Money and Inflation

Money - any generally acceptable means of payment in exchange for good and services and in settling debts

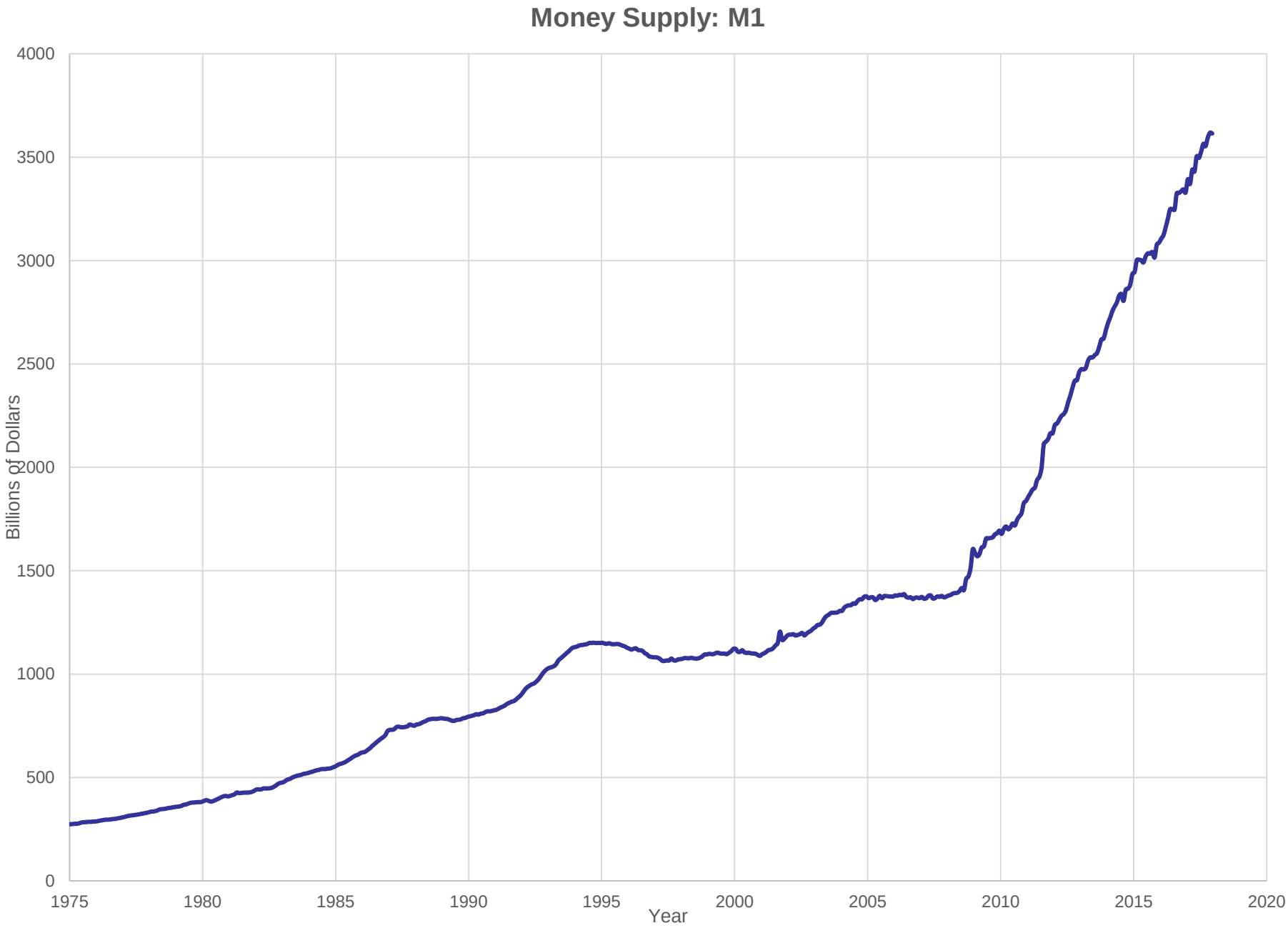
Serves as

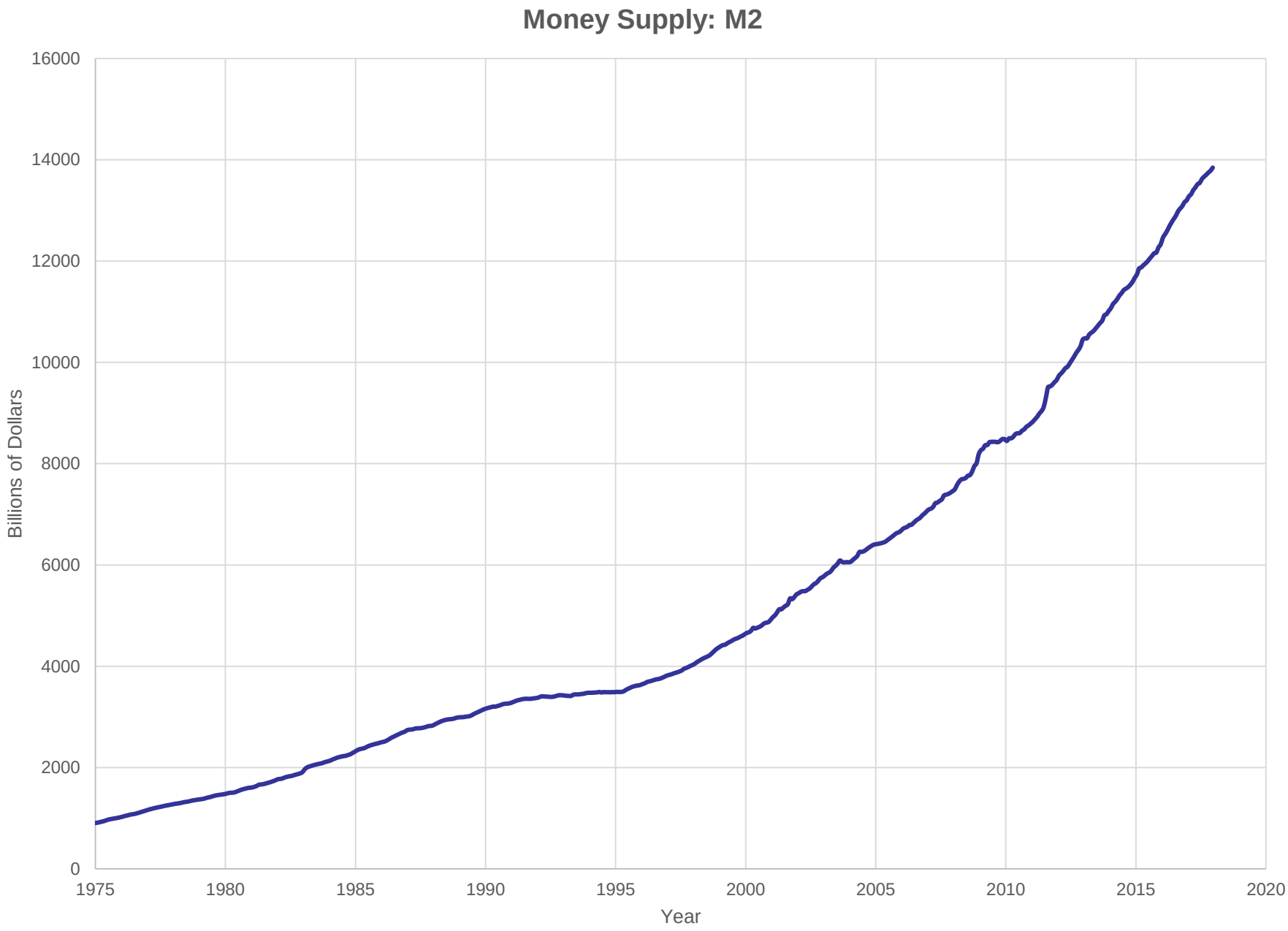
- medium of exchange
- unit of value
- store of value
- standard of deferred payment

Stages of History

- Autarky – no trade, no specialization, no money
- Barter – trade good for goods
  - » Need double coincidence of wants
- Money
  - Commodity money (shells, metals, coins…)
  - Fiat money (legal tender, paper money)
  - Bank money (checking accounts)

Money


Money Supply: M1
4000
3500
3000
2500
2000
1500
1000
500
0
Billions of Dollars
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Year


Money Supply: M2
16000
14000
12000
10000
8000
6000
4000
2000
0
Billions of Dollars
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Year

Bitcoin Price (BTC)

Trade

$3,556.97 +$3,531.01 (26.4K%)

1H 24H 1W 1M 1Y ALL

Market Cap	Volume (24 hours)	Circulating Supply	All time high
$62.3B	$5.3B	17.5M BTC	$16.8K

National Money (since 1862)

	Billions $
Currency	$1,625.60
Checkable Deposits	$2,155.10
M1: Transactions Money	$3,780.70
Savings Accounts	$10,674.40
M2: Broad Money	$14,455.10

December 2018

Currency in Circulation (approx. in 2016)

denomination	bills in circulation (billions)	percent	Value (billions)	percent
1	11.7	29.5%	$11.7	0.8%
2	1.2	3.0%	$2.4	0.2%
5	2.8	7.1%	$14.0	1.0%
10	1.9	4.8%	$19.0	1.3%
20	8.9	22.4%	$178.0	11.1%
50	1.7	4.3%	$85.0	5.8%
100	11.5	29.0%	$1,150.0	78.8%
Total	39.7		$1,460.1	

Other terms

- MZM : money zero maturity
  - M2 + all money market funds – time deposits
  - $15,753.5 billion (Dec 2018)

- Monetary Base : high powered money
  - Currency + bank reserves
  - $3,373.00 billion (Dec 2018)

Money Supply

- Federal Reserve sets the nation's nominal money supply
- Fed has some political independence
- Control money supply with 3 tools
  - Reserve requirement
  - Discount rate
  - Open market operations
- Control of money supply is monetary policy

Money Supply

- High powered money = H = currency + reserves = C + R
- Money supply = M = currency + deposits = C + D
- H (money multiplier) = M
- Money multiplier *m* depends on the currency/deposit ratio and the reserve/deposit ratio

Derivation

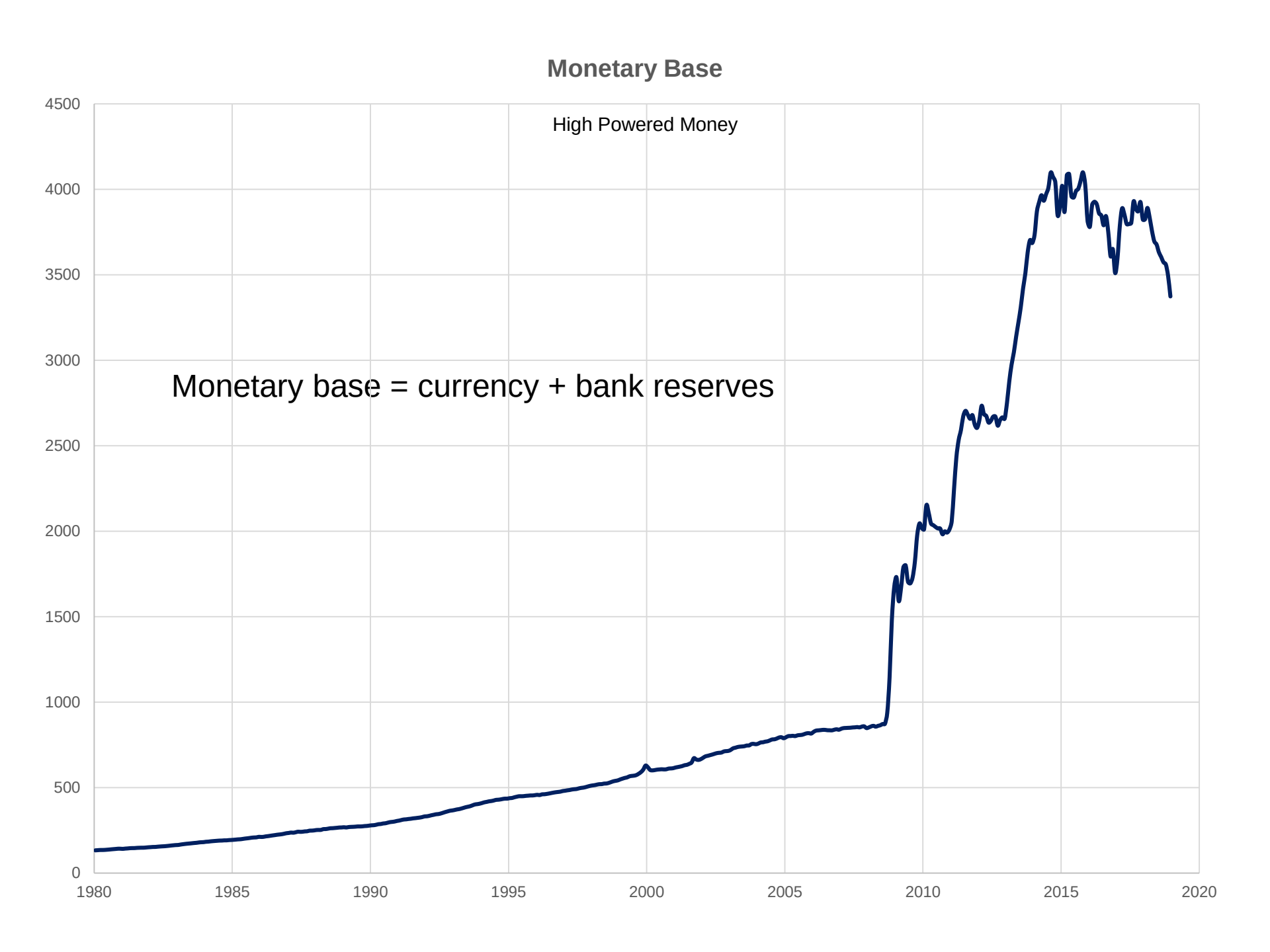
$$C + D = C + D$$

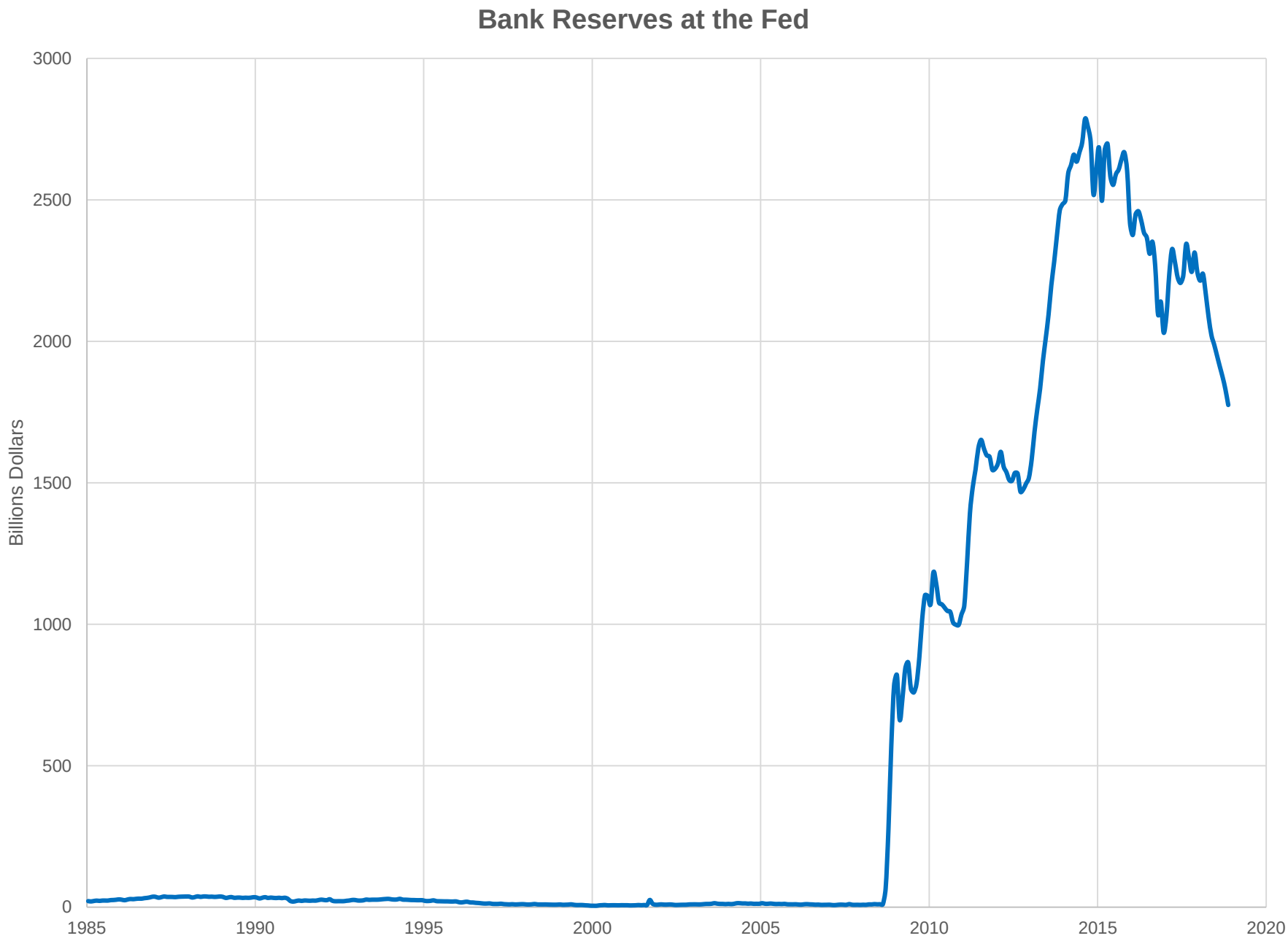
$$(C + R)\frac{(C + D)}{(C + R)} = C + D$$

$$(C + R)\frac{\left(\frac{C}{D} + \frac{D}{D}\right)}{\left(\frac{C}{D} + \frac{R}{D}\right)} = C + D$$

$$H\left(\frac{cr + 1}{cr + rr}\right) = M$$

$$H(m) = M$$

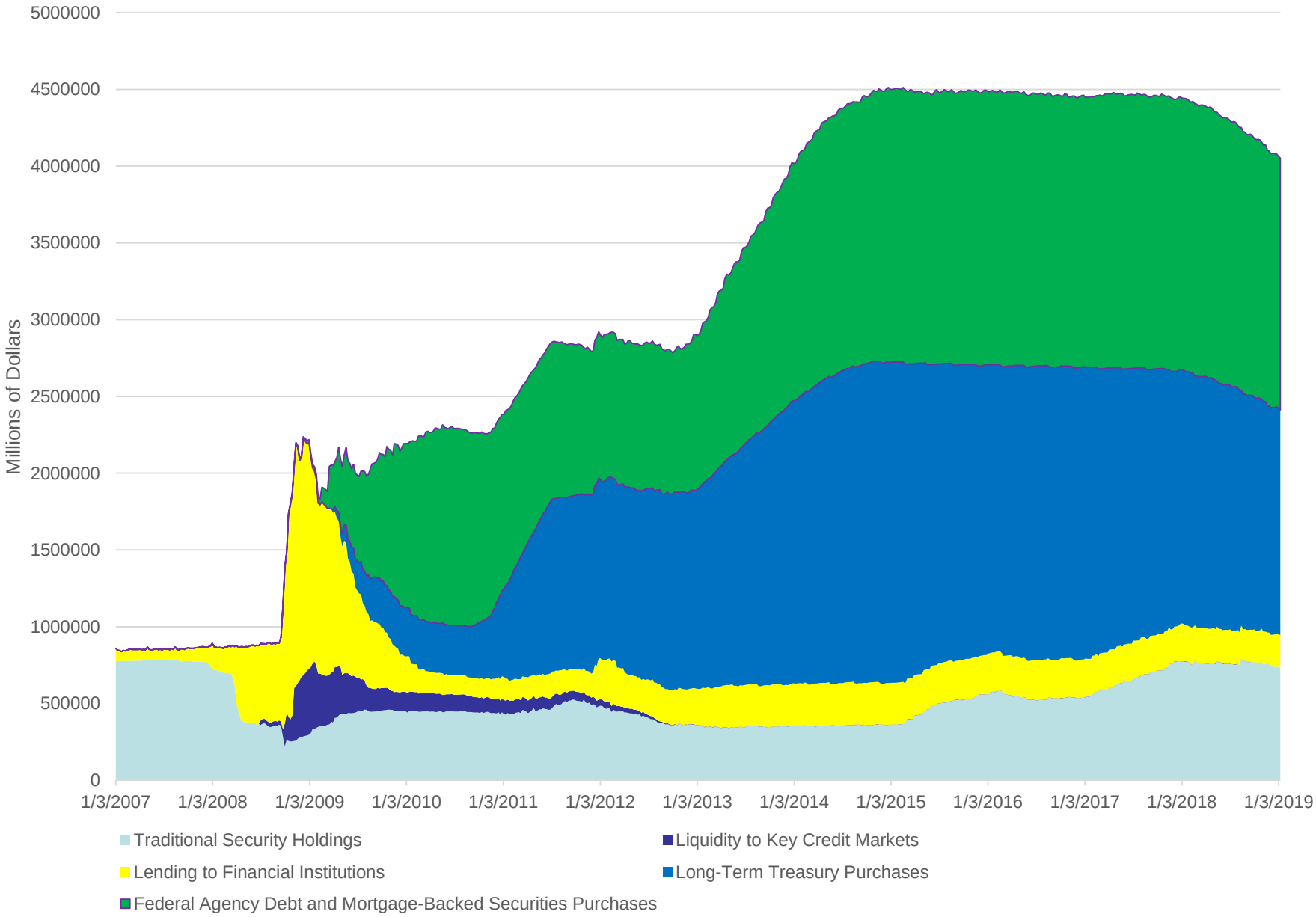

Monetary Base
High Powered Money
Monetary base = currency + bank reserves
4500
4000
3500
3000
2500
2000
1500
1000
500
0
1980
1985
1990
1995
2000
2005
2010
2015
2020

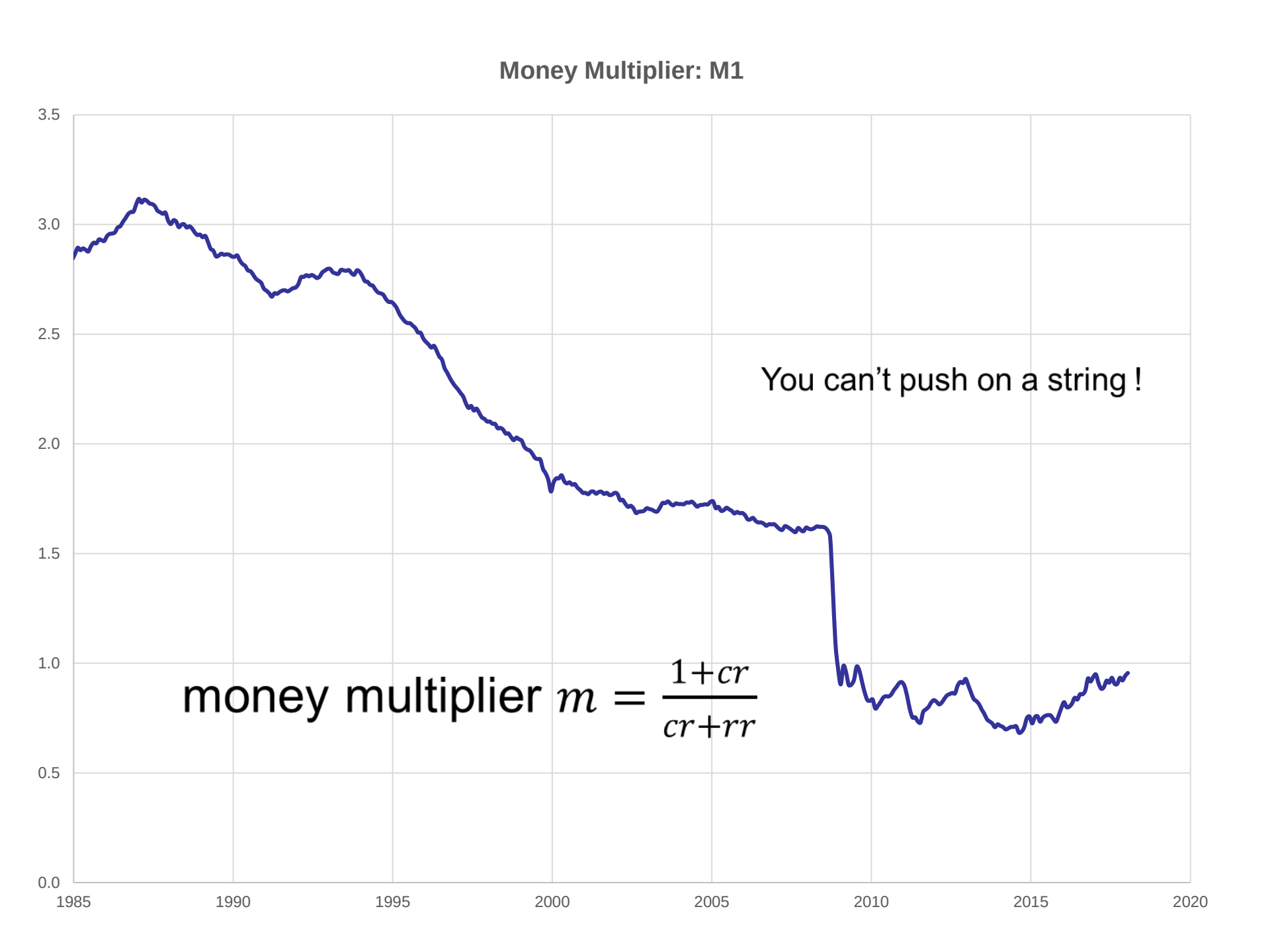

Bank Reserves at the Fed
Billions Dollars
3000
2500
2000
1500
1000
500
0
1985
1990
1995
2000
2005
2010
2015
2020

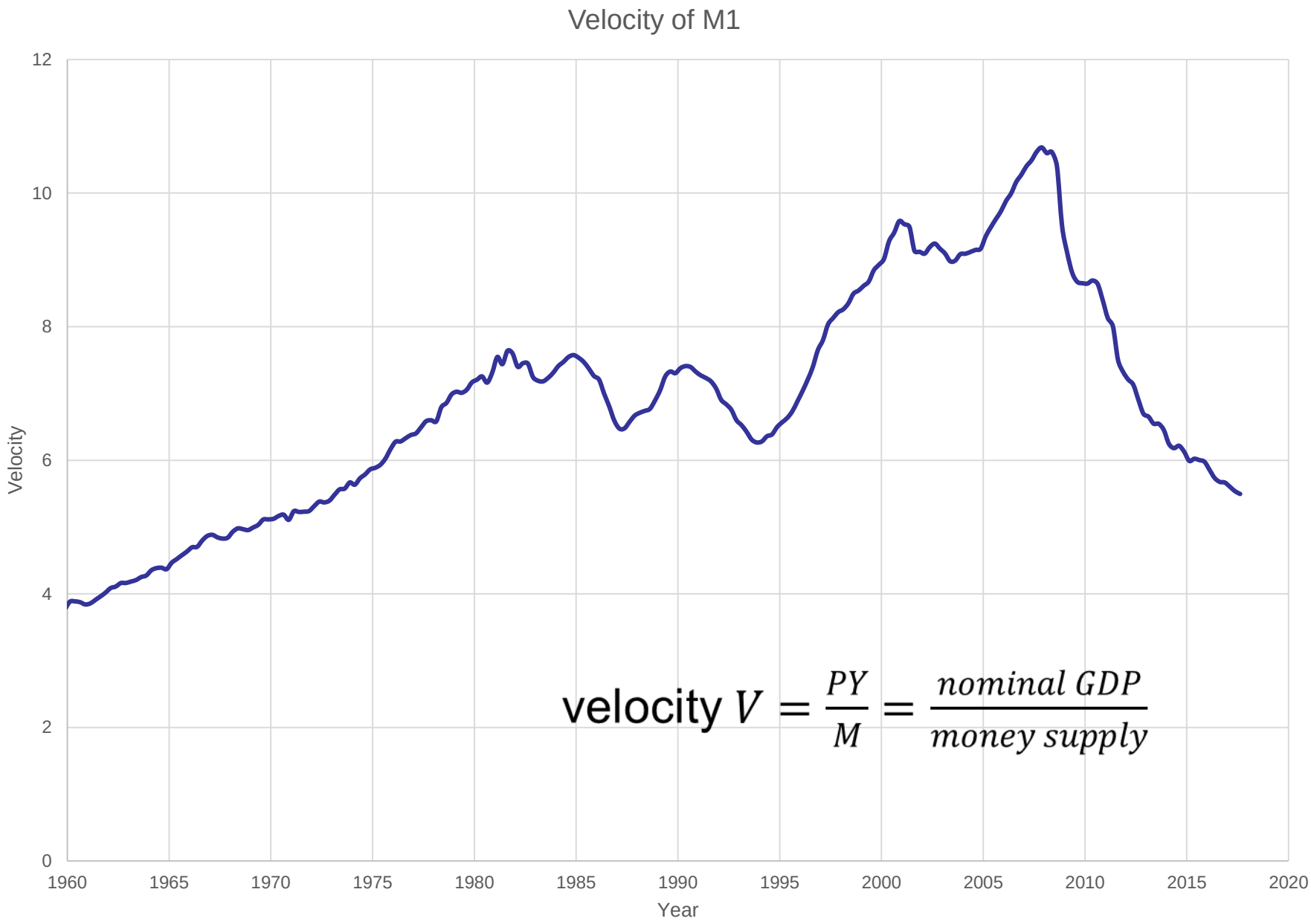
Federal Reserve Balance Sheet

Billions $ January 2019

Assets		**Liabilities**	
Gold	11	Currency	1,657
Treasury Securities	2,222	Reserves	1,625
Mortgage Backed Securities	1,633	Deposits other than Reserves	467
Other	184	Other	301
Total	$4,050	**Total**	$4,050


Credit Easing: Balance Sheet of Federal Reserve
Millions of Dollars
5000000
4500000
4000000
3500000
3000000
2500000
2000000
1500000
1000000
500000
0
1/3/2007
1/3/2008
1/3/2009
1/3/2010
1/3/2011
1/3/2012
1/3/2013
1/3/2014
1/3/2015
1/3/2016
1/3/2017
1/3/2018
1/3/2019
Traditional Security Holdings
Liquidity to Key Credit Markets
Lending to Financial Institutions
Long-Term Treasury Purchases
Federal Agency Debt and Mortgage-Backed Securities Purchases


Money Multiplier: M1
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1985
1990
1995
2000
2005
2010
2015
2020
You can’t push on a string !
money multiplier $m = \frac{1+cr}{cr+rr}$


Velocity of M1
12
10
8
6
4
2
0
Velocity
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Year
velocity $V = \frac{PY}{M} = \frac{nominal\ GDP}{money\ supply}$

Wizard of Oz

Allegory about monetary policy

Yellow brick road	Gold standard
Cowardly Lion	William Jennings Bryan
Dorothy	America
Tornado	Free Silver Movement
Oz	Ounce of Gold
Ruby Slippers	Originally silver slippers

Money Demand

- People hold money to buy goods and services and to carry out transactions
- The cost of holding money is the nominal interest rate
- $M^d = k_o \cdot P \cdot T$
  - k_o constant
  - P price of transactions
  - T # of transactions

Money Demand

- Assume # of transactions is proportional to income Y (*k* is constant)
  - $M^d = k \cdot P \cdot Y$
- Real money demand
  - $\left(\frac{M}{P}\right)^d = k \cdot Y$
  - $\left(\frac{M}{P}\right)^d$ is proportional to income
- Money supply = Money demand
  - $\left(\frac{M}{P}\right) = k \cdot Y$

Quantity Equation

- MV=PY (this is an identity)
  - M: nominal money supply
  - V: velocity of money
  - P: price level
  - Y: real GDP
- Velocity of money is the number of times the stock of money is turned over in a year to purchase GDP

Velocity of Money

- Velocity of M1
  - $\frac{P \cdot Y}{M_1} = \frac{nominal\ GDP}{M_1} = \frac{\$20{,}658}{\$3{,}700.7} = 5.58$
- Velocity of M2
  - $\frac{P \cdot Y}{M_2} = \frac{\$20{,}658}{\$14{,}201.9} = 1.45$

Money Demand

- We have $\frac{M}{P} = kY$ and $MV = PY$
- $k = \frac{1}{V}$ or $V = \frac{1}{k}$
- We have assumed that the velocity of money is constant.
- This may *not* be a good assumption
- But let us begin from here

Money, Prices & Inflation

- Quantity Equation
  - MV=PY
  - ln(M) + ln(V) = ln(P) + ln(Y)
  - $\frac{\Delta M}{M} + \frac{\Delta V}{V} = \frac{\Delta P}{P} + \frac{\Delta Y}{Y}$
  - $g_M + g_V = g_P + g_Y$
- If V is constant, then $g_V = 0$
  - $g_P = \pi = \text{inflation}$
  - $g_M = \pi + g_Y$

Friedman's Monetary Rule

- g_Y depends on exogenous factors (labor, capital, technology)
- $\pi = g_M - g_Y$
- Since $g_Y \approx 3\%$, set $g_M = 3\%$ in order to get $\pi = 0$
- Or set $g_M = 5\%$ in order to get $\pi = 2\%$
- Inflation depends on the growth rate of money
- "inflation is a purely monetary phenomenon" Milton Friedman

Interest Rates

- Real interest rate is determined by
  - $I(r) = S_N$
- $r = i - \pi$
- Fisher effect (Irving Fisher)
  - If g_M increases by 1%, π rises by 1% and i rises by 1% (r is unchanged)
- Expectations matter
  - $r_t = i_t - \pi_t^e$

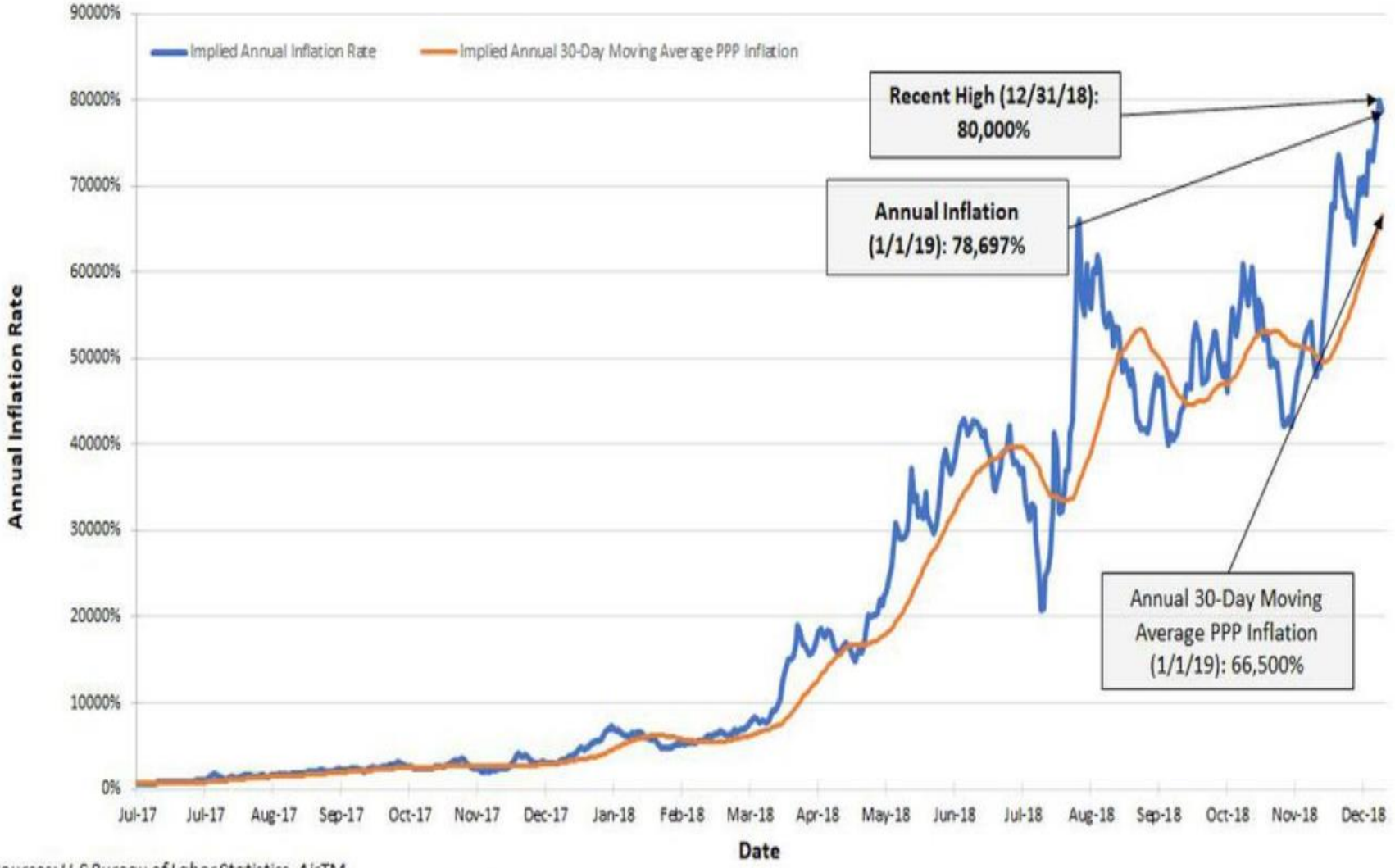
$$r = i - \pi$$

- Real vs Nominal
  - Consumption and investment depend on r
  - Money demand depends on i
- This complicates our life
- Money demand depends on Y and i
  - $\left(\frac{M}{P}\right)^d = L(i, Y)$
- Velocity depends on Y and i
  - $V = \frac{P \cdot Y}{P \cdot L(i,Y)} = \frac{Y}{L(i,Y)}$

$$i = r + \pi$$

- If you increase the growth rate of M, real money balances can fall
  - Real money demand falls as i increases
- Current price level depends on current money supply AND expected inflation
  - Fed announces increase in future money supply
  - $M = P \cdot L(r + \pi^e, Y)$
  - Price level rises today

Venezuela's Annual Inflation Rate



Sources: U.S Bureau of Labor Statistics, AirTM

Calculations by Prof. Steve H. Hanke, The Johns Hopkins University.

Note A: These inflation rates are implied by the movements in the black-market VEF/USD exchange rate.

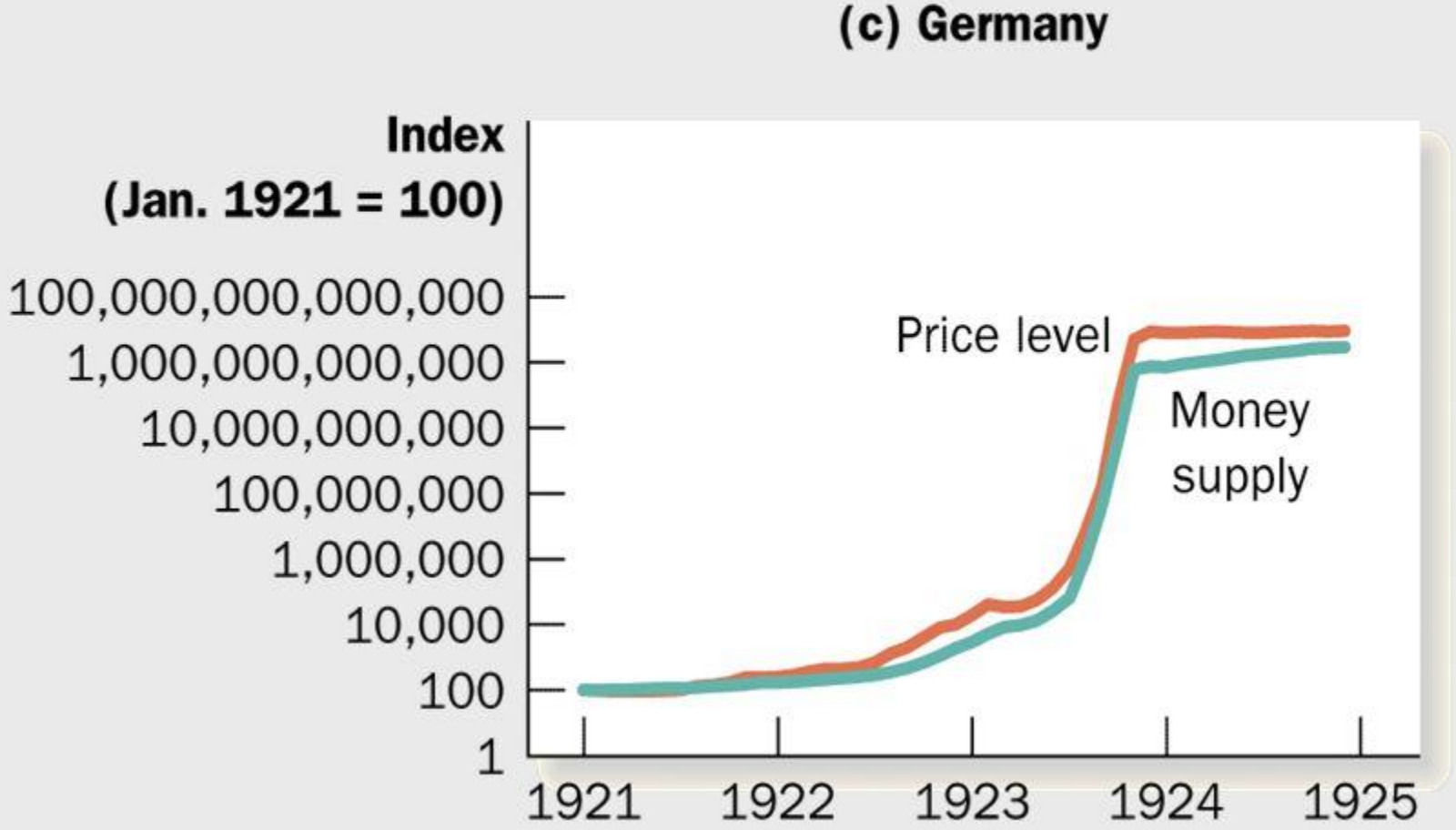
TABLE 1
ZIMBABWE'S HYPERINFLATION

Date	Month-over-month inflation rate (%)	Year-over-year inflation rate (%)
March 2007	50.54	2,200.20
April 2007	100.70	3,713.90
May 2007	55.40	4,530.00
June 2007	86.20	7,251.10
July 2007	31.60	7,634.80
August 2007	11.80	6,592.80
September 2007	38.70	7,982.10
October 2007	135.62	14,840.65
November 2007	131.42	26,470.78
December 2007	240.06	66,212.30
January 2008	120.83	100,580.16
February 2008	125.86	164,900.29
March 2008	281.29	417,823.13
April 2008	212.54	650,599.00
May 2008	433.40	2,233,713.43
June 2008	839.30	11,268,758.90
July 2008	2,600.24	231,150,888.87
August 2008	3,190.00	9,690,000,000.00
September 2008	12,400.00	471,000,000,000.00
October 2008	690,000,000.00	3,840,000,000,000,000,000.00
14 November 2008	79,600,000,000.00	89,700,000,000,000,000,000,000.00

NOTES: The Reserve Bank of Zimbabwe reported inflation rates for March 2007–July 2008. The authors calculated rates for August 2008–14 November 2008.
SOURCES: Reserve Bank of Zimbabwe (2008a) and authors' calculations.

Sources: Imara Asset Management Zimbabwe and author's calculations.

Hyperinflation in Germany



Source: Mankiw, *Principles of Macroeconomics*, 3rd ed. (2004), instructor ancillaries

Ending a Hyperinflation

- Easy if V is constant
- If V is not constant, we need to increase M before we stabilized M
- But increasing M creates a credibility problem
- Need fiscal reform to achieve credibility

Costs of Inflation

- $\pi = \pi^e + \pi^u$
- Expected inflation
  - Shoe leather costs, menu costs
- Unexpected inflation
  - Redistribution of wealth
    - Not a cost to society as a whole
  - Increases uncertainty in economic life
- Economic costs of moderate inflation are minimal