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Selected Aspects of the Demand for Money Function

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SELECTED ASPECTS FOR THE DEMAND FOR MONEY FUNCTION

A Thesis

Approved for the Department of Economics

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INTRODUCTION

The demand for money function is the result of a long process of theoretical development. Yet there is still controversy over some of the basic issues; for example, as to whether or not interest rates should be included in the demand for money function. Various empirical studies have been conducted lending support to either view, and brought with them other methodological problems.

This paper will attempt to trace some of the theoretical developments of the demand for money function. It begins with a survey of the classical view or the "quantity theory of money." With this as a background, the Keynesian view will be discussed, as well as some empirical studies based on Keynes' formulation. Since various attempts have been made at the calculation of the interest elasticity of the demand for money, the income elasticity, and the role played by other variables, such as wealth, some relevant empirical studies and their findings will be discussed. Some modern approaches to the demand for money, such as the interest elastic transactions demand, and the neoclassical approach, will be evaluated.

The second chapter contains demand for money equations based on data covering the years 1951 to 1968, and comparisons
are made with the results obtained by others in previous studies. The various elasticities will be compared and evaluated so that any significant changes, which might affect policy can be seen.

Finally, Chapter III contains a brief summary and conclusions.
CHAPTER I
THE DEMAND FOR MONEY

1. Survey of the Classical View

Many of the classical writers have discussed the role of money and the motives for holding it.\(^1\) Their approach is often summed up in what is known as the "quantity theory of money," and reflects the classical view that the only motive for holding money was the transactions motive. This is based on the assumption that man is rational, discrete, and self-interested. Therefore, it would be irrational to hold money for reasons other than to facilitate transactions, since money has no inherent utility. Although savings did exist, it was never in the form of idle cash, but was savings on which a return was received. One person's savings would be transformed into another's transactions; for example, they would be borrowed by an entrepreneur to acquire capital goods. Patinkin summarizes the Classical view of the demand

for money by stating that in its cash balance version individuals hold, for convenience, a certain proportion \((K)\) of their planned transactions \((T)\) in the form of real money balances.\(^2\) The demand for the balances is then \(KT\). The demand for nominal money balances is \(KPT\) where \(P\) is the price level. When this demand for money is equated to the supply of money \(M\), the result is \(M = KPT\), the Cambridge equation. In the transactions version, \(V\), the velocity of circulation replaces its reciprocal \(K\), and the result is the equation of exchange \(MV = PT\).

According to Teigen the implication of this view of the role of money is that the economic process is not accurately represented by static-equilibrium analysis, but is dynamic.\(^3\) Under static assumptions receipts of income and payments would be synchronized so that transactions balances would not be required. Also, no one would emerge from the market-clearing process holding cash balances since money, considered only useful in transacting, would have been exchanged for goods and a higher level of utility could have been reached. However, income receipts and payment requirements occur at different periods of time rather than simultaneously. This


fact is a condition for the holding of transactions balances, but is not sufficient to explain their existence since it is possible for the currently idle transactions balances to be converted into income-yielding, perfectly liquid assets, such as savings deposits, which can again be converted into money when needed. Assuming the static assumptions, with no one desiring to hold cash balances, the velocity of circulation (ratio of money value of income \( Y \), or money value of transactions \( T \), to the stock of money) would approach infinity. Later writers in the classical tradition then attributed the fact that velocity is finite to the uncertainty attached to future transactions needs or what is known as the precautionary motive for holding money based on unforseen contingencies. The precautionary motive for holding money was considered to be a function of the level of transactions, but still did not explain the existence of transactions balances since perfectly liquid, income-yielding assets could satisfy this motive.\(^4\)

The general Classical view is that the demand for money varies with the transactions level. Gardner Ackley summarizes the quantity theory as follows:\(^5\) Assuming that

\(^4\)The modern approach to the demand for money balances for transactions purposes takes into account the cost of converting these balances into and out of these income-yielding assets, which may exceed the return from holding the assets. This approach is discussed below.

payments habits are given, that there is a given vertical structure of production, prices are flexible upward and downward, and that people do not desire to hold idle money balances, then the price level is proportional to the quantity of money in circulation, or to put it mathematically-

(1) \[ MV = PtT \]

(2) \[ MC = Y = PoY \]

where,

\( M \) = quantity of money in circulation
\( V \) = transactions velocity of money, during a time period
\( Pt \) = average price level of all transactions
\( T \) = "physical Volume" of transactions occurring during the time period
\( Y \) = money national output (or income)
\( Po \) = average price level of final output
\( y \) = physical volume of final output

In equation (1) \( V \) is constant because the institutional arrangements and customary practices that determine velocity (such as, frequency with which payments are made and received by economic units) change very gradually. \( T \) is also considered constant because of given technology. Then \( P \) is proportional to \( M \), or increases or decreases in \( M \) will result in proportional increases and decreases in \( P \).

In the second equation, the reasons why \( V \) is constant also apply to \( C \), with the added possibility that the volume of final output can, at a particular time, be a
constant fraction of the total volume of transactions. "Thus, if money stays in all balances only the necessary minimum period of time, and if the number of balances the average dollar must go through in making a complete circuit from one income recipient to another is given, C will be a constant, of course smaller than \( V \)."\(^6\) Then assuming competition and flexible prices, \( y \) is assumed at a maximum level because output is produced by a fully-employed labor force with a fixed stock of capital and given technology; \( P \) is considered to be passive so again \( P \) depends on changes in \( M \).\(^7\)

The following equation is simply an alternate statement of the second equation (with slightly different notation), which may help to clarify a few points: \(^8\)

\[
M = kY \quad 0 < k < 1
M = kPQ
\]

where

\( M \) = nominal money stock
\( P \) = price level
\( Q \) = volume of physical output (for example, GNP at constant prices)
\( Y \) = money value in current dollars of national income or product (for example, GNP in current dollars)
\( k \) = fraction of money income held as cash balances


As explained above, k is determined by institutional factors. It would tend to be larger if wages and salary payments are made infrequently and smaller if expenditures are made right after income is received instead of being spread out. It would also tend to be smaller the greater the degree of vertical integration in business firms. Since k is assumed to be stable, the implication is that the income velocity of money Y/M is constant. While the classical view assumed a zero interest elasticity of demand for money, Keynes realized that under certain conditions, and depending on the rate of interest, it could be rational to hold money balances as part of asset portfolios as well as for transactions. Velocity is no longer constant if demand for money is related to interest as well as to income. For example, adding the interest rate (r) to the equation above gives M = kY - mr (m > 0) and since velocity V = Y/M = Y/ kY -mr and since the demand for money must equal the stock of money then (kY - mr) is constant. The interest rate and income must change in the same direction since as Y rises, r must rise so that (kY - mr) remains unchanged. If Y rises, then velocity rises, therefore velocity varies directly with income and the interest rate. The classical assumption that income velocity is constant also implies that the income elasticity of the demand for

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money is unity since

$$\eta_m = \frac{\Delta M}{\Delta Y} \cdot \frac{Y}{M}$$

and if $M = kY$, $\Delta M = k \Delta Y$ and $\Delta M = k$

then $\eta_m = k \frac{Y}{M} = k \frac{Y}{kY} = 1$.

In addition to constant velocity (unitary income elasticity) and a zero interest elasticity, in the classical model real output and employment are determined independently of the monetary sector. Consider figure 1. Employment is determined by the supply of labor $SL$ and the demand for labor $DL$, the level of output (with a given production function) is determined by the level of employment $N$, and prices $P$ are determined by the money supply $MV$. Consider graph B. The intersection of the supply of labor curve and the demand for labor curve gives the point of full-employment $N_1$, and the real wage $(W/P)_1$ which is necessary to achieve full employment. At employment $N_1$, output $O_1$ takes place (graph A). Graph C shows that the price level is dependent on $M$ and $V$ so that the curve $M_1V$ shows some money supply with a constant velocity. At output $O_1$ the price is $P_1$, and graph D shows the money wage $W_1$. Consider an increase in the money supply to $M_2V$. This results in higher prices from $P_1$ to $P_2$. If the money wage does not rise proportionately with the price rise, the real wage would fall causing employers

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Figure 1: The Classical Model Without Savings and Investment

to try to expand output because of higher profits, but it also means that less labor would be available. Competition among employers would force the money wage up so that the real wage would remain unchanged.

Current information concerning the income velocity tends to show that it is not constant and that the demand for money is responsive to changes in the interest rate and also that the income elasticity of the demand for money is probably less than one.\(^1\) The quantity theory then seems to be inadequate.

2. The Early Keynesian View

Keynes was not satisfied with the classical approach to the demand for money, mainly because the classical approach overlooked the fact that people might desire to hold money as an asset. The classical view revolved around the idea that money serves as a medium of exchange. But since money serves as both a medium of exchange and as a store of value, three motives are assigned to the demand for money, (1) the transactions motive, (2) the precautionary motive, and (3) the speculative motive.

The reason for the transactions demand for money "... is to bridge the interval between the receipt of

\(^1\)This will be discussed in the second chapter.
income and its disbursement. It is determined by the institutional and customary factors which can be considered to be relatively stable for the economy as a whole in the short run. It is determined in a large part by income, that is, changes in the level of income may result in changes in the amount of transactions balances.

The purpose of the precautionary demand is to secure oneself against unforeseen contingencies or for a 'rainy day' that may never come. Like the transactions demand, it is a function of the level of income, that is, the higher the income level, the better one is able to set money aside for this purpose.

The transactions demand and the precautionary demand are not in conflict with the classical approach since both consider money to be a medium of exchange. The reasoning was that no balances would be held outside what was needed for transactions and precautionary purposes, even at very low interest rates, since some return was better than no return at all. However, Keynes felt that people would hold money for speculative purposes because of uncertainty concerning the future rate of interest. To illustrate, assume that

---

14At the moment it is assumed that the transactions demand and the precautionary demand are interest inelastic. Actually, at high rates of interest people might exchange these balances for income-earning assets.
liquid assets can be held in only two ways, riskless money and consol bonds—a type of bond with no maturity date or redemption value. The only way a person can convert it into money is to sell it to someone else. Assume that 5 percent is the rate being earned on these securities that sell for $1000. Then the bond pays $50 per year in interest or

\[ V = \frac{R}{i} \]

\[ 1000 = \frac{50}{.05} \]

where \( R \) is the return and \( i \) is the interest rate. If the interest rate is expected to rise, it would be better to hold the $1000 as a speculative balance instead of buying the bond. If the interest rate should rise to 5.26 percent then the price of the bond would fall to $950 (\( \frac{50}{.0256} = 950 \)).

If the investor bought the bond and held it for a year he would have earned $50 in interest but lost $50 upon selling the bond. However, suppose the interest rate had gone to 6 percent, then the price of the bond would have fallen to $833.33 (\( \frac{50}{.06} = 833.33 \)) with a loss of $116.67. If the interest rate had fallen to 4 percent, the bond price would rise to $1250 (\( \frac{50}{.04} = 1250 \)) with a net gain of $300.

Therefore, the choice as to whether one buys a bond or holds his money in speculative balances depends to some extent on one's expectations concerning the future rate of interest. Those that expect the interest rate to fall, and therefore,
the price of bonds to rise, would probably buy bonds. They consider the present price of bonds to be "low," and the present rate of interest to be "high." Likewise, those who expect the future rate of interest to rise, would sell bonds since they consider the present rate of interest to be "low" and the present price of bonds to be "high." Naturally this assumes that there is some "normal" rate in order for comparisons to be made. This "normal" itself may be changing, but nevertheless wealth-holders can still develop some notion of "normal," and comparisons can be made. 15

For the reasons given above, the speculative demand for money has an inverse relationship with the rate of interest. Keynes summarized an individual's demand for money by the following equation: 16

\[ M = M_1 + M_2 = L_1(Y) + L_2(r) \]

or for convenience

\[ M = M_1(Y) + M_2(r) \]

where \( M_1 \) is the transactions demand and the precautionary demand shown as a function of income, and \( M_2 \) is the speculative demand which is an inverse function of the rate of interest. Concerning the speculative demand, Keynes recognized the possibility that at very low rates of interest people would rather hold cash than bonds. At this time "... the

speculative demand for money schedule becomes infinitely elastic or nearly so. At this low rate of interest, if individuals feel that it will not go lower (and therefore, will only rise) they will not hold bonds since if they did, they would be facing the possibility of capital loss if the interest rate should rise. This has become known as the "liquidity trap." In this situation, money injected into the system would probably be converted into cash rather than being converted into bonds. Graphically, the speculative demand and the total demand become somewhat horizontal at low rates of interest. In figure 2, the transactions demand (Graph A) is shown to be interest inelastic, while both the speculative and total demand schedules take on an inverse "J" shape, becoming elastic at some low rate of interest.

Keynes' formulation became the basis of various macroeconomic studies which attempted to give empirical evidence to support the speculative demand function and to demonstrate the inverse "J" shape. A study by James Tobin attempted to discover the relationship between idle balances and the short term interest rate covering the years 1922 to 1945. His procedure is as follows:


Figure 2: The Transactions, Speculative and Total Demands for Money

"To estimate the deposits in each year required for transactions purposes, total debits to demand deposits for each year were divided by the 1929 velocity. The result was subtracted from the actual average demand deposits for the year to obtain "idle" deposits, money which was not necessary to support the volume of transactions. This procedure results in arbitrarily defining "idle" deposits for 1929 as zero. Average "idle" deposits so computed are plotted against the average rate on prime commercial paper."19

Tobin made separate calculations for all commercial banks, for New York City banks only and for banks in one hundred centers outside New York, and for Chicago Banks only. The graph showing the relationship between average "idle" deposits and the average commercial paper rate at all commercial banks for the period studied is depicted on the next page. Not only does it show an inverse relationship, but it also takes on an inverse "J" shape.

There are several questionable assumptions in this type of analysis; for example, the assumption that the asset demand for money was zero in 1929 and the assumption that the ratio of transactions balances to income is constant.20 However, there is also another problem. The liquidity preference function is a demand function (demand for cash balances)


20By the assumption that the entire stock of money was needed to finance income flows, and so the ratio of money stock to income was considered to be the proportion required for transactions. This is assumed to be constant and was subtracted from the stock of money to obtain the residuals or speculative balances.
Figure 3: Relationship Between Average "Idle" Deposits and Average Commercial Paper Rate, All Commercial Banks (1922-41)

which is a function of price (the interest rate). Therefore, quantities observed at a given time are points on both a demand and supply curve—the intersection of the curves or the equilibrium points. Since these curves can shift over time, the observed points may not be showing the true shape of the demand curve or the supply curve. In figure 4, the observed points might be interpreted as a rather elastic demand curve, when in fact this is not the case. 21

3. Some Refinements

In order to avoid some of the problems encountered by the Tobin study, various economists, such as Stedry, Latane, Bronfenbrenner and Mayer, either introduced new variables into their equations (such as wealth) or attempted to explain the total demand for money instead of just the asset demand. 22 Although there are still some difficulties with studies of this type, they still are something of an improvement over the previous studies.

Stedry feels that Tobin's study gives reliable results for the period 1919-1947 but poor results when it


Figure 4: Observations on the Intersections of Systematically-Shifting Demand and Supply Curves

is extended beyond 1947. He states that the rise in interest rates covering the years 1948 to 1954 did not return the volume of idle balances along the curve to the level of the 1920's with comparable interest rates. Also, as the interest rates rose, there was no noticeable decrease in idle balances. He then feels that if Tobin's formulation is to be accepted, there must have been a fundamental change in the community's propensity to hold cash. However, Stedry feels that no such drastic change in money-holding habits has actually occurred, but that the apparent change is due to Tobin's neglect of changes in wealth in his formulation. Since total wealth has increased substantially since 1919 and especially after the second World War, Stedry believes that the asset demand for money can not be considered to be only a function of the rate of interest. Given the interest rate, the amount of money demanded by individuals would increase (probably less than proportionately with total assets) and given the level of assets, the proportion of wealth held in the form of cash would vary inversely with the interest rate. Based on this, his explanation is that "... the seeming zero interest elasticity of the demand for idle balances in the postwar period would be that the interest rate effect and the wealth effect on the demand for cash, which could be expected to be acting in opposite directions in this period, has roughly offset each other."\(^\text{23}\) In his statistical study Stedry

assumes that the ratio of wealth to transactions is constant, and uses transactions in his equation to represent the influence of wealth. His result is

\[ \log M = -1.44 - .621 \log r + \log T \]
for the financial sector, and

\[ \log M = -1.29 - .21 \log r + \log T \]
for the non-financial sector. Since the equations are expressed logarithmically, the coefficients represent elasticities. Therefore, .621 represents the interest elasticity of the demand for money for the financial sector, and .21 represents the interest elasticity of the demand for money for the non-financial sector. The negative sign shows that the interest rate has an inverse relationship with the demand for money. However, it can be seen that the demand for money is interest inelastic according to Stedry's calculations, while it appears to be somewhat more interest elastic according to Tobin.

In a study done by Bronfenbrenner and Mayer, wealth was included as one of the variables and the demand for total balances as well as the demand for idle balances was calculated. The study covered the years 1919 to 1956. The dependent variable X1 is usually deflated idle balances (otherwise it is total balances) calculated by a method similar to that of Tobin except for the use of 1926 instead of 1929. The

\[ 24 \text{Stedry, Op. Cit., p. 304.} \]
independent variable $X_2$ represents the short term interest rate (4-6 month commercial paper rate). $X_3$ is the logarithm or the national wealth, $X_4$ is the logarithm of prior year idle balances, and $X_5$ is income. The results are as follows: 

Estimate 1 (idle balances all years):  
\[ X_1 = 4.2066 - 0.5304 X_2 + 1.6849 X_3 + 0.5416 X_4 \]

Estimate 2 (idle balances 1926-27 omitted):  
\[ X_1 = -1.9552 - 0.2772 X_2 + 0.3269 X_3 + 0.7158 X_4 \]

Estimate 3 (total balances all years):  
\[ X_1 = 1.065 - 0.0928 X_2 - 0.1158 X_3 + 0.7217 X_4 + 0.344 X_5 \]

The t test was applied to test whether or not the coefficients were significantly different from zero. According to this test, the calculated value of t (t = b / standard error of b where b is the coefficient) is compared with the tabulated value. If the tabulated value is greater than the calculated value, the null hypothesis, that b is equal to zero, is accepted. However, if the calculated value is greater than the tabulated value, the null hypothesis is rejected, and the alternative hypothesis, that b is significantly different from zero, is accepted. The t test was applied and it was found that all variables except $X_3$ (wealth) were shown to be significant at the one percent level. The Von Newmann test, a test for the presence of autocorrelation, was also conducted, and no significant autocorrelation was found.

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If the test had shown the presence of autocorrelation, the coefficients would still remain unbiased, but the standard errors would be biased and therefore, the t test would become invalid. Since the variables are all expressed logarithmically, the coefficients represent elasticities so that the interest elasticities are approximately .3 and .5 for idle balances and .09 for total balances. It may be seen that there is no evidence for the fact that elasticities go to zero at high interest rates or to infinity at low rates.

Latane's study, which covered the period 1909 to 1958, attempted to examine the relationship between income velocity \(\frac{Y}{M}\) and its reciprocal to long term interest rates. The results of his study are

\[
\frac{Y}{M} = .77r + .38
\]

which means that if \(r\) changed by 1, \(\frac{Y}{M}\) would change by .77 in the same direction. The interest elasticity of the demand for money calculated on the basis of this equation was .89, that is, the demand for money was found to be interest inelastic. 26

Although these studies represent a refinement over the previous studies, they are still faced with some problems. The interest rate or the money stock are usually considered as given, and therefore they do not take into consideration

the fact that the rate of interest and the money stock are determined jointly by supply and demand schedules for money. Because of this neglect, estimates of the coefficients and elasticities are biased, which is an important consideration if policy decisions are to be based on these estimates.

In order to avoid some of these problems, Teigen has attempted to estimate the supply and demand elasticities jointly.\(^{27}\) Teigen's demand and supply functions of the form

\[
\begin{align*}
\text{(demand)} & \quad M = a_1 + b_{11} rY - b_{12} Y \\
\text{(supply)} & \quad M = a_2 + b_{21} r - b_{22} rd
\end{align*}
\]

were tested using quarterly data from 1946 to 1959. In the above equations \(M\) is the money stock, \(r\) is the short term interest rate, \(Y\) is income, \(rd\) is the discount rate, and \(M^*\) is "... the amount of money which could be supported by unborrowed reserves, based on existing reserve requirements and other institutional characteristics of the system."\(^{28}\) The elasticity estimates calculated by Teigen are shown in the following table:

\(^{27}\) Only a brief discussion of Teigen's method and empirical results will be given here. For a complete discussion including derivations see R. L. Teigen, "Demand and Supply Functions for Money in the United States: Some Structural Estimates," Econometrica, Vol. 32, October 1964, pp. 476-509.


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The single equation estimates were also calculated and the results are given in columns 2 and 4.

Teigen's results bring into view some interesting points. For one thing, Teigen's .054 interest elasticity of demand is considerably smaller than the .89 interest elasticity of demand reported by Latane (see Chapter I, section 3 of this paper). This might be because Latane used long term interest rates while Teigen used short term interest rates, and since long term rates vary less than the short term rates, interest elasticities using the long term rate will be higher. Other points brought out by the Teigen study are that there is a substantial interest elasticity of money supply; that elasticities estimated jointly are larger in absolute value than their counterparts; and that the low
interest elasticity with respect to demand and the high degree of explanation achieved suggest that the liquidity trap--the fact that the demand for money will become infinitely elastic at a low rate of interest--does not exist.

4. Some Modern Approaches to the Demand for Money

The classical view considered the demand for money to be interest inelastic while Keynes considered the transactions demand to be interest inelastic. However, Hansen, Baumol and Tobin considered the possibility of an interest elastic transactions demand.

The need for transactions balances is created by the failure of receipts and expenditures to be perfectly synchronized, which is determined by certain institutional and conventional factors. To give a simple example, suppose that an individual receives $100 on the first of the month and that his monthly total outlay is distributed evenly over this time. Then, his cash balances would be $100 at the

2999 percent of the variance was explained in the demand equation, and 73 percent in the supply equation.


beginning of the month and zero at the end, or an average cash balance of $50. Then why would not this individual hold the transactions balances in assets with a higher yield and convert them into cash when an outlay must be made. In this case his average cash holding would be zero, his holding of assets $50 or some intermediate possibility of dividing the $50 between cash and assets. However, the problem here is the cost of frequent entry and exit which Baumol calls a "brokers fee;" it includes all non-financial costs of borrowing or making a cash withdrawal. These include opportunity losses which result from having to dispose of assets just at the moment the cash is needed, administrative costs, and psychic costs (trouble involved in making a withdrawal)." But at some very high rate of interest it might still be profitable to convert what would otherwise be idle transactions balances into income earning securities. According to figure 5, interest rate $r_4$ is sufficiently high to attract some people into converting transactions balances into securities, and at higher rates the amount diverted becomes larger. At rates above $r_4$ the transactions demand becomes interest elastic or less interest inelastic.

The neoclassical approach. -- Some economists, such as Milton Friedman, still base their work on the quantity

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Figure 5: Interest Elastic Transactions Demand for Money

theory of money. Friedman states that his findings "... indicate that the quantity theory approach to income change is likely to be more fruitful than the income-expenditure theory approach; that the first corresponds to empirical relations that are far more stable over the course of business cycles than the second."35 Because of the stable relationship between income and money, Friedman concludes that for policy the control of the stock of money is the most useful tool for affecting the level of aggregate income.36

In one study, Friedman obtained a 1.8 income elasticity while the effect of the rate of interest was shown to be too small to be statistically significant.37 The fact that Friedman achieves a very high income elasticity and a zero interest elasticity might depend, at least to a certain extent, on the definitions of the money stock and of income. In most of the empirical studies previously mentioned, the money stock was defined as currency and demand deposits. However, Friedman defines this as currency, demand deposits and time


deposits in commercial banks. While GNP is often used for income, Friedman uses what he calls "permanent income" which is calculated by a weighted average of present and past income.

The fact that Friedman's results depend to a large extent on his definitions has made them the subject of some controversy. Teigen points out that the source of the interest elasticity of money demand is due to the variations in the interest rate relative to the cost of shifting into and out of other liquid assets, such as time deposits and short term securities, so that the inclusion of time deposits in the money stock obscures the movements between them based on interest rate changes. Therefore, Friedman has "stacked the cards" against finding a significant interest elasticity. Also, Friedman's use of permanent income (as he defined it) is more stable than the use of observed income, so that movements of money stock are greater in relation to movements of permanent income than to movements of observed income, resulting in a high income elasticity.

The role of wealth.-- There is some controversy concerning the role of wealth in the demand for money function. According to Meltzer, the only thing that theorists now agree on is "... that the demand function for money is to be treated as a problem in balance sheet equilibrium or asset

choice. However, the precise way that wealth affects the demand function is the subject of some dispute.

One view of the role of wealth relates wealth with the demand for idle balances. Since people attempt to obtain a certain combination of yield and risk in their portfolios, they may wish to hold money as an asset because of its liquidity and freedom from capital loss. These balances would be related to the level of national wealth and the interest rate, and if the transactions demand is a function of income and the interest rate, then total demand would be a function of income, wealth and the interest rate. This view was adopted by Bronfenbrenner and Mayer (section 3 of this chapter). However, as was already mentioned, wealth was shown to be statistically insignificant in their study.

Another view considers money to be only one of a number of financial assets, and some measurement of wealth is considered to be a constraint upon the choice among these assets. Then these demand for money functions usually exclude income in favor of wealth and other asset yields as explanatory variables. Friedman's use of per capita permanent income


41Ibid.
is somewhat allied to this view although the problem is that it combines wealth, interest rates, population and lagged income in a single variable and therefore combines their separate effects. 42

CHAPTER II
A COMPARISON OF
VARIOUS DEMAND FOR MONEY STUDIES

Chapter I section 3 of this paper presented various empirical studies on the demand for money and their results. However, comparison of coefficients among the various studies was made difficult since each study used different variables. For example, some use wealth as a variable, some use short term interest rates and others use long term interest rates. Therefore, the writer has attempted to calculate the various coefficients based on studies by Stedry and Latane using the same variables in order to facilitate comparison. Although the same variables have been used, the time periods involved differ. The relationships are assumed to be linear in the form \( y = a + bX + u \) with \( a \) and \( b \) to be determined. A straight line was fitted to the data by the method of least squares, so that the sum of the squared deviations from the fitted line will be at a minimum. The assumptions of the

\[43\] This study covers the years 1951 to 1968.

\[44\] The assumption of linearity seems to be justified on the basis of graphs 1 to 4 in Appendix B where the money stock (the dependent variable) was plotted against the independent variables-- gross national product, long term interest rates, short term interest rates, and demand deposits.
Gaus-Markov theorem are made so that
\[ E(u) = 0 \]
\[ E(u_i u_j) = 0 \text{ when } i \neq j \]
\[ E(u_i u_j) = \sigma^2 \text{ constant variance when } i=j \]
\[ E(X,u) = 0 \]

In each case the value of \( R^2 \), the ratio of explained variation to total variation was calculated. The value of \( t (t = b/\text{standard error of } b) \) was determined so that the null hypothesis could be tested. The value of the Durbin-Watson d statistic, which tests for the presence of autocorrelation was also calculated. Although the Durbin-Watson test and other tests for autocorrelation are usually ignored in demand for money studies, the results of the test will be included here. These tests are usually ignored because of the fact that autocorrelation is almost always present in studies of this type, and while the coefficients will still remain unbiased, the standard errors will be somewhat biased (usually downward), causing the t test to become invalid. However, as in the other studies, the writer will apply the t test. In all studies the following notation applies:

\[ M = \text{money stock} \]
\[ Y = \text{gross national product measured in current dollars} \]
\[ rs = \text{short term interest rate (4-6 month commercial paper rate)} \]
\[ rl = \text{long term interest rate (rate on aaa bonds)} \]
\[ T = \text{demand deposits} \]
A study done by Latane covering the years 1919 to 1952 gave the following results:

\[ M = 0.8 \frac{Y}{r} + 0.1 Y \]

with a \( R^2 \) value of 0.76. Using data covering the years 1951 to 1968, the following results were obtained using the same equation:

\[ M = 80.53 + 0.000438 \frac{Y}{r} + 0.1172 Y \]

\[ (0.00086) \quad (0.0071) \]

\[ t = 5.09 \quad t = 16.49 \]

where the numbers in parenthesis beneath the coefficients are the standard errors, and the row beneath the standard errors are the calculated values of \( t \). The coefficient of the wealth variable \((Y/r)\) for the years 1951 to 1968 is substantially less than the result obtained by Latane. According to the \( t \) test, if the calculated value of \( t \) is greater than the tabulated value of \( t \), the null hypothesis, that \( b \) (the coefficient) is equal to zero, is rejected in favor of the alternative hypothesis, that it is not significantly different from zero. If the calculated \( t \) is less than the tabulated \( t \), the null hypothesis is accepted, that \( b \) is not significantly different from zero. The tabulated value for \( t \) at \( n-k \) (18-2=16) degrees of freedom at \( .05 \) level of significance is 2.12. In the case of the coefficient of \((Y/r)\), 2.12

---

The coefficient of income is slightly larger than that obtained by Latane and is significant according to the t test since 16.49 is greater than 2.12, so that the null hypothesis is rejected. The result of $R^2$ adjusted for degrees of freedom is .977 of 97.7 percent of the variation is explained by the equation. The Durbin-Watson d statistic is 1.117. The hypothesis is that if $d$ is less than the lower limit ($d_l$) reject the hypothesis of random disturbance in favor of that of autocorrelation and if $d$ is greater than the upper limit ($d_u$) do not reject the hypothesis. If $d_l < d < d_u$, the test is inconclusive and further observations are required. With $n = 18$ and with $k = 2$, $d_l = 1.05$ and $d_u = 1.53$. Since $1.05 < 1.117 < 1.53$, the test is inconclusive.

The same equation was run logarithmically so that the coefficients would represent elasticities. The results are

$$\log M = 1.48 + .338 \log Y + .1155 \log Y_{FL}$$

\begin{align*}
(0.0313) \quad (0.0898) \\
\text{t=12.39} \quad \text{t=1.28}
\end{align*}

According to the t test, 2.12 is greater than 1.28 so that the coefficient of wealth is insignificant. However, the coefficient of $Y$ is statistically significant since 12.39
is greater than 2.12 so that the null hypothesis is rejected and the alternative accepted, that the coefficient is significantly different from zero. The coefficient .388 represents the income elasticity of demand. The $R^2$ value for this equation is .961 and the Durbin-Watson $d$ statistic is .724. Since this value is less than $d_1$ (1.05) the hypothesis of random disturbance is rejected in favor of that of autocorrelation.

Another study done by Latane\textsuperscript{46} which covered the years 1909 to 1958 gave the results

$$M = \frac{Y}{.77r_1 + .38}.$$ 

The results using data for the years 1951 to 1968 are

$$M = \frac{Y}{.611r_1 + .996} \quad (t=1.95)$$

The tabulated value of $t$ ($n-k$ or 18-1 = 17 degrees of freedom)\textsuperscript{47} is 2.11. Since 2.11 is less than 11.95 the null hypothesis is rejected. The $R^2$ value for the equation is .893 and the Durbin-Watson $d$ statistic is .521. With $n = 18$ and $k = 1$, $d_1 = 1.16$ and $d_u = 1.39$. Since .521 is less than 1.16 autocorrelation is present.

\textsuperscript{46}Latane, "Income Velocity and Interest Rates: A Pragmatic Approach," \textit{Op. Cit.},

\textsuperscript{47}The exact form of the equation run was $Y = a + br$ so that $k = 1$, which then becomes $M = \frac{Y}{a + br}$. 
The same equation in log form gave the results

\[ \log M = \frac{\log Y}{3.59 + .732 \log r_1} \]

\[ t = 13.56 \]

Since 13.56 is greater than 2.11 the null hypothesis is rejected. The R² value for the equation is .915 and the Durbin-Watson d statistic is .552. Since this is less than dL (1.16) the hypothesis of random disturbance is rejected in favor of that of autocorrelation. In Latane's study, the interest elasticity calculated using this equation was .89. Since the above equation is in log form, the coefficient of r1 (.732) represents the interest elasticity, more inelastic than that calculated by Latane.

Stedry's study 48 covering the years 1919 to 1958 gave the following results

\[ \log M = -1.29 - .21 \log r_1 + \log T \]

For the period 1951-1968 the results are

\[ \log M = .097 + .0048 \log r_1 + 1.037 \log T \]

\[ t = 5.04 \]

\[ t = .3642 \]

The Durbin-Watson d statistic is .323 which is less than dL (1.05), so that the hypothesis of random disturbance is rejected in favor of that of autocorrelation. The R² value is .996. Since both calculated t values are less than the tabulated value of 2.12, the null hypothesis is accepted. The resultant elasticities are insignificant.

Another equation was run using short term interest rates and income covering the years 1951 to 1968. The results are

\[ \log M = 1.94 - 0.0438 \log r_s + 0.4658 \log Y \]

\[ (0.036) \quad (0.0435) \]

\[ t=1.217 \quad t=10.66 \]

Here again the Durbin-Watson d statistic shows the presence of autocorrelation (\( d = 0.533 \) which is less than \( d_1 = 1.05 \)). The \( R^2 \) value was 0.961. The t test applied to the coefficient of the interest rate again shows that it is not significantly different from zero, that is, 2.12 is greater than 1.217. The t test applied to the coefficient of income shows that it is significantly different from zero, that is 10.66 is greater than 2.12 so the null hypothesis is rejected. The income elasticity of demand calculated by this equation is then 0.4648.

The empirical results are summarized in table 2. From column 1 it can be seen that the coefficients of income remained nearly the same. However, from column 2 it can be seen that there is a substantial difference between the coefficients of wealth. Although Latane did not calculate the elasticities, those based on the data from 1951 to 1968 are contained in columns 4 and 5. From column 4 it can be seen that the income elasticity of the demand for money is less than 1 based on the data from 1951 to 1968, and based on two different equations. The coefficients of the long term interest rate (column 3) is smaller when it is based on data covering 1951 to 1968 than on that calculated
Table 2. Summary of Empirical Results

<table>
<thead>
<tr>
<th>Study</th>
<th>Coefficients</th>
<th>Elasticities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Y</td>
<td>Y/rl</td>
</tr>
<tr>
<td>Latane (1954)</td>
<td>.1</td>
<td>.8</td>
</tr>
<tr>
<td>1951-68 study</td>
<td>.1172</td>
<td>.0004</td>
</tr>
<tr>
<td>Latane (1960)</td>
<td>.611</td>
<td></td>
</tr>
<tr>
<td>1951-68 study</td>
<td>.611</td>
<td></td>
</tr>
<tr>
<td>Stedry study</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1951-68 study</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1951-68 study</td>
<td>.4658</td>
<td></td>
</tr>
</tbody>
</table>

on the data covering 1909 to 1958. From column 6 it can be seen that the demand for money is interest inelastic, with a smaller elasticity for the years 1951 to 1968. From column 7 it can be seen that the demand for money is also interest inelastic when the short term interest rate is used, and does not seem to be significantly different from zero. However, the coefficients of demand deposits changed only slightly according to column 8.

It is interesting to note that except for one of Latane's equations, the interest elasticity was shown to be significantly different from zero by the t test during the period 1951 to 1968. Even in the study where the interest elasticity was shown to be significant, it was inelastic and
more inelastic than that calculated by the corresponding study. Where the income elasticity was calculated, it was significant and less than one. Wealth was also shown to be insignificant.

The results showing highly inelastic or zero interest elasticities for the period 1951 to 1968 are somewhat at variance with the results received by others. This fact, compounded with an insignificant coefficient for wealth, might suggest that some structural changes have taken place in the economy.
This paper has attempted to survey certain aspects of the theory of the demand for money. The quantity theory of money reflected the classical view that the only motive for holding money was the transactions motive. Money was considered to be only a medium of exchange, and since it had no inherent utility, it would only be held to facilitate transactions. The discrepancy between the receipt of income and its disbursement made transactions balances necessary but was not completely sufficient to explain their existence. These balances could be converted into perfectly-liquid, income-yielding assets which could be converted into money when needed. However, Keynes realized that money served not only as a medium of exchange but also as a store of value. People might want to hold money as an asset. Three motives were then assigned to the demand for money: the speculative motive, the transactions motive and the precautionary motive. The reason for the transactions demand was to bridge the gap between income receipts and payments, and was considered to be interest inelastic. The precautionary demand was to secure oneself against unforeseen contingencies and was also considered to be interest inelastic. Both of these demands were in accord with the classical theory.
However, Keynes brought out the fact that people might want to hold money for speculative purposes because of uncertainty concerning the future rate of interest, that is, if the interest rate is expected to fall, the price of bonds would rise and visa versa. Keynes also recognized the possibility of an interest rate so low that people would prefer to hold cash rather than buy bonds. At this low rate of interest, the speculative demand for money would become infinitely elastic. This has become known as the liquidity trap.

The formulations of Keynes became the basis of various macroeconomic studies. Tobin attempted to calculate idle balances so that the relationship between these and interest rates could be seen. Tobin plotted average idle balances against interest rates for the years 1922 to 1945 in order to show the inverse relationship and that the curve becomes rather elastic at low rates of interest. Besides the questionable assumption that the asset demand for money was zero in 1929, the study still contained another problem, that the observed quantities are both points on a demand and on a supply curve which may be shifting, so that the true shapes of the curve may not be known. Later attempts concentrated on total rather than asset demand, and included other variables in their calculations. The calculated interest elasticities varied from .09 in one equation by Bronfenbrenner and Mayer, to .89 in one of Latane's equations. While Latane found that wealth was a significant variable, Bronfenbrenner and Mayer
found that it was not. To some extent the differences might be attributed to the different time periods covered by these studies, and to the different equations and methods of estimation. Although these studies were a refinement over previous studies, they still did not take the supply of money function into account. For this reason estimates of coefficients and elasticities are somewhat biased. Teigen attempted to deal with this problem by the joint estimation of demand and supply elasticities. His results showed a 0.054 interest elasticity of demand and substantial interest elasticities of supply. In each case, the single equation estimates were shown to be biased downward. Teigen's method seems to be an improvement over the previous studies since it takes into account both the demand and supply functions for money, and therefore, attempts to deal with some of the problems encountered by the other studies.

Some modern approaches to the demand for money were discussed, including the interest elastic transactions demand, the neoclassical approach, and the role of wealth. Hansen has recognized the possibility that the transactions demand may become interest elastic at high rates of interest. The reason for this elasticity is that at some high rate of interest it might still be profitable to convert otherwise idle transactions balances into income earning securities in spite of the cost of frequent entry and exit into securities. The section on the neoclassical approach dealt mainly with a study done by Milton Friedman in which a 1.8 income elasticity, and a zero interest elasticity were calculated. While these
results appear to be largely at variance with the results obtained by other studies, it was noted that Friedman's results depended to some extent on his definitions. For example, he defines the money stock as currency, demand deposits and time deposits, while it was defined in the other studies as simply currency and demand deposits. The section on the role of wealth briefly discussed two views concerning wealth. While some consider the demand for money to be a function of the interest rate, income, and wealth, others would rather exclude income in favor of wealth.

In chapter II equations calculated on data covering the years 1951 to 1968 were compared with corresponding equations covering earlier time periods. Although the coefficients of income did not differ significantly, there was a wide divergence between the .8 coefficient of wealth calculated by Latane and the .00438 coefficient calculated on the 1951 to 1968 data. The coefficient of the interest rate and interest elasticity were significantly different from zero by the t test when only based on one equation, but yielded smaller results than the corresponding ones calculated by Latane. While Stedry calculated a .21 interest elasticity, based on his equation a .0048 elasticity was calculated which was shown to be insignificant by the t test. In general, then, the results based on data covering the years 1951 to 1968 show a highly inelastic or zero interest elasticity for the demand for money. If this is actually the case, then changes in the interest rate would probably have very little
effect on the demand for money. Nevertheless, these results are not conclusive since they contain bias, and it seems that further research is needed in this area if the correct choice of policy instruments is to be made.
## APPENDIX A

**DATA USED FOR EMPIRICAL WORK**

<table>
<thead>
<tr>
<th>Year</th>
<th>Current Gross National Product (billions of dollars)</th>
<th>Money Stock (billions of dollars)</th>
<th>Long Term Interest Rate (percent)</th>
<th>Short Term Interest Rate (percent)</th>
<th>Demand Deposits (billions of dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1951</td>
<td>328.40</td>
<td>122.60</td>
<td>0.0286</td>
<td>0.0217</td>
<td>96.50</td>
</tr>
<tr>
<td>1952</td>
<td>345.50</td>
<td>127.39</td>
<td>0.0296</td>
<td>0.0233</td>
<td>100.10</td>
</tr>
<tr>
<td>1953</td>
<td>364.60</td>
<td>128.30</td>
<td>0.0320</td>
<td>0.0252</td>
<td>101.10</td>
</tr>
<tr>
<td>1954</td>
<td>364.80</td>
<td>132.30</td>
<td>0.0290</td>
<td>0.0158</td>
<td>104.90</td>
</tr>
<tr>
<td>1955</td>
<td>398.00</td>
<td>135.20</td>
<td>0.0306</td>
<td>0.0218</td>
<td>107.40</td>
</tr>
<tr>
<td>1956</td>
<td>419.20</td>
<td>136.90</td>
<td>0.0336</td>
<td>0.0331</td>
<td>108.70</td>
</tr>
<tr>
<td>1957</td>
<td>441.10</td>
<td>135.89</td>
<td>0.0389</td>
<td>0.0381</td>
<td>107.60</td>
</tr>
<tr>
<td>1958</td>
<td>447.30</td>
<td>141.20</td>
<td>0.0379</td>
<td>0.0246</td>
<td>112.60</td>
</tr>
<tr>
<td>1959</td>
<td>483.70</td>
<td>142.00</td>
<td>0.0438</td>
<td>0.0397</td>
<td>115.10</td>
</tr>
<tr>
<td>1960</td>
<td>503.70</td>
<td>141.00</td>
<td>0.0414</td>
<td>0.0385</td>
<td>112.10</td>
</tr>
<tr>
<td>1961</td>
<td>520.10</td>
<td>145.50</td>
<td>0.0435</td>
<td>0.0297</td>
<td>115.90</td>
</tr>
<tr>
<td>1962</td>
<td>560.30</td>
<td>147.39</td>
<td>0.0433</td>
<td>0.0326</td>
<td>118.80</td>
</tr>
<tr>
<td>1963</td>
<td>590.50</td>
<td>153.00</td>
<td>0.0426</td>
<td>0.0355</td>
<td>120.50</td>
</tr>
<tr>
<td>1964</td>
<td>632.40</td>
<td>159.30</td>
<td>0.0440</td>
<td>0.0397</td>
<td>123.10</td>
</tr>
<tr>
<td>1965</td>
<td>683.90</td>
<td>166.80</td>
<td>0.0449</td>
<td>0.0438</td>
<td>130.10</td>
</tr>
<tr>
<td>1966</td>
<td>743.30</td>
<td>170.30</td>
<td>0.0513</td>
<td>0.0555</td>
<td>132.10</td>
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<tr>
<td>1967</td>
<td>783.10</td>
<td>181.30</td>
<td>0.0551</td>
<td>0.0510</td>
<td>140.90</td>
</tr>
<tr>
<td>1968</td>
<td>860.60</td>
<td>193.00</td>
<td>0.0618</td>
<td>0.0590</td>
<td>149.60</td>
</tr>
</tbody>
</table>

APPENDIX B

GRAPH 1: SCATTER DIAGRAM OF MONEY STOCK VERSUS CURRENT GROSS NATIONAL PRODUCT (1951-1968)
APPENDIX B

GRAPH 2: SCATTER DIAGRAM OF MONEY STOCK VERSUS THE LONG TERM INTEREST RATE (1951-1963)
APPENDIX B

GRAPH 2: SCATTER DIAGRAM OF MONEY STOCK VERSUS THE SHORT TERM INTEREST RATE (1951-1968)

Money Stock

0 120 130 140 150 160 170 180 190 200

Short Term Interest Rate
APPENDIX B

GRAPH 4: SCATTER DIAGRAM OF MONEY STOCK VERSUS DEMAND DEPOSITS (1951-1969)


