University of Pittsburgh
Economics 280

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Lecture Notes for Week # 7

"J.M. Keynes' liquidity preference analysis...reinforced the shift of emphasis from the transactions version of the quantity theory to the cash balances version – a shift of emphasis from mechanical aspects of the payments process to the qualities of money as an asset... More recent work has gone still further in this direction, treating the demand for money as part of capital or wealth theory, concerned with the composition of the balance sheet or portfolio of assets."
– Milton Friedman, *A Theoretical Framework for Monetary Analysis*, 1970.

7 The Demand for Money

Now that we have some understanding of what interest rates are and how they are determined, we turn our attention to the issue of the *demand for money.*

7.1 The Classical Theory

Recall our earlier discussion of the *equation of exchange*:

$$MV = PY,$$

in which M denotes the nominal money supply, V is the velocity of circulation of money (the number of times, on average that each dollar of M turns over in a year) and PY is nominal income or GDP. The equation of exchange is transformed into the classical *quantity theory of money* by the addition of two assumptions.

First, the classical economists believed that the velocity of circulation of money could be viewed as *constant* and independent of the money supply in the short–run, i.e. $V = \overline{V}$, though it may vary over the long–run. The rationale for this assumption is that institutional changes and technological innovations that might alter the transactions behavior of individuals seem to occur very slowly over time, so that in the short–run it seem reasonable to assume that the rate of turnover of money does not change, even if the quantity of money changes. Second, the classical economists believed that real economic activity, i.e. real GDP is not affected by changes in the quantity of money, and that on average, real GDP is at the so– called "full employment level" where the economy is using all of resources as efficiently as possible. Let us denote this full employment level of real GDP by Y^*. The classical economists thought that GDP would be at or close to this level of GDP because they believed that prices and wages were very quick to adjust. So for example, if there were unemployed resources (workers, factories, etc.) wages would fall quickly so as to restore the economy to a situation where it was producing the Y^* (full employment) level of GDP.

With these two assumptions, $V = \overline{V}$ and $Y = Y^*$, the equation of exchange is transformed into the quantity theory of money which says that *a change in the quantity of money leads to an equal proportional change in the level of prices.* To understand why this statement is true, let us use our two assumptions in the equation of exchange: $M\overline{V} = PY^*$ Rearranging, we have:

$$P = \frac{\overline{V}}{Y^*}M. \tag{1}$$

If $\overline{V}$ and Y^* are roughly constant and independent of changes in the money supply, then, according to the quantity theory, a change in the quantity of money, ΔM (which represents the difference in the money supply at two dates, i.e. $M_t - M_{t-1}$) will lead only to a change in the level of prices, P $(P_t - P_{t-1})$:

$$\Delta P = \frac{\overline{V}}{Y^*}\Delta M \tag{2}$$

If we divide equation (2) by equation (1) we obtain:

$$\frac{\Delta P}{P} = \frac{\Delta M}{M}.$$

This equation summarizes the classical quantity theory prediction: The percentage change in the price level $(\Delta P/P)$ is equal to the percentage change in the money supply $(\Delta M/M)$. *Example 1.* Suppose nominal GDP (PY) is \$9 trillion and the velocity of circulation of money, V, is 2.5. By the equation of exchange, the quantity of money, M, must be \$9 trillion / 2.5 = \$3.6 trillion. Now suppose the quantity theory of money holds. If the money supply increases by 11% (i.e. $\Delta M/M = .11$) what is the new quantity of money and the new level of nominal GDP?

The new quantity of money is 11% higher and equal to $\$3.6 \times 1.11 = \$3.996$ trillion. The quantity theory prediction is that nominal GDP will be 11% higher because the price level P will have increased by 11% (with no change in real GDP, Y). If the new quantity of money is \$3.996 trillion, and V remains constant at 2.5 as the quantity theory assumes, then PY must now be $\$3.996 \times 2.5 = \$9.99$ trillion. This figure represents an increase of 11% in nominal GDP: $[(\$9.99 - \$9)/\$9] = .11$.

To the classical economists, the quantity theory was not only a prediction of the source of changes in the price level (namely changes in the money supply). It was also a theory of the demand for money. The classical theory of money demand is that the demand for money is proportional to nominal income; if the velocity of circulation of money V is assumed fixed at $\overline{V}$, then the equation of exchange can be written as the demand for money equation:

$$M^d = kPY, \text{ where } k = \frac{1}{\overline{V}}$$

is a constant fraction, $0 < k < 1$. Since most measures of money M are less, in current dollar terms, than the value of nominal GDP it follows that velocity $\overline{V} = PY/M > 1$, implying a value of $k \in (0, 1)$. This view of the demand for money says that money demand will rise as income (GDP) rises and will fall as income (GDP) falls.

While the classical view of the demand for money still remains very relevant today, it suffers from several shortcomings. In particular, the classical view ignores the effect of *interest rates* on money demand. The idea that interest rates (in addition to the level of nominal income) could affect money demand was first formally introduced by economists John Maynard Keynes and John Hicks in the 1930s. This new "Keynesian" (pronounced kān' zē en) view of why people demand money has become known as *liquidity preference theory*. The other shortcoming of the classical view is that it assumes the velocity of circulation of money is constant, when in fact it is not; the velocity of circulation of money fluctuates quite a lot.

7.2 Liquidity Preference Theory

Keynes sought to further refine the classical view of money demand by pointing to three possible reasons for why people demand money. These three reasons or motives for demanding money are:

1. Transactions Motive. The transactions motive for demanding money is that money is needed for the purpose of conducting transactions. Since transactions tend to increase with increases in income, the transactions demand for money will also increase with increases in income (GDP).

2. Precautionary Motive. People often demand money for precautionary purposes, so as to have money available for unexpected events such as auto repairs, sale–priced merchandise or emergency situations. Money is preferable to other assets for this purpose because it is the most liquid asset and serves as the medium of exchange for transactions purposes. Other assets, e.g. a house, may not be so easily liquidated in times of immediate need. This precautionary motive for demanding money will also be proportional to a nation's income. Nevertheless, the precautionary motive for demanding money is somewhat different from the transactions motive. The precautionary motive arises from the possibility of *unanticipated* transactions needs while the transactions motive arises from *fully anticipated* transactions needs.

3. Speculative Motive. Both the transactions and precautionary motives suggest that the demand for money is proportional to a nation's income; as GDP increases (decreases) the transactions and precautionary demands for money increase (decrease). Keynes *speculative* motive for demanding money differs from these two previous motives because it takes account of the role that interest rates may play in affecting money demand.

   For simplicity, Keynes imagined that all of wealth, W, was held either in the form of money or bonds. Bonds, of course, pay interest while money does not. Keynes further postulated that there is a *natural rate* of interest that people expect to prevail, on average over time. If market interest rates are currently above this natural rate, then it is expected that interest rates will eventually fall back to the natural rate and if market rates are below this natural rate then it is expected that interest rates will eventually rise up to the natural rate. The position of market interest rates relative to this natural rate affects the demand for bonds and since the only other form of wealth is money, changes in the rate of interest also affect the demand for money.

   Suppose that market interest rates are currently *above* the natural rate so the expectation is that interest rates will eventually fall. We know that when interest rates start to fall, bond prices will eventually rise, and bond holders will realize *capital gains*. In anticipation of this rise in price, the demand for bonds will be high when the interest rate is above the natural rate. If the demand for bonds as a form of wealth is high, then the demand for the other form of wealth, money, must be relatively low.

   On the other hand, if market interest rates are below the natural rate, it is expected that interest rates will eventually rise. The anticipated rise in interest rates will lead to *lower* future bond prices, and the possibility of capital losses for current bond holders. Therefore, if interest rates are below the natural rate the demand for bonds will be relatively low, while the demand for the other form of wealth, money, will be relatively high.[1]

We conclude that the *speculative demand* for money consists of an inverse relationship between money holdings and interest rates. If market interest rates are relatively high, the demand for money will be low, and if market interest rates are relatively low, the demand for money will be high.

In summary, there are two factors that affect the demand for money. The first is the level of real income or GDP, denoted by Y and the second is the market interest rate, i. We can write the Keynesian money demand function as follows:

$$M^d = [kY + \ell(i)W]\, P$$

where $\ell(i)$ is the fraction of real wealth W held in the form of money $0 \leq \ell(i) \leq 1$, and P is the price level. The fraction $\ell(i)$ is an inverse function of i; if i increases, $\ell(i)$ decreases, and vice versa. The first term in brackets, kY, represents the transactions and precautionary motive, while the second term, $\ell(i)W$, captures the speculative motive. If we consider short periods of time over which wealth is not increasing the second term can be regarded as a essentially constant, and the money demand equation reduces to a version of the classical money demand equation, $M^d = kPY$+constant.

Often we will consider the demand for *real money balances*, which we shall denote by $\frac{M^d}{P}$. This is the demand for money in *real terms*, taking account of the purchasing power of that money, as indicated by the current level of prices, P. We can rearrange the above equation to give us the demand for real money balances as follows:

$$\frac{M^d}{P} = [kY + \ell(i)W].$$

Unlike the classical theory, the Keynesian liquidity preference theory allows for a variable velocity of circulation of money. To see this, let us take the inverse of the equation above, which we write as

$$\frac{P}{M} = \frac{1}{[kY + \ell(i)W]}.$$

Next, multiply both sides by real GDP, Y to get:

$$\frac{PY}{M} = \frac{Y}{[kY + \ell(i)W]} = V.$$

Recall that $\frac{PY}{M} = V$, the velocity of circulation of money. It follows that under the liquidity preference theory, the velocity of circulation of money may not be constant, but will instead depend on the level of real income Y, the market interest rate i, and the level of wealth, W. Suppose, for example, that market interest rates rose, but there was no effect on income Y or wealth W. An increase in i reduces the fraction ℓ, of wealth held in the form of

[1] Here we are assuming that capital losses on bonds potentially outweigh the inflation costs of holding money.

money. Investors put more of their wealth in interest earning assets as the opportunity cost of holding real money balances has increased. Consequently, the denominator in the expression above is reduced implying that the velocity of circulation of money increases: $i \uparrow \Rightarrow \ell(i) \downarrow \Rightarrow [kY + \ell(i)W] \downarrow \Rightarrow V \uparrow$.

7.3 The Modern Quantity Theory

A modern restatement of the classical quantity theory of money was provided by Milton Friedman in 1956.[2] The modern quantity theory is quite similar to the Keynesian liquidity preference theory in that it views money as an asset, and not just as a medium of exchange for transactions purposes only. In this regard, the modern quantity theory can be viewed as an elaboration upon the liquidity preference theory, although there are some important differences.

The modern quantity theory of money states that the demand for real money balances can be described by the equation:

$$\frac{M^d}{P} = f\left(W, Er_b - Er_m, Er_e - Er_m, E\pi - Er_m\right)$$

Here W denotes the wealth of the economy, which can be thought of as the present discounted value, at interest rate i of future national income or GDP, Y, received in every future period over an infinite horizon:

$$W = \sum_{N=1}^{\infty} \frac{Y}{(1+i)^N} = \frac{Y}{i}$$

$Er_b$is the expected return on bonds, Er_m is the expected return on money, Er_e is the expected return on equities (stocks), $E\pi$ is the expected inflation rate.

What do these differences in expected returns represent? The difference $Er_b - Er_m$ reflects the amount by which the return on *bonds* is expected to exceed the return on money. The return on bonds, as we have learned, reflects both the interest paid to bondholders and the expected capital gains or losses from selling bonds prior to their maturity date. The expected return from holding money reflects 1) any interest that is received from holding money in an interest earning checkable deposit account and 2) the services provided by banks on deposit accounts. When either the interest rate or the services provided by banks on checkable deposits increases (decreases), the expected return from holding money also increases (decreases).

The second difference, $Er_e - Er_m$, reflects the amount by which returns on *equities* are expected to exceed the return on money. The third difference, $E\pi - Er_m$ reflects the amount by which returns on *goods* are expected to exceed the return on money. The higher is the expected inflation rate, the higher is the appreciation in the price of goods, particularly *investment goods* like houses, the higher is the potential capital gains on these goods.

According to the modern restatement of the quantity theory, the demand for real money balances is proportional to changes in wealth, and is *inversely* proportional to changes in

[2] Milton Friedman, "The Quantity Theory of Money: A Restatement," in M. Friedman, ed. *Studies in the Quantity Theory of Money*, Chicago: University of Chicago Press, 1956, pp. 3–21.

$Er_b - Er_m$, $Er_e - Er_m$, or $E\pi - Er_m$. Notice the similarity with portfolio analysis: the demand for money can be viewed as the demand for just one type of asset in an individual's portfolio of assets. The demand for money will depend on the expected returns on these other assets relative to the expected return on money.

Friedman's restatement of the quantity theory differs from Keynes's liquidity preference theory in that Friedman considers returns from several assets, not just bonds, and he also consider returns from buying goods. Another difference is that in Friedman's view the demand for money is sensitive to market interest rates only to the extent that these rates rise relative to the return on holding money. However it is generally the case that if interest rates on bonds rise, interest rates on other borrowed funds, e.g. deposits made at banks will also rise, so that it is typically the case that there will be little change in a difference such as $Er_b - Er_m$ when interest rates rise. Thus, Friedman's demand for money theory suggests that a rise in market interest rates need not lead to a reduction in the demand for money. Rather, what is needed is an increase in expected returns on alternative assets relative to the expected return on holding money.

7.4 Equilibrium in the Money and Bond Markets

Let us return, once again, to Keynes' assumption that all wealth is held in the form of either money or bonds. It might help to think of these two possible forms of storing wealth as representing all non–interest and all interest–earning assets forms of wealth.

Given our assumption, it follows that the demand for money, M^d, and the demand for bonds, B^d, must equal the total value of wealth:

$$M^d + B^d = W.$$

If there is demand for wealth in the form of either money or bonds, there must be a corresponding *supply* of these two forms of wealth as well. It follows that the supply of money, M^s, and the supply of bonds, B^s, must also equal wealth so that we may rewrite the above equation as:

$$M^d + B^d = W = M^s + B^s.$$

Rearranging the above equation (and dropping the W term) we can write:

$$B^d - B^s = M^s - M^d.$$

This equation tells us that if there is an equilibrium in the money market, so that $M^s = M^d$, the we must, by definition have equilibrium in the bond market as well. That is,

$$M^s = M^d \Rightarrow B^d = B^s.$$

Moreover, the equilibrium interest rate determined in the bond market will be the same as the equilibrium interest rate determined by the equality of money supply and money demand in the money market. Therefore one can either use the equilibrium analysis of the bond market to determine equilibrium market interest rates (recall our earlier analysis of equilibrium in the bond market) or one can use an equilibrium analysis of the money market using (say) the liquidity preference view of money demand to determine the equilibrium interest rate (as we shall do below).

The fact that equilibrium in one of two possible markets for wealth implies equilibrium in the other should be obvious, since there can only be one independent equilibrium condition for the two markets. The notion that equilibrium in the money market implies equilibrium in the bond market and vice versa, is known in economics as *Walras' Law*, which says that if there are a total of N possible markets, and there is equilibrium in $N-1$ of these markets, then the Nth market must be in equilibrium as well.

7.5 Money Market Equilibrium: An Example

Let us now consider an example of how the aggregate demand and supply of money together determine the equilibrium interest rate. The example is based on Keynes' liquidity preference view of money, as it is easy to construct a simple money demand relationship using this theory of money demand. The theory of aggregate money supply will be developed a little later in the course when we have considered the monetary policy actions of the central bank as well as the role of the private banking sector in determining the aggregate supply of money.

Following the liquidity preference view, suppose the aggregate demand for money can be characterized by the following equation:

$$M^d = (.5Y - 40i)P,$$

where M^d denotes the aggregate demand for money measured in trillions of current dollars, Y denotes real GDP, i is the interest rate and P is the current price level. The coefficient of .5 that multiplies Y reflects the assumption that the demand for money for transactions and precautionary purposes is equal to one–half of real GDP, i.e. we have chosen to set $k = .5$. The second term, $-40i$ is meant to capture the speculative demand for money. Recall that in our algebraic formulation of the liquidity preference view, the term $\ell(i)W$ was used to capture the speculative demand for money. Here we use a simpler term, $-40i$, that captures the same idea. The coefficient of -40 that multiplies the interest rate i is a measure of the *sensitivity* of aggregate money demand to a change in the interest rate. The negative sign in front of this coefficient tells us that money demand will vary *inversely* with the interest rate in line with the prediction of the speculative motive for money demand.

In order to maker further progress, it will help to reduce the number of variables on the right hand side of the equation above from three (Y, i, P) to just one. We want to focus on the determination of the equilibrium interest rate, so we will fix both Y and P. (We are invoking, once again, the *ceteris paribus* assumption, that other things are held constant, in order to make some sense of the relationship between money demand and interest rates). Let us set Y = \$6 trillion, and the price level $P = 1$. Then our liquidity preference, demand–for–money equation simplifies to:

$$M^d = 3 - 40i.$$

Using this money demand equation, we can construct a *demand schedule*, which tells us how the demand for money varies with changes in the only remaining variable, the interest rate

Demand for Money Schedule

i	M^d (trillions of \$s)
.01	2.6
.02	2.2
.03	1.8
.04	1.4
.05	1.0
.06	0.6
.07	0.2

We can use the information in this table to draw a *demand curve* for money, which we do below. Note also that $M^d = 0$ when $i = 3/40 = .075$; this value for i will serve as the intercept of our downward sloping demand curve.

The liquidity preference theory provides us with an understanding of the how aggregate money demand is determined but it does not have anything to say about the determination of the aggregate *supply* of money. The supply of money, for now, can be thought of as being under the control of the central bank; in the U.S. the aggregate money supply is controlled by the Fed.[3] Let us suppose, for our illustrative example, that the Fed has determined that the aggregate money supply should be equal to \$1 trillion. That is, we suppose that

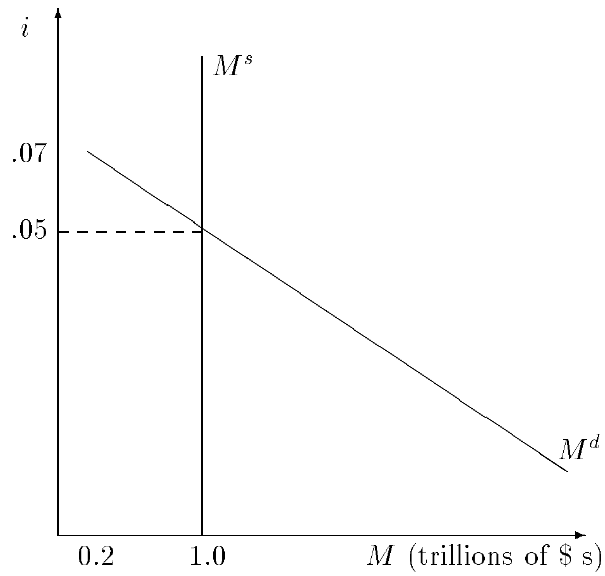
$$M^s = \$1 \text{ trillion},$$

and that this supply of money is not sensitive to changes in the interest rate.

If we were to graph our aggregate money demand equation using the money demand schedule give above, together with our assumption about the aggregate supply of money, we would obtain the following demand–supply diagram that characterizes the aggregate "money market."

[3]More accurately, the money supply is determined by the decisions of the Fed and the lending decisions of banks. We will discuss the determination of the aggregate money supply in further detail later in the course.

Aggregate Demand and Supply of Money



Note that the intersection of the demand and supply curves for money determines the equilibrium interest rate just as the demand and supply for bonds determines the equilibrium interest rate in the bond market. By Walras' law, the equilibrium interest rate as determined in the money market must be the same as the equilibrium interest rate determined in the bond market (and vice versa). In this illustrative example, the equilibrium interest rate is found to be 0.5 (5%), and the equilibrium quantity of money demanded and supplied is equal to $1 trillion.

Changes in Money Demand

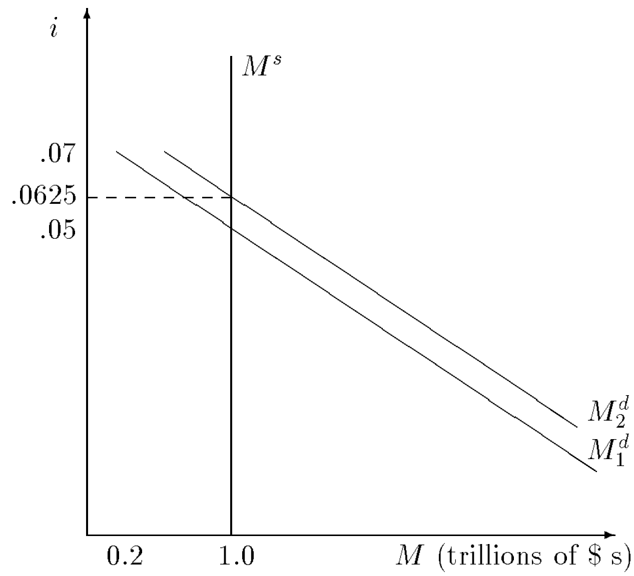
We know that changes in the market interest rate, the only variable in our money demand equation, will lead to movements along the money demand curve; as interest rates rise, money demand will fall, and vice versa. What causes the demand for money curve to *change*, i.e. to shift its position? The answer is a change in any factor other than the interest rate. These other factors are the ones we have held fixed by assumption, i.e. the level of real GDP, Y or the price level P. If these other factors change, then the demand curve will also change. Let us consider each possibility in turn.

Consider first, the possibility of a change in Y. Suppose Y increases from $6 to $7 trillion. Then, ceteris paribus, the demand for money equation changes to:

$$M^d = 3.5 - 40i$$

Graphically, the money demand curve shifts out and to the right as depicted in the figure below.

An Increase in Aggregate Money Demand



The old money demand curve is represented by M_1^d and the new money demand curve is represented by M_2^d. What is the new equilibrium interest rate? We could find it by looking carefully at the intersection of the new money demand curve, M_2^d with the money supply curve, M^s, but we could also find it *algebraically* as follows:

$$M^d = 3.5 - 40i = 1 = M^s$$

$\Rightarrow$

$$2.5 = 40i$$

$\Rightarrow$

$$i = \frac{2.5}{40} = .0625.$$

The new equilibrium interest rate is found to be higher, at .0625 (6.25%). In general, we may conclude that if real GDP increases (the economy grows) the demand for money curve will shift up and to the right and the equilibrium interest rate will, ceteris paribus, increase. Of course, if real GDP decreases (the economy contracts) the money demand curve shifts in the other direction (down and to the left) and the equilibrium interest rate would, ceteris paribus, decrease.

Let us now return to the case of the original demand curve, M_1^d, and ask what happens to money demand if the price level, P, increases from 1 to 1.1, so that there is an inflation of prices of 10% (Inflation rate = (1.1-1)/1). In this case, the demand for money equation that we originally had, $M_1^d = 3 - 40i$, changes to:

$$M_2^d = 3.3 - 44i$$

To see what happens graphically, you could first use M_2^d to construct a new demand schedule and then plot the observations from this schedule as the new money demand curve. You would find that relative to the original money demand curve, this new demand for money curve has shifted out and to the right. You would also find that the slope of this new money demand curve has become somewhat flatter (less steep), but that the intercept had not changed.[4] That is because the change in the price level impacts on both the intercept and the slope of the money demand equation. Another way to see the consequence of a change in the price level is to note that the sensitivity of money demand to interest rates has changed from -40 to -44, so that money demand will now be more sensitive to interest rate changes: an increase in interest rates now leads to a greater change in the quantity of money demanded as compared with before the change in the price level. Since the new money demand curve lies to the right of the old money demand curve, we know that the new equilibrium interest rate must be greater than 5%. Question: How would you find the new equilibrium interest rate?[5]. More generally, we conclude from this exercise that an increase in the price level (inflation) increases the demand for money and leads to higher equilibrium interest rates, ceteris paribus (keeping the money supply fixed). Alternatively, if a decrease in the price level (deflation) causes the demand for money curve to pivot downward to the left, and become more steeply sloped; in this case the equilibrium interest rate would, ceteris paribus, decrease.

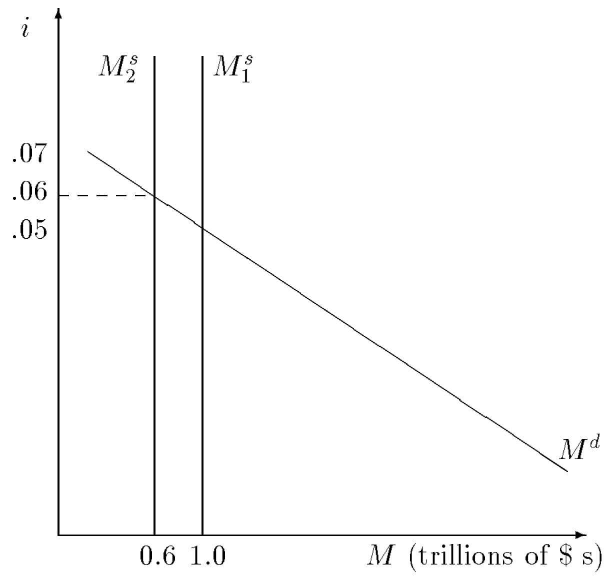
Changes in Money Supply

The other determinant of equilibrium interest rates is the aggregate money supply. What happens when the money supply is changed? (We will later explain the mechanics of changes in the money supply). Let us return again to case of our original demand– supply diagram, where $M^d = 3 - 40i$ and $M^s = \$1$ trillion. Suppose the Fed takes actions to reduce the supply of money so that the money supply changes from $M_1^s = \$1$ trillion to $M_2^s = \$0.6$ trillion as illustrated in the diagram below.

[4]Recall that the intercept is found by setting $M^d = 0 \Rightarrow i = 3.3/44 = .075$. The result of the change in the price level is that the slope of the money demand curve becomes less steep; it changes from $-1/40$ to $-1/44$.

[5]Algebraically, of course: $3.3 - 44i = 1, \Rightarrow i = 2.3/44 \approx .0523$

A Decrease in Aggregate Money Supply



Assuming no change in money demand (the ceteris paribus assumption, once again), the reduction in the money supply leads to an increase in the equilibrium interest rate from 5% to 6%. In general, we can conclude from this exercise that reductions in the supply of money shift the money supply curve to the left and, ceteris paribus, increase the equilibrium interest rate. On the other hand, increases in the money supply shift the money supply curve to the right and, ceteris paribus, reduce the equilibrium interest rate.