PREDICTING NOMINAL GNP AND TESTING
THE VARIABILITY OF THE DOMESTIC MONEY STOCK
AGAINST M₁

by

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CHAPTER I

INTRODUCTION

The 1972 article by Albert Burger and Anatol Balbach, "Measurement of the Domestic Money Stock," presented some interesting and important facts concerning the current measure of the United States money stock. For instance, they demonstrate various effects that the outflow of dollars can have upon money aggregates. These effects are not at all apparent because of the way money aggregates are currently defined. It is their contention that the money stock at present does not give a true and accurate picture of just how much U.S. citizens hold, versus the dollar holdings of foreign residents. As they explain, such an oversight can thwart the intended goals of the monetary authorities. This may be supported by a report that appeared in the Federal Reserve Bulletin of August 1971. It states that during 1971 there was a slowing of monetary growth. The only apparent and plausible explanation appears to be the outflow of U.S. currency into foreign exchange markets. This can be explained rather easily

1 Much of the first section of this paper is a review and discussion of the paper by A. Burger and A. Balbach, "Measurement of the Domestic Money Stock" in Federal Reserve Bank of St. Louis Review. (May, 1972), pages 10-23.
by assuming that the Federal Reserve was trying to pursue a policy of 5% annual money growth. During this time, money fell off of its 5% path and decreased through no apparent cause of the Federal Reserve. Dollars were flowing into foreign accounts.²

In some cases, as that above, dollars do flow out of the country; however, in more cases than one it is observed that the dollars do not leave the country. In such cases demand deposits of U.S. residents decline and demand deposits of foreign residents in U.S. banks increase. In this situation, dollars that were once held by U.S. residents and would have gone into the purchase of domestic goods and services, now lie in foreign accounts in U.S. banks. Of course, one should not assume that these balances lie idle, and for that matter, it could not be assumed that every dollar in these foreign accounts goes into the purchase of domestic goods and services. It might be that they are held solely for transactions in the exchange markets or other international financial markets. It is then easy and reasonable to assume that foreign deposits in the U.S. banks undergo different portfolio adjustments than do the deposits of residents.

Because of the importance of this phenomenon, Burger and Balbach have broken the money stock down into two components — foreign and domestic. It is their belief that the money stock does not reflect total spending in the United States because the foreign component has grown relatively larger over time. They state that "it may be that total spending responds not only to changes in money but also to changes in the proportion held by U.S. residents."\(^3\)

It is the purpose of this study to take this new approach and:

1. review the arguments of Burger and Balbach, presenting the separation of the money stock into two separate components, and

2. present and discuss how this new money stock series alters velocity and total spending as compared to the old money stock series.

CHAPTER II

REVIEW OF MEASUREMENT OF THE DOMESTIC MONEY STOCK

Let us begin by turning our attention to several elementary reasons why foreign deposits in U.S. banks should be considered with special interest. This will also lead us down an avenue of inquiry that may give us some insight into why the current measure of the money stock should be abandoned.

The importance of foreign deposits can be determined, in part, by the amount that they have grown and by the percentage of the current money stock that they constitute. Since 1971 through the second quarter of 1975, foreign demand deposits have risen by 98.51%, while over the same time foreign time deposits have risen by 143.83%. In July of 1975, foreign demand deposits constituted 4.15% of M₁ (currency and demand deposits held by the public). Foreign time deposits and demand deposits were 3.46% of M₂ (M₁ + time deposits) for July 1975. In December of 1974, foreign demand deposits were as much as 5% of M₁, and at this same time demand deposits were 4% of M₂.

As we have stated earlier, it is easy to imagine that foreign holders of dollars undertake different portfolio adjustments than do U.S. residents. For instance, they may hold demand deposits and time deposits for liquidity. They may then use these liquid assets to pur-
chase securities or to move into foreign exchange markets. This may depend on the interest rate differentials that appear in these markets. These dollars could also sit idle in these accounts, as contingency balances, to be used at a much later time.

Unfortunately, there is no way of knowing the volatility of these funds, or for that matter how long they are idle. It is important to note, however, that these accounts have steadily increased over the past years, and that the percentage of money stock that they constitute has increased.

In effect, we are saying that these dollar balances are not held by U.S. residents and do not, as a whole, go into the purchase of goods and services in the U.S. economy. These balances may flow dramatically into accounts of foreigners, as they did in 1969, 1970, and 1971, leading to a sharp reduction in the growth of the U.S. money supply.

What this emphasizes, then, is that total spending might depend not only on the growth in money, but also on the composition of the money stock - that held by U.S. residents versus that held by foreign residents. Foreign balances can be idle or volatile, but if they add nothing to total domestic spending on goods and services, why should they be counted in the money stock?

Even though foreign holdings are 5% of total $M_1$, which
appears not to be very sizeable, it is our concern whether this small amount is very important. In the October 1960 _Federal Reserve Bulletin_, it states:

> The amount of money in existence and changes in this amount influence the course of economic developments. For this reason, accurate measurements of the money supply and of changes in the supply are of great importance....

A 5% level of foreign holdings could have extremely significant effects on the level of total spending. If this is true, then the Federal Reserve System should seek to take measures to offset changes in foreign holdings and insure that there is an appropriate domestic money stock. This can best be emphasized by the following:

> The Federal Reserve System has primary responsibility for regulating the total volume of money available to meet the public's demand.

In order to obtain a better understanding of what effect international transactions have on the current money stock, let us review Albert Burger's and Anatol Balbach's article, specifically that section titled "Impact of International Transactions on the Current Money Stock."

This section begins by defining $M_1$ and $M_2$. "$M_1$ as currently defined includes domestic demand deposits, U.S.

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5Ibid.
commercial bank demand deposits due to foreign individuals, partnerships, corporations, commercial banks, central banks, and international institutions; deposits of U.S. branches of foreign banks, U.S. agencies of foreign banks, and Edge Act subsidiaries of domestic banks;⁶ and foreign deposits at the Federal Reserve."⁷ M₂ includes all of the above with the addition of domestic and foreign time deposits. It is easily observed, then, that foreign holdings of U.S. dollars appear in the money stock. It is this definition of money, which does not reflect domestic holdings of dollars, that concerns them.

In this light let us look at their discussion and observe what foreigners do with their dollars and the effect this has on the domestic money stock.

Foreigners may find themselves holding more dollars for several reasons. If U.S. imports increase relative to exports, they will have increased dollar holdings. Likewise, the same will occur if U.S. residents increased purchases of foreign assets. To understand what effect this circumstance will have on the money stock as currently defined, let us ask ourselves the question that Burger and

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Balbach asked: "What do foreigners do with the increased dollar banances?" They have five choices, which are as follows:

(1) increase purchases of U.S. goods and services

(2) increase deposits at U.S. banks or foreign branches of U.S. banks

(3) increase deposits at banks in their own country

(4) increase their deposits at branches of foreign banks in the United States

(5) increase their holdings of U.S. currency.  

If foreigners increase their purchases of U.S. goods and services with their increased dollars, then money is injected back into the hands of U.S. residents, and there is no change in the money stock.

Their second alternative would be to increase deposits at U.S. banks or foreign branches of U.S. banks. In this case, it is emphasized that demand deposits of foreign residents increase. As $M_1$ is currently defined, foreign holdings of dollars in demand deposits are included in the money stock. There is no change in $M_1$, just a matter of the composition from domestic demand deposits to foreign demand deposits.

The third case is perhaps the most difficult, so let us return to it immediately after the fourth case.

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8 Ibid., p. 12.
In the fourth case we observe that foreigners increase dollar deposits at branches of foreign banks inside the United States. If this occurs, money supply as currently defined will decrease. The dollar holdings of foreign branches of U.S. banks are not currently included in the money stock.

Now, let us consider the third case. Here we have foreigners increasing dollar deposits at banks in their own country. Thus, these foreign commercial banks have increasing deposits of dollars. What do they do with these dollar deposits? They have two alternatives:

(1) foreign commercial banks can increase dollar deposits at correspondent banks in the U.S.

(2) foreign commercial banks can sell these dollars to their central banks.

If foreign banks increase dollar deposits at correspondent banks in the United States we are moved back to the previous effects that occurred in case four—money supply will decrease. However, foreign commercial banks can increase dollar deposits at U.S. banks and their foreign branches.

Here, it can be observed that there is no change in the money stock. We have in effect the same situation that was presented in case two. Thus, domestic demand deposits fall and foreign demand deposits increase.

Let us return now to foreign commercial banks selling

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9 Ibid.
dollars to their central banks. What are the possible alternatives open to the central bank? What can they do with the dollars? They have four choices:

(1) increase dollar deposits at U.S. commercial banks

(2) increase dollar balances at the Federal Reserve

(3) increase dollar balances at the Federal Reserve and instruct the Fed. to purchase U.S. government securities for its (the central bank's) account.

(4) buy special non-marketable securities from the U.S. Treasury.  

Of these alternatives, if they choose (1), increase dollar deposits at U.S. commercial banks, it would be observed that there is no change in the money supply. If they choose to increase their dollar balances at the Federal Reserve, there will be no initial change in the money supply. However, this will decrease the reserve base since reserves held by the Fed in this form are not included in the monetary base equation. This, in effect, will decrease the money supply over time. There will not be, for instance, as many demand deposits in U.S. commercial banks.

A third alternative is for the central bank to instruct the Federal Reserve to buy U.S. government securities with its increased dollars for its account. This of course

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Ibid.
causes no change in the money supply because these dollars are now put back in the hands of U.S. residents.

The fourth alternative would be for the central bank to buy non-marketable securities from the U.S. Treasury. It is not clear at first glance whether these dollars now owned by the Treasury decrease the money supply or leave it unchanged. It is now the Treasury which must decide what it must do with the dollars. The Treasury has three choices:

(1) increase deposits at commercial banks.

(2) increase treasury deposits at the Federal Reserve.

(3) spend the dollars.\textsuperscript{11}

In the last case, where the Treasury spends the dollars, there is no change in the money stock. As with foreigners increasing purchases of U.S. goods and services, dollars in this case are put back into the hands of U.S. residents.

If the Treasury increases deposits at commercial banks, the money stock would decrease. This is because Treasury deposits in commercial banks are not included in the current measure of the money stock. Also, the Federal Reserve does not include these deposits by the

\textsuperscript{11}\textit{Ibid.}, p. 13.
U.S. Treasury in the reserve base.

Let us now turn our attention to foreign holdings of time deposits and certificates of deposit (CD's), which are included in $M_2$ and $M_3$ respectively. A good starting point for this would be to assume that a foreigner, instead of holding demand deposits or selling his dollars to the central bank, prefers to put his dollars into time deposits. With this action $M_4$, as currently defined will decrease and $M_2$, which includes demand deposits, will remain unchanged. Net time deposits have risen and time deposits held by foreigners have increased while demand deposits of U.S. residents have decreased.

Because reserves required against demand deposits are greater than reserves required against time deposits, reserves held by banks decrease.

If the foreigner wishes to hold his dollars in the form of CD's, then $M_1$ and $M_2$ would both decline, because neither of them includes large negotiable CD's of $100,000 or more. What will remain unchanged in this case is $M_3$ ($M_1 + M_2 + CD's$).

From what we have reviewed it is clear that the current definition of $M_1$ does not represent an accurate measure of total domestic holdings of $M_1$ and does not reflect outflows of dollars into foreign hands. "These
TABLE I
FLOW CHART OF FOREIGN HOLDINGS OF U.S. DOLLARS

<table>
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<th>U.S. imports increase relative to exports.</th>
<th>U.S. residents increase purchases of foreign assets.</th>
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<td>What do foreigners do with increased dollars?</td>
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<tr>
<td>Foreigners increase purchases of U.S. goods and services.</td>
<td>Foreigners increase deposits at branches of foreign banks in the U.S.</td>
</tr>
<tr>
<td>Money injected back into the hands of U.S. residents.</td>
<td>Foreigners increase deposits at branches of foreign banks in their own country.</td>
</tr>
<tr>
<td>No change in money stock.</td>
<td></td>
</tr>
<tr>
<td>Foreigners increase deposits at U.S. banks or foreign branches of U.S. banks.</td>
<td></td>
</tr>
<tr>
<td>Demand deposits of U.S. residents decrease; demand deposits of foreigners increase.</td>
<td>Foreign commercial banks do with dollar deposits?</td>
</tr>
<tr>
<td>No change in money stock.</td>
<td>They can sell these dollars to their central bank.</td>
</tr>
<tr>
<td>Foreign banks can increase dollar deposits at correspondent banks in the U.S.</td>
<td></td>
</tr>
<tr>
<td>If foreigners of foreign banks increase demand deposits at U.S. branches of foreign banks; money stock will decrease.</td>
<td>Demand deposits of U.S. residents at U.S. banks decrease; demand deposits of foreign banks at U.S. banks increase.</td>
</tr>
<tr>
<td>Money stock decreases.</td>
<td>No change in money stock.</td>
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(Table I cont'd.)

What does central bank do with dollars?

Increase dollar deposits at U.S. commercial banks.
No change in money stock.

Increase dollar balances in Fed.
No change initially in money stock. Money stock decreases; decrease in reserve bank.

No change in money stock.

Buy special non-marketable securities from U.S. Treasury.

What does treasury do with proceeds from sale of securities?

Increase Treasury deposits at commercial banks.
Money stock decreases.

Spend the proceeds.
No change in money stock.

Increase Treasury deposits at commercial bank.
Money stock decreases; decrease on Reserve bank.
transactions must be viewed as neutral in terms of their impact on the U.S. economy through money stock, as currently defined. It is also of considerable importance that dollars that are in demand deposits that flow to foreigners and are then converted to time deposits increase foreign time deposits, decrease domestic demand deposits, and produce an expansionary effect because of the lower reserves required on time deposits.

Domestic Money Stock

It is because of the above cases that Burger and Balbach feel that foreign holdings of time deposits and demand deposits should be excluded from the measurement of the money stock. For example, \( DM_1 \) (domestic money stock) should represent currency and demand deposits held by U.S. residents and should reflect dollar outflows. In the case where demand deposits of U.S. residents decreased and demand deposits of foreigners increased, it has been noted that money stock as currently defined does not change. However, measured outflows of U.S. dollars to foreigners which are then put in demand deposits and time deposits would produce changes in the revised money aggregates-\( DM_1 \) and \( DM_2 \). It should also be noted that if "foreign deposits at the Federal Reserve rise domestic

\[ \text{Ibid.} \]
money stock would decrease by the amount of the increase of foreign deposits at the Federal Reserve as well as by the effect of the decrease in the reserve base.\textsuperscript{13}

Construction of the Domestic Money Stock Series

To construct a domestic money stock series, it is necessary to sort out of the current money stock, domestic demand deposits, and domestic time deposits. It is necessary to know foreign demand deposits and foreign time deposits. This data is found in the Federal Reserve Bulletin table entitled "Short Term Liabilities to Foreigners Reported by Banks in the United States, by Type." "Assets and Liabilities of Large Commercial Banks" and "Member Bank Reserves, Federal Reserve Bank Credit and Related Items." These tables show foreign time deposits, foreign demand deposits, and foreign deposits at Federal Reserve Banks.

Burger and Balbach point out that transactions involving these accounts generate cash items in the process of collection (CIPC) the same as do domestic deposit transactions. "Therefore, if foreign deposits are removed from the money stock data, some estimate of the cash items arising from transactions in these accounts

\textsuperscript{13}Ibid., p. 14.
must be added back into the money stock data (CIPC, including foreign CIPC, are deducted from gross demand deposits)."\(^{14}\) If this adjustment is not made, biased estimates of the domestic money stock will result from foreign deposits transactions. However, data for CIPC resulting from foreign deposit transactions are not available. Therefore, Burger and Balbach estimate foreign CIPC in the following manner:

\[
\text{CIPCF} = \frac{(\text{DDF})}{(\text{DD}_{\text{LCB}})} \times (\text{CIPC}_{\text{LCB}})
\]

where

\begin{align*}
\text{CIPCF} & \text{ = foreign cash items in the process of collection resulting from transactions involving foreign demand deposit accounts} \\
\text{DDF} & \text{ = demand deposits due to foreigners at commercial banks, not including foreign demand deposits at the Federal Reserve} \\
\text{DD} & \text{ = all demand deposits reported by large commercial banks} \\
\text{CIPC} & \text{ = all cash items in the process of collection by large commercial banks.}
\end{align*}

In constructing DM\(_1\) and DM\(_2\), Burger and Balbach used not seasonally adjusted data for cash items in the process of collection and deposits. To arrive at a seasonally adjusted money stock series, domestic demand deposits and domestic time deposits were seasonally adjusted by them using the X-11 seasonal adjustment computer program.

\(^{14}\text{Ibid., p. 18.}\)
They computed seasonally adjusted domestic money stock by taking seasonally adjusted domestic demand deposits and adding them to seasonally adjusted currency component of the money stock. To obtain seasonally adjusted $DM_2$, $DM_1$ was added to seasonally adjusted net domestic time deposits. Their construction of the domestic money stock series is presented by the following:

Construction of Domestic Money Stock Series

**Domestic Money Stock** ($DM_1$)

- Demand Deposits Component of Money Stock (NSA)
- Less:
  - Foreign Demand Deposits (NSA)
- Plus:
  - Cash Items in process of Collection
  - Associated with Foreign Demand Deposits (NSA)
- Equals:
  - Domestic Demand Deposits (NSA)
- Plus:
  - Seasonal Adjustments by X-11 Program
- Equals:
  - Domestic Demand Deposits (SA)
- Plus:
  - Currency Component of Money Stock (SA)
- Equals:
  - Seasonally Adjusted Domestic Money ($DM_1$)

**Domestic Money Stock** ($DM_2$)

- Net Time Deposits (NSA)
- Less:
  - Net Foreign Time Deposits (NSA)
- Plus:
  - Seasonal Adjustment by X-11 Program
- Equals:
  - Seasonally Adjusted Net Domestic Time Deposits
- Plus:
  - Seasonally Adjusted $DM_1$
- Equals:
  - Seasonally Adjusted Domestic Money Stock ($DM_2$)\(^{15}\)

We have now reviewed the Burger-Balbach paper, their reasons why there should be a domestic money stock series, and the construction of such a series. At present there has been no published empirical work dealing with such a series as presented by them. In the following chapters we propose to set up and make an empirical test using their domestic money stock series.
CHAPTER III
STUDIES IN VELOCITY

In this chapter we will address the stability of velocity and the problem of forecasting nominal income. Velocity will be measured using Burger and Balbach's recommended changes in the definition of the money stock. We will begin this section by reviewing some of the early literature on velocity. We will then present a brief statement of Fisher's equation of exchange and velocity of transactions. Next we will cover the Cambridge formulation of the velocity of money. We will then review some recent empirical tests and theories concerning velocity. It will then be possible to present our empirical test, ideas about the stability of velocity, and how well domestic money stock predicts nominal income.

Let us first begin by discussing the concept of velocity. Velocity is given by the ratio of income to money stock \((Y/M)\); where \(Y\) is the income and \(M\) is the money stock. It is the number of transactions made per dollar in a year or the turnover rate of a dollar. For instance, if national income was six billion dollars per year and the money supply totaled two billion dollars, then velocity would be three. One dollar had to be turned over three times in
a year in order to generate a national income of six billion dollars.

Whereas, this is an elementary statement of velocity, it by no means is a simple concept, but has its own complexities as we shall see later. Velocity is also a subject which did not have its birth in recent years, but has developed over centuries, having its greatest theoretical formulation in this century.

Perhaps one of the first discussions of velocity appeared in Verbum Sapiente by Sir William Petty in 1664. In this work the idea is brought forth that only a small amount of money is needed to support a large volume of trade. Although, he never spoke of the word velocity, per se, it is noted that he felt that money "completes a circular course." 16

Others throughout the 18th and 19th centuries spoke of the circulation of money. Some of these are John Locke and Richard Cantillon, "regarded to be the founder of the velocity of circulation," 17 and whose ideas are most like Petty's.

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17 Ibid., p. 505.
In the early part of this century Irving Fisher developed the "equation of exchange" which expresses his Quantity Theory of Money. In this theory Fisher relates total spending in the economy to the money stock to obtain the circulation of money. By multiplying the price of a commodity by the total quantity of the commodity sold, one would have the total expenditures for that commodity. By multiplying all commodities sold by their respective prices and then summing over them, one would then have the total expenditure for all commodities. This can be stated best by the following equation:

\[ p_1q_1 + p_2q_2 + p_3q_3 + \ldots + p_nq_n = \frac{\sum_{i=1}^{n} p_iq_i}{M} = P \times Q \]

where \( p_1 \) is the respective price of good \( q_1 \) and \( q_1 \) is the total of that good sold. \( P \) and \( Q \) are the average price and quantity of all goods sold. If \( P \times Q \) (expenditures for goods and services) is then divided by the money stock, the result will be the turnover of money exchanged for these goods. This is

\[ V = \frac{P \times Q}{M} \]

where \( V \) is the velocity of transactions and \( M \) is the money stock. It represents the number of times a dollar must be exchanged in the economy to support the total purchase of goods and services, given the money stock.\(^{18}\)

The amount of money needed to support the volume of transactions is smaller than total expenditures. This observation can be made by comparing data for GNP and the money stock. Thus, a small volume of money can meet the desires of people in purchasing goods and services.

Fisher assumed that velocity and quantities bought were fixed—not that they could change over time, but that they were institutional factors which went through slow or gradual change. Given that the stock of money could be increased or decreased, Fisher had an equation which could explain price movements. If money were to increase with no change in velocity or quantity, then prices would increase. Thus, prices respond directly to changes in money and velocity, and inversely to quantity.19

Another version of the above was proposed by the "Cambridge" economists. This included such men as Alfred Marshall and A. C. Pigou. Their theory stresses that money serves in making transactions easier. Because of this, money yields satisfaction or utility. For example, if all of one's money balances could be placed into interest earning assets and could be converted back into money immediately upon request, money balances would be zero. However, such a world does not exist. Transaction costs

19Ibid., pp. 165-167.
of converting the interest earning asset back into money may be large enough to wipe out any short term yield, and thus, holding money may present to a person a higher yield than the interest earning asset. Because of transaction cost of changing interest earning assets into money and the need for money for transactions at unforeseen times, individuals will hold part of their income in the form of money. Thus, the Cambridge equation for money demand is:

\[ M_d = k \cdot Y = k \cdot P \cdot O \]

which states that money demand varies proportionately with money income. In this equation:

- \( M_d \) = the quantity of money demanded
- \( k \) = the proportionality factor
- \( Y \) = the level of money income
- \( P \) = the index of the general price level
- \( O \) = index of real output in the economy.

The quantity of money demanded equals the quantity of money supplied:

\[ M_d = M_s \]

The proportionality factor "k" is very much like the "V" term (velocity) in Fisher's equation. K is similar to \( 1/v \), however, they are not equal to each other. Fisher's formulation can be equated with the Cambridge formulation in the following manner:

\[ M \cdot V' = P \cdot Q' \]

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20 Ibid., pp. 168 - 172.
\[ Q' = \text{the level of real output} \quad (Q' < Q) \]
\[ V' = \text{the income velocity of circulation} \]

\( Q' \) is equal to 0 in the Cambridge formulation, and \( k \) is equal to \( 1/V' \), thus
\[ M = kY = k \cdot P \cdot Q = 1/V' \cdot P \cdot Q'. \]

We now have the amount of money which will support a level of real output in the economy. The reciprocal of \( k \) is the income velocity of money and represents the rate of turnover of a dollar spent for the purchase of goods and services in the economy.\(^{21}\)

With this brief presentation and explanation of velocity, it appears that this set of equations is a mere tautology. However, it is not. For instance, if velocity is stable, it will be possible to predict nominal income from the quantity of money. However, for some money aggregates such as \( M_1 \) (currency plus demand deposits), velocity has been unstable, and has shown an unexplained rise since World War II. This makes \( M_1 \) an unpopular money aggregate for forecasting nominal income.

Richard Selden, Milton Friedman, and others have addressed the question of this rise in the velocity of \( M_1 \) in their works in respective order The Postwar Rise \(^{21}\)Ibid., pp. 169-170.
in the Velocity of Money and A Monetary History of the United States, 1867-1960. With an understanding of the velocity for $M_1$ has risen, it may be possible to forecast nominal income with this money aggregate.

In his book, Richard Selden set out to achieve two objectives: "to explain the upward trend in velocity since 1946 and to develop a sectoral approach to velocity analysis."22 By using variables such as interest rates, real income per capita, yields on money substitutes, and relating them to velocity, an attempt could be made to explain its upward trend. He notes that for the latter years of his test the regression equations performed poorly in explaining velocity.23

In the second approach Selden analyzed velocity by economic sectors. For instance, he looked at the behavior of velocity in geographic regions, industry groups and divisions, and corporate sectors. In his analysis he found in general that all sectors had an increasing velocity with the increase being much more significant in certain ones. In this analysis he emphasizes that there is no reason to expect that the same variables determine

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23Ibid., p. 486.
velocity for all sectors; "the level of real income may be decisive for one yields on money substitutes for another." 24 Changes in expectations for some sectors may be much more frequent and profound, also. 25

The conclusion that Selden reached in his analysis was that it is not possible to explain fully the postwar rise in velocity. An important finding, however, was that "the cost of holding money as determinant of these velocity differences according to size is suggested." 26 That is, of course, the size of the industry or sector in question.

A paper by H. A. Latane in 1954 proposed an explanation of stability and postwar rise in velocity. He found as did others that "the rise in yields on alternative assets, by inducing holders of money to economize on money balances was the major factor accounting for the postwar rise in velocity." 27

Milton Friedman contends that this view has a serious defect in that it explains too much. He feels that if

24 Ibid.
25 Ibid.
26 Ibid., p. 531.
interest rates can explain the later postwar rise they should also explain the early postwar rise. The explanation for the early postwar rise is just a matter of recovery from low wartime levels. Interest rates do not account for this early rise. Thus, "the interest rate explanation is superfluous." 28

A point suggested by R. A. Gordon in a 1950 paper was that velocity should be studied more closely by using private expenditures. This would exclude government spending. The justifications for this are two fold:

1) the money supply does not include government holdings and

2) an increase in government spending might crowd out private consumption.

The first case will give biased estimates of velocity and the second will result in a constant or increasing velocity with private consumption crowded out. Thus, velocity, using only private expenditures, would be lower than if government expenditures were included. 29

A test was made using Gordon's principles to explain the postwar behavior of velocity. In this test private expenditures were used instead of Gross National Product


and Net National Product. In another test private expenditures plus tax payments to the government were used. The final results, however, added little in explaining the postwar rise in velocity.\textsuperscript{30}

A study by J. P. Gould, M. H. Miller, C. R. Nelson, and C. W. Upton tested to see if the random walk hypothesis in velocity continued for updated data as it did in earlier test in a paper by Gould and Nelson. The results were positive and a random walk model was used up to 1973. These results showed that from 1869 to 1950 changes in velocity were independent of changes in the money stock. "Changes in velocity amplified rather than offset changes in the rate of growth of money."\textsuperscript{31} From 1950 to 1973 the results are different. "There is a tendency for changes in velocity to offset changes in money."\textsuperscript{32}

A recent paper by Leonall C. Andersen, "Selection

\textsuperscript{30} Tom Wyrick, "Federal Fiscal Expenditures and the Determination of the Income Velocity of Money: An Exploratory Essay," (1975, This is a paper presented in a Monetary Theory seminar class.) p. 1-17.


\textsuperscript{32} Ibid.
of a Monetary Aggregate for Economic Stabilization," discusses which method and which monetary aggregate best predicts nominal income. The monetary aggregate which has the smallest error in predicting nominal income is the one which is generally chosen and thus, has the most predictability.

Andersen uses two approaches, which will be applied later in this paper. The first is an examination of the ratio of GNP to the monetary aggregate in question. This provides information about the stabilities of income velocities for different aggregates. The aggregate with the smallest variability (greatest stability) in its income velocity is the one which is expected to forecast GNP with the smallest error. This is the "indirect approach."

The second approach, which is the direct forecasting method, uses a model of nominal income determination. By this method the monetary aggregate that forecasts nominal income with the smallest error is the best aggregate to choose.

Andersen examines Milton Friedman's indirect approach. Friedman feels that $M_2$ ($M_1$ plus time deposits) should be chosen as a more viable predictor of nominal income because of its relative stability over time. He rejects the use of $M_1$ because of its upward trend over
the past 25 years. He asserts that using $M_1$ for judging desired monetary growth would require forecasting its secular growth in velocity. He says that there is no suitable means at present for doing this. The velocity of $M_2$ is less variable over short periods and over long periods of time. This makes it safe, in Friedman's opinion, to specify monetary objectives in terms of $M_2$ than $M_1$.

Andersen proceeds by examining seven measures of velocity for seven monetary aggregates and observes their long run and short run variability.

His measurements of the variability of a time series are the standard deviation and the coefficient of variation. "The larger the value of these measures, the greater is the variability of this particular series."\textsuperscript{33}

In his test for long run variability (1952-1973) it was found that $V_{mb}$ (velocity of the monetary base) and $V_1$ (velocity of $M_1$) had by far the greatest variability for the whole period. $V_6$ (velocity of $M_6$, defined in the following paragraph) had the smallest. After a break in trend $V_2$ (velocity of $M_2$) had the smallest long run variability.

It has been argued by many that the monetary aggregate with the least variability over the sample period chosen would best forecast nominal income with the smallest error. Andersen asserts that if this is to be taken as true, then the best monetary aggregate to use in forecasting income would be $M_6$. $M_6$ consists of:

- total liquid assets plus large, negotiable certificates of deposits, commercial paper, savings bonds, short term U. S. Government securities and credit union shares.\textsuperscript{34}

This income velocity is the most stable showing the least variability of all money aggregates.

As has been stated, $M_1$ and the monetary base would be expected to predict nominal income with the greatest amount of error, "since substantial break occurred in their trends of velocity and they have the largest long run variability in velocity."\textsuperscript{35}

Looking further into Andersen's analysis, he argues that using $M_2$ to forecast GNP because of its greater stability (according to Friedman) is not justified. The changes in magnitude of the growth of velocity of $M_1$, and $M_2$ are almost identical. According to Andersen, the velocity of $M_2$ is subject to as much uncertainty as the velocity of $M_1$. Thus, we can assume that both forecast

\textsuperscript{34} Ibid., p. 9.
\textsuperscript{35} Ibid., p. 12.
velocity with the same degree of error. Further, he states that just because a monetary aggregate is relatively stable and has a small variability, it does not indicate that we can assume that it will forecast nominal income with the smallest error. He concludes that "high variability does not preclude predictability."

Of course, using the concept of velocity and the velocity series of the monetary aggregate which possesses the greatest stability is of great use in predicting nominal income. However, Andersen has tried another approach to see which monetary aggregate best forecast nominal income. This method as we have stated is termed the "direct forecasting approach," based on his model of nominal income determination.

We will not discuss this model in any depth at present, but will in the next chapter when we apply such a model to the domestic money stock series.

The Andersen analysis concluded that the monetary aggregate which predicted nominal income with the least error is the monetary base. This was also the monetary aggregate with the greatest variability and least stability.  

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36 Ibid., p. 13.
37 Ibid., pp. 9-15.
In conclusion, we have reviewed some early theories and have shown some of the major developments in velocity. We then presented several papers discussing the unexplained rise in the velocity of \( M_1 \) since World War II. By explaining this rise in the velocity of \( M_1 \), it might have been possible through the indirect forecasting approach to predict nominal income with this aggregate. Another method, termed the direct forecasting approach, was applied by Andersen, who found that because the velocity of a money aggregate is highly variable or rising, it by no means should be excluded from forecasting models.

In the following chapter we will apply the analysis of this section of the paper and examine the variability of \( DM_1 \) against \( M_1 \). We will be concerned basically with the Andersen analysis, since it encompasses a discussion of the variability of velocity and forecasting analysis.
CHAPTER IV

EMPIRICAL ANALYSIS

In this chapter we will observe the stability and variability of the velocity of $\text{DM}_1$ (domestic money stock) and $M_1$ and determine which measure is the most stable and least variable. We will then show by using Andersen's theory of "nominal income determination" which aggregate, $M_1$ or $\text{DM}_1$, will forecast nominal GNP with the least error.

By showing the variability of the velocity of these two aggregates, we will be able to report which money aggregate, $M_1$ or $\text{DM}_1$, Friedman would choose to obtain a more accurate forecast of nominal GNP. This, as Andersen calls it, is the indirect forecasting method. It is not definite, however, whether the money aggregate which has the most stable and least variable velocity will forecast nominal GNP with the least error. Our empirical studies in this chapter will point out which aggregate will

forecast nominal GNP with the least error by using the Andersen theory.

Let us begin by stating that even if we knew that one velocity series for the chosen aggregate is more stable or less variable than another, this in itself tells us very little. What we would wish to do is to choose some money aggregate which would predict nominal GNP with the least error. If we chose as Friedman did to take that aggregate with the least variability and greatest stability and relied on this one to forecast nominal GNP, we may be in grave error. We will thus, for the remainder of this paper, follow along in much the same way which Andersen did in his paper "Selection of a Monetary Aggregate for Economic Stabilization" and examine which money aggregate, M₁ or DM₁, will best forecast nominal GNP by using the Friedman method (indirect approach) and Andersen's method (direct forecasting approach).

By examining the graph of income velocities on the following page, where DM₁ is the velocity of the domestic money stock and M₁ is the velocity of M₁, it can be observed that the long run variability of both of these measure over the period 1960 to 1974 had upward trends through the fourth quarter 1966. A break occurred the quarter immediately following with not as a pronounced
growth through the fourth quarter 1974. The trend in the growth rate for $M_1$ went from a 3.19 percent annual rate for 1966 to 1966 to a 1.80 percent annual rate for 1967 to 1974. For $DM_1$ we can observe an average growth of 3.21 percent annual rate to an average of 2.49 percent annual rate for the same periods, respectively, as $M_1$. (Table 2)

By using the standard deviation and the coefficient of variation, which is the ratio of the standard deviation to the mean, we have two measures of the variability of a time series. By comparing these two statistical measures for each money aggregate, respectively, we will be able to observe which one has the greatest variability. The greater the variability of the velocity series, the larger the values are of this measure.

Table 3 looks at these measures for the long run variabilities of the aggregates. It is observed that both have about the same stability and little difference in variation.

The conclusions which we can draw from this analysis is that $M_1$ would be expected to forecast nominal GNP with the least error because of the smaller variability of its velocity relative to $DM_1$. However, as Andersen states this is a short cut method in determining which aggregate will forecast best. It can be seen that since the variability of the aggregates are so similar that
TABLE 2

VELOCITY GROWTH
(Compounded Annual Rates of Change)

<table>
<thead>
<tr>
<th>Velocity</th>
<th>I/1960-IV/1974</th>
<th>Sub-period One</th>
<th>Sub-period Two</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dates</td>
<td>Growth</td>
<td>Dates</td>
</tr>
<tr>
<td>$M_1$</td>
<td>2.45 I/60-IV/66</td>
<td>3.19 I/67-IV/74</td>
<td>1.806</td>
</tr>
<tr>
<td>$DM_1$</td>
<td>2.83 I/60-IV/66</td>
<td>3.21 I/67-IV/74</td>
<td>2.498</td>
</tr>
<tr>
<td></td>
<td>1960-1974</td>
<td>Sub-period One</td>
<td>Sub-period Two</td>
</tr>
<tr>
<td>----------------</td>
<td>-----------</td>
<td>----------------</td>
<td>----------------</td>
</tr>
<tr>
<td></td>
<td>Standard</td>
<td>Coefficient</td>
<td>Standard</td>
</tr>
<tr>
<td></td>
<td>Deviation</td>
<td>of Variation</td>
<td>Deviation</td>
</tr>
<tr>
<td>$M_1$</td>
<td>0.470</td>
<td>0.110</td>
<td>0.272</td>
</tr>
<tr>
<td>$DM_1$</td>
<td>0.475</td>
<td>0.110</td>
<td>0.272</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.224</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.225</td>
</tr>
</tbody>
</table>
the test is inconclusive. $\text{DM}_1$ might forecast nominal GNP as well as $M_1$.

In order to discover which money aggregate will best forecast nominal GNP with the least error, it is necessary that we employ Andersen's direct forecasting approach. His monetary model of nominal income determination will be implemented to determine whether $M_1$ or $\text{DM}_1$ will forecast the best. As Andersen states it "the basic feature of the model is that the change in the rate of change in nominal spending by households and business firms for newly produced goods and services is postulated to respond to the discrepancy between the rates of change in actual and desired nominal money balances."\(^{39}\) The empirical form of the model consists of the following equations:

1) $\Delta \ln \frac{Y^d_t}{Y^d_{t-1}} = b_0 + b_1 \Delta \ln M_t + b_2 i^{\frac{3}{2}} w_i \Delta \ln Y^d_{t-i} + b_3 \Delta \ln r_t + b_4 D_1 + b_5 D_2 + \varepsilon_t$

2) $\Delta \ln Y_t = W(t) \Delta \ln \frac{Y^d_t}{Y^d_t} + (1-W(t)) \Delta \ln Z_t$

3) $W_t = \frac{(1-\delta)Y^d_t}{Y^d_t} = \text{in which } \delta \text{ is the average ratio of imports to } Y^d + Z \text{ in sample period.}$

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\[ \Delta \ln \gamma^d_t - \Delta \ln \gamma^d_{t-1} = \text{change in the rate of change in spending by households and business firms for product (measured by consumption plus investment).} \]

\[ b_0 = \text{response of spending by households and business firms to average rate of change in technical efficiency of the payments system.} \]

\[ \Delta \ln M_t = \text{rate of change in a monetary aggregate.} \]

\[ \xi = \sum_{i=1}^{\xi} w_i \Delta \ln Y_{t-i} = \text{weighted sum of past rates of change in nominal income (measured by nominal GNP).} \]

\[ \Delta \ln r_t = \text{rate of change in nominal short-term interest rate (measured by the 4-6 months commercial paper rate).} \]

\[ \Delta \ln Y_t = \text{rate of change in nominal income (measured by nominal GNP).} \]

\[ D_1 = \text{zero-one dummy variable for major strikes. One in 1959-II, 1964-IV and 1970-IV.} \]

\[ D_2 = \text{zero-one dummy variable. One in quarter following a major strike.} \]

\[ \varepsilon_t = \text{a random error term.} \]

\[ \Delta \ln Z_t = \text{rate of change in government spending plus foreign spending on domestic product (measured by National Income accounts for total government purchases of goods and services plus exports.} \]

\[ \delta = \text{average ratio of imports to} \gamma^d + Z \text{ in sample.} \]

\[ ^{40} \text{iBid., p. 13.} \]
Equation (1) is estimated by using ordinary least squares for each monetary aggregate $M_1$ and $DM_1$. The parameters are estimated from the beginning of the sample period, third quarter 1959 to the fourth quarter 1968. They are then re-estimated by extending the sample period by four quarters until fourth quarter 1974 for each monetary aggregate. (See Table 4.)

Dynamic simulations are then conducted using the complete model. Actual values of government spending and exports are used and the $4\ln Y$ term is generated within the model.

These simulation exercises are conducted in order to discover which of these two monetary aggregates forecast nominal GNP with greater efficiency on a comparative basis. Forecasts are made for four, eight, and twelve quarters. The forecast error is determined by the difference between the predicted and the actual levels of GNP as a percent of actual GNP for four, eight, and twelve quarters.

For the fourth quarter, eighth quarter, and twelfth quarter forecast errors were calculated by using the root-mean-squared error (RMSE) and the maximum error (ME). The aggregate which possesses the smallest RMSE forecasts the best, on average, level of GNP. "The aggregate with
# TABLE 4

**ESTIMATED REGRESSION COEFFICIENTS III/59-IV/74**

<table>
<thead>
<tr>
<th></th>
<th>Constant</th>
<th>$D_1$</th>
<th>$D_2$</th>
<th>$\Delta \ln M_t$</th>
<th>$\Delta \ln Y_{t-1}$</th>
<th>$\Delta \ln Y_{t-2}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$M_1$</td>
<td>0.00733</td>
<td>0.01923*</td>
<td>0.00133</td>
<td>0.73049*</td>
<td>-0.96583*</td>
<td>-0.27369</td>
</tr>
<tr>
<td>$DM_1$</td>
<td>0.00769</td>
<td>0.01855*</td>
<td>0.00275</td>
<td>0.6925*</td>
<td>-0.96079*</td>
<td>-0.26726</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>$\Delta \ln Y_{t-3}$</th>
<th>$\Delta \ln Y_{t-4}$</th>
<th>$R^2$</th>
<th>D.W.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$M_1$</td>
<td>0.23262</td>
<td>0.10848</td>
<td>0.5262</td>
<td>1.6629</td>
</tr>
<tr>
<td>$DM_1$</td>
<td>0.22352</td>
<td>0.11491</td>
<td>0.5075</td>
<td>1.6629</td>
</tr>
</tbody>
</table>

* Coefficient is significant at 5% level.
the smallest maximum error is the best if avoidance of large forecasting errors is desired."\textsuperscript{41} (Table 5)

From these tests it can be observed that no final conclusion can be reached as to which monetary aggregate predicts nominal GNP with the least error. Our variability test of the two monetary aggregates also revealed little if anything concerning which aggregate predicted best, also.

Let us discuss just momentarily why such conclusions might be reached. In a conversation with Mr. Burger at the St. Louis Federal Reserve the point was brought out by him that it may be difficult to test the domestic money stock against $M_1$ because of their similarities in movement over time. This can easily be observed by reviewing the graph on velocity. It is also obvious with our results. This appears to be the principle reason for these inconclusive results.

\textsuperscript{41}\textit{Ibid.}, p. 15.
TABLE 5

ERRORS IN SIMULATED LEVEL OF GNP

<table>
<thead>
<tr>
<th></th>
<th>M₁</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4 qt.</td>
<td>8 qt.</td>
<td>12 qt.</td>
</tr>
<tr>
<td>Max. Error</td>
<td>29.17</td>
<td>29.17</td>
<td>29.17</td>
</tr>
<tr>
<td>RMSE</td>
<td>11.03</td>
<td>11.03</td>
<td>11.03</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>DM₁</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4 qt.</td>
<td>8 qt.</td>
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<td>29.17</td>
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</tr>
<tr>
<td>RMSE</td>
<td>11.03</td>
<td>11.03</td>
<td>11.03</td>
</tr>
</tbody>
</table>
CHAPTER V

CONCLUDING REMARKS

It has been the purpose of this paper to examine and discuss the concept of the domestic money stock as proposed by Albert Burger and Anatol Balbach, then to pursue their analysis and put it in a frame of reference of how it can better explain the growth in velocity against $M_1$.

By examining the literature on velocity and gaining an understanding of this concept we were able to apply Leonall Andersen's analysis to test how much difference there was between the growth rate in $M_1$ and $DM_1$. The difference was negligible. Then we tested to see if $M_1$ would predict nominal GNP better than $DM_1$ again using Andersen's approach. Both predicted nominal GNP with the same degree of error.
BIBLIOGRAPHY


VITA

Johnny Scott Greene, son of Mr. and Mrs. Roland C. Greene, Sr., was born on June 10, 1951 in Portsmouth, Virginia. He attended Cypress Elementary School in Nansemond County, Virginia and high school at Forest Glen High School from which he graduated on June 6, 1969. He received a Bachelor of Arts degree in Philosophy with a minor in English from Virginia Polytechnic Institute and State University, Blacksburg, Virginia in June, 1973. He re-entered Virginia Polytechnic Institute and State University in September 1973 and began working toward a Master of Arts degree in Economics.

J. Scott Greene
PREDICTING NOMINAL GNP AND TESTING

THE VARIABILITY OF THE DOMESTIC MONEY STOCK AGAINST $M_1$

by

Scott Greene

(Abstract)

A proposal was made by Albert Burger and Anatol Balbach to measure the money stock by excluding foreign holdings of U. S. dollars. This measure termed "domestic money stock" was tested against $M_1$ to observe which was the least variable and which would predict GNP with the least error. The test were conducted by using Leonall Andersen's "monetary model of nominal income determination." The final results showed that due to the closeness in the percentage change of the two measures of the money stock, that little if any of the two measures had different values for variability, and both predicted nominal GNP with the same error.