Demand for Money

One of the central questions in monetary theory is the stability of money demand function, i.e., whether and to what extent the demand for money is affected by interest rates and other factors. The answer to this question has a lot to do with the effect of money on the aggregate economic activity. Here we will focus on the role of interest rate in the demand for money.

1 Quantity Theory of Money

Quantity Theory is basically a theory of *how nominal value of aggregate income is determined*. Moreover, the theory tells us how much money is held for a given amount of aggregate income, it is also a theory of demand for money.

1.1 Equation of Exchange

Fischer (1911) examined the link between money supply (M) and the total spending on final goods and services ($P \times Y$, aggregate nominal income, nominal GDP) and concluded that money supply and nominal GDP is linked by the income velocity of money V (or the rate of turnover of money, i.e., the average number of times per year a dollar is spent in buying final goods and services):

$$MV = PY.$$

This equation of exchange is basically an identity. To convert this equation of exchange into a theory of how nominal income is determined requires an understanding of factors that determine the income velocity of money.

Note that we can also define V_T so that

$$MV_T = PT,$$

where T denotes all the transactions for a given year in the economy, including transactions of intermediate goods, existing assets, financial assets, etc. The movement of V_T may divert from that of V particularly when the transactions of financial assets fluctuate.

1.2 Quantity Theory

Fischer considered that V is determined by institutional and technological factors that affect the way individuals conduct transactions. E.g., When more transactions are conducted by credit cards, the demand for money will decline relative to the nominal income, and thus V will fall. Since institutional and technological factors change slowly over time, V can be assumed to be a constant in the short run.

When V is assumed to be a constant, the identity becomes the Quantity Theory of money: $M\overline{V} = PY$, which says that nominal income is determined solely by movements in the quantity of money.

Moreover, in the view of classical economists (including I. Fischer), wages and prices are completely flexible and thus real output remains at the full-employment level. Therefore, real output Y can also be considered constant in the short run, i.e., $M\overline{V} = P\overline{Y}$.

This implies that movements in price level result entirely from changes in the quantity of money.

Because the Quantity Theory tells us how much money is held for a given amount of aggregate income, it is in fact a theory of demand for money, i.e.,

$$M = \frac{1}{V}PY.$$

In money market equilibrium, $M = M^d$, thus the function of money demand is

$$M^d = \frac{1}{V}PY.$$

Since real output and velocity are considered to be fixed in the short run, this implies that the function of demand for money is stable in the short run.

Suppose $V = 12$, this means that the average amount of money holding equals to 1/12 of total spending on final goods and services for the whole year (PY), which supports consumption expenditures for around one month.

Alternatively, the demand for real money balance is given by

$$\frac{M^d}{P} = \frac{1}{V}Y.$$

1.3 Is Velocity a Constant

The data shows that, even in the short run, the velocity is far from a constant.

In the US, the velocity of M1 became more volatile since early 1980s, corresponding to financial innovation and deregulation during that period, while the velocity of M2 was relatively stable. This led the Fed to drop M1 and adopt M2 as an intermediate target in 1987.

Consider V1a (for M1A), V1b (for M1B), and V2 (for M2) in Taiwan. First, there is a clear downward trend for these velocities. This may be due to an increasing proportion of transactions conducted by credit cards, rather than cash. When the ratio C/D declines, the multiplier rises, leading to a rise in monetary aggregates and lowering the velocity. Moreover, V2 are more stable than V1a and V1b.

2 Liquidity Preference Theory

Why do individuals hold money? Keynes abandoned the classical paradigm in the General Theory (1936) and developed a theory of money demand that emphasizes the role of interest rates. There are three motives for holding money: transaction, precaution, and speculation. The speculative motive for money demand is particularly related to changes in the interest rate.

In Keynes' view, there are two types of assets: money (non-interest bearing) and bonds (interest bearing). Keynes postulates that, in the view of the public, there is a normal interest rate i^n. If the *current interest rate is at a lower level than the normal rate* ($i < i^n$), the public expects the interest rate will rise and the bond price will be lower. The capital loss from lower bond price may outweigh the interest payment, leading to a lower expected return for bonds. Thus, the public will be more likely to hold more money rather than bonds, and the demand for money will increase. This says that the demand for money is negatively correlated with *the current level of interest rate.*

Keynes further proposed that demand for money also depends on the current real income. Thus, the Liquidity Preference theory of demand for real money balance is given by

$$\frac{M^d}{P} = f(i, Y).$$

By the definition of velocity of money and the equilibrium condition of money market,

$$V \equiv \frac{PY}{M} = \frac{Y}{M/P} = \frac{Y}{f(i, Y)},$$

which says that as i increases, real money balance $f(i, Y)$ declines, leading the velocity V to rise. This explains why the velocity fluctuates substantially.

Since the nominal interest rate is pro-cyclical, velocity is also pro-cyclical.

What will happen to the demand for money if the public anticipates that the future interest rate will be higher?

When the interest rate is *expected to be higher*, the price of bond will be lower (causing capital loss), leading to a lower expected return on bond. Therefore, the public prefer to hold more money than bond today, *given the current level of interest rate*. This leads the function of demand for money $f(i, Y)$ to *shift* rightward.

2.1 Baumol-Tobin Model of Demand for Money

Baumol-Tobin model concentrates on the transaction demand for money, showing that even the money balances held for transactions can be sensitive to interest rates.

Consider there are two assets: cash and deposits, where the latter is interest-bearing.

Assume that purchases must be made with cash. At the start of the period, your income is deposited into a interest-bearing deposit account. You must withdraw money from the account to pay for purchases. Suppose you spend the cash smoothly down to zero till the end of the month. Let

PY = beginning of the month nominal income;
i = (monthly) deposit nominal interest rate;
$P\delta$ = transaction costs in nominal terms;
Z = the amount of withdrawal each time.

What is the optimal number of transactions (withdrawals)? The total number of times you have to go to the bank is $n = PY/Z$ and your *average cash balance* (*money demand*) is

$$M^d = \left[\frac{1}{2} \times \left(\frac{PY}{n} \times \frac{1}{n}\right)\right] \times n = \frac{PY}{2n} = \frac{Z}{2}.$$

The opportunity cost for holding cash is $i \times Z/2 = i \times PY/(2n)$ and the transaction cost is $P\delta$. Thus the total costs of managing cash is

$$TC = nP\delta + \frac{iPY}{2n}.$$

To minimize the total costs of managing cash, take derivative with respect to n: $P\delta - iPY/(2n^2) = 0$. Thus, we solve for the optimal number of trip to the bank:

$$n = \sqrt{\frac{iY}{2\delta}},$$

and the *money demand (average cash balance)* is $M^d = \frac{Z}{2} = \frac{PY}{2n} = P\sqrt{\frac{\delta Y}{2i}}$, thus the *demand for real money balance* is

$$\frac{M^d}{P} = \sqrt{\frac{\delta Y}{2i}}.$$

This is the square-root rule for transaction component (cash) of the demand for money. One problem with this formula is that the number of withdrawals should be an integer, but we have in fact treat it as a continuous variable.

We can derive some properties of this money demand function. Take natural log on the transaction demand for money function

$$\ln \frac{M_t^d}{P_t} = \frac{1}{2} \ln \frac{\delta}{2} + \frac{1}{2} \ln Y_t - \frac{1}{2} \ln i_t.$$

This money demand function implies that (i) The elasticity of transaction cost is 0.5; (ii) The money demand elasticity of interest rate is -0.5; and (iii) The money demand elasticity of income is 0.5.

According to the result of (iii), we know that the transaction demand for money exhibits economies of scale. That is, when income increases, the transaction demand for money increases less proportionally. As a result, the income velocity of money rises.

3 Friedman's Modern Quantity Theory

M. Friedman applies the theory of asset demand to the demand for money. He considers a broader spectrum of assets and the demand for real money balance is related to wealth (permanent income) and the expected returns on other assets *relative to that on money*:

$$\frac{M^d}{P} = f\left(Y_p, r_b - r_m, r_e - r_m, \pi^e - r_m\right),$$

where

Y_p = permanent income;
r_b = expected returns on bonds;
r_e = expected returns on equity;
r_m = expected returns on money.

There are four types of assets here: bonds, equities, goods, and money. Note that $\pi^e - r_m$ is the expected return from holding goods (consumer durables, gold, etc.) relative to holding money.

These relative returns are negatively related to money demand: the higher the returns of bonds, equity and goods relative the return on money, the lower the quantity of money demanded.

3.1 Implications and Comparison with Keynes' Theory

We compare these two frameworks of money demand in terms of incomes, relative returns among assets, and

(1) Since permanent income, which is a long-run average all future incomes, is more stable than the current income, the demand for money will not closely co-move with business cycle movements (fluctuations in real come).

(2) There are multiple interest rates that are relevant for determining the demand for money, i.e., the expected returns of other assets, other than bonds, will also affect the demand for money. In contrast, Keynes lumped financial assets other than money into one category – bonds – because he considered these returns in general moving together.

Friedman stresses that the expected return on money r_m is not constant (Keynes assumes that $r_m = 0$). The return on money depends on the services provided on bank deposits (check cashing, bill paying, etc.) and the interest on some checkable deposits.

The spread between returns will also be stable since returns would tend to rise or fall roughly at the same time, causing the spreads to remain the same. So in Friedman's model changes in interest rates have little or no impact on money demand.

Therefore, the demand for money mainly depends on permanent income

$$\frac{M^d}{P} = f\left(Y_p\right).$$

In sum, Friedman's money demand function is much more stable than Keynes' in terms of its dependence on permanent income and being insensitive to interest rates. If the money demand function is stable, velocity will be fairly predictable:

$$V \equiv \frac{PY}{M} = \frac{Y}{M/P} = \frac{Y}{f\left(Y_p\right)}.$$

Note that as current income rises, permanent income also rise, yet less proportionally. Thus, the velocity is also pro-cyclical.

Still one problem remains with these theories of money demand. Since there are other low risk interest bearing assets: equities, money market mutual funds, U.S. Treasury Bills, real assets, and others. So why would anyone hold money (M1) as a store of wealth? Economist today still try to develop models to solve this "rate of return dominance" puzzle.

4 Empirical Evidence on Money Demand

The main differences between Keynes and Friedman lie in the sensitivity of money demand to interest rates and the stability of the money demand function over time.

Early Keyesian found money demand is indeed sensitive to interest rates. Later research also supports this finding.

As for the stability of the money demand function, up until the mid-1970s, researchers found the money demand function to be remarkably stable, i.e., the relationship between money demand, income and interest rates did not change over time.

However, starting in 1974, the stability of the money demand function (M1) began to break down. Existing money demand functions were *overpredicting* money demand (i.e. actual money demand was lower than what old money demand functions were predicting). This case of the "*missing money*" was a problem for policy makers that relied on these functions to predict the effects of monetary policy. Since the Fed was engaging monetary targeting and used M1 as intermediate target, it is primarily important for M1 to maintain a stable relationship with the goals. An unstable money demand function means that the relationship between money demand, income and interest rates changes over time. Since in equilibrium $M^d = M$, an unstable money demand function implies that the relationship between money supply and income (GDP) breaks down.

What caused this breakdown? It is likely that financial innovations and deregulation in the 1970s (money market accounts, NOW accounts, electronic funds transfers, credit cards, etc.).

With the problems in the M1 money demand functions, the Fed turned to M2 targeting. However, the stability of M2 money demand functions also broke down in the 1990s. This cause the Federal Reserve to stop setting targets for M2 in 1993 after abandoning M1 targets in 1987.