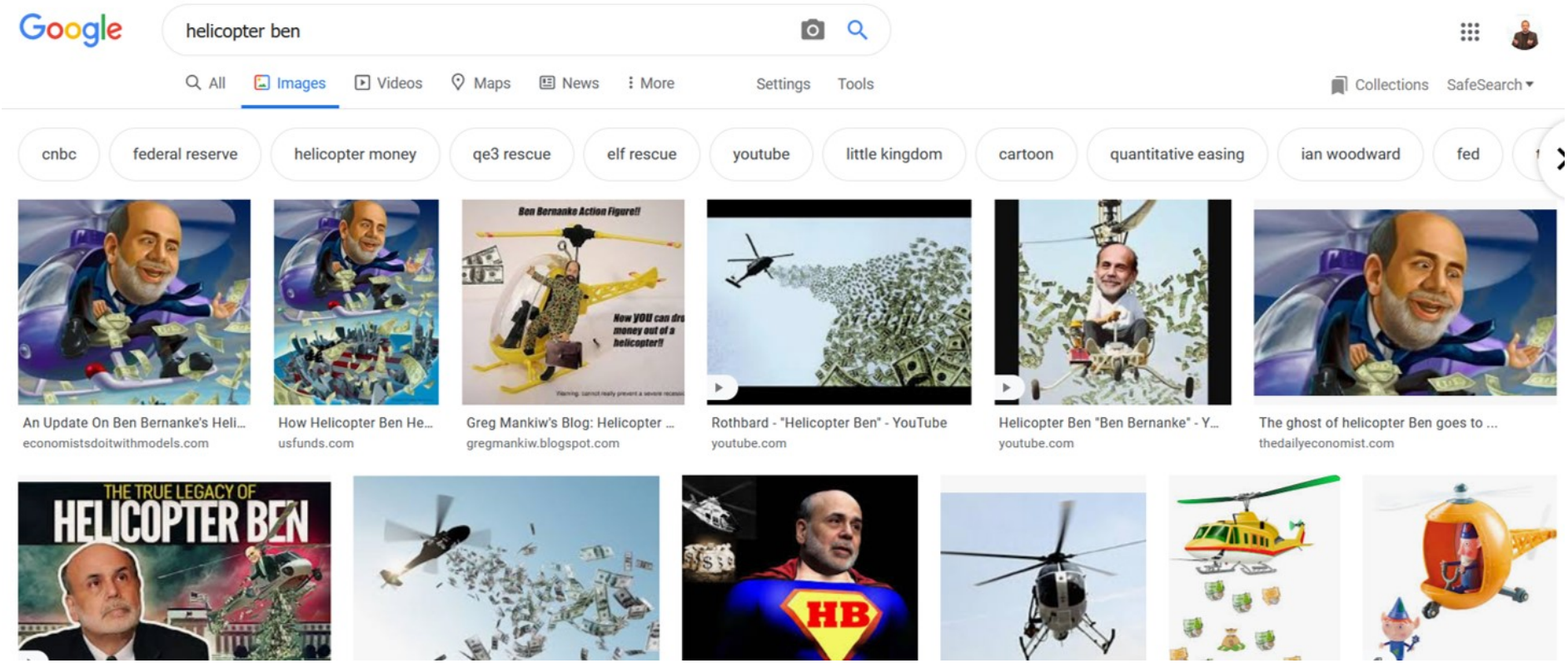
How the quantity of money is controlled

- Federal Reserve: Open market operations
- ECB: Open market operations
  - Main refinancing operations (conventional monetary policy)
  - Various Asset Purchase Programs (unconventional monetary policy: Quantitative Easing abbreviated by QE).

In theory: Helicopter money



In practice: Helicopter Ben



US: M2 is important

Symbol	Assets included
C	Currency
M1	Currency plus demand deposits, traveler's checks, and other checking deposits
M2	M1 plus retail money market mutual fund balances, saving deposits, and small time deposits

Assumptions

- The central bank controls money supply directly and completely via helicopter money.
- The commercial banking system (=private banks) does not play a role.
- Central bank has full control over money supply.
- Real world: Commercial banks and private households influence the development of money supply.

Money Supply: Definition

- Money supply = Currency*+ Demand Deposits
- *Currency in the hands of private households and real companies = non-banks

$$M = C + D \tag{1}$$

Some transactions...

- Central bank buys a bond (1000) from a private household and pays with *"freshly printed"* bank notes.
- Money in circulation (= in the hands of the private sector): 1000.
- The private household deposits the notes with a commercial bank.
- Commercial banks stores the bank notes *"in its cellar"* and does NOT provide loans to other customers.
- Commercial banking system does not affect money supply!
- Money supply is only affected by the central bank and its operations with the private sector.

Balance sheet

Firstbank's Balance Sheet

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

- Money supply = Currency*+ Demand Deposits
- *Currency in the hands of private households and real companies = non-banks

The role of commercial banks

- Fractional reserve banking: Commercial banks keep only a fraction of their deposits in reserve.
- Commercial banks provide loans to the private sector.
- In the process of giving credit: Commercial banks create money.
- Reserve deposit ratio (rr): Fraction of deposits kept in reserve

$$rr = mr + vr \tag{2}$$

- rr: reserve deposit ratio
- mr: minimum reserve requirements (is set by the central bank)
- vr: voluntary reserves (decided by the commercial bank itself)

Voluntary reserves (p. 95): *"From 2007 to 2014, the reserve ratio increased substantially, because banks chose to hold substantial quantities of excess reserves."*

Step 1: Central bank injects liquidity

Firstbank's Balance Sheet

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

Step 2: First bank provides a loan of 800

Firstbank's Balance Sheet

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

Step 3: Second bank provides a loan of 640

Secondbank's Balance Sheet

Assets		Liabilities	
Reserves	$160	Deposits	$800
Loans	$640		

Step 4: Third bank provides a loan of 512

Thirdbank's Balance Sheet

Assets		Liabilities	
Reserves	$128	Deposits	$640
Loans	$512		

How much money can be created?

$$
\begin{aligned}
\text{Original Deposit} &= \$1{,}000 \\
\text{Firstbank Lending} &= (1 - rr) \times \$1{,}000 \\
\text{Secondbank Lending} &= (1 - rr)^2 \times \$1{,}000 \\
\text{Thirdbank Lending} &= (1 - rr)^3 \times \$1{,}000 \\
\hline
\text{Total Money Supply} &= [1 + (1 - rr) + (1 - rr)^2 \\
&\qquad + (1 - rr)^3 + \ldots] \times \$1{,}000 \\
&= (1/rr) \times \$1{,}000.
\end{aligned}
$$

- $rr = 0.2$ and $B = 1000$
- $M = 1/0.2 \cdot 1000 = 5000$

Derivation of the formula: $M = 1/rr \cdot B$

$$M = \left[1 + (1 - rr)^1 + (1 - rr)^2 + (1 - rr)^3 + \ldots + (1 - rr)^{\infty - 1} + (1 - rr)^{\infty}\right] \cdot B$$

Dividing both sides by $(1 - rr)$ leads to:

$$\frac{1}{(1 - rr)} M = \left[\frac{1}{(1 - rr)} + 1 + (1 - rr)^1 + (1 - rr)^2 + \ldots + (1 - rr)^{\infty - 1}\right] \cdot B$$

$$M = \left[1 + (1 - rr)^1 + (1 - rr)^2 + (1 - rr)^3 + \ldots + (1 - rr)^{\infty - 1} + (1 - rr)^{\infty}\right] \cdot B$$

$$\frac{1}{(1 - rr)} M = \left[\frac{1}{(1 - rr)} + 1 + (1 - rr)^1 + (1 - rr)^2 + \ldots + (1 - rr)^{\infty - 1}\right] \cdot B$$

Subtracting one from the other:

$$M - \frac{1}{(1 - rr)} M = \left[-\frac{1}{(1 - rr)} + (1 - rr)^{\infty}\right] \cdot B \tag{3}$$

$$M - \frac{1}{(1-rr)}M = \left[-\frac{1}{(1-rr)} + (1-rr)^{\infty}\right] \cdot B$$

Last term $(1-rr)^{\infty}$ converges against zero:

$$\frac{1-rr-1}{1-rr}M = -\frac{1}{1-rr} \cdot B \qquad \Rightarrow \qquad \frac{-rr}{1-rr}M = -\frac{1}{1-rr} \cdot B \tag{4}$$

Multiplying though $-\frac{1-rr}{rr}$, we get:

$$M = \frac{1}{rr} \cdot B \tag{5}$$

Final notes

- Banking system creates money – not wealth!
- It increases the economy's liquidity – not its wealth!
- Explanation:
  - When the bank creates a loan for customer 1 (in the first step) it also creates a deposit on the account of customer 1!
  - When customer 1 goes shopping and transfers money to customer 2.
  - Customer 1 has a loan and customer 2 the money.
  - Net wealth of the whole economy has not changed!

Bank capital, leverage, and capital requirements

- Bank capital: Equity of the bank

Realbank's Balance Sheet

Assets		Liabilities and Owners' Equity	
Reserves	$200	Deposits	$750
Loans	$500	Debt	$200
Securities	$300	Capital (owners' equity)	$50

Bank capital, leverage, and capital requirements

- Leverage ratio:

$$\text{Leverage ratio} = \frac{\text{Total assets}}{Equity} = \frac{1000}{50} = 20 \tag{6}$$

  - 1 unit of equity *'securers'* 20 units of assets.
  - With 1 unit of equity the bank operates with 20 units of assets
  - *"The larger the leverage ratio the larger the risk!"* ???
  - Leverage ratio can increase when the commercial bank increases its operations (*assets* $\uparrow$) or when (*equity* $\downarrow$)
- Capital requirements: *equity*/*asset* ratio should always be larger than a limit – set by the regulator.

Definitions

- Monetary base (B): The total number of dollars
  - held by the public as currency (C) in form of notes
  - and by commercial banks as reserves on accounts with the central bank (R).

$$B = C + R \tag{7}$$

- Reserve deposit ratio (rr): Is the fraction of deposits that commercial banks hold as reserves. It is determined by
  - the business policies of commercial banks and
  - laws which are regulating the commercial banking sector (bank regulator, central bank).

$$rr = \frac{R}{D} \tag{8}$$

Definitions

- Currency deposit ratio (cr) is the amount of currency private agents hold as a fraction of their deposits.

$$cr = \frac{C}{D} \tag{9}$$

Modifications

$$M = C + D \tag{10}$$

$$B = C + R \tag{11}$$

Dividing one by the other:

$$\frac{M}{B} = \frac{C + D}{C + R} \quad \Big| \cdot \frac{\frac{1}{D}}{\frac{1}{D}} \tag{12}$$

$$\frac{M}{B} = \frac{\frac{C}{D} + 1}{\frac{C}{D} + \frac{R}{D}} \tag{13}$$

Modifications

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

$$\frac{M}{B} = \frac{cr + 1}{cr + rr} \quad \Big| \cdot B \tag{14}$$

$$M = \frac{cr + 1}{cr + rr} \cdot B \tag{15}$$

$$M = m \cdot B \quad with \quad m = \frac{cr + 1}{cr + rr} \tag{16}$$

- m: Money multiplier

Interpretation

$$M = \frac{cr + 1}{cr + rr} \cdot B$$

- Money supply depends in a positive relationship on the monetary base.
- The lower rr the larger m, the more money can be created.
- Money multiplier the smaller, the larger cr. Proof: See next slide!

Proof: Not so important!

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

$$\frac{dm}{dcr} = \frac{1 \cdot (cr + rr) - 1 \cdot (cr + 1)}{(cr + rr)^2} \tag{17}$$

$$\frac{dm}{dcr} = \frac{rr - 1}{(cr + rr)^2} < 0 \quad if \quad rr < 1 \tag{18}$$

What if...

What if $cr = 0$?

$$M = \frac{cr + 1}{cr + rr} \cdot B$$

$$M = \frac{1}{rr} \cdot B$$

$$rr = mr + vr \tag{19}$$

What if on top of $cr = 0$ also $vr = 0$?

$$rr = mr \quad \text{so that} \quad M = \frac{1}{mr} \cdot B \tag{20}$$

Money creation process is only limited by the minimum reserve requirements – set by the central bank!

Instruments

- Change monetary base.
- Minimum reserve requirements.
- Interest on reserves.

Problems & limitations

- The central bank has substantial power to influence the money creation process,
- but it cannot control the development of money supply perfectly.
- The central bank cannot
  - directly control, whether a commercial bank gives a credit or not (loan supply),
  - determine, wether a private customer wants a credit (credit demand) or
  - fully control the cash preferences of private households.