

Money

We now turn our attention to the market for another asset, money. We begin by defining money. It is not as easy to define as it seems. Historically, money has been defined to be any asset that serves the following three purposes:

1. Means of exchange. Money makes it easier for agents to purchase goods and services. This reveals the main benefit of money, it provides convenience. Suppose, as a counterfactual, all transactions must be conducted through barter. I produce kangaroo jerky and am looking to acquire napalm. You have excess napalm and I am willing to pay the market price. But, if you dislike kangaroo jerky, and are only willing to accept payment in sweatpants, then we may not be able to easily complete the transaction. Instead I have to expend time and effort to find someone who is willing to trade kangaroo jerky for sweatpants, which I then can trade for napalm. Money prevents this type of waste of resources.

In the absence of an agreed upon means of exchange, economies revert to *barter*, the type of transactions just described. The development of money is among the most significant economic innovations in history, just behind the poker chip.

2. Unit of account. This means that money provides a standard way of quoting prices. Thus instead of saying that one can of napalm costs three pairs of sweatpants, two tubes of kangaroo jerky, etc., it is quoted in units of money (dollars in the United States).

3. Store of value. Money provides a method of saving.

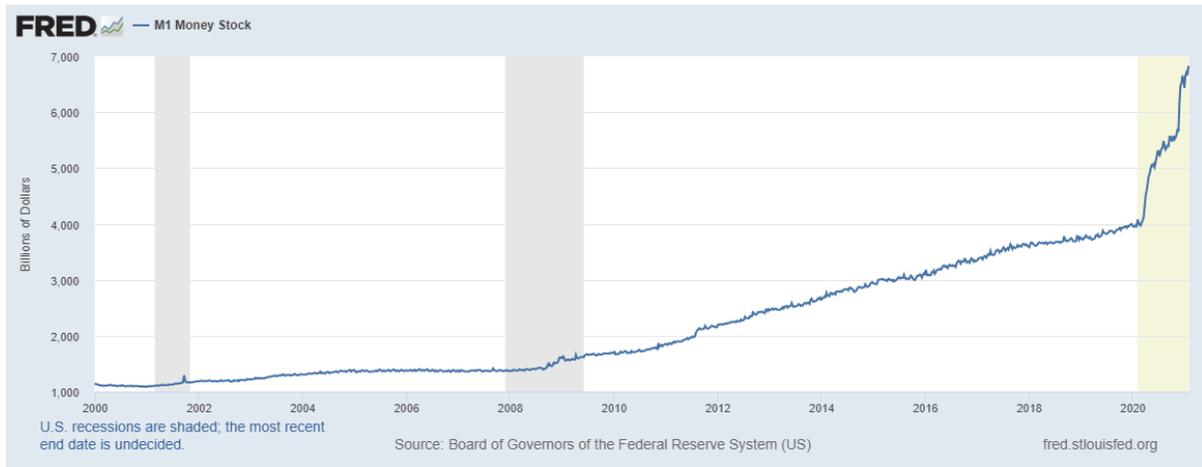
Currency obviously meets all three criteria and is thus included in any measure of money. But currency is not the only such asset. Checkable deposits, for example, meet all three criteria well and are also included in any measure of money. Other assets meet some of these criteria, or imperfectly meet all three. Consider savings accounts. A household cannot usually pay directly from a savings account, but it isn't hard to convert savings accounts to currency. They are thus a pretty good means of exchange. Many assets fall in a gray area. In deciding what to count as money, the means of exchange criteria is probably the most important.

One class of interesting assets to consider are cryptocurrencies. Should they be treated as a form of money. They were designed to use as a means of exchange. Despite some progress in this area, however (Tesla announced they would accept Bitcoin in February 2021), their use

as a means of exchange is still very limited. They also make a poor store of value because of their extreme volatility.

There are three widely used measures of money. $M1$ (\$6.8 trillion as of February 2021)¹, the most restrictive includes only currency, electronic reserves held at or by the Federal Reserve, checkable deposits, and travelers' checks.

Figure 1: M1 Money Stock



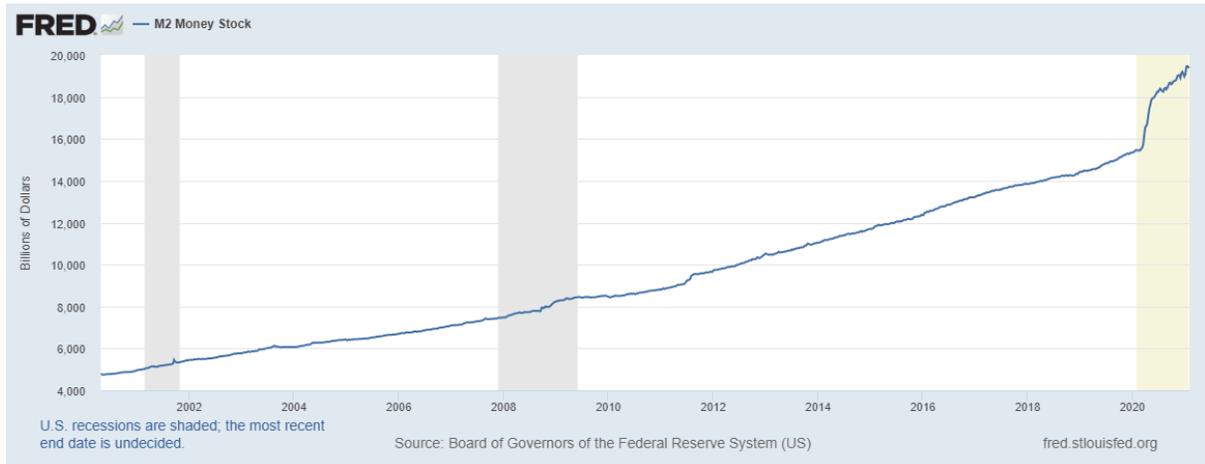
Because most of $M1$ is checkable deposits, and only about \$2.1 trillion is currency, we need to be cautious about thinking of money as something chosen by policy makers. As we will see later, the Central Bank (the Federal Reserve in the United States) manages the money supply. But it does not directly choose it.

$M2$ (\$21.4 trillion as of February 2021) is more inclusive. It includes $M1$, as well as many savings accounts and short term CDs. $M3$ is the broadest. It includes $M2$ (and thus $M1$), as well as longer term CDs and other assets.

None of these measures are perfect. $M3$ is so problematic, and measured with such error, that the Fed briefly stopped reporting its value. These measures are best used as a way to track changes in the stock of money rather than as true measures. Many other assets are arguably money, poker chips, and stamps in some prisons, are two such examples.

¹\$2 billion of this is in the form of \$2 bills. Who knew?

Figure 2: M2 Money Stock



Money has two properties, not explicitly part of its formal definition, that are worth noting. First, it is usually a relatively “liquid” asset in that it can easily be converted to currency if needed. This is closely related to its need to act as a means of exchange. Highly illiquid assets such as housing are never counted as money. Second, money is not usually an interest bearing asset. As a result, the interest rate, represents the opportunity cost of holding money.

A Brief History of Time²

We can roughly divide the history of money into three phases, each of which featured a different type of money.

1. Commodity money. The earliest forms of money were literally made from a valuable commodity, often gold. By minting the money, a government served the purpose of ensuring the quality of the commodity and dividing it into agreed upon units. During this era, society often believed that money had to be made from a material with intrinsic value or households would not value it. That commodity’s use as money, however, inflated its value above its intrinsic value.

2. Commodity backed money. This is similar to #1. Rather than literally make the money from a commodity, the government agrees to exchange one unit of money for a fixed quantity of that commodity. The obvious advantage of this approach is that it is more convenient to carry around notes backed by gold than lugging around gold coins themselves. The best known

²Because time=money, this is also a section on the history of money. Man, that joke sucked.

example of this type of money is the gold standard in the United States. That existed from 1873 until 1933, and then in a limited form until 1971. During this period, the U.S. dollar was legally valued at a fixed quantity of gold.

The appeal of commodity or commodity backed money is that it may reduce the potential for politically motivated manipulations of the money supply. The downside is that supply shocks to the commodity subject the economy to excessive short run price volatility.³ For example, a period without significant discoveries of gold in the late nineteenth century led to a deflation that resulted in a global “Long Depression” from 1873-1896. Significant gold discoveries had the opposite effect, resulting in damaging inflation. As a result, most macroeconomists view a return to a gold standard as a very poor policy proposal. Empirical evidence suggests that the demise of the gold standard has resulted in greater stability for prices. We will see later in the course that short run price stability is regarded as a key goal of monetary policy.⁴ More stable prices passes through to more stable employment and GDP growth.

3. Fiat money. In modern economies, the value of money derives only from the decree (fiat) of the government. The United States dollar is fiat money, it is not convertible to a commodity and, unless you enjoy pictures of dead Presidents, its is essentially intrinsically worthless. The appeal of fiat money is that it may be managed in order to provide greater price stability than commodity backed money.

Ultimately, money is a social convention. Individuals accept dollars because they know that everyone else does as well. If nobody else accepted dollars as payment, then neither would you. Therefore if enough households believe that fiat money cannot work, then it will not work. It would probably be a mistake to suggest that the Roman Empire’s use of commodity money was misguided because commodity money would not have worked at that point in history. But if fiat money is widely accepted, then the fact that it is not backed by a volatile commodity is for the best.

Macroeconomists overwhelmingly support the switch from commodity backed money to fiat money. The goal of monetary policy is low and stable inflation. Table 1 shows the standard deviations of the annualized monthly inflation rates for the periods of the pure gold standard,

³Demand shocks, such as the relative popularity of gold jewelry, may also create excess price volatility although these are less important historically.

⁴Here short run is up to a few years. Price stability over long horizons, such as 100 years, is irrelevant because firms and households do not plan over such long horizons.

partial gold standard, and no gold standard in the United States.⁵ Inflation has clearly been most stable in the final period, even including the high inflation rates of the late 1970s.

Table 1: Inflation Volatility During and After the Gold Standard

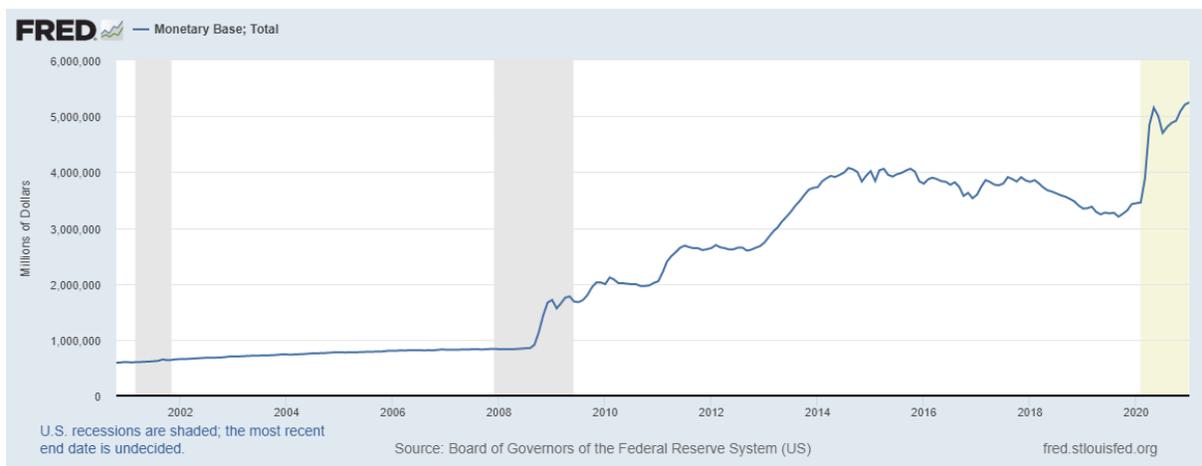
Period	St. Dev. (π_t)
1873-1933	11.5%
1933-1971	7.1%
1971-2012	4.5%

The Fed and the Money Supply

Monetary authority is the generic term for the entity that controls the money supply. In most developed economies, the *Central Bank* is the monetary authority. The *Federal Reserve* is the Central Bank of the United States. The European Central Bank conducts monetary policy for the Eurozone, the People’s Bank of China is the Chinese monetary authority, etc. The Fed has the following legal authority:

1. The Fed determines the *monetary base*. Notably, the monetary base (also known as $M0$) is not the money supply. The monetary base (\$5.2 trillion as of February 2021) consists of currency and reserves (like deposits) held by financial institutions at the Federal Reserve. The latter do not.

Figure 3: U.S. Monetary Base



⁵CPI Data combined with NBER Historical Data (prior to 1913).

2. The Fed sets a target for the *Federal funds rate*. This is an interest rate at which banks can borrow reserves (balances at the Fed) from each other. This rate itself is not too important. It is an overnight interest rate and the number of transactions using it is small. But the Fed hopes that other interest rates which are more economically important (*e.g* mortgage rates, interest rates that firms borrow at) move along with the Federal Funds Rate.

The Fed is charged with doing #1 and #2 in a way that stabilizes prices and achieves full employment. This is known as the Fed's dual mandate. The Fed interprets "full employment" as the natural rate of (un)employment. It interprets price stability as a predictable, 2% rate of inflation. Beginning in 2020, The Fed started working to ensure that inflation averages 2% over time rather than each month.

3. The Fed has considerable regulatory authority over banks. One example is stress testing where the country's largest financial institutions must submit to periodic Fed reviews to ensure that they are sound enough to survive an economic downturn.

4. The Fed acts as a lender of last resort. If access to credit becomes limited in a way that threatens the overall health of the economy, then the Fed is charged with making loans to mitigate or prevent a financial crisis. The Fed exercised this authority during the 2008 financial panic, most notably by making emergency loans to Bear Stearns (an investment bank) and AIG (an insurer). It did so again during the covid-19 crisis. Central Banks were originally set up for this purpose, not to set interest rates.

The Fed changes the monetary base through *open market operations*. "Open market" implies that the Fed buys or sells assets just as any other large entity would. The Fed may buy or sell any type of asset. Historically, however, the Fed usually buys or sells Treasuries. In the past twelve years, however, the Fed has purchased significant amounts of other assets, most notably mortgage backed securities.

When conducting an *open market purchase*, the Fed buys Treasuries (or some other asset) and pays with new reserves held at the Fed. During an *open market sale*, the Fed sells Treasuries (or another asset) in exchange for money which then reduces the monetary base.

To understand the money creation process, we must understand fractional reserve banking. When a commercial bank accepts customers' deposits, only a fraction of these deposits must be held as *reserves*. Reserves refer to money held by the bank in order to conduct withdrawals. Reserves consist of vault cash (which serve as the subject of many bank robbery movies) or as

electronic accounts at the Fed (less exciting). Traditionally (prior to 2008), commercial banks profit by lending out the bulk of customers' deposits at higher interest rates than those paid on deposits themselves. The Fed sets the minimum level of deposits that banks must hold. Until recently, this was set at 10% in the U.S, known as the *required reserve ratio*. Since March 2020, however, the Fed has set it at zero. Banks often, however, hold reserves in excess of 10%, especially if credit worthy borrowers are scarce. Consider the following illustrative example:

Step 1: The Fed conducts a \$100 billion open market operation. Suppose that the Fed buys these bonds from Bank of America and deposits (by fiat), \$100 billion into Bank of America's account at the Fed. Or the Von Otter family of Flint, Michigan sells the bonds to the Fed and then deposits \$100 billion of newly coined pennies into their savings account at Bank of America.

Step 2: Bank of America must hold (prior to 2020) at least \$10 billion of this new high powered money in reserve. Suppose it chooses to hold \$10 billion in excess reserves (thus holding \$20 billion in total reserves) and lends out the remaining \$80 billion. The recipient of this loan has their checking account at Bank of America credited with \$80 billion. Because checkable deposits count as money, the total change in the money supply is then \$180 billion.

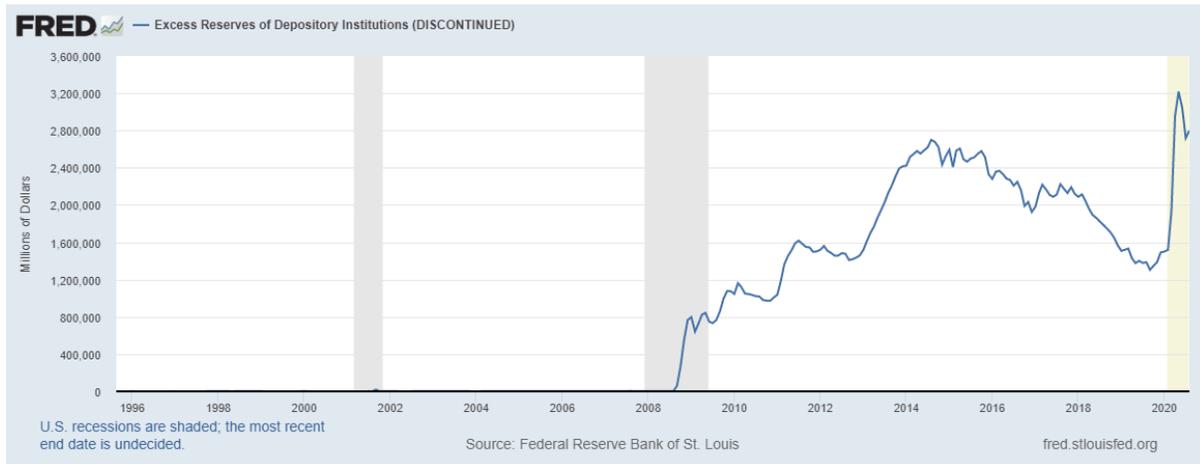
Step 3: Bank of America must hold \$8 billion of this new checkable deposit as reserves. It may, however, lend out some or all of the remaining \$70 billion. This further increases the money supply through the same process as Step #2.

The process then continues an infinite number of times, with each increase in the money supply smaller than the previous increase. The total change in the money supply is thus possibly greater than the initial change in the monetary base. The effectiveness of the money creation process itself depends on the state of the economy. We consider two cases:

1. When banks are eager to lend, they hold fewer reserves and the increase in the money supply for a \$1 increase in the monetary base is larger. This was typically the case prior to 2008 and changes to the monetary base usually caused increases in the money supply.
2. Since 2008, however, the economy has been in an *ample reserve* setting where banks choose to hold more reserves than the need to. As a result, increases in the monetary base are less effective at changing the money supply.

The money multiplier is the ratio of the money supply to the monetary base. Many macroeconomics textbooks model money so that the money multiplier equals one divided by the re-

Figure 4: Excess Reserves



quired reserve ratio, implying a money multiplier of ten (when the required reserve ratio was 10%). This theory assumes banks hold no excess reserves, which is empirically implausible. Ignore this claim if you see it.

Figure 5 reports the M1 money multiplier. It has been less than one since the Great Recession. This is because banks have chosen to hold excess reserves so that the monetary base is larger than M1:⁶

Figure 5: M1 Money Multiplier



The Money Market

⁶Source: St. Louis Fed

We now consider supply and demand for money. This is more complicated for two reasons than the example of soda that we considered near the beginning of the semester. First, money does not have an ordinary price. We will thus use the interest rate as a quasi-price of money. Remember that money is generally not an interest bearing asset. The interest rate is thus the opportunity cost of holding money instead of another asset that pays interest.

Second, the supply of money is very different than the case of a perfectly competitive market. We have seen that one part of money supply is determined by the Central Bank. Another part of money supply comes from commercial banks who decide whether to loan out their customers' deposits or hold them as excess reserves. We will largely delay the discussion of how Central Banks choose the money supply until the next topic when we look closely at monetary policy. We will, however, assume that money supply is upward sloping. As interest rates rise, it becomes more attractive for commercial bank to make loans instead of holding excess reserves.

The demand for money originates from households (and firms):

1. Households like to hold some of their wealth as money because money is convenient. Households obtain utility from holding money because it is easier to conduct transactions with money than less liquid assets.
2. Households may choose to hold their assets either as money or non-money assets that pay interest or yield a positive expected return (*e.g.* stocks or bonds). If we think of the choice as being between riskless bonds and money, then the opportunity cost of holding money is the interest rate.

From these assumptions, we obtain the following:

1. Money demand is increasing in Y . Money makes it easier to conduct transactions. As Y increases, households conduct more transactions and the marginal utility of money increases.
2. As i increases, households are forgoing more interest income by holding money. Money demand is thus decreasing in the interest rate.
3. Money is a nominal variable, meaning that its value is sensitive to changes in the price level. We can convert a nominal to a real variable by dividing by the price level, P . Suppose that the price level doubles. Now, real money ($\frac{M}{P}$) is cut in half, reflecting the reduced purchasing

power of any nominal amount of money. It is often preferable to work with real money rather than nominal money.

The money demand curve is downward sloping, reflecting #2. Reflecting #1, when Y increases, money demand shifts to the right.

Combining money supply and demand:

Graph: Money Market:

Although the backstory is very different, the mechanics of the money market are now just basic supply and demand. Let us now suppose that the Central Bank is able to increase the money supply for some reason. We see that the interest rate declines. You may have heard about the Federal Reserve raising or lowering interest rates. When we discuss monetary policy and open market operations, we will further develop this connection between money supply and interest rates.

The Quantity Theory of Money

We now consider an additional simple theory of money, known as the *quantity theory of money*. The starting point is the equation of exchange. This equation simply states, that if all output is purchased using money then:

$$MV \equiv PY \tag{1}$$

P is the price level and Y is real aggregate output. Their product is thus nominal aggregate output (measured by nominal GDP). M is some measure of money. V is velocity, the amount of times per period that each unit of money is spent. MV is therefore total purchasing which must equal nominal output. The symbol \equiv means that this equation is always true. That is because velocity is not measured directly, but is instead defined so that (1) holds with equality.

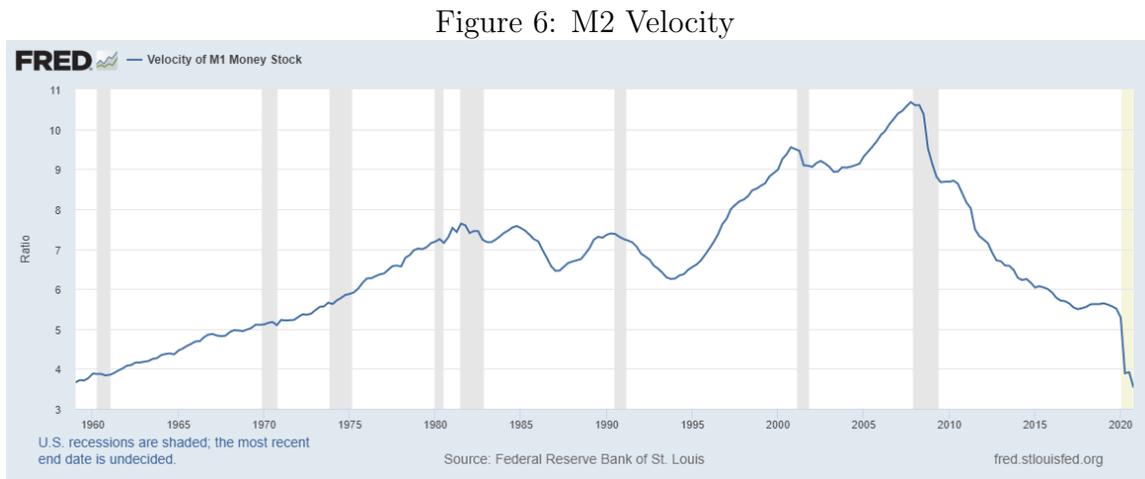
The quantity theory relies on two assumptions:

1. Changes to M do not affect P .

2. V is constant.

If this is correct, then a 1% increase in M affects neither V nor Y , but only increases P by 1%. In other words, changing the money supply only has a proportional effect on inflation and nothing else.

Most monetary economists believe that these are good assumptions in the long run, but not the short run. The latter point is easily made by showing the recent behavior of velocity (measured using the M1 definition of money). Table 6 plots velocity:



Velocity has declined since the Great Recession and has decreased further since the pandemic began. The latter isn't surprising, velocity typically declines during economic downturns. It is of interest to examine what has happened to the monetary base, money supply, and velocity in the United States. Table 2 shows these variables prior to the Financial Crisis of September 2008, and at two points afterwards:

Table 2: Measures of Money: 2008-2021

	March 2008	July 2011	February 2020	February 2021
Monetary Base	860.617	2704.491	3543.8	5247.6
M1	1401.6	1980.4	4088.9	6812.2
V (M1)	10.624	7.482	5.50	3.53
Money Multiplier (M1)	1.62	0.73	1.14	1.30

There has been quite a bit of concern that the U.S. money supply has grown so dramatically, with the implication (based on the quantity theory of money) that this will result in extreme

inflation. Such a statement confuses the monetary base with the money supply. Because the money multiplier has plummeted (due to excess reserves), the money supply has not risen nearly as much as the monetary base. It has, however, increased dramatically. This has not been inflationary, however, because of the major decline in velocity. Inflation has been very low throughout this period and policy maker have been at least as concerned with deflation.

A similar decline in velocity occurred at the start of the Great Depression. Rather than increasing the money supply, however, the Federal Reserve allowed the money supply to decline. The left hand side of (1) thus declined by a large amount. This required large declines in prices or output. The Great Depression exhibited both. Former Chairman of the Federal Reserve Ben Bernanke has cited this example to blame the Fed's poor policy as a major contributor to the Great Depression.⁷

⁷Ben Bernanke at at the H. Parker Willis Lecture in Economic Policy, Washington and Lee University, Lexington, Virginia, March 2, 2004.