WORKING PAPER SERIES

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Working Paper 1981-009A
http://research.stlouisfed.org/wp/1981/1981-009.pdf

1981

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81-009

*Our thanks go to Courtenay C. Stone, Michael David Bordo, Adam Gifford Jr., Donald Hooks, Roy Kinney, and Jora Minasian for their helpful comments. We acknowledge the staff of the Research Department of the Federal Reserve Bank of St. Louis for the use of their facilities during work on this paper. All conclusions, opinions, and errors contained in this paper are those of the authors.

THE LIQUIDITY EFFECT: CHANGES IN THE GROWTH RATE OF MONEY AND THE EX ANTE REAL RATE OF INTEREST*

by
W. W. Brown and G. J. Santoni

I. Introduction

One of the most widespread and firmly held beliefs amongst economists is that changes in the rate of monetary growth produce opposite, albeit temporary, changes in the nominal rate of interest. Since the expected rate of inflation is initially assumed to be either unchanged (due to the public's inability to correctly perceive the change in monetary growth) or moves in the same direction as the change in monetary growth, the conclusion generally reached is that changes in the rate of money growth produce opposite changes in the *ex ante real* rate of interest, at least temporarily.

It is somewhat puzzling that this belief should have become so widely accepted. There is little theoretical support for it and alternative interpretations of the empirical evidence are readily suggested. The purpose of this paper is to examine the validity of this purported relationship between money growth and the ex ante real rate of interest. The theoretical foundations are examined in part II.

In part III, empirical tests of the relationship are reported. The results demonstrate that there is virtually no support for the proposition that the ex ante real rate of interest is influenced, even in the short run, by changes in the rate of money growth. Claims to the contrary remain basically unsubstantiated.

II. Theoretical Considerations: The "Liquidity Effect."

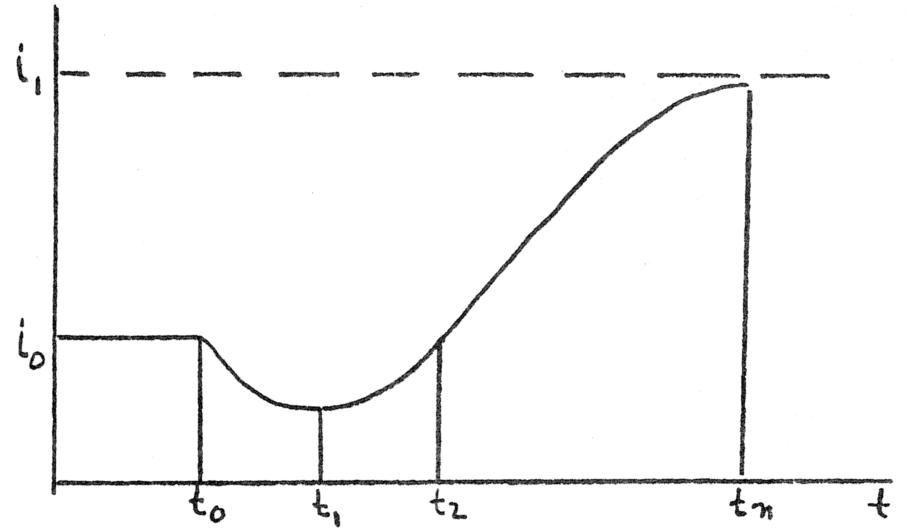
Changes in the growth rate of money are alleged to have a "liquidity effect" on the ex ante real rate of interest.[1/] The roots of the theory run deep.[2/] In developing the theoretical argument, it is typically assumed that "the first round effects of money creation are ignored...In addition to money, there is one uniform security which is the vehicle for all borrowing and lending...investment expenditures are financed by current borrowing... and encompass the total demand for loanable funds. The total supply comprises lending by households, which is derived from two sources: from saving part of current income to add to wealth and from transferring money into securities..."[3/]

The typical argument runs as follows. An increase in the rate of change in the stock of money results initially in an excess supply in the money market at the existing nominal rate of interest. A portion of this excess flows into the loanable funds market bidding up the price of securities and pushing nominal yields down to the level necessary to clear this market. The money market, however, continues to be characterized by excess supply (though not as large as initially) since only a portion of the additional money entered the market for loanable funds. The downward movement of yields in the loanable funds market results in a downward movement in the ex ante real rate of interest with the result that real investment demand is stimulated and real saving out of current income is reduced. The difference is made up by "the flow of funds supplied out of the discrepancy between actual and desired money balances..."[4/] The contention is that real investment rises, stimulating economic activity. After a time (roughly six months), these effects reverse themselves with the result that the ex ante real interest rate returns to its original level.

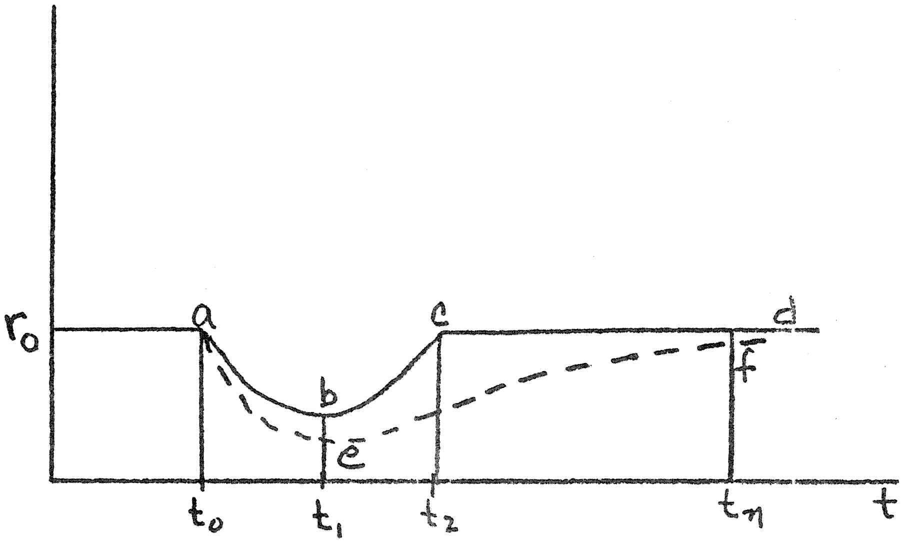
Figure 1 depicts the hypothesized time path of the liquidity effect on the nominal rate of interest, i (Panel A), and ex ante real rate of interest, r (Panel B), which results from a permanent increase in the monetary growth rate that occurs in month t_0. The liquidity effect reduces both the nominal and ex ante real rate

Figure 1

Panel A: Time Path of the Nominal Rate



Panel B: Time Path of the Real Rate



of interest. These decline for a period of $(t_1 - t_0)$ months, after which time the <u>nominal</u> rate reverses direction and begins rising. After $(t_2 - t_0)$ months, the <u>nominal</u> rate of interest passes through its original level and converges upon a new higher level consistent with the higher rate of price change induced by the monetary expansion. The convergence upon the new level occurs after a period of $(t_n - t_0)$ months.[5/]

The hypothesized time path of the ex ante real rate of interest is less clear. The path may follow the line abcd or aef or some intermediate path. The movement of the ex ante real rate follows from Fisher's theory of the nominal rate of interest (summarized in equation 1), the time path of the nominal rate (shown in panel A), and the assumptions one makes regarding the adjustment of price expectations, P_e.

(1) $i = r + P_e$

If price expectations do not begin adjusting until t_2, the second term on the right side of equation (1) is zero over the interval $t_0 - t_2$ and the implied path of r is given by abcd. In this case, the time path of r mirrors the time path of i over this interval. If, on the other hand, price expectations begin adjusting immediately, the second term on the right of (1) is positive throughout the interval $t_0 - t_n$. The implied path of r, given the path of the nominal rate, is a path like aef.

Of course, if price expectations were to adjust perfectly at t_0 to the change in the monetary growth rate, the nominal rate of interest would immediately rise to i_1, leaving r unchanged. This possibility is ruled out, however, since the nominal rate of interest apparently follows a path similar to that shown in panel A of figure 1.[6/]

The liquidity effect concerns, the specific channel(s) through which monetary policy operates. At the heart of the analysis is the implication that changes in the monetary growth rate cause a short run shift in the demand for capital assets relative to the demand for flows of present services. Accordingly, relative prices are systematically altered and this is reflected by variation in the ex ante real rate of interest.

Some Theoretical Reservations

One of the more forceful exceptions to the liquidity effect was expressed by Frank Knight in an article which appeared in 1941.

> The rate of interest in its normal aspect as the rate of return on investment is the ratio between two value magnitudes, income and wealth. A change in the unit of value can effect this ratio only as it affects one of its terms more than it affects the other. Of course if created money is used exclusively to buy bonds, or even to construct equipment, it can temporarily raise the relative price which the principle, or source, will yield. Such an occurance is a temporary disturbance only...(A)t equilibrium any relative price will be the same as before the monetary disturbance occurred--...For the interest rate, the controlling cause is the income-cost of producing capital goods, per unit of expected income-yield."[7/]

The crucial point is that the impact, if any, of increased monetary growth on the ex ante real rate of interest is a consequence of the types of goods purchased as a result of the faster money growth. According to Frank Knight, the theoretical impact of the liquidity effect is ambiguous. The ex ante real rate of interest may rise, fall or remain unchanged depending upon whether the new money is spent on services flows, sources of flows (capital goods) or both. Certainly, the temporary impact, if any, will be reflected by changes in the prices of service flows relative to the prices of capital goods. This particular implication is one of those examined in section III.

The argument regarding the existence of a liquidity effect is confusing in several respects. At a very intuitive level, a systematic lagged relationship between changes in the growth rate of money and the interest rate implies that potential profits are left unexploited by market participants. Arguments regarding the existence of the liquidity effect provide no explanation indicating why profit-seeking activity does not eliminate the hypothesized pattern in the interest rate. Indeed, the hypothesized reaction of the interest rate to a change in the monetary growth rate is inconsistent with the substantial evidence relating to the existence of efficient markets. Further, the first round effects of money creation are specifically ruled out. Yet these are precisely the effects that would be expected to alter the real rate of interest, though the impact can not be unambiguously predicted.

A more basic criticism of the liquidity effect turns on the fundamental behavior underlying saving and investing. Investment is the act of converting present flows of income into goods productive of future flows of income. Saving, on the other hand, is the act of forgoing consumption of present flows of income to provide the raw material for the investment process. It is not possible to produce goods which yield future income flows (invest) without forgoing present consumption (saving).

Canned peaches, which yield future consumption benefits, can not be produced without foregoing the consumption of fresh peaches. It is not possible to invest in wine without saving present grapes, nor invest in cheese without saving milk.

The theoretical analysis underpinning the liquidity effect, however, appears to suggest that money can serve as the basis for investment. This is particularly explicit in Cagan's equations (3) and (4) which he calls the "heart of the model."[8/] These equations reduce to

$$\frac{I - S}{Y} = C\left[\frac{M^S - M^D}{M^D}\right]$$

which states that the excess of real investment over real saving expressed as a fraction of real income is proportional (C) to the excess supply of nominal money balances expressed as a fraction of nominal money demand. That is, the "excess of investment over saving is financed by the lending of undesired money holdings."[9/]

If it were somehow possible to finance additional real investment by creating additional nominal units of money, real present wealth could be increased indefinitely--surely a curious result. If true, money not only matters, <u>it solves the problem of scarcity</u>.

As noted, the real rate of interest is reflected in the <u>relative</u> price of present consumer goods in terms of the present price of capital goods. It makes little sense to talk about a change in the interest rate without reference to a corresponding change in this <u>relative</u> price. Friedman explicitly introduces a discussion of the movement in relative prices (and demands) in his treatment of the liquidity effect. Given an increase in the rate of change in the money supply, Friedman argues...

> From a longer-term view, the new balance sheet (of the public) is out of equilibrium, with cash being temporarily high relative to other assets. Holders of cash will seek to purchase assets to achieve a desired structure. This will

> bid up the prices of assets...These effects can be described as operating on "interest rates," if a more cosmopolitan interpretation of "interest rates" is adopted than the usual one which refers to a small range of marketable securities. The key feature of this process is that it tends to raise the prices of sources of both producer and consumer services relative to the prices of the services themselves...It therefore encourages the production of such sources (this is the stimulus to "investment"...) and, at the same time, the direct acquisition of services rather than of the source (this is the stimulus to "consumption" relative to "saving"). But these reactions in there turn tend to raise the prices of services relative to the prices of sources, this is to undo the initial effect (our emphasis) on interest rates...Of course, all these forces operate simultaneously (our emphasis) and there are ebbs and flows and not merely movement in one direction.[10]

The above quote raises several problems that are worth considering. If individuals find they are holding too much cash relative to the sources of services after an increase in the growth rate of money, they will also find they are holding too much cash relative to the flow of services themselves. The money demands for both the sources of services (capital goods) and the services themselves (consumption goods) will rise. We see no reason to presume a systematic shift in relative demands since any shifts of the type described imply the existence of profitable trades which are left unexploited by market participants.[11] Why do profit seeking individuals behave in a manner which causes a short run distortion in the purchase price of homes, office buildings, autos, shares of stock, etc. relative to their rental values?

Friedman, himself, seems to be vacillate on this point. He first refers to "initial" effects which are eventually reversed and then asserts that "all these forces operate simultaneously." If all of these forces operate simultaneously, it is unclear whether there are any initial effects to be reversed or any systematic alterations in relative demands and prices.

A similar argument was employed by Frank Knight in objecting to the existence of a liquidity effect. In his critique of The General Theory..., Knight argues that:

> (I)t is self-evident that at any time (and at the margin) the rate of interest equates both the desirability of holding cash with the desirability of holding nonmonetary wealth and the desirability of consuming with that of lending and so with both the other two desirabilities. For to any person who has either money or wealth in any form, or to anyone who holds salable service capacity, all three of these alternatives are continuously open. He can consume or hold wealth, and if he holds wealth he can hold it in the form of money or real things -- and the latter, of course, in innumerable forms, and with various sorts of claims to money as intermediaries, . . . The statement also involves all the abstractions which are involved in assuming that the rate of interest is merely a price ratio between present and future income, ...12/

In our opinion, convincing theoretical argument regarding the existence of the liquidity effect is lacking. What is required is an empirical test of the liquidity effect. If this hypothesis is correct, the price of services (goods which are less durable) will move systematically relative to the present price of sources of services (more durable goods or assets) given a change in the rate of change in the money supply. For example, given an increase in the monetary growth rate, rents will fall relative to the purchase price of houses, the price of nondurables will fall relative to durables, spot prices will fall relative to future prices, dividend yields will fall relative to stock prices. These are but a few of the host of adjustments that will take place if the above hypothesis is correct.

III. Empirical Tests of the Liquidity Effect

Generally, a different data set has been employed to test the hypothesis than that suggested above. In a major test of the liquidity effect, Cagan and Gandolfi regress monthly changes in the commercial paper rate on lagged monthly changes in the rate of change of the stock of money. Their analysis covers the period 1907-1965.[13/] It should be noted that this test will pick up first round effects which the theoretical argument does not depend upon.

They "omitted those years in which unusually large changes in monetary growth occurred; these were the years 1918-19, 1929-32, and 1942-48. In no case, however, did the deletions make a significant difference in the pattern of the coefficients"[14/] which is reasonably well summarized in figure 1.

We attempted to duplicate Cagan and Gandolfi's experiment for the 1907-1965 period. Our re-estimate is presented in Table 1. Additionally, a plot of the estimated time path of the change in the nominal interest rate (in basis points) associated with a one hundred basis point increase in the monetary growth rate is presented in figure 2. This plot shows the cummulative effect in basis points on the nominal interest rate at time t of a permanent one hundred basis point change in the monetary growth rate occurring at time zero.[15/]

The results (presented in Table 1) are similar to those of Cagan and Gandolfi. All signs are identical and, with one exception, the same coefficients are significant. There is a slight difference in the estimated time path of the nominal interest rate. The path estimated here reaches a minimum of -2.89 basis points in month seven (theirs, -2.63 in month six), reaches its original level in month sixteen (theirs in month fifteen) and ends up 1.47 basis points higher than originally in month thirty-eight (theirs at 2.01).

The most obvious problem with these results is that, after more than three years, there is so little apparent adjustment toward the "new equilibrium." A one hundred basis point increase in the monetary growth rate will, ignoring tax effects, eventually result in a 100 basis point increase in the nominal rate of interest. Yet after more than three years, the nominal rate of interest is esentially unchanged if these estimates are to be believed. Both the length of the adjustment lag and the magnitude of the adjustment remaining after three years greatly strains the theory.

There is, however, an alternative explanation of these results that is consistent with economic theory and efficient financial markets. To test this explanation requires reestimating the Cagan-Gandolfi equation for specific subperiods between 1907 and 1965. The period 1971-1979, a period of clear and sustained inflation, is also estimated as a check on the procedure.

A. The Effect of the Gold Standard: 1907-January 1934

The Gold Standard Act became law in March of 1900 and remained in force until January of 1934 when it was superseded by the Gold Reserve Act. During this period the price of gold was fixed at $20.67 per ounce and, equally important, gold circulated as a medium of exchange. Maintenance of this type of gold standard ties the hands of the monetary authorities. ". . . (T)he stock of money must be whatever is necessary to balance international payments"[16/] Hence, any change in the growth rate of money which, if maintained, would cause the future supply of money to deviate from that necessary to maintain the balance of payments and the fixed exchange rate between the dollar and gold must eventually be offset by a change in the opposite direction.

Changes in the growth rate of money for the 1900-1934 period are consistent with this hypothesis regarding money supply growth under the gold standard. Table 2 presents the results obtained when the change in the growth rate of money in month t is regressed on past monthly changes occurring over the previous 39 months. The unadjusted R-squares are .68 in the case of M_1 balances and .53 for M_2 balances. Seventy-six of the seventy eight estimated coefficients have the expected negative signs. The two which do not are insignificant. Ten of the coefficients are significant in the case of M_1 while twenty are significant in the case of M_2.

During this period, individuals holding monetary assets were, in large part, insulated from changes in the real value of their assets induced by a decision on the part of the monetary authorities to inflate or deflate the currency. The gold standard acted as a constraint on the behavior of the monetary authority, reducing the probability that a long term inflation or deflation would be experienced (in the absense of new gold discoveries or improvements in mining technology). Friedman and Schwartz note that ". . . the gold standard ruled supreme when the act (The Federal Reserve Act) was passed, and its continued supremacy was taken for granted. . ."[17/] In an important article concerning this subject, Benjamin Klein concludes that, under the gold standard, any unanticipated change in the general level of prices "was likely to reverse or 'correct' itself, i.e., 'average out' over time."[18/]

Maintenance of the gold standard required the monetary authority to accomodate any changes in the demand for dollars in order to maintain the price of dollars in terms of gold. Under this system, changes in the interest rate and changes in monetary growth rates will be inversely correlated but not because changes in monetary growth drive the real rate of interest.

1. Real Disturbances

To illustrate, suppose the real interest rate in the U.S. rises relative to rates in the rest of the world. This means that the prices of present consumption goods rise relative to the prices of existing durable (capital) goods in the U.S. Present consumption goods will flow from abroad (where their prices in terms of capital goods are low relative to U.S. prices) in exchange for U.S. capital goods. This will eventually bid down the real interest rate in the U.S. to the world level. In the interim, however, an initial reaction to this rise in the U.S. interest rate is a reduction in the quantity of dollars demanded. The excess supply of dollars (at the existing relative price of dollars in terms of commodities) will be matched by an excess dollar demand for commodities. While the excess demand for commodities is general, it will, as noted, be weighted particularly in favor of present consumption goods. The excess dollar demand for commodities places upward pressure on the dollar price of these goods which is matched by downward pressure on the price of dollars in terms of commodities. The dollar price of gold, of course, is one of the prices subjected to the upward pressure. Since the monetary authority is charged with maintainance of the dollar price of gold, it must absorb the excess supply of dollars which is a concomitant of the rise in the interest rate. This results in an observed inverse relationship between the interest rate and growth rate of money.

As the interest rate eventually declines in response to the increased inflow of present consumption goods from abroad, the above process will work in reverse. Under these conditions the interest rate and the growth rate in the stock of money again move in opposite directions as the monetary authority acts to fix the price of gold. The direction of causality, however, is the reverse of that implied by the liquidity effect.

2. Monetary Disturbances

An observed inverse relationship between the growth rate in money and the interest rate will also result from unanticipated monetary disturbances under a gold standard as well as from the real disturbances discussed above. Suppose the monetary authority increases the growth rate in money (for whatever reason) and this is unanticipated. The general level of prices will begin to rise. However, because the "gold standard can be considered to have been a period of mean reversion in the rate of price change...the relationship between the current rate and future rates (of price change) was negative..."[19/] In other words, any increase in the price level produced by a positive rate of monetary growth eventually would have to be offset by a reduction in the price level produced by a negative rate of monetary growth in order to maintain the dollar price of gold.[20/] In addition, Klein finds evidence that the inverse relationship between present and future rates of price change was expected. If this is true, the nominal rate of interest would fall with an increase in the growth rate of money but not because the real rate is pushed down. Rather, the nominal rate falls because the expected future rate of inflation falls.

In order to determine whether tests for the liquidity effect are sensitive to the gold standard, separate regressions were run for the periods 1907-1933 and 1934-1965. Regressions were run for money defined as M_2 balances. The previous discussion suggests that, during the 1907-1933 period, the (spurious) "effects" of lagged changes in monetary growth on the interest rate will be stronger than for the entire period. In addition, the change in the interest rate was regressed on changes in the rate of change in the money supply in the contemporaneous month and 38 months into the future. Initially, this specification can be viewed as a benchmark against which the lagged specification can be compared.

Table 3 presents the results for the gold standard period (1907-1933). It presents estimates of both the lagged and led relationship between the interest rate and changes in money's growth rate. Consider the lagged relationship first. As expected, the R-squared is considerably higher (nearly twice as high) for this sub-period than was the case for the entire period. The pattern of signs is roughly the same. However, the number of coefficients which are significant declines from eighteen to nine. Most of the reduction is accounted for by a decline in the significance of the positive coefficients in months nine through twenty-two. The gold standard also helps account for the apparent lack of adjustment of the interest rate to changes in the monetary growth rate. As indicated earlier, a 100 basis point change in the monetary growth rate has no appreciable impact on the interest rate after 38 months. This, however, is to be expected if the dollar price of gold is fixed. Under these conditions, there can be no long run inflation or deflation. During the gold standard period, changes in the monetary growth rate were viewed as <u>temporary</u> not <u>permanent</u> (see the data in Table 2 and Klein's discussion). Consequently, the cummulative effect on the nominal interest rate of a change in the monetary growth rate would be expected to be nearly zero.

Now consider the regression which leads the independent variables. These results are very poor by comparison. The R-square is near zero and none of the coefficients are significantly different from zero at the five percent level. The lagged specification performs considerably better than this alternative during the 1907-1933 subperiod. During this period the relevant information regarding the future rate of change in the money supply is contained in past changes.

B. Off the Gold Standard: 1934-1965

Table 4 presents the results obtained in the period following the end of the gold standard (1934-1965). These results are in striking contrast to those for the 1907-1933 period. First, the R-square in the lagged relationship falls considerably when compared to the lagged relationship for the gold standard period. Further, the pattern of signs is somewhat altered and the number of significant coefficients falls to four. The sign of the coefficient of the contemporaneous change in the growth rate of money and of the previous three monthly changes remains negative and significant. However, these results are much weaker than those which apply to the previous period. The F ratio, in fact, suggests that they arise randomly. Based on these observations, previous tests of the liquidity effect appear to be quite sensitive to the period during which the U.S. was on the gold standard.

The second set of results in Table 4 demonstrate what occurs when the change in the growth rate of money is allowed to lead the change in the interest rate. They also differ appreciably from those obtained for the gold standard period. The R-square is high relative to both the results we obtained when we lagged the independent variables for the 1934-1965 sub-period and for the period as a whole (1907-1965). In fact, it is as high as the result obtained for the 1907-1933 lagged relationship. Further, ten of the coefficients are significant at the five percent level. With the exception of two, in months thirteen and fourteen, all coefficients which are significant are positive.

What accounts for the fact that the lagged series is more powerful in explaining changes in the interest rate than the led series during the gold standard period while the reverse is true after 1933? We conjecture that the answer turns on market participants correctly perceiving the difference in the constraints faced by the monetary authority during each of these periods. When the U.S. moved off the gold standard in 1934 the monetary authority was no longer required to confine its actions to maintaining the price of gold in terms of dollars. In short, it was set free to pursue inflationary or deflationary policy thereby driving the nominal rate of interest up or down accordingly. Efforts to predict these policy swings explains the significance of and perponderance of positive signs obtained for the relationship which leads the change in the growth rate of money before the change in the interest rate.[21/] The consequences of past changes in monetary policy on rates of inflation are discounted into current interest rates. Only future policy changes which alter the rate of inflation (to the extent they are successfully predicted) affect current period interest rates.

During the gold standard, past changes in monetary growth contain information regarding future changes. However, during the later period (1934-1965) this is not the case. Thus, during this later period, the explanatory power of past changes in monetary growth fall when compared to the gold standard period and, correspondingly, the power of the lagged relationship falls relative to the led relationship, which is what the results in Tables 3 and 4 indicate.

C. The Recent Period: 1971-1979

As a further test of this explanation, we considered a more recent period (1971-1979). This period was chosen because August 15, 1971 marks the date when the U.S. abandoned the Gold Reserve Act. The price of the dollar in terms of gold is no longer fixed and it is no longer illegal for U.S. citizens to buy and sell in gold for other than decorative or industrial purposes.

The results for this period are presented in Table 5. As before, the estimate of the equation which leads changes in the growth rate of money is stronger than the lagged estimate. Six of the coefficients differ significantly from zero in the lagged relationship and these are positive. Twenty four of the estimated coefficients differ significantly from zero in the led relationship. Twenty three of the twenty four have positive signs. Note, finally, that both the R-square and F-ratio are higher for the led relationship than for the lagged relationship.

Figure 2 plots the lagged time path of the interest rate associated with a one percent permanent change in monetary growth implied by the 1971-79 data. The difference between this path and the path implied by previous estimates is striking.

The results described above do not provide much evidence for the existence of the liquidity effect. Previous tests are clearly sensitive to the period of the Gold Standard Act (1900-1933). After 1933, estimates of equations which lead changes in the growth rate of money appear to explain more of the variation in the interest rate than those equations which lag changes in the growth rate of money.[22/] Past tests of the liquidity effect have rested upon the observation of a lagged adjustment of the nominal interest rate to a change in the monetary growth rate. The results of the tests presented here, however, appear to be more consistent with the hypothesis that market participants anticipate future changes in the monetary growth rate. As a result, changes in the nominal interest rate appear to lead actual changes in monetary growth.

D. Other Tests: The Liquidity Effect and Relative Prices

Since the ex ante real rate of interest is reflected in relative prices, a further test of the liquidity effect can be performed by examining the effect of variation in the growth rate of money on changes in the prices of present consumption goods in terms of the prices of longer lived goods and assets.

Monthly data regarding variation in the relative prices of nondurable in terms of durable goods, rents in terms of home purchase prices, used cars in terms of new cars, short-term bond prices in terms of the prices of shares of stock, and short-term bond prices in terms of long-term bond prices were, therefore, examined. Each of these ratios expresses the price of earlier availability. If the liquidity effect operates, each of these relative prices will be inversely related to the first six lagged monthly changes in the rate of change in the money supply. Recall that, according to previous empirical evidence, the nominal rate of interest falls for about six months in response to a permanent increase in the monetary growth rate. Hence, given price expectations, the implication is that the real interest rate declines. This decline should be reflected by downward movement in these relative prices.

To check this hypothesis, we regressed the change in each of the above relative prices on changes in the rate of change in the money supply in the contemporaneous month and over the previous six months as in the following equation

$$\Delta(P_C/P_A)_t = \psi + G_0\Delta\dot{M}_t + \ldots + G_6\Delta\dot{M}_{t-6}$$

P_C is an index of the price of a present consumption good or service and P_A is an index of the present price of a future good or asset. The results are presented in Table 6. The results of the estimates are inconsistent with the hypothesis that the ex ante real rate of interest is inversely related to changes in the rate of change in the money supply. The R-squares are all very near zero. The corrected R-squares are all zero and the F-ratios suggest a random relationship.[23/]

IV. Conclusions

In this paper we have investigated the systematic relationship that is commonly thought to exist between changes in the ex ante real rate of interest and changes in the rate of change in monetary growth. Examination of the theoretical argument underpinning the generally accepted view that real rates initially decline and slowly return to their former equilibrium when monetary growth increases suggests that, at best, the hypothesis rests on a very tenuous foundation.

Reexamination of some of the original empirical evidence used to support the hypothesis indicates that the results are sensitive to the time period under examination. In particular Cagan and Gandolfi's results, which were very much responsible for the currency of the hypothesis, are quite sensitive to the fact that the U.S. was on a gold standard during much of the period studied.

Interest rate behavior in the 70's, a period of sustained inflation, is strikingly different from that during the earlier gold standard period. Further there is no evidence of a systematic relationship between relative prices, which are known to depend on the ex ante real rate of interest, and changes in monetary growth.

Taken together, neither the theoretical argument nor evidence supporting the existence of a liquidity effect stand-up to Frank Knight's dictum that "this position is mere man-in-the-street economics."[24/] It seems apparent that a substantial amount of "reworking" will be required before any confidence can be placed in descriptions of the effects and timing of monetary policy on ex ante real interest rates.

FOOTNOTES

* Our thanks go to Courtenay C. Stone, Michael David Bordo, Adam Gifford Jr., Donald Hooks, Roy Kinney, and Jora Minasian for their helpful comments. We acknowledge the staff of the Research Department of the Federal Reserve Bank of St. Louis for the use of their facilities during work on this paper. All conclusions, opinions, and errors contained in this paper are those of the authors.

1/ Phillip Cagan, Changes in the Cyclical Behavior of Interest Rates (New York: National Bureau of Economic Research, 1966) Occasional Paper 100; Phillip Cagan, The Channels of Monetary Effects on Interest Rates (New York: National Bureau of Economic Research, 1972); Phillip Cagan, "Comment: Can the Fed Control Real Interest Rates," Rational Expectations and Economic Policy, ed. Stanley Fischer (New York: National Bureau of Economic Research, 1980); Milton Friedman "The Lag in the Effect of Monetary Policy," The Optimum Quantity of Money and Other Essays ed. Milton Friedman (Chicago: Aldine Publishing Company 1970); Milton Friedman, "Factors Affecting the Level of Interest Rates," Money Supply, Money Demand and Macroeconomic Models ed. J. T. Boorman and T. M. Harilesky (Boston: Allyn and Bacon 1972). For a standard textbook treatment, see Michael R. Darby, Macroeconomics: The Theory of Income, Employment and the Price Level (New York: McGraw Hill, 1976), pp. 166-69.

2/ Phillip Cagan and Arthur Gandolfi, "The Lag in Monetary Policy as Implied by the Time Pattern of Monetary Effects on Interest Rates," American Economic Review Papers and Proceedings (May 1969), pp. 277-84.

2/ John Maynard Keynes, The General Theory of Employment, Interest, and Money (London: Macmillan and Co. 1936), chapters 13-14.

3/ Phillip Cagan, The Channels of Monetary Effects..., p. 85.

4/ Ibid. p. 87.

5/ A number of studies have apparently found evidence consistent with this hypothesized time path of the nominal rate. See, for example, Milton Friedman, "Factors Affecting the Level of Interest Rates," pp. 210-11.

6/ The theory linking the behavior of the ex ante real interest rate to changes in the monetary growth rate has been muddled by a series of recent papers. These claim to have found evidence indicating an incomplete adjustment of the nominal rate of interest to changes in price expectations. (See John A. Carlson, "Short-term Interest Rates as Predictors of Inflation: Comment," American Economic Review (June 1977), pp. 469-75, esp. p. 472; Jan Walter Elliot, "Measuring the Expected Real Rate of Interest: An Exploration of Macroeconomic Alternatives," American Economic Review (June 1977), pp. 429-44, esp. p. 442; Martin Feldstein and Otto Eckstein, "The Fundamental Determinants of the Interest Rate," Review of Economics and Statistics (November 1970), pp. 363-75, esp. p. 366; Douglas K. Pearce, "Comparing Survey and Rational Measures of Expected Inflation," Journal of Money, Credit and Banking (November 1979), pp. 447-57, esp. p. 453 and 455; Robert Shiller, "Can the Fed Control Interest Rates," Rational Expectations and Economic Policy, ed. Stanely Fischer (New York: National Bureau of Economic Research 1980); Robert Mundell, "Inflation and Real Interest," Journal of Political Economy (June 1963), pp. 280-283.) The upshot of this discovery has been the claim that the ex ante real rate of interest is systematically altered by variation in price expectations. It is not clear, however, that the evidence has been correctly interpreted. See W. W. Brown and G. J. Santoni, "Unreal Estimates of the Real Rate of Interest," Federal Reserve Bank of St. Louis Review (January 1981), pp. 18-26.

7/ Frank Knight, "The Business Cycle, Interest, and Money A Methodological Approach," Review of Economic Statistics (May 1941), p. 222. See as well: Don Patinkin, Money, Interest and Prices (New York: Harper and Row, 1965), p. 380.

8/ Phillip Cagan, The Channels of Monetary Effects . . ., p. 88.

9/ Ibid. p. 89. See, in addition, Harry G. Johnson, Macroecoomics and Monetary Theory (Aldine Publishing Co., 1972), pp. 108-12. "If we introduce the possibility of converting money (wealth) into a permanent stream of income (by investment) then...the neutrality property will disappear (p. 110)." This is what the liquidity effect allows. The proponents of the hypothesis, however, do not explain how, or if, the conversion is possible.

10/ Milton Friedman, "The Lag in the Effect of Monetary Policy," pp. 255-56

11/ Individuals eventually take advantage of this situation but not, according to Friedman, until a considerable period of time has elapsed.

12/ Frank Knight, "Unemployment: And Mr. Keynes' Revolution in Economic Theory," Journal of Economics and Political Science (1937), pp. 112-13.

13/ The earliest period for which M_2 balances are available is May 1907. Monthly data regarding M_1 balances are not available until June 1914.

14/ Phillip Cagan and Arthur Gandolfi, "The Lag in Monetary Policy as...," p. 282.

15/ Ibid., p. 280.

16/ Milton Friedman and Anna Schwartz, A Monetary History of the United States (Princeton University Press, 1963), p. 191.

17/ Ibid., p. 191.

18/ Benjamin Klein, "Our New Monetary Standard: The Measurement and Effects of Price Uncertainty," Economic Inquiry (December 1975), p. 471; see, as well, I. B. Ibrahim and Raburn M. Williams, "The Fisher Relationship Under Different Monetary Standards," Journal of Money, Credit and Banking (August 1978), pp. 363-70.

19/ Benjamin Klein, "Our New Monetary Standard:...," pp. 467-8.

20/ The evidence presented in Table 2 is consistent with this argument.

21/ An alternative explanation is that the monetary authority attempted to "smooth" movements in interest rates once off the gold standard. Therefore the money stock became endogenous to (past) interest rate movements. This explanation, however, depends upon the ability of the monetary authority to influence the ex ante real rate of interest. The evidence we consider below appears to be inconsistent with this proposition.

22/ We have estimated equations for the 1934-54 and 1954-79 subperiods in addition to those reported in the text. In each case, the estimates which lead the growth rate of money are stronger than those which lag the growth rate of money. This is true even though the lagged estimates contain first round effects.

23/ One might question whether changes in these relative prices track changes in the real rate of interest. To check this, we regressed annual changes in the yield of high grade corporate bonds (Standard and Poor's) on annual changes in the ratio of the consumer Price Index divided by an index of stock prices (Standard and Pocr's) for the period 1901-1933. Given Klein's evidence, changes in the bond yield during this period should reflect changes in the real interest rate. The CPI is, of course, heavily weighted in the favor of present consumption goods and thus represents the average price of current consumption. The stock price index is an index of the prices of capital goods. Changes in the ratio of these two prices should track changes in the real rate of interest as reflected by changes in bond yields during the gold standard period. The results are given below.

$$\Delta i = 4.03 + \underset{(3.56)^*}{13.05}\Delta\,(CPI/STDP) \quad RSQ = .30,\ F = 12.67$$

When the dependent and independent variables are de-trended, the results are:

$$\overline{\Delta i} = .02 + \underset{(6.92)^*}{18.54}\,\overline{\Delta}(CPI/STDP) \quad RSQ = .61,\ F = 47.85$$

Both sets of results are consistent with the claim that changes in the real rate of interest are reflected by changes in the relative price of present goods in terms of capital goods.

24/ Frank Knight, "The Business Cycle,...," p. 222.

Table 1

Data Period: 1907-1965

Estimated Equation: $\Delta i_t = \gamma + E_0 \Delta \dot{M}_t + \ldots + E_{38} \Delta \dot{M}_{t-38}$

R-square = .10
F-ratio = 1.85
Durbin-Watson = 1.38

Coefficient	Estimate	T Ratio
E_0	-.36	4.49*
E_1	-.56	5.24*
E_2	-.62	4.85*
E_3	-.61	4.31*
E_4	-.44	2.95*
E_5	-.24	1.55
E_6	-.06	.39
E_7	.07	.44
E_8	.27	1.73
E_9	.35	2.20*
E_{10}	.29	1.86
E_{11}	.34	2.18*
E_{12}	.48	3.08*
E_{13}	.43	2.73*
E_{14}	.32	2.00*
E_{15}	.35	2.23*
E_{16}	.35	2.20*
E_{17}	.34	2.17*
E_{18}	.42	2.68*
E_{19}	.47	3.00*
E_{20}	.47	2.98*
E_{21}	.40	2.51*
E_{22}	.33	2.06*
E_{23}	.24	1.51
E_{24}	.15	.92
E_{25}	.08	.50
E_{26}	-.05	.30
E_{27}	-.13	.82
E_{28}	-.15	.99
E_{29}	-.20	1.32
E_{30}	-.16	1.05
E_{31}	-.14	.95
E_{32}	-.17	1.16
E_{33}	-.19	1.28
E_{34}	-.19	1.35
E_{35}	-.22	1.60
E_{36}	-.08	.67
E_{37}	-.05	.46
E_{38}	-.06	.73

*Indicates significant at the five percent confidence level

NOTE: Units of the coefficients are basis points per 1 percentage point change in the monthly rate of change in the money stock (100 basis points = 1 percentage point).

Table 2

Data Period: 1900-1933

Estimated Equation: $\Delta\dot{M}1_t = \alpha + B_0\Delta\dot{M}1_{t-1} + \ldots + B_{38}\Delta\dot{M}1_{t-39}$ R-square = .68 F-ratio = 8.44			Estimated Equation: $\Delta\dot{M}2_t = \bar{\alpha} + B_0\Delta\dot{M}2_{t-1} + \ldots + B_{38}\Delta\dot{M}2_{t-39}$ R-square = .53 F-ratio = 6.91		
Coefficient	Estimate	T Ratio	Coefficient	Estimate	T Ratio
B_0	-1.26	15.41*	B_0	-.89	13.85*
B_1	-1.21	9.21*	B_1	-.81	9.46*
B_2	-.95	5.77*	B_2	-.59	5.86*
B_3	-.79	4.25*	B_3	-.56	5.24*
B_4	-.67	3.35*	B_4	-.54	4.67*
B_5	-.57	2.69*	B_5	-.49	4.04*
B_6	-.51	2.37*	B_6	-.48	3.83*
B_7	-.39	1.75	B_7	-.34	2.60*
B_8	-.29	1.30	B_8	-.33	2.41*
B_9	-.33	1.45	B_9	-.41	2.98*
B_{10}	-.35	1.54	B_{10}	-.48	3.32*
B_{11}	-.19	.83	B_{11}	-.28	1.90
B_{12}	-.15	.67	B_{12}	-.22	1.48
B_{13}	-.29	1.29	B_{13}	-.24	1.61
B_{14}	-.42	1.87	B_{14}	-.30	1.98*
B_{15}	-.47	2.10*	B_{15}	-.24	1.56
B_{16}	-.44	1.93	B_{16}	-.15	1.02
B_{17}	-.42	1.83	B_{17}	-.13	.87
B_{18}	-.42	1.80	B_{18}	-.13	.88
B_{19}	-.46	1.94	B_{19}	-.27	1.82
B_{20}	-.51	2.12*	B_{20}	-.35	2.40*
B_{21}	-.56	2.32*	B_{21}	-.47	3.16*
B_{22}	-.36	1.47	B_{22}	-.30	2.01*
B_{23}	-.28	1.17	B_{23}	-.40	2.65*
B_{24}	-.25	1.07	B_{24}	-.45	3.01*
B_{25}	-.19	.83	B_{25}	-.41	2.71*
B_{26}	-.19	.80	B_{26}	-.32	2.08*
B_{27}	-.23	1.01	B_{27}	-.26	1.67
B_{28}	-.27	1.19	B_{28}	-.23	1.44
B_{29}	-.32	1.42	B_{29}	-.24	1.54
B_{30}	-.36	1.61	B_{30}	-.27	1.79
B_{31}	-.32	1.46	B_{31}	-.21	1.41
B_{32}	-.18	.81	B_{32}	-.09	.61
B_{33}	-.05	.24	B_{33}	+.04	.28
B_{34}	-.03	.15	B_{34}	+.01	.09
B_{35}	-.16	.82	B_{35}	-.18	1.28
B_{36}	-.18	1.02	B_{36}	-.27	2.01*
B_{37}	-.14	1.01	B_{37}	-.19	1.72
B_{38}	-.05	.59	B_{38}	-.09	1.21

*Indicates significant at the five percent confidence level.

Table 3

Data Period: 1907-1933

Lagged Estimate:			Led Estimate:		
$\Delta i_t = \theta + E_0 \Delta\dot{M}_t + \ldots + E_{38}\Delta\dot{M}_{t-38}$			$\Delta i_t = \bar{\theta} + N_0 \Delta\dot{M}_t + \ldots + N_{38}\Delta\dot{M}_{t+38}$		
R-square = .19			R-square = .03		
F ratio = 1.45			F ratio = .18		
Durbin-Watson = 1.44			Durbin-Watson = 2.46		
Coefficient	Estimate	T Ratio	Coefficient	Estimate	T Ratio
E_0	-.53	3.41*	N_0	-.51	.84
E_1	-.82	3.99*	N_1	-.56	.62
E_2	-.79	3.27*	N_2	-.83	.79
E_3	-.61	2.34*	N_3	-1.09	.99
E_4	-.38	1.37	N_4	-1.10	.98
E_5	-.26	.89	N_5	-1.20	1.05
E_6	-.10	.34	N_6	-1.25	1.08
E_7	.12	.37	N_7	-1.30	1.11
E_8	.52	1.61	N_8	-1.05	.89
E_9	.62	1.85	N_9	-.42	.35
E_{10}	.38	1.12	N_{10}	-.29	.23
E_{11}	.48	1.35	N_{11}	-.02	.01
E_{12}	.91	2.53*	N_{12}	.54	.44
E_{13}	.88	2.42*	N_{13}	.93	.77
E_{14}	.51	1.41	N_{14}	1.03	.87
E_{15}	.35	.95	N_{15}	.96	.81
E_{16}	.28	.76	N_{16}	.59	.51
E_{17}	.47	1.32	N_{17}	.33	.28
E_{18}	.81	2.27*	N_{18}	.07	.06
E_{19}	.89	2.52*	N_{19}	-.08	.07
E_{20}	.72	2.04*	N_{20}	-.21	.18
E_{21}	.56	1.58	N_{21}	-.40	.35
E_{22}	.57	1.59	N_{22}	-.28	.24
E_{23}	.51	1.42	N_{23}	-.23	.20
E_{24}	.38	1.04	N_{24}	-.08	.07
E_{25}	.22	.60	N_{25}	.14	.12
E_{26}	.04	.10	N_{26}	.21	.18
E_{27}	-.11	.29	N_{27}	-.39	.34
E_{28}	-.19	.52	N_{28}	-.27	.25
E_{29}	-.35	1.00	N_{29}	-.28	.25
E_{30}	-.41	1.11	N_{30}	-.56	.53
E_{31}	-.36	1.00	N_{31}	-.63	.62
E_{32}	-.32	.89	N_{32}	-.60	.61
E_{33}	-.26	.73	N_{33}	-.46	.48
E_{34}	-.28	.82	N_{34}	-.35	.39
E_{35}	-.36	1.08	N_{35}	-.24	.28
E_{36}	-.20	.61	N_{36}	-.27	.35
E_{37}	-.16	.57	N_{37}	-.33	.48
E_{38}	-.18	.93	N_{38}	-.03	.05

*Indicates significant of five percent confidence level.

Table 4

Data Period: 1934-1965

Lagged Estimate:			Led Estimate:		
$\Delta i_t = \beta + E_0 \Delta \dot{M}_t + \ldots + E_{38} \Delta \dot{M}_{t-38}$			$\Delta i_t = \bar{\beta} + N_0 \Delta \dot{M}_t + \ldots + N_{38} \Delta \dot{M}_{t+38}$		
R-square = .03			R-square = .19		
F ratio = .31			F ratio = 2.10		
Durbin-Watson = 1.14			Durbin-Watson = 1.38		
Coefficient	Estimate	T Ratio	Coefficient	Estimate	T Ratio
E_0	-.15	2.17*	N_0	0.0	0.0
E_1	-.24	2.40*	N_1	.37	3.86*
E_2	-.28	2.24*	N_2	.36	3.15*
E_3	-.29	2.04*	N_3	.37	2.88*
E_4	-.22	1.49	N_4	.39	2.87*
E_5	-.10	.69	N_5	.33	2.36*
E_6	0.0	0.00	N_6	.31	2.19*
E_7	.05	.35	N_7	.28	1.94
E_8	.04	.30	N_8	.24	1.69
E_9	0.0	0.00	N_9	.19	1.34
E_{10}	-.03	.28	N_{10}	.02	.15
E_{11}	-.06	.46	N_{11}	-.06	.40
E_{12}	-.05	.44	N_{12}	-.20	1.34
E_{13}	-.02	.13	N_{13}	-.35	2.37*
E_{14}	.02	.16	N_{14}	-.34	2.21*
E_{15}	.04	.36	N_{15}	-.27	1.79
E_{16}	.09	.74	N_{16}	-.27	1.77
E_{17}	.09	.77	N_{17}	.07	.44
E_{18}	.10	.85	N_{18}	.26	1.70
E_{19}	.11	.92	N_{19}	.35	2.29*
E_{20}	.10	.90	N_{20}	.33	2.11*
E_{21}	.08	.69	N_{21}	.30	1.93
E_{22}	.03	.26	N_{22}	.30	1.88
E_{23}	.02	.15	N_{23}	.13	.79
E_{24}	-.04	.34	N_{24}	.07	.43
E_{25}	-.08	.67	N_{25}	.14	.89
E_{26}	-.09	.75	N_{26}	.01	.08
E_{27}	-.06	.53	N_{27}	.03	.21
E_{28}	-.06	.49	N_{28}	.02	.14
E_{29}	-.04	.34	N_{29}	-.04	.26
E_{30}	.01	.10	N_{30}	-.18	1.04
E_{31}	-.02	.19	N_{31}	-.09	.53
E_{32}	-.03	.25	N_{32}	-.06	.30
E_{33}	-.04	.38	N_{33}	0.0	0.0
E_{34}	-.05	.46	N_{34}	.06	.35
E_{35}	-.07	.68	N_{35}	.17	.91
E_{36}	-.02	.28	N_{36}	.15	.93
E_{37}	-.02	.27	N_{37}	.12	.93
E_{38}	-.01	.17	N_{38}	.04	.48

*Indicates significant at the five percent confidence level.

Table 5

Data Period: September 1971-December 1979

Lagged Estimate:			Led Estimate:		
$\Delta i_t = \delta + E_0 \Delta \dot{M}_t + \ldots + E_{38} \Delta \dot{M}_{t-38}$			$\Delta i_t = \bar{\delta} + N_0 \Delta \dot{M}_t + \ldots + N_{38} \Delta \dot{M}_{t+38}$		
R-square = .47			R-square = .62		
F ratio = 1.38			F ratio = 2.49		
Durbin-Watson = 1.02			Durbin-Watson = 1.07		
Coefficient	Estimate	T Ratio	Coefficient	Estimate	T Ratio
E_0	-3.97	1.93	N_0	-6.54	4.31*
E_1	1.86	.75	N_1	-1.91	1.15
E_2	4.42	1.61	N_2	-1.02	.58
E_3	6.61	2.33*	N_3	.29	.16
E_4	5.07	1.69	N_4	1.60	.89
E_5	5.88	1.87	N_5	5.89	3.27*
E_6	8.01	2.35*	N_6	7.72	4.19*
E_7	8.47	2.34*	N_7	5.08	2.67*
E_8	5.02	1.40	N_8	3.24	1.69
E_9	1.87	.51	N_9	4.53	2.34*
E_{10}	.14	.04	N_{10}	3.40	1.80
E_{11}	2.09	.58	N_{11}	1.38	.75
E_{12}	2.57	.73	N_{12}	-.77	.42
E_{13}	1.51	.44	N_{13}	1.48	.77
E_{14}	1.29	.39	N_{14}	1.45	.72
E_{15}	1.05	.33	N_{15}	-1.85	.88
E_{16}	3.09	.96	N_{16}	.01	0.0
E_{17}	2.58	.83	N_{17}	3.82	1.73
E_{18}	3.97	1.38	N_{18}	6.00	2.67*
E_{19}	3.78	1.32	N_{19}	7.13	3.08*
E_{20}	2.35	.85	N_{20}	7.59	3.27*
E_{21}	.84	.31	N_{21}	7.48	2.96*
E_{22}	2.98	1.10	N_{22}	9.14	3.49*
E_{23}	-1.55	.59	N_{23}	7.03	2.70*
E_{24}	-1.35	.54	N_{24}	8.63	3.22*
E_{25}	-2.16	.92	N_{25}	9.68	3.48*
E_{26}	-.77	.34	N_{26}	11.16	3.93*
E_{27}	1.66	.73	N_{27}	11.74	4.04*
E_{28}	3.17	1.36	N_{28}	12.13	4.05*
E_{29}	2.98	1.25	N_{29}	13.08	4.43*
E_{30}	5.62	2.38*	N_{30}	12.02	4.16*
E_{31}	5.92	2.51*	N_{31}	12.64	4.30*
E_{32}	4.58	2.01*	N_{32}	11.99	4.35*
E_{33}	2.90	1.30	N_{33}	11.05	4.34*
E_{34}	1.97	.89	N_{34}	9.91	4.08*
E_{35}	-.36	.16	N_{35}	8.54	3.72*
E_{36}	-.23	.11	N_{36}	7.32	3.29*
E_{37}	-.39	.19	N_{37}	6.69	3.31*
E_{38}	-.75	.40	N_{38}	3.13	1.89

*Indicates significant at the five percent confidence level.

Table 6

Data Period 1956-1979

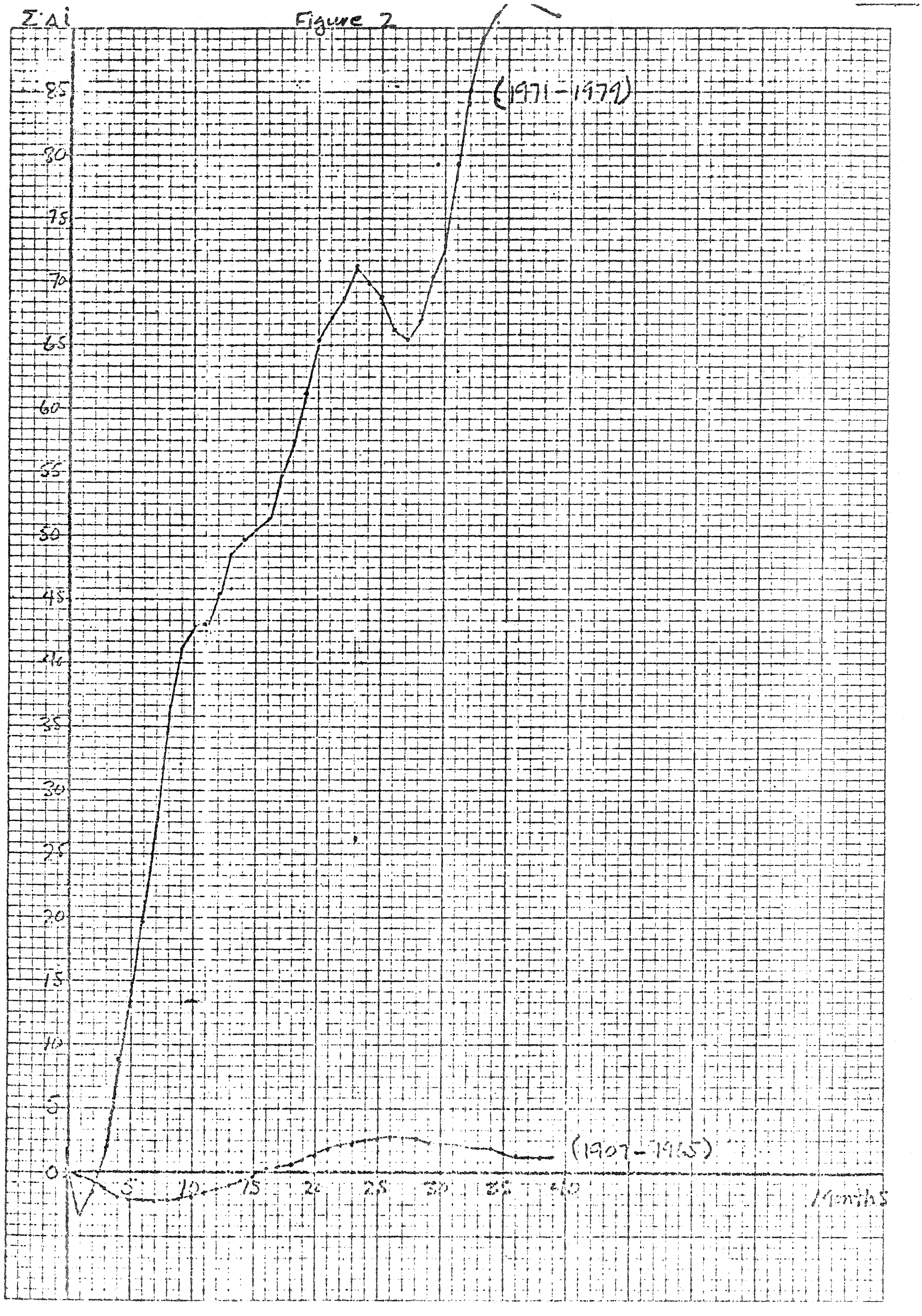
Estimates of Equation $\Delta(P_C/P_A)_t = \psi + G_0\Delta\dot{M}_t + \ldots G_6\Delta\dot{M}_{t-6}$

Dependent Variable	Coefficients G_0	G_1	G_2	G_3	G_4	G_5	G_6	Corrected R-square	R-square	F
ΔP_1	.006 (.59)	.013 (1.10)	.007 (.57)	.012 (1.00)	-.009 (.74)	-.007 (.60)	-.010 (.93)	0	.016	.658
ΔP_2	.002 (.28)	.002 (.26)	.001 (.07)	-.002 (.32)	-.009 (1.28)	-.017 (2.40)*	-.009 (1.42)	0	.022	.931
ΔP_3	-.048 (1.56)	-.069 (2.01)*	-.014 (.40)	.008 (.23)	.032 (.89)	.018 (.52)	.021 (.68)	0	.023	.966
ΔP_4	-.197 (2.36)*	-.128 (1.38)	-.085 (.88)	.072 (.74)	-.137 (1.42)	-.169 (1.80)*	-.088 (1.06)	0	.028	1.179
ΔP_5	.024 (.62)	.004 (.08)	.002 (.05)	.054 (1.20)	-.005 (.11)	-.008 (.18)	.039 (1.00)	0	.017	.717

ΔP_1 = Δ(Price on nondurable goods/Price of durable goods)
ΔP_2 = Δ(Rental price of homes/Home purchase price)
ΔP_3 = Δ(Price of used cars/Price of new cars)
ΔP_4 = Δ(Price of short-term bonds/Price of shares of stock)
ΔP_5 = Δ(Price of short-term bonds/Price of long-term bonds)

T ratios appear in parentheses.
* indicates significant at the 5 percent confidence level.

Figure 2



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