# The Money Multiplier and Interest on Reserves in the Principles of Macroeconomics Course

David W. Brasfield, Murray State University, Kentucky, USA
Eran Guse, Murray State University, Kentucky, USA

**ABSTRACT**

Standard principles textbooks continue to present the money multiplier within a framework where the central bank is mainly conducting open market operations in an environment where banks remain "fully loaned up." The standard result is that the change in the money supply is equal to the change in reserves times the so-called money multiplier (1/r where r is the required reserve ratio). Since the Great Recession, however, this presentation is flawed as the Fed is currently using interest on reserves (IOR) as the most important policy tool, and in addition, banks are holding large amounts of excess reserves created by the Federal Reserve. We show that open market operations today may not lead to the multiple changes in the money supply as typically taught in the Principles course. We provide some suggestions as to how to approach teaching current monetary policy, but the proximate purpose of this study is to encourage thought and discussion of how Principles of Macroeconomics instructors should approach the pedagogy of the outdated money multiplier concept and/or interest on reserves when discussing monetary policy.

**Keywords:** Money multiplier, interest on reserves, open market operations, monetary policy

## INTRODUCTION

"The Fed uses open market operation to adjust reserves and thus change nominal interest rates with the goal of nudging the federal funds rate toward the Fed's target." Chiang (2017) Principles of Economics textbook.

"The shift in policy tools also affects the task of some of society's explainers, including journalists and teachers of economics, because most of the past textbook descriptions of how monetary policy works will not be accurate for years to come." Ihrig, Meade, Weinbach (2015).

The fact that money is created from bank credit in a process known as the "money multiplier" is thought of as common knowledge in economics. This idea was first presented prior to the Great Depression and Keynesian monetary policy by Phillips (1920) and Crick (1927), and it is commonly presented in the "money creation" chapter of most principles of macroeconomics textbooks frequently using "T-accounts" to illustrate the process. Teaching the multiplier allows the student to grasp the concept of monetary policy in which open market operations start a process that either creates or destroys bank loans, the money supply, and ultimately affect the economy. Since the Great Recession, however, the manner in which central banks conduct money creation and monetary policy has changed; consequently, we believe that we should change the way we teach these concepts.

The onset of quantitative easing brought forth many predictions of an explosion in inflation (see Shiff et.al. (2009) for example) based on the growth of the Fed's balance sheet and therefore excess reserves in the banking system. This reserve growth led many to predict a massive expansion in the money supply via the money multiplier process. Clearly, this did not happen and, largely, economists now understand why the money multiplier did not work as advertised. The money supply did increase but not proportional to the increase in reserves (or more appropriately, the monetary base). The increased supply of excess reserves was not loaned out – far more reserves were created than the current loan demand, thus we actually saw a substantial drop in the money multiplier (see Fig. 1). This failure of the multiplier process was subsequently exacerbated by a new tool adopted by the Fed: the payment of interest on reserves (IOR -adopted in Oct. 2008). Originally, Milton Friedman (1959) suggested that central banks should pay interest on required reserves in order to reduce the implicit tax created by requiring banks to hold reserves against deposits. Recently, works of Goodfriend (2002), and Ennis and Weinberg (2007) presented reasons why paying interest on reserves can improve a central banks control of monetary policy (the Fed Funds rate) without necessarily changing the supply of reserves. Since 2008, the Federal Reserve has been using the interest rate on

reserves as its major tool for conducting monetary policy (the Federal Reserve System 2009). However, the impact of this tool and, in particular, its effect on the money multiplier process does not seem to have been incorporated into principles of macroeconomics texts in any meaningful way. Hence, the result is that many of us continue to teach a process that is essentially incorrect in the modern financial environment, thereby perpetuating this outdated view of current Fed actions and their impact on the money supply to our students. This was brought home to the authors in discussions with other participants at our presentation of an early version of this work at the 22nd (April 2017) Annual Teaching Workshop at the University of Kentucky. Many in the audience were unaware of the changes to the Fed's operating procedures. More recently, this can be seen in the concern many feel about the Federal Reserve's process of "normalizing" the balance sheet, i.e. ending the reinvesting of maturing bonds (Pan 2017) as a tightening of policy and reduction of the money supply – something we have not seen however.

In this paper, we call for a change in the way we teach the outdated concept of the money multiplier. The traditional way is based on a partial equilibrium analysis under (implicitly or explicitly) a standard set of behavioral assumptions, in particular the assumption of a zero or constant ratio of excess reserves to deposits. This leads to a constant money multiplier, so that we write $\Delta M^S = m*\Delta MB$, where $M^S$ denotes the money supply, m is the money "multiplier" (>1 given a fractional required reserve ratio), and MB is the monetary base, defined as reserves plus currency. As we discuss below, under the new policy environment, this particular assumption is no longer realistic. Thus, since Oct. 2008 the accepted concept of the money multiplier is a misrepresentation of reality, and many of us continue to teach a money multiplier process that is simply wrong. Here, we first discuss the money creation process and the changes to it, some history and evidence regarding these changes, and then present views on how an instructor might present the process of money creation and destruction when discussing modern monetary policy.

## THE MONEY CREATION PROCESS

In discussing the money creation process, we should first describe the definition of money. Most principles level textbooks prefer to define money as M1; however, we are going to address the traditional approach using M2, as it allows for money creation to more appropriately go into several different types of deposits.

Consider the money supply: $M^S = C + D$; where C is currency in circulation and D is deposits held by the public (which can include demand deposits, savings deposits, small time deposits, retail money market mutual funds, and traveler's checks). For banks, the funds acquired via deposits can be held either as reserves (R) or they can be loaned out to the public. In the US, banks follow a fractional reserve system where banks have to hold a required amount of reserves, set by the central bank, and proportional to the demand deposits (the required reserve ratio – 'r') held at that bank. Since 2008, banks have received interest on reserves from the Federal Reserve System, but this is less than the interest they can receive from making loans to the public. The interest paid on reserves can be thought of as the opportunity cost of making loans, but this is typically not discussed. These loans are the public's liability and when made, money is created, which will then be held as deposits in banks and/or as currency. The amount of currency the public wishes to hold depends on current preferences for liquidity versus deposits. There is typically an assumption of a constant currency to deposit ratio – 'c' (some textbooks simplify by assuming zero currency holdings and focus on deposit creation).

As loan proceeds are spent, other banks gain these funds as deposits. They also must hold a percentage (r) of the additional demand deposits as required reserves. The remaining excess reserves can then be lent, creating further deposits and/or currency, thus money. This process continues (in diminishing amounts) according to the leakage of funds brought about by the required reserve ratio. As a result, we obtain a multiplied increase in deposits and thus money. A crucial assumption in this (traditional) process is that banks wish to hold zero excess reserves against deposits (this ratio 'e' = 0), or they wish to hold a small but constant ratio. Thus, they will always loan a constant proportion of any additional reserves. It is important to note that the availability of excess reserves is the constraining factor to loan and thus money creation – there is always available loan demand for these reserves.

Traditionally we teach that the policy tool of open market operations is the most important/frequent way the above occurs. If a central bank buys securities from a bank, they then would make this purchase by crediting the bank's reserve account with the Fed. These reserves are initially excess reserves as there are no deposits to hold reserves against. As the bank wishes to make profits, it may (assumed will) choose to lend these funds out to its customers.

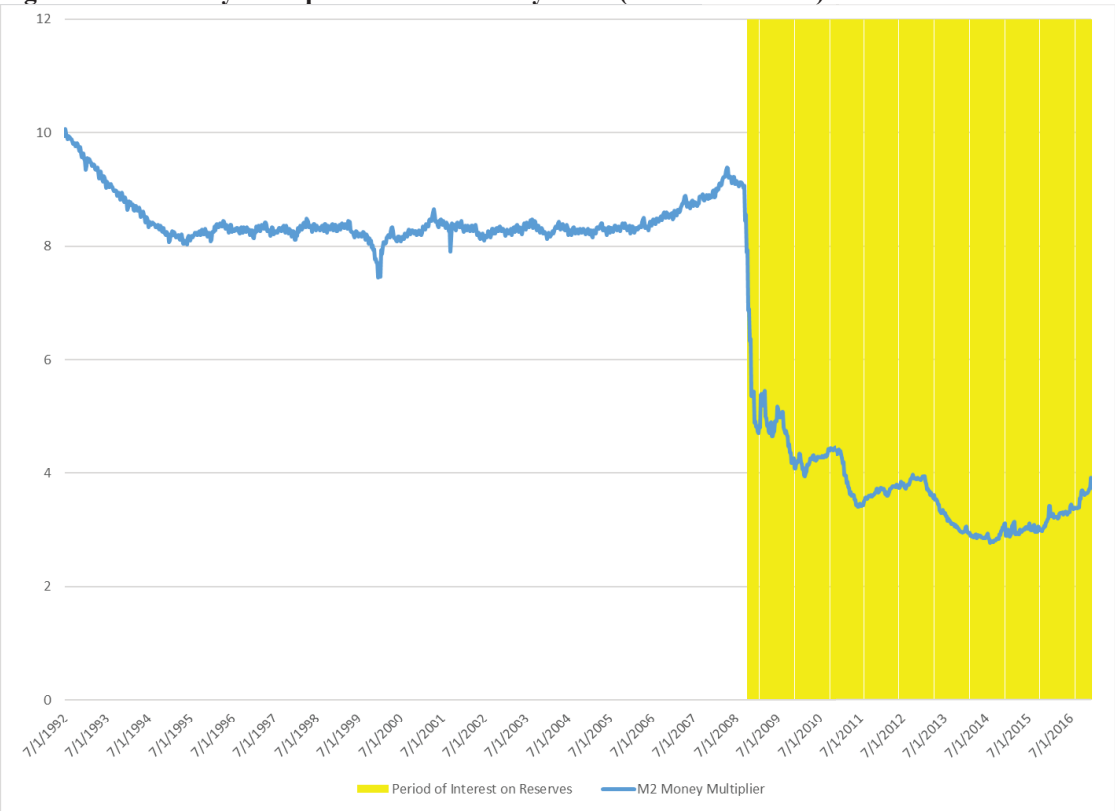
The customers who receive these loans can hold their funds as currency or can choose to deposit their funds into a bank – either is an increase in the money supply. As banks face a required reserve ratio of $0 < r < 1$, any \$1 increase in deposits will lead to the banks being required to hold an additional \$1*r in reserves. Banks can then choose to lend the remaining balance to the public if they wish (again assumed so), further increasing the money supply. As before, the loan proceeds are spent, deposited into another bank, and the process continues.

Thus, we can see (and teach) that the initial change in reserves can result in a larger increase in the money supply - the money multiplier process. This is the traditional treatment of how the Fed's purchases of assets (typically government bonds via open market operations), which expands the size of the Fed's balance sheet, should lead to a much larger increase in the money supply. Current principles of macroeconomic texts suggest to the reader that the Fed's current policy is conducted using these open market operations. Under the assumption that banks remain "fully loaned up" and thus a zero excess reserve ratio 'e', and a zero currency ratio 'c' from above, [1] the common textbook money multiplier (m) simplifies to: m = 1/r. This result suggests that the multiplier m can only change by changing r, which is set by the central bank.

The mathematics of the traditional multiplier process implies that any change in the monetary base will lead to a change in the money supply that is proportional to the money multiplier, or:

(1) $\Delta M = m \times \Delta MB.$

**Figure 1: M2 Money Multiplier = M2/Monetary Base (1/1992 – 12/2017)**




Unfortunately, the discussion and mathematics of the traditional presentation are flawed, being based on the assumptions that lead to the multiplier being constant. Figure 1 shows clearly that this is not an accurate

[1] Mankiw (2016) presents a similar multiplier where he assumes a constant non-zero excess reserve ratio. He refers to the sum of the required reserve ratio and the excess reserve ratio as the "reserve ratio". Mathematically it is the same result as r above.

representation of modern reality. It turns out that the growth in reserves and the monetary base in recent years has not been matched, much less exceeded, by the growth in the money supply.

What happened? Mathematically the "money multiplier" can be derived by looking at the following ratio: $m \equiv \frac{M}{MB}$. From this definition, we obtain the following:

(2) $\Delta M = m \times \Delta MB + \Delta m \times MB.$

From the discussion above, traditional simplifying assumptions yield $\Delta m = 0$ and we are left with equation 1.

From equations (1) and (2) we can conclude that the traditional money multiplier is actually an "average product" of money creation when, in fact, we are generally more interested in the "marginal product" of money creation from open market operations. For example, if m = 5, but an increase of $1 in MB leads to only an increase in M of 3, this means that the average product of money creation would be decreasing, i.e. the measured multiplier m.

Equation 2 highlights that there are two ways the money supply can change: a) via changes in the monetary base MB, and b) via changes in the multiplier. Often, only an aside, we teach that the size of the money multiplier is dependent on the size of the leakages that tend to reduce the amount banks lend. These leakages include: the required reserve ratio, any excess reserves that a bank may desire to hold, and currency held by the public. The required reserve ratio has a negative effect on the multiplier as if this is increased, then banks will have to hold more in reserves and will be able to lend less. The amount of excess reserves banks choose to hold has a similar effect on the money multiplier, except in this case, banks are choosing not to lend on their own. Finally, the amount of currency the public chooses to hold has a negative effect on the money multiplier. In this case, if the public is choosing to hold more currency, then they are choosing to hold fewer deposits. Deposits (minus required reserves) are funds available to banks to lend, so if the public is choosing to hold more currency, then the banks will have less funds to lend. It is important to note that if loans are not made by banks, then money cannot be created.

From the discussion above, we conclude that there are three ways that the money supply can change. First, a change in reserves leads to a change in the funds that can be lent by banks. Second, if banks choose (excess reserve ratio) or are forced (required reserve ratio) to hold more or less reserves, than this changes the circular connection between deposits and loans and the resulting amount of money created. Finally, the amount of currency held by the public affects the funds held as deposits and again the amount of money created. These changes in the money supply are typically connected to a model where "the interest rate" is determined by the supply and demand for money.

**THE ISSUE**

The current banking environment is much different than it was when we, the instructors of principles of macroeconomics, likely took our first course in macroeconomics. However, most of us are still teaching this course in the same way we were taught. In terms of monetary policy, there have been critical changes (some well-known, some not) subsequent to the start of the Great Recession that effectively have led to the "money multiplier" becoming essentially endogenous and no longer a stable basis to determine money expansion. These factors include:

- The adoption of IOR as the tool to influence the fed fund rate (FFR) (10/08)
- The movement to the zero lower bound at the time of the Lehman bankruptcy (9/08)
- Concurrently, a substantial increase in reserves over time
- Three periods of Quantitative Easing – which also expanded the quantity of reserves
- Oct. 2017 – beginning of a process to shrink the amount of reserves (normalization).

It is important to note that given the above, the banking system as a whole currently is not fully loaned out (a necessary assumption in the standard discussion of the money multiplier) as many banks are instead holding a very large amount of excess reserves. Most of these reserves were created through the process of quantitative easing (QE), and in a modern day "Operation Twist" the Federal Reserve has also changed its portfolio of assets from short term assets to add longer term assets as well. The large amount of excess reserves stems from the reaction to the Great Recession and changes in the monetary policy process. These excess reserves allow the Fed Funds rate to remain stable in the case of shocks to reserve demand (Goodfriend (2002), pg. 4). Instead of using open market

operations, it can closely set the Fed Fund rate at its target via the interest rate it pays on these reserves (along with other rates). This change allows the Federal Reserve to be able to change its target Fed Funds rate without making changes in its portfolio, or necessarily reserves or money. Open market operations are no longer the main policy tool of the Fed. Consider an open market purchase by the Fed, the reserves created would be injected into a system that already has a large surplus of reserves. Hence, no new loans would be made or money created. An open market sale would not lead to a shortage of reserves in our system awash in reserves. Again, banks would not need to call in loans and destroy money. The textbook process fails. In effect, the money supply is today determined by increases (or decreases) in qualified loan demand – a demand easily fulfilled with the surplus of reserves. But unless the next banks in the system have unmet loan demand (unlikely) the money expansion process stops, there is no "multiplier." However, changes in the interest rate on reserves – the opportunity cost to banks of making loans, may change the money supply if banks respond by changing loan rates and thus affecting the quantity of bank loans demanded. But they cannot systematically force a desired change in the money supply. Given the Fed's new operational procedures, it would thus make sense to update the way we teach the creation (or lack thereof) of money from Fed policy changes.

## POSSIBLE TEACHING APPROACHES

The following are approaches that we have discussed and in some cases adopted, but they are by no means exhaustive. It is probably well to separate the concepts of money creation and monetary policy in course development in that, although we are used to thinking about monetary policy in terms of changes in the money supply, which is not the current procedure. Instead, policy is now formulated through interest rate movements initiated by changes in the interest rate on reserves. The money supply is simply allowed to vary in an endogenous fashion with any resulting changes in loan demand.

### Approach 1: Do not teach the multiplier

The simplest approach and that which will take the least amount of class time is simply to not teach the money creation process in the principles course and to leave it for later discussion in upper division courses. Knowledge of the money creation process is useful for economics majors, but (being endogenous) is not necessary for a discussion of monetary policy and in most programs it could more readily be taught in Money and Banking courses. The typical principles course is not populated by economics majors and dropping this material (which is currently incorrect anyway) would free up time that could be better spent elsewhere. Additionally, at the Money and Banking level, students are more likely to have had some accounting and thus transactions among the T-accounts so often used would not be so "unsettling" to the students.

Of course, monetary policy should be introduced and, more correctly, discussed as a process of changing interest rates. Textbook choice might be an important factor as the instructor may find their book does not discuss IOR, instead deriving the Fed Funds rate via a market for reserves. The Fed Funds market could be kept in the course as a means of further reinforcing the workings of markets, but is not necessary. It is straightforward to discuss IOR as an opportunity cost of reserves and that banks would attempt to pass such changes along, thus changing bank loan rates. This would then be shown to affect spending (i.e. investment most likely) and Aggregate Demand. This would be an easy, and more currently correct approach to begin a discussion of monetary policy. The downside to this approach alone is that there is no formal way to incorporate feedbacks from Aggregate Supply and Demand that might influence interest rates in general. In other words, it would be difficult (but not impossible) to discuss the impact of shocks to the economy on "the interest rate" apart from the impact of the FED changing IOR. If one wished to bring in the money supply, changes in such could easily be taught as a function of bank loans and, as elaborated below, one can then introduce the money market as a tool to describe the determination of interest rates in general.

### Approach 2: Including the Money Market

If one wished, an instructor could introduce money in either (or both) of two ways. Changes in the money supply can be introduced as the endogenous result of the loan process. Noting that the banking system is not constrained by a shortage of excess reserves, open market operations (either adding or subtracting reserves) should have no impact on lending or thus money creation. Thus, as developed earlier, to teach this in the traditional way is misleading. However, as one author here does, it is straightforward to demonstrate that when a bank grants a new loan to a

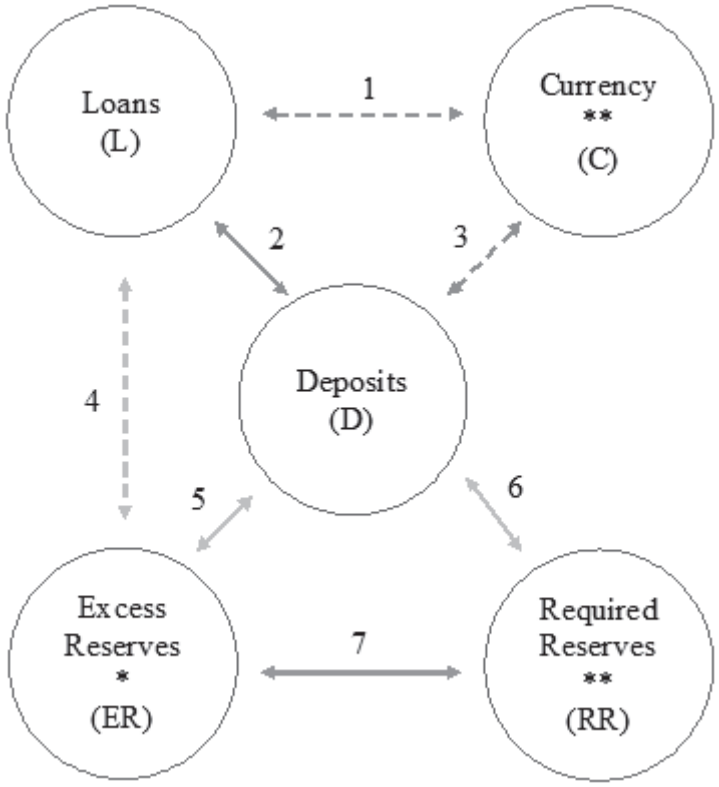
customer money (either M1 or M2) is created as deposits expand. It is important to recognize, however, that the "process" stops here. Excess reserves that may flow to another bank when the loan proceeds are spent are simply adding to a system already flush with reserves that could not be lent, thus the traditional formulation of the money multiplier does not hold. Effectively, the money supply fluctuates with loan demand.

On the other hand, loan demand (actually, the quantity of loans demanded) will vary negatively with "the interest rate" that banks charge, and thus will be affected by the Fed's changing of IOR. Hence, an instructor can relate an "expansionary" monetary policy (reducing IOR) to an increase in the money supply, and vice versa. One can take this a step further and introduce the money market with "the interest rate" as the price of money, money supply a function of policy as just described, and money demand a function of real GDP and prices as typically derived in modern principles of macroeconomics texts. This allows the instructor to incorporate feedbacks from Aggregate Supply and Demand to the money market, thereby influencing interest rates in the economy.

**Approach 3: The Money Creation Circular Flow Diagram**

If an instructor still wishes to discuss money creation, one way is to use what we will refer to as the money creation circular flow diagram. Figure 2 shows flows from the relevant assets and liabilities of the public (firms, households, and the government), the banking system, and the central bank. Loans, excess reserves, and required reserves represent the assets held by the banking system, and currency and deposits (the money supply) represent assets held by the public. The arrows on the diagram represent the interactions between these assets as they flow in the money creation process. The nodes for currency (C) and required reserves (RR) are denoted by a "**" as they indicate end nodes for the monetary base in the money creation process. The node for excess reserves (ER) is denoted by a "*" indicating a possible end node for the monetary base given banks' preferences for giving loans, the opportunity cost of lending out reserves (the interest the central bank pays on reserves), and the public's demand for loans.

**Figure 2: The Money Creation Circular Flow Diagram**



There will be natural flows in this diagram when the public pays back their existing loans. When funds from a loan are paid back there will be a flow from C and RR (through D) to L back to ER and RR. The money supply will initially decrease due to this change by the amount the loans have been paid back. However, as these excess reserves flow back into the banking system, the banks will tend to wish to lend these reserves back to the public. Another natural flow may be due to a change in the public's preference to holding currency. If the public wishes to hold more currency, then the public will withdraw some deposits leading to a flow from total reserves (ER+RR) to C. This may lead to a deficiency of RR meaning that the banks would have to call in loans. This process of calling in loans is similar to the process described in an open market sale below. When the public wishes to hold more C, then the money supply could go down, and when the public wishes to hold less C, then the money supply could go up.

*Teaching Money Creation*

The Money Creation Circular Flow diagram can be used in place of discussing traditional money creation using T-accounts and requires no mathematics. The instructor can first present the circular flow diagram to the students. The instructor would start with the excess reserve node and explain that all excess reserves could be lent out to the public. The dotted line shows that lending out the excess reserves is optional to the banks. Then the next natural step is to talk about how the funds created by the loan could be handled. The public would choose how much to hold as currency and then the remaining funds must be held as deposits. The currency and deposits created from the loans are the money created from the loans. The new bank deposits are now additional funds to the banking system (minus the additional required reserves) which may wish to lend these funds out to increase profits. The next step is to suggest to the student that this process creates a loop of additional possible lending. It is important to include a simple numerical example to effectively demonstrate the loop in the process and how changes in reserves, preferences, required reserves, and interest paid on reserves leads to money creation or destruction. The appeal of this approach to teaching money creation is that there is no need for a constant money multiplier. The students should be able to understand money creation and that the money supply may increase more than one for one with an increase in the monetary base. However, they should also understand that money is created from bank loans and thus money is created only if banks are willing to make loans and the public is willing to take loans.

*Open Market Operations*

We first consider the discussion under the familiar policy using open market operations. The initial process comes from the loans node "L." If the central bank buys the loans from the banks, then the loan value flows from "L" to "ER." If the central bank buys the loans from non-banks, then the loan value flows from "L" thru "D" and then to "ER" and "RR." With an increase in ER, the banking system is able to (if banks wish) lend these funds to the public. The reserves flow from ER through L and D and then to C, RR, and ER. The sum of the flows to C, RR, and ER must be equal to the amount that initially left ER. The more of the monetary base that flows to C and RR, the less that will be available to continue to lend (ER). Therefore, money creation depends on how much currency the public wants to hold of additional funds and how much the banking system is required to hold as required reserves. Further to this, the banking system may wish to hold on to some ER reducing the flow from ER. The more the banking system wishes to hold as ER, the smaller the increase in money. As funds flow back to ER, these funds can continue to be lent as long as the banks are willing to lend the funds and the public wants to borrow these funds. The circular process gives the result of the "money multiplier." Another appeal of using this method is that we can discuss the limitations of open market operations. It is important to show the student that money may not be created from open market operations if the banking system chooses not to (or is unable to) lend out any of their excess reserves.

The open market sale is similar to the open market purchase. When the central bank sells bonds to the banking system this represents a flow from total reserves (ER+RR) to L. When the central bank sells bonds to non-banks this represents a flow from total reserves (through D) to L (this may include some payment from C to L as well). Under either situation, there is a reduction in total reserves. If there are few excess reserves, then the open market sale reduced RR and now banks need to call in loans to meet their reserve requirement. This process must continue until D is at least equal to $\frac{RR+ER}{r}$. The money supply here contracts by the change in C and D. However (as it is at the time of this writing), this process may not lead to a reduction in the money supply if ER is larger than the size of the open market sale as there would be no need for the banking system to call in loans.

*Changes in the Required Reserve Ratio*

The change in the required reserve ratio works much like the process described above for open market operations. When the central bank reduces r, this leads to a flow from RR to ER leading to a possibility that the banking system may lend as described after an open market purchase. If the banking system wishes to lend the additional excess reserves, then the money supply will increase. Notice that the flow from RR to ER can always occur. If the central bank increases r, then this would lead to a flow from ER to RR. This flow under normal circumstances cannot occur as the ER in the economy may be smaller than the necessary funds for the flow. For the banking system to get these funds, they must call in loans. The dynamics for this flow is described above under the open market sale. If the loans must be called in, then this will lead to a decrease in the money supply. However, if ER is large enough to make up for the change in RR, then no loans will be called in and the money supply will not decrease.

*Changes in the Discount Rate*

The third tool of monetary policy, the discount rate, while an uncommonly used tool, was used during the Great Recession. If desired, it can be taught using the money production circular flow diagram. When a central bank lends funds to banks this leads to an increase in total reserves. When banks choose to pay these loans back this leads to a decrease in total reserves. Decreases in the discount rate may influence banks to take out more discount loans which would lead to an increase in ER. If a decrease in the discount rate leads to more discount loans, then the discount loans leads to an increase in ER. As a result, money would be created similar to the process described above under an open market purchase. If an increase in the discount rate leads to fewer discount loans, then this would lead to a decrease in total reserves. As a result, loans must be called in leading to a reduction in the money supply as described under the open market sale. However, the key to this policy is that discount loans must be happening for there to be any change in total reserves. If banks are not currently interested in getting these loans from the central bank, then there would be no change in total reserves and, therefore, no change in the money supply.

*Changes in Interest Paid on Reserves*

Excess reserves historically have been comparatively very low as banks held excess reserves as "insurance" for fluctuations in deposits and revolving loans such as credit cards. However, at the time of this writing, excess reserves are very high meaning that banks are choosing to not lend these funds as the interest paid for lending them out is not sufficient to compensate the banks for the risk involved in the additional loans. As discussed above, the banking system's preference to holding ER depends on the opportunity cost of lending, the interest the central bank pays for reserves. If the central bank increases this interest rate, then banks will be less likely to wish to lend out their excess reserves. Therefore, as the public pays back their loans to the banks, the banks will choose to hold these funds as excess reserves rather than lending these funds back to the public. This leads to a decrease in the money supply by the change in the amount of loans held by the public. If the central bank reduces the interest rate paid on reserves, then this will encourage banks to lend out their excess reserves. As they lend out these reserves, the money creation process occurs. In addition, for the banks to lend these additional funds to the public, they must offer the loans at a lower interest rate. The lending process will continue until either the excess reserves flow into C and RR or the interest rate paid for loans declines enough such that banks no longer wish to lend out any more funds to the public. Therefore, a reduction in the interest paid on reserves may lead to an increase in the money supply and an increase in the interest rate paid on reserves will lead to a future decrease in the money supply.

**Approach 4: The Accounting Discussion of Money Creation**

Another way to discuss money creation is by looking at the assets and liabilities of the central bank and the banking system. The simple answer to the question "where does money come from?" is the following: loans from the central bank and the banking system. Monetary policy is performed in order to increase or decrease loans which changes the money supply.

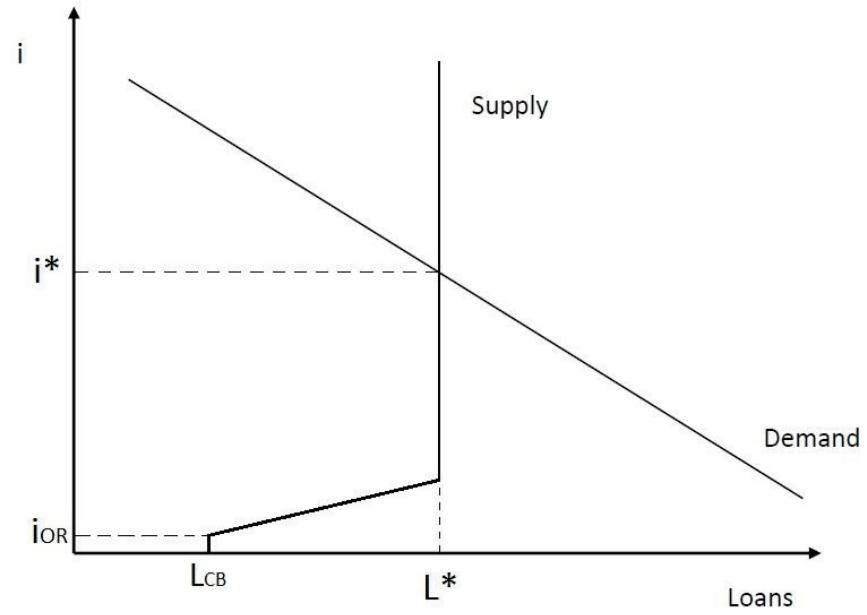
For the central bank, the relevant assets for money creation are loans made to the public obtained from open market operations (CL) and loans made to the banking system through discount loans (DL). The relevant liabilities for the central bank are reserves (R) and currency (C). For the banking system, the relevant assets for money creation are reserves and loans made to the public (BL). The relevant liabilities are deposits at banks (D) and discount loans from

the central bank. Therefore, we get the result that $CL + DL = R + C$ and $BL + R = D + DL$. Combining these equations we obtain: $CL + DL + BL + R = R + C + D + DL$. Noticing that reserves and discount loans cancel in this equation, we obtain: $C + D = M = CL + BL$ or the money supply is equal to total loans made to the public by the central bank and the banking system. Therefore, the money supply is dictated by the number of loans that banks chose and are able to make plus the number of loans that the central bank chooses to make indirectly through open market operations.

This idea allows the instructor to indirectly discuss the tools of monetary policy without using the money multiplier. Open market operations either introduce more funds into the hands of banks to lend or remove those funds. Changing the discount rate either encourages banks to get additional loans from the central banks to make loans or discourages loans. Changing the reserve requirement allows for more funds to lend or restricts these funds. Finally, changing the interest rate the central bank pays for reserves either encourages banks to lend or discourages the banks from doing so.

In addition to this discussion, the instructor can demonstrate graphically the effect on the interest rate from changes to any of these tools of monetary policy. We suggest a simple supply-demand model as shown in Figure 3. The supply of loans comes from the central bank (LCB) and from banks. The supply curve starts at LCB as these loans are determined by the central bank's balance sheet and is vertical here suggesting the supply is perfectly inelastic. The supply curve from LCB until L* is upward sloping as banks are choosing how much to lend and how many excess reserves to hold. As the interest rate increases, relative to IOR, banks choose to lend more funds and hold fewer excess reserves. When the interest rate is sufficiently larger than IOR, then banks will wish to be fully funded making the supply of loans to be perfectly inelastic. Several factors will change supply: IOR, the banking system's preferences for lending, and the size of the central banks' balance sheet given changes to open market operations. The demand for loans is determined by the interest rate via the law of demand and the federal deficit. A change in one of the tools of monetary policy will lead to the appropriate shift in the supply of loans. The student can view this change as a change in the money supply (loans) as well as a change in the interest rate. Here, the money supply is allowed to change due to a change in the interest rate which leads to a change in nominal spending in the economy.

**Figure 3: Supply and Demand Model for Loans**




The supply-demand model of loans is useful as it can be used for the discussion of both monetary and fiscal policy. In addition to this, the effectiveness of policy can be discussed by the location of the initial equilibrium (where it is located on the supply curve). A change in one of the four tools of monetary policy will shift the supply of loans

either by having the central bank lend more or less (open market operations) or having the banking sector lend more or less (interest on reserves, discount rate, required reserve ratio). In addition, we can demonstrate the effect on the interest rate from an increase or a decrease in the government's deficit.

**Conclusion**

The well-known money multiplier in monetary economics is currently not relevant in many major economies when discussing monetary policy. However, most instructors of principles of macroeconomics continue to teach this idea in the same way as they always have. This is a disservice to the profession as we are sending out a new generation of ignorant students who do not understand how many of the largest central banks are currently conducting monetary policy. It is our belief that we can improve this problem by changing the way we teach money creation and monetary policy. This change needs to be adopted by the instructors of the principles of macroeconomics course, but more importantly, this change needs to be made in the textbooks we have our students read. In this paper, we presented several ways to discuss the new changes in monetary policy and how these changes affect the money supply in the economy. This list was not a complete list of possible approaches to teach the change in monetary policy, but we hope that it leads to a continued discussion of the topic in the profession.

**REFERENCES**


Chiang, E. P. (2017) *Economics Principles for a Changing World*. Worth Publishers. New York, NY.

Crick, W. F. (1927) "The Genesis of Bank Deposits." *Economica*, no. 20. pp. 191–202.

Ennis, H. M. and Weinberg, J. A. (2007) Interest on Reserves and Daylight Credit. *Economic Quarterly*. V. 93, No. 2. pp 111-142.

Friedman, M. (1959) "A Program for Monetary Stability". New York: Fordham University Press.

Ihrig, J. E.; Meade, E. E. and Weinbach, G. C. (2015). "Monetary Policy 101: A Primer on the Fed's Changing Approach to Policy Implementation," *Finance and Economics Discussion Series 2015-047*. Washington: Board of Governors of the Federal Reserve System, http://dx.doi.org/10.17016/FEDS.2015.047.

Goodfriend, M. (2002) Interest on Reserves and Monetary Policy. *Economic Policy Review*. Federal Reserve Bank of New York. May 2002.

Mankiw, N. G., (2016) *Principles of Economics* Eighth Edition, Cengage Learning.

Pan, L. (2017) "Fed Balance Sheet Normalization and Impact on Cash Investment Strategies"; Capital Advisors Group; https://www.capitaladvisors.com/research/fed-balance-sheet-normalization/

Phillips, A. (1920) *Bank Credit: A Study of the Principles and Factors Underlying Advances Made by Banks to Borrowers.* The Macmillan Company, New York.

Schiff, P.; Rogers, H.; Jeffrey l.; Sumner, S.; Parker, R.; Grant, J., Gjerstad, S.; Smith, V. and Luskin, D. (2009) Inflation Returns!. *Reason* October 2009; The Reason Foundation.

The Federal Reserve System. (2016) *The Federal Reserve System Purposes & Functions*; Tenth Edition; October 2016.

Williamson, S. (2016) Interest Rate Control is More Complicated Than You Thought. *The Regional Economist*. St. Louis Federal Reserve Bank; April 2016.