THE ECONOMICS OF GOLD PRICE MOVEMENTS*

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Recent gyrations in the price of gold may lead one to wonder whether economic theory has any power to explain gold price movements. Some observers believe that "the ongoing frenzy in the gold market may be only an illusion of crowds, a modern repetition of the tulip-bulb craze or the South Sea Bubble."[1] Has gold fever infected otherwise rational individuals, or is there an economic rationale behind this behavior?

Almost daily during the surge in the price of gold in late September and early October 1979, for instance, the financial press reported frenetic trading in gold and other precious metals. Typical reactions of gold dealers were: "The market was just crazy and wild" and "You can't explain it by talking of inflation and such things. It's absolutely insane."[2]

The view that markets occasionally fall prey to speculative manias and panics has long been accepted by many economists who regard such phenomena as a potential phase of market behavior. These economists maintain that at certain times mob psychology may dominate the market, thereby preempting the role of economic considerations in market behavior. In contrast to this view is the opposite contention that economic theory, relying on the assumption that market participants act rationally, is sufficient to explain price movements in speculative markets. This article seeks to explain changes in the price of gold from the latter point of view. Section I develops a simple model of gold price movements. Section II applies the theory in the preceding section to interpreting movements in the price of gold since the simultaneous legalization of private ownership of gold in the United States and beginning of gold futures trading in 1975. Section III presents empirical evidence to support the contention of market rationality, and finally Section IV offers some concluding comments.

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[1] **Wall Street Journal**, 26 September 1979, p. 22.

[2] ————, 19 September 1979, p. 3.

I. ECONOMIC ANALYSIS OF GOLD PRICE MOVEMENTS

To begin, it is useful to distinguish between gold stocks and flows. The stock of gold is the quantity held at a given time, whereas the net flow of gold is the change in that stock during a particular interval of time. Production flows add to stocks as newly mined and refined gold becomes available to the market; consumption flows deplete stocks as gold is put to uses that render it irrecoverable. Gold's use in electronics, for example, depletes stocks of gold, since recycling gold is frequently uneconomical in these applications. The metal's use in art also depletes stocks because once incorporated in a work of art, gold is no longer available to the market. Presumably, if such a work of art is deemed "priceless," no price of gold would cause the work to be scrapped and the gold to be melted down, regardless of how high the price might be. In view of these distinctions, gold stocks should be understood to mean readily marketable stocks at a particular time.

Owners of gold stocks have the choice of selling gold today or storing it for future sale. This decision depends on current and anticipated future prices. The storage of gold yields no return other than the prospect of an appreciation in price. The assumption about rational behavior implies that participants in the gold market act to maximize anticipated net revenue from the storage of gold. They store a quantity of gold such that the anticipated appreciation in the price of gold equals the net marginal costs of storing gold.

Net marginal costs of storage are implicit storage costs that consist of the following components: (1) marginal outlay for storage, (2) marginal interest cost, and (3) marginal convenience yield. Marginal outlay costs comprise the charges for warehousing (in vaults) and insuring additional stocks of gold. The marginal interest cost reflects the opportunity cost of owning additional stocks of noninterest-bearing gold rather than alternative interest-bearing assets. Finally, the marginal convenience yield is the monetary

value imputed to holding gold stocks for commercial uses which require gold for fabricating goods. The convenience yield accrues from avoiding costly changes in the production schedule and the associated frequent spot purchases of gold. Additionally, stocks of gold prevent loss of sales because of temporary shortages of gold on hand for fabrication.[3]

Marginal storage costs are defined above as net of the marginal convenience yield, which has the opposite sign from the other marginal components. The marginal convenience yield is a decreasing function of stocks held, diminishing to zero for some sufficiently large level of stocks. As long as the marginal convenience yield is positive, it offsets the other marginal costs of storage to some degree. Equation 1 expresses the definition of net marginal storage costs mathematically:

$$(1) \quad \text{NMSC} = \text{mo} + \text{mi} - \text{mc}.$$

The net marginal storage costs, NMSC, are the sum of the marginal outlay, mo, and the marginal interest cost, mi, minus the marginal convenience yield, mc.

The equilibrium relationship between anticipated gold price appreciation and net marginal storage costs is summarized in the following relationship:

$$(2) \quad E(P_{t+1}) - P_t = \text{NMSC}.$$

Equation 2 indicates that equilibrium in the gold market requires the difference or spread between the market's anticipated price of gold next period, $E(P_{t+1})$, and the current price, P_t, to equal net marginal storage costs, NMSC.

The aggregate effect of individual market participants seeking profits assures that the equilibrium condition in the gold market holds. A geometric model of price movements will help illustrate the relationship between the price spread and net marginal storage costs. For this exposition, marginal outlay and convenience yield are assumed to be negligible compared to the marginal interest cost. Under these conditions, if the interest rate is r percent, then the full equilibrium rate of gold price appreciation over the period will be r percent. Such an equilibrium is shown in Figure 1 for a gold price of P_0 at the beginning of the period, and a price of P_1 at the end of the period, where the percentage price appreciation $\log P_1 - \log P_0$ is r percent.[4]

Now suppose some economic or political disturbance occurs that causes market participants to revise their anticipations of price appreciation so that an incipient excess demand (positive or negative) develops at the initial price. Market participants will try to profit from the change in anticipations and in so doing will bring the anticipated price spread over the period back into equality with the interest rate. Specifically, suppose the anticipated end of period gold price rises from P_1 to P_1^* so that the anticipated capital gain on gold over the period momentarily exceeds r percent. Market participants will attempt to realize profits by storing gold; but since the stock of gold is essentially fixed, they will only succeed in bidding up the spot price. Equilibrium will be restored at a new spot price of P_0^*, where the anticipated capital gain has been brought back to r percent.

It should be emphasized that the anticipated future price does not completely determine the spot price. A change in current supply conditions could affect the spot price which in turn would cause anticipated future prices to be revised via the storage adjustment process. As discussed in more detail in the next section, individuals may choose to hold more wealth in gold than in other assets in times of political and economic uncertainty because of the greater security and anonymity of gold. Such a shift in the composition of wealth might be made without regard for the

[3] This discussion of storage applies to any storable commodity. See [2] for a detailed treatment of the theory of storage.

[4] The reader may wonder how this theory of gold price movements would account for secularly stable gold prices. In this situation, the anticipated price of gold would equal the current price. Individuals would be willing to hold gold, a noninterest-bearing asset, only if net marginal storage costs for gold were zero. This implies that the marginal convenience yield would offset the positive marginal interest cost, which would occur for sufficiently small stocks of gold.

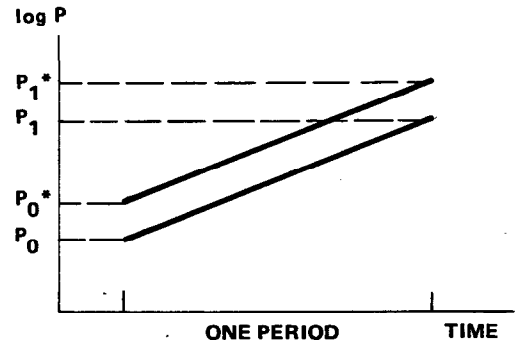


Figure 1

metal's future rate of price appreciation. The spot price of gold would be bid upward, drawing gold out of storage for sale on the spot market. The anticipated future price of gold would also rise, since the interest rate would otherwise exceed the price spread.

The preceding theory of gold price movements is readily applied to gold futures markets.[5] An individual's decision to store gold for future sale requires a prediction of the gold price. Futures trading facilitates this process by making market price anticipations explicit in futures prices. According to the theory of gold price movements, net marginal storage costs should influence the spread between futures prices.

Chart 1 shows the percentage spread between the prices of the October 1980 and the December 1979 futures contracts during 1979.[6] From January through September 1979, the spread fluctuated around 8 percent. After September, the spread widened rapidly and varied around 11 percent. The greatest increase of 1.53 percentage points occurred between the observations on October 5, 1979 and October 12, 1979. This was the week the Federal Reserve announced a more restrictive monetary policy. The associated rise in short-term interest rates sharply increased the opportunity cost of storing gold.

In the particular case of the futures contracts in Chart 1, the relevant opportunity cost is not a directly observable interest rate. Rather, it is a forward interest rate over a 10-month period beginning in December 1979 given implicitly in the term structure of interest rates. The forward rate implicit in the futures price spread for these contracts was in the neighborhood of 10 percent at an annual rate in the months before the October 6th policy change. The implicit forward rate increased to roughly 13 percent following the policy change. This observation is consistent with the view that the market anticipated persistently higher interest rates associated with tighter monetary policy. Consequently, the spread between gold futures prices increased because of the higher anticipated net marginal storage costs for holding gold.

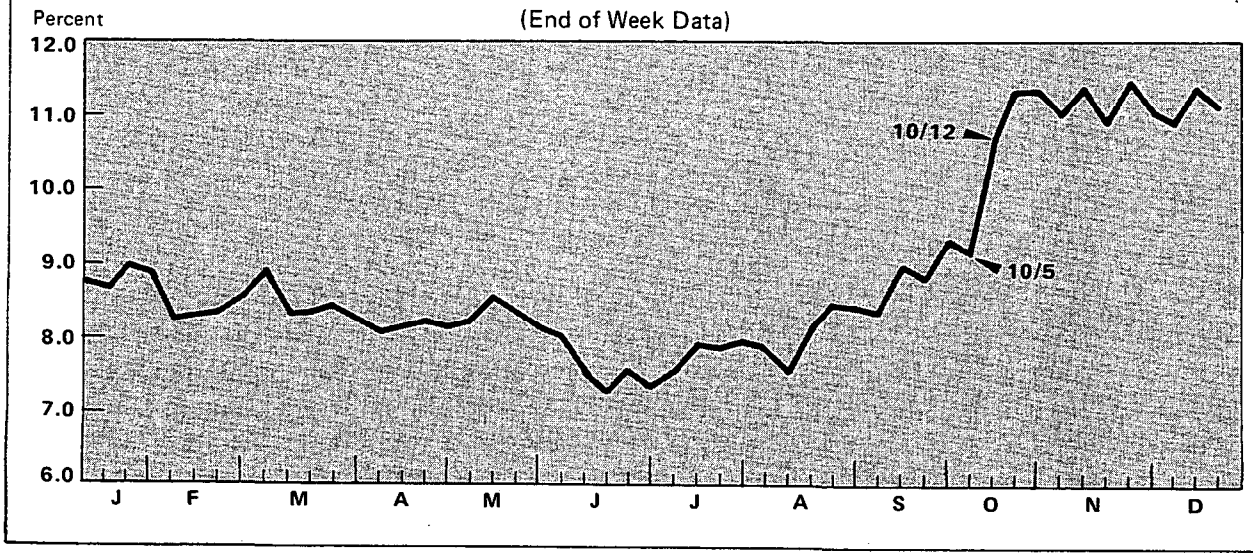
[5] A futures market is a market for the deferred (future) delivery of a commodity. The gold futures market broadens the time frame for buying and selling gold. Gold may be bought and sold for immediate delivery in the spot market, or it may be bought and sold today for deferred delivery via the purchase and sale of gold futures contracts. A futures contract is a legally binding agreement to buy or sell a standardized amount of a commodity in a specified future period at a specified price. The price of this financial instrument is determined in an open, competitive auction on the trading floor of a futures exchange. See [3, 5] for detailed discussions of futures markets.

[6] These contracts were traded on the Commodity Exchange in New York.

Chart 1

PERCENTAGE SPREAD BETWEEN THE OCTOBER 1980 FUTURES PRICE AND THE DECEMBER 1979 FUTURES PRICE DURING 1979

(End of Week Data)



II.
INTERPRETING GOLD PRICE MOVEMENTS

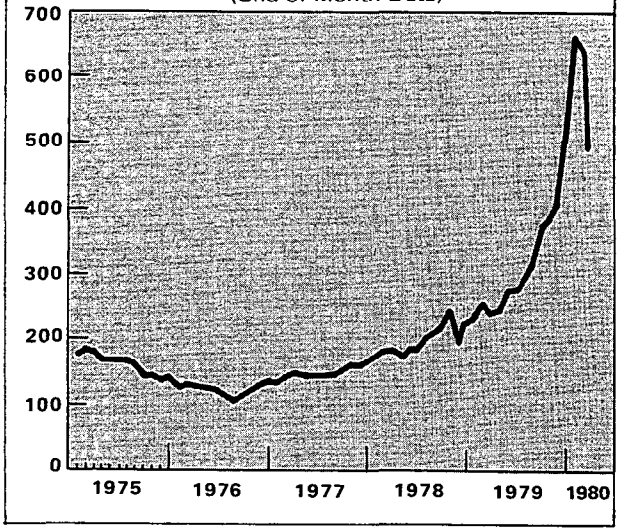
Gold prices change over the course of time because of the influence of disparate economic and political forces on the market. Generally, these influences affect the gold market simultaneously, though at times certain factors exert a greater impact on the market price than other factors. Chart 2 shows the path of the gold price since 1975, reflecting the net result of these various factors on the price of gold.

This section examines the probable causes of gold price movements. The economic and political forces that affect the gold market fall into the following basic categories: (1)extreme political and economic uncertainty, (2) flow supply and demand for gold, (3) inflation, and (4) government auction policy. No systematic attempt is made to single out events that may have affected the price of gold in particular instances since 1975. Rather, each factor is discussed separately with regard to its probable relative importance in causing price movements.

(1) Extreme Political and Economic Uncertainty. Gold is a unique commodity because throughout history it has been considered the ultimate store of value, a haven for the preservation of wealth, particularly in times of turmoil. Gold has served preeminently as a store of value for many reasons, the most important of which are outlined below.

Chart 2

THE PRICE OF GOLD
LONDON P.M. FIX
(End of Month Data)



Stocks of gold grow only very slowly because increasing stocks requires the use of much labor, capital, and time. Many other real assets share the quality of scarcity. For example, the stock of Rembrandt's masterpieces is also in fixed supply, and each painting is universally deemed to be an exceptional store of value relative to other assets. The critical difference between gold and Rembrandt paintings as stores of value stems from the relative liquidity of these assets. Gold is a homogeneous, divisible, and virtually indestructable asset; Rembrandt paintings are not. The difference in liquidity means that gold is readily marketable in any quantity. The transactions costs involved in auctioning Rembrandt paintings are considerable by comparison. These distinctions can be made for other real assets compared to gold as well. In short, few other real assets possess to the same degree the properties that create gold's demand as a store of value.

Times of economic turmoil and political upheaval tend to produce a demand for gold to safeguard wealth. Gold is a concentrated, anonymous asset. Wealth held in the form of gold is less susceptible to confiscation by governments than wealth held in other forms. Small quantities of gold generally exchange for large physical quantities of other real assets. Gold is therefore highly mobile compared to most other forms of wealth, ideal for taking flight across national boundaries. Also, wealth may be converted from gold into other assets without divulging the precious metal's history of ownership.

Particularly during 1979, the political and economic unrest that has beset much of the Middle East and neighboring Asia has engendered a considerable demand for gold as a store of value. Newspaper accounts of activity in the gold market routinely reported the market's speculation that the Middle Eastern demand for gold was the driving force behind the upsurge in the price of gold in late 1979 and early 1980. But before the international turmoil of 1979, other factors were probably more important causes of gold price movements.

(2) Flow Supply and Demand for Gold. Evaluating the impact of flow supply and demand on gold price movements requires a consideration of stock-flow relationships. On the one hand, the demand for gold consists of the derived demands for gold originating from goods fabricated using gold and of the demand for gold itself as an asset. On the other hand, the supply of gold consists of newly mined gold

coming into the market and of gold being drawn from stocks. The salient characteristic of gold markets is that changes in flows, i.e., changes in the rate of commercial demand for gold or in gold's rate of production, affect the stock of gold insignificantly compared to changes in rates of production and consumption on the stocks of other storable commodities. For this reason flow supply and demand for gold have a relatively small impact on the price of gold.

Table I gives a rough estimate of the size and composition of the world gold stock in December 1975. Table II provides world gold production and consumption data since 1968. Official and private holdings of gold dwarf the magnitudes of gold production and consumption flows. Official stocks are equivalent to approximately 30 years' recent annual worldwide production, while readily marketable private stocks amount to slightly more than 10 years' annual production.

To put these stock-flow data in perspective, consider an alternative metal, copper, which differs

Table I

ESTIMATED WORLD GOLD STOCKS

(millions of troy ounces with metric ton equivalents)

Estimated Private Gold Stocks, December 1975

	million oz.	metric tons
Coins	400	12442
Private bullion holdings	75	2333
Industrial inventories	25	778
Total	500	15552

Source: Wolfe [13].

Official Gold Stocks, IMF and Central Banks of Non-Communist Countries, December 1975

1168	36322

Source: Samuel Montagu & Co. [1].

Estimated Quantity of Gold in Artwork and Jewelry

1000	31104

Source: Wolfe [13].

Table II

GOLD FLOWS 1968-1978[1]

Components of Supply
Metric Tons

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Non-Communist world mine production	1245	1252	1274	1236	1183	1121	1006	953	967	968	969
Net trade with Communist bloc[2]	−29	−15	−3	54	213	275	220	149	412	401	410
Official sales[3]	620	−90	−236	96	−151	6	20	9	58	269	362
Net private purchases	1836	1147	1035	1386	1245	1402	1246	1111	1437	1638	1741

Components of Demand
Metric Tons

Fabrication categories:											
Carat jewelry	912	904	1062	1060	996	512	220	519	931	996	1001
Electronics	82	100	89	86	105	127	92	67	76	77	85
Dentistry	60	60	59	63	66	68	57	62	76	82	87
Other industrial/decorative uses	58	63	62	69	71	72	67	60	66	67	75
Medals, medallions, and fake coins	40	44	54	52	41	21	7	21	47	47	46
Official coins	68	26	46	54	63	54	287	244	184	137	259
Total fabrication categories	1221	1197	1372	1383	1341	854	729	973	1380	1405	1552
Net private bullion purchases[4]	615	−50	−337	3	−96	548	517	138	57	233	189
Net private purchases	1836	1147	1035	1386	1245	1402	1246	1111	1437	1638	1741

[1] For the non-Communist world.

[2] Most of the Communist bloc total represents sales of newly mined gold by the Soviet Union.

[3] Definition of official sales has been extended from 1974 to include activities of government controlled investment and monetary agencies in addition to central bank operations. This category also includes IMF disposals.

[4] This category excludes coins, but includes small bar hoarding and all other forms of bullion investment.

Source: Consolidated Gold Fields Limited, Gold 1979.

greatly from gold in terms of the foregoing economic relationships. As a base or nonprecious metal, copper is mined in huge amounts compared to gold or other precious metals and has wide-ranging industrial uses. Based on Bureau of Mines data, world mine production of gold and copper in 1977 was respectively 1,212 and 7,687,000 metric tons. Commercial stocks of copper in the United States amounted to 522,000 metric tons as of December 31, 1977, increasing 4.9 percent over the previous year. In 1977, industry used 2,050,000 metric tons; U. S. refinery production and refined imports of newly mined copper came to 1,712,000 metric tons. (This figure does not include 410,000 metric tons of copper recovered from scrap.) The high ratio of consumption and production to stocks on hand for copper gives these flows the potential to affect the price dynamics in the copper market significantly.

In sharp contrast to the copper market, the commercial use of gold is a relatively unimportant component of the total demand for this precious metal. Unfortunately, statistics on gold and copper stocks are difficult to compare because only data relating to commercial stocks are reliable. Statistics relating to private noncommercial stocks are largely conjectural. According to the estimates in Table I, commercial inventories represent only 5 percent of the estimated private world gold stocks in December 1975. Bureau of Mines data show that in the United States commercial gold stocks constituted 59 percent of year-end 1977 gold stocks. The remainder consisted predominantly of gold bullion. This statistic for the U. S. does not include the considerable quantity of gold coins held privately.

The copper price might behave differently from the gold price owing to the particular stock-flow relationships in the two markets. Because of the relatively great quantities of copper held in storage, marginal outlay costs are probably substantial for firms using copper as an input to production. To minimize costs, therefore, industries probably draw more copper from current copper production than from copper stocks. Firms store copper primarily to have stocks on hand to maintain a smooth flow of production of goods fabricated with copper. These commercial stocks provide a convenience yield to the firm for the reasons discussed in the preceding section. It should be noted, of course, that a small fraction of gold stocks is held for its convenience yield analogously to copper stocks. However, most gold stocks may be termed speculative stocks, i.e., stocks for which the primary motivation for ownership rests on an anticipation of capital gain. Because of the great industrial demand for copper, however, commercial stocks are likely to be of far greater magnitude than purely speculative copper stocks.

The greater relative magnitude of flows to stocks and the greater price sensitivity of flow supply and demand to the current price for copper compared to gold could potentially make for differences in the price dynamics of these two metals. For example, events temporarily affecting production (such as a strike) or consumption (such as a recession) are more likely to affect the price of copper than gold. As another example, a speculatively induced fall in the spot price would be more likely to reduce current production and increase current consumption for copper than gold. The greater production and consumption effect could tend to offset the initial spot price fall and prolong the price adjustment to anticipated future disturbances.

(3) **Inflation.** The following provides an analysis of the effects of a fully anticipated inflation on the path of the gold price. Suppose there occurs an increase in the government budget deficit. Furthermore, suppose it to be financed largely with money creation so that the public comes to expect an increase in the long-run rate of money growth and an associated increase in the long-run rate of inflation. What happens to the price of gold?

Because this is a fully anticipated increase in the rate of inflation, an inflationary premium is incorporated into the nominal rate of interest. For example, if anticipated inflation rises by 5 percentage points, the nominal rate of interest will rise by the same amount. This means, first of all, that the new long-run equilibrium rate of gold price *appreciation* will be higher by 5 percentage points. In other words, in the new long-run equilibrium the gold price will rise at the new, higher general rate of inflation.

Figure 2 illustrates these changes in the path of the gold price. The change in the rate of money growth and inflation occurs at time t. For reasons outlined above, the tilt of the gold price path is greater after time t. But the whole "level" of the price path is shown to shift up at time t as well. Why should this be the case?

The dollar price of gold is the relative price of gold in terms of dollars. The relative price depends on the demand for gold relative to dollars, which in turn depends on the relative anticipated rate of return on gold versus dollars. Inflation and the increased anticipated capital gain on gold increases the return on gold relative to money. It is the one time perma-

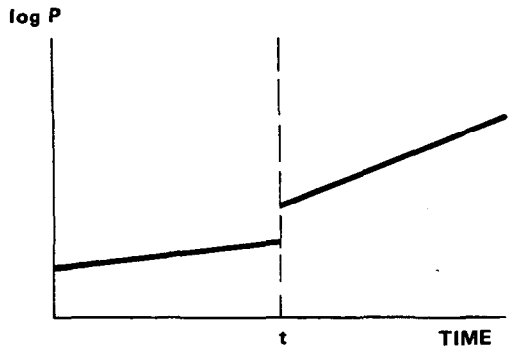


Figure 2

nent increase in the demand for gold relative to money associated with anticipated inflation that leads the entire price path to shift up at time t. This relative rate of return effect is partly responsible for the sensitivity of the spot price of gold to a change in anticipated inflation.[7] In the foregoing example, anticipated inflation rises by 5 percentage points. However, if the sensitivity of demand for gold relative to money with respect to a change in the anticipated rate of price appreciation is high, the jump in the gold price at time t could greatly exceed 5 percentage points.

(4) **Government Auction Policy.** Official gold stocks of the non-Communist world's central banks and the International Monetary Fund (IMF) amounted to 35,382 metric tons as of September 30, 1978. These stocks constitute roughly half of the world's gold stock and therefore have the potential to influence the gold price significantly if supplied to gold markets in sizable quantities. Particularly in the late 1970's, as seen in Table II, these official stocks of gold have contributed substantially to supplies of gold on world markets.

The International Monetary Fund and the United States Treasury have been principal sellers of gold through their auctions during this period. In January 1976, the IMF announced that it would sell one-sixth of its gold stocks via monthly auctions. The U. S. Treasury announced in December 1974 that it would conduct gold auctions. Two Treasury auctions occurred in 1975. Partly to support the exchange value of the dollar in 1978, the Treasury decided to hold regular monthly auctions commencing in May 1978. Both the Treasury and IMF auction series continue to the present day.[8] What are the probable effects of auctions on the price of gold?

An analysis of the probable effects of official auctions on the gold price based on the model of gold price movements is given in general terms in the following example. After an announcement by the U. S. Treasury of a gold auction, including the quantity to be auctioned and the time of the auction, the actual auction would have little effect on the gold price when it occurs if the market anticipates the auction. The market price would fall in reaction to the initial announcement, entirely discounting the effects of the auction before it takes place.

Obviously, the gold market does not predict the effects of such an auction perfectly; the market price changes as forecasts are revised. For example, if the demand at a given price has been underestimated at the time of the auction, the price will rise to clear the market.

III.
EMPIRICAL EVIDENCE

This section presents empirical evidence in support of the model of gold price movements set forth in Section I. That simple model is based on the assumption that participants in the gold market are rational and act in their self-interest. The aggregate effect of their actions produces a particular path of the gold price. It is assumed that these market participants continually assess new information about the gold market and all the political and economic events that impinge on the supply and demand for gold. This view of the market implies that the apparently erratic short-run changes in the price of gold register the market's perception of changing economic events. Some important questions arise in this context. How quickly does the market respond to new information? Does the price of gold reflect available information at a given time, or does it take time for new information to affect the market price?

[7] The price of gold is also likely to be more sensitive to changes in anticipated inflation than prices of other storable commodities. Gold is more liquid than other storable commodities since the transactions costs of bringing buyer and seller together tend to be less. Therefore, in response to a change in anticipated inflation, anticipated net revenue from storage can be maximized more readily for gold than for other commodities.

[8] On October 16, 1979, the Treasury changed its gold auction policy in a move officially designed to "deter speculation." Further auctions would be announced only several days in advance, at which time at least the minimum amount of gold to be auctioned would be disclosed. See **Wall Street Journal**, 17 October 1979, p. 4. One auction on November 1, 1979 has been undertaken by the Treasury under this new policy. See Henderson and Salant [12] for an account of the effects of this kind of policy on the price of gold. The last scheduled IMF auction will be in May 1980.

The economic theory of gold price movements implies that available information about the future price of gold is rapidly discounted into the current spot price. According to this theory, to the extent that stocks are sufficiently large relative to flows, successive price changes tend to be uncorrelated. Additionally, futures prices should be unbiased forecasts of future spot prices. In other words, errors in forecasting future spot prices should arise from unpredictable influences on future spot prices, not from systematic biases in predicting these prices. Forecast errors therefore should be uncorrelated and have zero mean.

Regression analysis is used to empirically evaluate the gold market's response to new information. The following regression estimates the amount of current price movement that can be explained (1) by past price movements and (2) by the level of a current interest rate. Price movements are expressed as monthly percentage changes, e.g.,

$$\Delta \ln P_t \equiv \ln P_t - \ln P_{t-1}.$$

The percentage change in the gold price in the current period, $\Delta \ln P_t$, is regressed on the percentage change in the gold price in preceding monthly periods, $\Delta \ln P_{t-1}$ and $\Delta \ln P_{t-2}$, and the yield on a security of one-month maturity, r_t. The regression equation is specified as follows:

$$(3) \quad \Delta \ln P_t = \alpha + \beta_1 r_t + \beta_2 \Delta \ln P_{t-1} + \beta_3 \Delta \ln P_{t-2} + u_t.$$

The disturbance term u_t captures any movements in the current price not explained by the included lagged percentage price change variables or by the interest rate.

The data consist of first-of-month gold prices as quoted at the P.M. Fixing of the London Gold Market and first-of-month Treasury bill yields (on a discount basis) of one-month maturity. These data span a period from January 1973 to December 1979, although after differencing and lagging the variables, the sample period runs from April 1973 to December 1979, containing 81 observations.

Equation 3 was estimated as follows:

$$\Delta \ln P_t = -.028 + .678 r_t + .056 \Delta \ln P_{t-1} + .043 \Delta \ln P_{t-2}$$
$$(.035) \quad (.519) \quad (.111) \quad (.113)$$

$$R^2 = .039 \quad SEE = .077 \quad SSR = .461 \quad DW = 1.99$$ [9]

As indicated by the R^2, this regression explains only 3.9 percent of the variation in the percentage change in the current gold price. The coefficients on the lagged percentage price changes are both insignificantly different from zero. (The standard errors appear in parentheses.) Current percentage price changes therefore appear to be statistically independent of percentage price changes in preceding months. In addition, the coefficient on the interest rate is significant at a 90 percent level of confidence, and the constant is insignificantly different from zero.

This test of statistical independence of price changes has a straightforward interpretation in terms of the model of gold price movements. The test results support the contention that market participants respond quickly, i.e., within a month, to new information. According to the empirical results, no further market price adjustment to that information occurs in the following month.

The interest rate coefficient also has an interesting interpretation. The model of gold price movements includes several assumptions about the components of net marginal storage costs. In particular, it was argued above that marginal outlay and convenience yield are negligible compared to marginal interest costs for gold. If this is in fact the case, other things held constant, a rise in the interest rate should cause an equiproportionate increase in the current percentage change in the gold price, i.e., the coefficient on the interest rate should differ insignificantly from unity.

The interest rate coefficient in the regression has an estimated value of .678, which is insignificantly different from unity and significantly different from zero at a 90 percent level of confidence under the appropriate one-tailed test. Even though the regression explains only a small amount of the variation in the current percentage price change, the interest rate is significantly correlated with the contemporaneous gold price change.

Viewed in isolation, the relatively weak significance of the estimated coefficient on the interest rate does not seem to shed much light on price movements. Is it reasonable to assume that the other marginal storage costs are negligible? A comparison of gold price movements with copper price movements can highlight several points about net marginal storage costs.

In particular, components of net marginal storage

[9] Because this regression includes lagged dependent variables, the Durbin-Watson statistic is biased toward 2 if there is no first order serial correlation in the residuals.

costs that are negligible for gold are likely to be important for copper. In the copper market, marginal outlay costs, especially for warehousing, may be an increasing function of copper stocks, and marginal convenience yield may be a positive, decreasing function of these stocks. Furthermore, net marginal storage costs are likely to be sensitive to changes in the physical volume of copper stocks held.

For example, an increase in the interest rate raises net marginal storage costs. If anticipations of future copper prices are unchanged, the current copper price would fall as holders of copper attempt to reduce their stocks in response to higher net marginal storage costs. The lower copper price would tend to reduce current production and increase current consumption, thereby reducing physical stocks. Consequently, net marginal storage costs would diminish because the marginal convenience yield would rise and marginal outlay costs would fall.

To evaluate the importance of an interest rate in explaining copper price movements, a copper price regression similar to the gold price regression is estimated. Since changes in marginal outlay and convenience yield are more likely to offset changes in the interest rate for copper than gold, the interest rate coefficient should come in less significantly different from zero in the copper price regression than in the gold price regression.

The sample period is the same as the period for the gold price series, and the data consist of first-of-month noon spot wirebar prices as quoted on the London Metal Exchange. The specification of the regression is the same as Equation 3.

The copper price equation was estimated as follows:

$$\Delta \ln P_t = .002 + .046 r_t + .187 \Delta \ln P_{t-1} - .054 \Delta \ln P_{t-2}$$
$$(.042)\quad (.606)\quad (.114)\qquad (.115)$$

$$R^2 = .035 \quad SEE = .095 \quad SSR = .699 \quad DW = 1.96$$

The coefficient on the interest rate is insignificantly different from zero and significantly different from unity. The t-statistic for the interest rate is .0756, which indicates far less statistical significance than the t-statistic (1.307) for the interest rate in the gold price regression. The considerably greater significance of the interest rate coefficient in the gold price regression as compared to the copper price regression supports the theoretical differences advanced above about the composition of net marginal storage costs for these metals.[10]

The copper price regression also reveals that copper price changes are serially uncorrelated at a 95 percent level of confidence. However, evidence that price changes are serially uncorrelated is less clear in the copper price regression than in the gold price regression. The suggested potential importance of flow supply and demand responses to copper price movements discussed in Section III appears to be weakly discernible, since copper price changes are serially correlated at a 90 percent level of confidence.

As an additional test, the gold market's response to new information is examined in the relationship between futures prices and future spot prices. If the market absorbs new information rapidly, futures prices should be unbiased forecasts of future spot prices. In the particular test constructed, the logarithm of the spot price on the first trading day of the delivery month is regressed on the logarithm of the futures price on the first trading day three months earlier. The estimated equation is:

$$(4)\quad \ln S_t = \alpha + \beta \ln F_{t-3} + u_t,$$

where S_t is the spot price, F_{t-3} is the futures price for the same contract lagged three months, and u_t is a random disturbance term.[11]

These data include the relevant spot and futures prices on contracts that have traded on the Chicago Mercantile Exchange's International Monetary Market. New delivery months occur in March, June, September, and December of each year. Running from the September 1975 through the December 1979 futures contracts, the sample consists of 18 observations. The sample is small. Nonetheless, these data permit a useful test of the gold market's ability to assimilate new information.

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[10] There is a statistical problem with the copper price series that could bias the interest rate coefficient downward and reduce its t-statistic. The copper price is quoted in pounds sterling and was converted to dollars using a first-of-month exchange rate series derived from the Federal Reserve's dollar/pound daily certified noon buying rates for cable transfers in New York City. The pound sterling copper price series and the exchange rate series are not contemporaneous, but differ by six hours. It is doubtful that this statistical problem alone could account for the great disparity in statistical significance of the interest rate coefficient in the gold and copper price regressions. One way to avoid the problem would be to use a British Treasury bill yield series, but such a series was not available to the author.

[11] The logarithmic transformation is used because it is the proportionate difference between these variables that matters, not the absolute difference.

If futures prices are unbiased predictors of future spot prices, the constant in this regression should differ insignificantly from zero and the coefficient on the futures price should differ insignificantly from unity.[12] Such estimates would be consistent with the view that a one percent increase or decrease in today's futures price would result in a one percent change in the spot price in the same direction three months later.[13] Equation 4 was estimated as follows:

$$\ln S_t = \underset{(.520)}{-0.815} + \underset{(.101)}{1.166}\ \ln F_{t-3}$$

$R^2=.893$ SEE=.124[14] SSR=.247 DW=2.23

At a 95 percent confidence level, the constant is insignificantly different from zero and the coefficient on the futures price variable is insignificantly different from unity.[15] The Durbin-Watson statistic indicates no first-order serial correlation in the residuals, i.e., forecast errors are uncorrelated.[16]

As an additional test, the futures price one month earlier, F_{t-4}, was added as a second explanatory variable:

$$(5)\quad \ln S_t = \alpha + \beta_1 \ln F_{t-3} + \beta_2 \ln F_{t-4} + u_t.$$

If futures price F_{t-3} reflects all available information at $_{t-3}$, including prices one month earlier, the estimated coefficient β_2 on the new explanatory variable should be insignificantly different from zero. In addition, the amount of variation in the dependent variable S_t explained by this regression, measured by the regression's R^2, should remain relatively unchanged. Equation 5 was estimated as follows:

$$\ln S_t = \underset{(.603)}{-0.929} + \underset{(.424)}{1.0001}\ln F_{t-3} + \underset{(.466)}{.1901}\ln F_{t-4}$$

$R^2=.894$ SEE=.128 SSR=.244 DW=2.07

The inclusion of the second futures price does not increase the explanatory power of this regression and the new variable's coefficient differs insignificantly from zero at a 95 percent level. Though admittedly not very powerful because of the small sample size, this further test of the gold market's response to new information provides additional statistical evidence to support the basic model of gold price movements.

IV. CONCLUSION

Financial writers cite a variety of factors that influence gold price movements. These writers typically view the price of gold as a barometer of economic and political instability. Left unexplained, however, is the mechanism determining gold price movements that leads these prices to foreshadow changes in the rate of inflation, the stability of governments, official gold auction policy, etc. This article has explained the economics that underlies movements in the price of gold.

As argued above, gold differs only *in degree* from other storable commodities in the way various economic factors influence its price. The spot prices of all storable commodities, including gold, are particularly influenced by anticipations of future spot prices. In the case of gold, however, the relative insignificance of flow supply and demand compared to stocks, the relative insensitivity of flow supply and demand with respect to spot price movements, and the relative liquidity of gold all tend to make current changes in the gold price especially sensitive to changes in its anticipated future spot price.

The episodic run ups and run downs in the price of gold associated with periods of economic and social turmoil have fascinated and frequently bewildered observers of the gold market. At such times, analysts often conclude that mob psychology overwhelms the

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[12] A further test of the independence of forecast errors involves a direct measure of serial correlation in these errors. The parameters α and β in regression 4 are constrained to equal 0 and 1 respectively, and the logarithm of the futures price is subtracted from the logarithm of the spot price to give a series of percentage forecast errors, FE. This procedure of constraining the coefficients in effect makes the assumption that forecast errors are indeed independent. An autoregression of these forecast errors directly tests the hypothesis that these errors are uncorrelated. The autoregression follows:

$$FE_t = \underset{(.034)}{.051} - \underset{(.283)}{.024}FE_{t-1} + \underset{(.280)}{.304}FE_{t-2}$$

$R^2=.085$ SEE=.129 SSR=.217 DW=2.06

The hypothesis that forecast errors are uncorrelated and have zero mean cannot be rejected at a 95 percent level of confidence.

[13] Note that by the delivery month the spot price may diverge from its futures price forecast as the market responds to new information received in the intervening period.

[14] Note that in this regression the standard error of estimate (SEE) multiplied by 100 is the average percentage forecast error over the sample period.

[15] The joint restriction that $\alpha=0$ and $\beta=1$ could not be rejected at a 90 percent level of confidence using the appropriate chi-square test with 2 degrees of freedom.

[16] Estimated residual autocorrelations at lags 1 and 2 were insignificantly different from zero at a 95 percent level of confidence.

market as market participants lose sight of so-called market fundamentals. However, the theory and empirical evaluation of gold price movements presented here demonstrate that *ad hoc* appeals to mob psychology are unnecessary to explain the behavior of the gold price. In other words, economic theory appears sufficient to account for gold price movements in recent years.

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RECENT FINANCIAL INNOVATIONS:

Causes, Consequences for the Payments System, and Implications for Monetary Control

Marvin Goodfriend, James Parthemos, and Bruce Summers

The past two decades have been characterized by a number of significant innovations in the U. S. financial system, which today differs greatly from the system existing at the beginning of the 1960's. Today's financial intermediaries, including commercial banks, handle a much larger volume of business and generally serve broader geographic markets than their counterparts of two decades ago. They are also more competitive and more inclined to offer a greater variety of services in an effort to maintain or expand market shares. Moreover, some intermediaries, such as credit unions, now play a more important role in the nation's financial system, and entirely new types of intermediaries, such as money market funds, have emerged. Generally speaking, both the variety of institutions offering financial services and the array of such services have increased significantly, especially in recent years.

The expanding variety of services offered by financial intermediaries has been paralleled by an increased diversity of the liabilities of these institutions. Twenty years ago, for example, the liabilities side of a typical commercial bank's balance sheet was heavily weighted with demand deposits and regular savings deposits. Today's typical bank balance sheet shows a sizable reduction in the relative importance of such deposits and a sharp increase in so-called "purchased funds," i.e., negotiable certificates of deposit, nonnegotiable certificates of deposit, repurchase agreements, Federal funds purchased, and in the case of very large banks, perhaps Eurodollar borrowings as well. Likewise, regular savings deposits (deposit shares) typified the liabilities of savings and loan associations in the 1950's but today have given way in large measure to time certificates of deposit. Much the same can be said for credit unions and mutual savings banks.

The liabilities of financial intermediaries represent indebtedness to their customers—to households, businesses, and governmental units for the most part. Collectively, claims on these institutions make up the predominant fraction of the public's holdings of liquid assets. Of the several types of these liquid assets, the public's holdings of demand deposit claims at commercial banks have commanded particular attention because they have traditionally been the principal means of making payment. Until recently, demand deposits possessed an advantage in that they were immediately available for spending while other liquid claims could be spent only after being converted into coin, currency, or demand deposits. For this reason, demand deposits along with coin and currency have been traditionally defined as "money" while other liquid claims at financial intermediaries have been considered to be money substitutes or "near money."

The outstanding volume of monetary assets at a given time and its rate of growth over time are important determinants of aggregate spending and inflation. Two statistical measures of the monetary aggregates, M_1 and M_2, have played an important role in the implementation of monetary policy since 1970. M_1, the measure of money narrowly defined, includes coin and currency in circulation outside the banking system and private demand deposits adjusted.[1] A broader measure, M_2, includes with M_1 time and savings deposits at commercial banks except for large denomination negotiable certificates of deposit.

I. FINANCIAL INNOVATION AND THE PAYMENTS SYSTEM

Recent innovations have had a direct impact on the payments system, i.e., on the types of assets and institutions involved in the consummation of payments between individual economic units. The payments system has historically comprised the nation's

[1] The demand deposit component of M_1 consists of (1) demand deposits at commercial banks other than domestic interbank and U. S. government demand deposits, less cash items in process of collection and Federal Reserve float and (2) foreign demand balances at Federal Reserve Banks.

14,500 commercial banks, a system of correspondent relations between individual banks, local clearing houses, and the Federal Reserve System. This network provides the machinery for transferring demand deposit claims between individual economic units. As mentioned above, until recently payments have been made almost exclusively with demand deposits or currency and coin.

As a result of recent innovations, claims on financial institutions other than commercial banks are being used to make payments. For several years it has been possible to transfer funds from savings accounts in thrifts to bank checking accounts by telephone, or to use these funds to make prearranged third-party payments. More recently in New England and New York Negotiable Order of Withdrawal (NOW) accounts have been offered by thrift institutions as well as by commercial banks. NOW accounts are a readily transferable means of payment. Share drafts at credit unions have also become a means of payment. NOW accounts and share drafts, however, differ from demand deposits at commercial banks in that they bear interest. Hence, for the first time since 1933, when interest on demand deposits was prohibited by law, what amounts to interest-bearing demand deposits comprises part of the nation's payments medium. Moreover, since November 1, 1978, commercial banks have been allowed to cover their customers' overdrafts by automatically transferring funds from savings to checking accounts. This too allows the use of interest-bearing deposits for making payments.[2]

The emergence of new types of assets that mediate transactions—that is, serve as money—pose special monetary control problems for the Federal Reserve System. A broadened spectrum of money and near money assets complicates the problem of determining an appropriate working statistical definition of money. Moreover, growth of monetary assets issued by institutions beyond the control of the central bank can significantly weaken the Federal Reserve's ability to control the monetary aggregates. The sections that follow contain detailed discussions of major factors promoting innovation, the innovations themselves, and their implications for monetary control.

[2] The U. S. Circuit Court for the District of Columbia ruled on April 20, 1979 that automatic transfer services, share drafts, and savings and loan association remote service units are not authorized under current law. However, the Court delayed the effect of its order until January 1, 1980 in order to give Congress time to consider legislation legalizing such services. Legislation passed in December 1979 allows financial institutions to continue offering these services until April 1, 1980.

II.
SOME FACTORS PROMOTING INNOVATION

The rapid pace of financial innovation of recent years is due largely to three major factors. The first of these is the serious inflation the economy has suffered since 1965 and especially since 1973. The second is the rapid development of computer and communications technology. The third is a change in the regulatory environment dating from the early 1960's.

Inflation has accelerated the pace of financial innovation through its impact on interest rates. Inflation is an important determinant of the level of interest rates because the level of interest rates reflects anticipations of future inflation and anticipations roughly follow recent experience with inflation. When inflation has been high anticipations of inflation are also high; and when inflation has been low so are inflationary anticipations. Inflation has continually risen in recent years, so inflationary anticipations have risen as well. In this environment lenders have sought higher interest rates as compensation for the depreciating purchasing power of their savings. Borrowers competing for funds have been willing to pay higher interest rates because they can expect corresponding increases in income from investments financed through borrowings. Consequently, rising rates of inflation have led to higher interest rates.

High interest rates increase the opportunity cost of holding noninterest-bearing assets and encourage the economizing of such assets. An example of how this leads to innovation is seen in the case of commercial banks, which are required by law to hold reserves in the form of noninterest-bearing assets.[3] The interest foregone on these reserves, and hence the cost of holding them, rises with the level of market interest rates. In a period of high rates, banks try harder to reduce the amount of reserves required by law. Banks can do this by encouraging shifts in liabilities from categories like demand deposits, which have a relatively high reserve requirement, to categories for which lower, or even no, reserves are required. For example, they might offer to enter repurchase agreements with customers holding demand deposits. This involves selling the customer government securities under agreement to buy

[3] Reserve balances of member banks held with the Federal Reserve are noninterest bearing. Nonmember banks hold reserves as specified by the individual states. A number of states allow various types of earning assets to satisfy their reserve requirements.

the securities back at a somewhat higher price (determined by prevailing market interest rates on such contracts) after a stipulated period, usually one to seven days. Such repurchase agreements (RP's) are liabilities of the bank to its customers, as are demand deposits. The difference is that, for a large bank, the reserve requirement against RP's is significantly lower than that against demand deposits.[4] Consequently, the bank in effect pays interest to the customer and simultaneously reduces its required reserves.

Commercial banks can achieve these results in a variety of other ways as well. Their efforts to do so have resulted in a significant diversification of bank liabilities, hence in the claims on banks held by bank customers. As mentioned above, the liabilities side of bank balance sheets now include, in much larger proportion than in the 1960's, RP's, Federal funds purchases, negotiable and nonnegotiable CD's, consumer type CD's, and in the case of large banks, Eurodollar borrowings and other liabilities to foreign branches. These liabilities all involve lower legal reserve requirements than demand deposits. To the extent that banks can find ways to convert demand deposit liabilities into these other forms, required reserves are reduced, allowing a given reserve to support a higher volume of both earning assets and liabilities.

High interest rates provide incentives for individuals and businesses to shift out of demand deposits and into these new types of bank liabilities. Hence, commercial banks and other financial institutions find a ready, indeed eager, market for new interest-bearing liquid substitutes for demand deposits that their ingenuity can devise. As a matter of fact, sharp-penciled corporate treasurers have been known to insist that their bankers stand ready to enter overnight repurchase agreements with them so that they can earn interest on balances that can be used rather promptly for making payments.

Arrangements allowing banks to reduce required reserves and the public to reduce its holdings of demand deposits are motivated simply by a desire to minimize individual costs of doing business. Unfortunately, however, the aggregate effect of these arrangements is the creation and rapid growth of highly liquid assets used by the public in place of demand deposits. As explained in Section V, this complicates monetary control.

The rapid development of computer and communications technology has given individual institutions the capacity to process massive amounts of data and to make transfers rapidly and efficiently. In many instances, sophisticated new equipment has resulted in sizable amounts of excess capacity, thereby creating incentives for expanding existing services and offering new kinds of services. In short, the revolution in computer and communications technology has played an important role in recent financial innovation.

Between the early 1930's and the 1960's, bank regulatory philosophy was dominated by a preoccupation with the soundness of individual institutions. Competition in banking was viewed as a double-edged sword, incorporating notable disadvantages as well as some generally accepted advantages in improving the quality of banking services to the public. Indeed, some bank regulations, such as the prohibition of the payment of interest on demand deposits and the limitation on interest payable on savings deposits, were designed explicitly to discourage competition.

In the early and middle 1960's major changes were made in Federal and state banking laws and regulations, most tending to encourage competition not only among banks but also between commercial banks and other financial institutions. With the introduction of the negotiable certificate of deposit in 1961, large commercial banks found a way to compete for money market funds. Shortly afterwards, both large and small banks, which up to the 1960's had shown relatively little interest in consumer type savings deposits, began moving vigorously into this market. These moves ushered in an era of ever sharpening competition within the commercial banking community and between commercial banks and other financial intermediaries. Subsequent changes in bank holding company law, liberalization of regulations for thrift institutions, and a more competitive international banking climate reinforced this move to more intensive competition. In any case, there has been in the period after 1961 a more or less steady relaxation of

[4] The marginal reserve requirement on net demand deposit balances over $400 million is 16¼ percent. Until the statement week of October 11, 1979 reserve requirements against RP's were zero. Since then, banks have been required to hold an 8 percent reserve against RP's and certain other categories of managed liabilities above a base amount. The base is either $100 million or the average amount of managed liabilities held by a member bank as of the two statement weeks ending September 26, 1979, whichever is larger. Member bank reserve requirements are listed in the **Federal Reserve Bulletin.**

regulatory constraints and a significant increase in competition among all types of financial institutions.[5]

The steady relaxation of regulatory constraints, however, has not always preceded on the initiative of the regulators themselves. The NOW account case provides a simple illustration of this. The secular rise in interest rates in the late 1960's was especially troublesome for mutual savings banks. As legal ceilings on the interest they could pay became increasingly restrictive, their ability to compete for funds deteriorated and their deposit growth slowed. Federal law prohibited payment of interest on checking accounts, but the prohibition did not extend to mutual savings banks that were not insured by the FDIC. In 1970 a state-insured Massachusetts mutual savings bank, looking for a way to attract deposits, petitioned the state commissioner of banking for authority to offer NOW accounts. The petition was denied but, on appeal, the state supreme court overturned the denial on grounds that state law provided no restrictions on the form in which deposits could be withdrawn. With the public becoming increasingly aware of losses suffered by earning no interest on checking balances, Federal law authorized the issue of NOW accounts by commercial banks and thrift institutions, first in Massachusetts and New Hampshire, then in all New England states, and finally in New York and New Jersey. To preserve competitive equity nationally, commercial banks have been allowed to offer automatic transfer services beginning in November 1978.

III.
A REVIEW OF SPECIFIC DEVELOPMENTS

Table I is a roughly chronological listing of innovations that have permitted the public to reduce its reliance on demand deposits. The influence of each of these developments on the management of payments balances by businesses and households is described below.

Corporate Cash Management Like other economic units, businesses have an incentive to minimize cash held for payments purposes. Doing so is a complex task, however, especially for large corporations whose operations are widely diversified geographically and by product line. A number of specialized cash management techniques have been developed to improve the efficiency with which money positions are managed. Some of these techniques, e.g., cash flow forecasting and internal accounting control systems, are available in-house or through nonbank vendors. Because of their central role in the payments process, however, commercial banks are the most important suppliers of corporate cash management services. Bank sponsored cash management systems are designed to accelerate collections into a large firm's regional checking accounts and then to further concentrate demand deposits into one account used to pay bills and fund short-term investments. The key elements in such a system include cash concentration, disbursement, and investment management.

The first step in cash concentration is development of a collection system for funds based on a group of local and regional banking organizations selected for their proximity either to the firm's field operations or to its customers. Customers are instructed to mail their payments to a lockbox under the control of a local bank, which collects remittances and credits the firm's checking account.[6] Information on the amount of collected balances in these local depositories is gathered by telephone, and then a depository transfer check (DTC) is written payable to an account in a regional "concentration" bank and drawn on the various local banks. The DTC, which is a nonnegotiable check that requires no signature, is commonly used to transfer funds between a corporation's accounts held in different banks. Since the DTC can be deposited in the regional concentration bank immediately after account balances are ascertained by phone, overnight credit is available as long as the regional bank and local depositories are all located in the same Federal Reserve regional check processing area. The regional bank can then wire the collected funds to the corporation's master checking account held at a bank in the home office city.

Disbursement of corporate funds can be centralized, all checks being written from the master account, or decentralized, with separate divisions of the company making payments in their respective localities. Centralized cash control can be maintained even in a decentralized check-writing environment using zero-balance accounts. Under this system, a com-

[5] An exception to this steady relaxation of regulatory constraints is the **Interest Adjustment Act** of 1966, which extended coverage of deposit rate ceilings to the thrift industry and established a differential between maximum rates that banks and thrifts could pay on deposits. This action was a direct result of the heightened competition for consumer deposits occurring in the early- and mid-1960's, which had resulted in a decline in thrift institution deposit growth relative to bank deposit growth.

[6] A simple rule of thumb is to choose local lockboxes so that mail from company operations in an area can be delivered overnight.

Table I

SUMMARY OF REGULATORY, LEGISLATIVE, AND TECHNICAL DEVELOPMENTS ENABLING THE PUBLIC TO REDUCE ITS RELIANCE ON NONINTEREST-BEARING DEMAND DEPOSITS

Development	Date or Period	Description
(1) Corporate cash management services	post-World War II	Corporate cash management services, for example, lockboxes, cash-concentration accounts, and information-retrieval systems, are technical innovations permitting more efficient management of cash balances. Their introduction by commercial banks goes back many years, although such services came to be used much more widely after World War II.
(2) Negotiable certificates of deposit (CD's)	1961	Negotiable CD's are marketable receipts for funds deposited in a bank for a specified period at a specified rate of interest. This instrument was originated in 1961 by a large money center bank.
(3) Savings accounts for state and local governments and businesses	1960's, 11/74, 11/75	Federally chartered savings and loan associations have been authorized to offer local governments and businesses savings accounts since the 1960's. Commercial banks were authorized to accept savings deposits from local governments starting November 1974 and from businesses (up to $150,000) starting November 1975.
(4) Telephone transfers from savings accounts	1960's, 4/75	Telephone transfers allow savings account customers to transfer funds either to checking accounts or to third parties by phone. Federal savings and loan associations have had this authority since the 1960's, whereas banks were granted it in April 1975.
(5) Repurchase agreements (RP's)	1969	Repurchase agreements are primarily short-term contracts for the purchase of immediately available funds collateralized by securities. RP's grew rapidly beginning in 1969 after Regulation D was amended to explicitly exempt from reserve requirements RP's backed by the sale of U. S. Government or Federal agency securities.
(6) Preauthorized third-party transfers	9/70, 4/75, 9/75	Preauthorized transfers are payments made from savings accounts for recurring transactions. Savings and loan associations were permitted to make preauthorized nonnegotiable transfers from savings accounts to third parties for household-related expenditures in September 1970 and for any purpose beginning in April 1975. Commercial banks were permitted to make preauthorized nonnegotiable transfers from savings accounts to third parties for any purpose in September 1975.
(7) Negotiable Order of Withdrawal (NOW) accounts	5/72, 9/72, 1/74 3/76, 10/78, 12/79	NOW accounts are savings accounts from which payments can be made by draft. State-chartered mutual savings banks began offering NOW accounts in Massachusetts after a May 1972 state court ruling authorizing such deposits. NOW's were offered by state-chartered mutual savings banks in New Hampshire in September 1972 with the approval of the state bank commissioner. Beginning January 1974 Congress authorized all depository institutions in the two above mentioned states to offer NOW's. Beginning March 1976, Congress authorized NOW's at all depository institutions in Connecticut, Maine, Rhode Island, and Vermont, authority that was extended to New York in November 1978 and New Jersey in December 1979.
(8) Savings and loan remote service units (RSU's)	1/74	RSU's are machines that allow a customer to make deposits to, and withdrawals from, his savings account at stores and other places away from the institution maintaining the account. The Federal Home Loan Bank Board authorized RSU's in January 1974. Although ruled illegal in April 1979, Congress subsequently passed legislation legalizing the service until April 1, 1980.
(9) Money market funds (MMF's)	early 1974	Money market funds are mutual funds specializing in short-term investments from which shares can be redeemed by checks drawn on designated commercial banks, or by wire transfer, telephone, or mail. Use of MMF's became widespread beginning in early 1974.
(10) Credit union share drafts	10/74, 3/78	Credit union share drafts are payments made directly from share accounts. An experimental share draft program was approved for Federal credit unions in October 1974 and made permanent in March 1978. Although ruled illegal in April 1979, Congress subsequently passed legislation legalizing the service until April 1, 1980.
(11) Preauthorized savings to checking transfers	11/78	Commercial banks were allowed to offer customers automatic savings to checking transfers starting November 1978. This led to the widespread offering of automatic transfer services (ATS), which are essentially zero-balance checking accounts fed from savings accounts. Although ruled illegal in April 1979, Congress subsequently passed legislation legalizing the service until April 1, 1980.

Source: Adapted from [1].

pany's disbursing agents write checks on designated disbursing accounts maintained at regional banks and having zero balances. Debit balances accumulate in these zero-balance disbursing accounts as checks are written and are offset by charges made on the corporation's master account.

Integral to the concept of corporate cash management is a prompt reporting system that monitors, and perhaps even forecasts, cash flow. Information contained in a reporting system would consist of detailed transactions data, including transfer activity between accounts and daily bank balances. The ultimate objective of such a reporting system is to provide information on the amount of money available for short-term investment.

Negotiable CD's As corporations became more adept at cash management during the 1950's, their investable bank balances increased significantly. Rather than holding idle demand deposits, short-term investments offering high liquidity and low risk were sought. Since few banks offered corporations interest-bearing deposits as alternatives to checking balances, businesses turned to other investment sources, particularly commercial paper, Treasury bills, and repurchase agreements with securities dealers. Consequently, there was a sharp decline in the importance of corporate deposits on the banking system's balance sheet. Large money center banks especially felt this loss of funds since they relied on corporate demand deposits to a greater extent than other, smaller banks. This situation prompted First National City Bank of New York to introduce in February 1961 the large negotiable certificate of deposit (negotiable CD), a new liability specifically designed to attract corporate funds.

Regulations limit negotiable CD's to a minimum maturity of 30 days. Although relatively short, this maturity is still unattractive to businesses seeking an investment outlet that allows quick conversion back to demand deposits. When first introduced in 1961, therefore, it was also announced that a major government securities dealer had agreed to make a secondary market in negotiable CD's. This secondary market makes negotiable CD's an attractive substitute for demand deposits. Corporations holding CD's can sell these in the secondary market at any time to raise cash, while firms desiring investments with maturities shorter than 30 days can acquire CD's with remaining terms to maturity that fit their liquidity needs. The marketability of prime CD's issued by large well known banks is generally greater than that for those issued by lesser known regional institutions. For this reason, investment in money center bank CD's is favored by corporations.

Negotiable CD's possess some characteristics that limit their attractiveness to corporate money managers. In particular, CD's are not nearly as homogeneous (in terms of rates, denominations, and other contractual features) as are, say, Treasury bills. Also, dealers mainly trade prime CD's in denominations of $1 million and will rarely split or consolidate certificates to facilitate a secondary market transaction. For these reasons, negotiable CD's may not always exactly fit the short-term investment needs of corporations. These limitations notwithstanding, negotiable CD's have become a major source of bank funds.

Repurchase Agreements Repurchase agreements (RP's) represent a particularly useful instrument for cash management that has become widely used only in the last few years. RP's are income-generating assets having a very low credit risk that are available in maturities as short as one day. Commercial banks became active suppliers of RP's after 1969 and now offer them as part of the cash management systems marketed to corporations.

Businesses having cash concentration systems are able to determine the amount of investable balances available in their checking accounts each morning. If funds are available to invest for only a very short period, they can be placed in the overnight or one-day RP market. To facilitate placement of idle checking balances in the RP market, an investment technique known as the continuing contract has been developed. Under this type of arrangement, a corporation agrees to provide its bank with a specific volume of funds to be automatically reinvested each day for a specified period. Continuing contracts in RP's reduce transactions costs since funds are exchanged only at the beginning and end of the contract period. Liquidity is preserved, however, since either the corporation or the bank can cancel the contract before maturity. Similar to the continuing contract is the preauthorized transfer arrangement. Under the latter arrangement, banks automatically invest a corporation's master checking account funds above a specified minimum in RP's.

The RP market has grown dramatically in recent years, especially the market for very short-term RP's. A special survey of 46 money center banks conducted in December 1977 showed RP's outstanding to nonfinancial businesses of $10.5 billion—31 percent under one-day contract, 11 percent under continuing contract, 22 percent under two- to seven-day con-

tract, and 28 percent under eight- to thirty-day contract. Another $3.8 billion was outstanding to state and local governments, which, like corporations, are active cash managers. The majority of state and local government RP's are either one-day or continuing contracts. Banks indicate that activity in the RP market has increased greatly since 1977.

Savings Accounts For Business Since a fairly large minimum investment is necessary in negotiable CD's and RP's, these instruments are not generally suited to the requirements of smaller businesses. An amendment to Regulation Q, effective November 10, 1975, has permitted businesses to hold savings accounts at commercial banks, subject to a ceiling limit of $150,000. This change was made to provide an investment outlet to small businesses holding temporarily idle funds. Such balances reached $10.5 billion by June 1979.

Savings and loan associations have been able to offer savings accounts to businesses for many years. Although data on the size of such balances are not available, indications are that they do not make up a large share of savings and loan liabilities.

Telephone and Preauthorized Third-Party Transfers From Savings Accounts Use of bank savings accounts by individuals has had the disadvantage in the past of necessitating personal trips to the bank in order to transfer funds to and from checking accounts. This inconvenience was at least partly reduced by 1975 changes in Regulation Q, allowing banks to transfer funds from savings accounts directly to checking or to third parties on the telephone-originated order of a customer, and also to pay recurring bills directly from savings accounts on a preauthorized basis. Telephone transfers to third parties have been authorized at savings and loan associations since the 1960's, while preauthorized third-party transfers for general purposes have been allowed since 1975.

The effect of these regulatory changes has probably been to increase the substitutability between checking and savings accounts. There is no way to measure directly the impact of telephone and preauthorized transfer services on cash management policies of households or businesses. Savings deposit turnover data do show signs of increasing since 1977, the first year they were collected; and it may be that telephone and preauthorized transfer services have encouraged greater use of savings accounts as payments balances.

There are two features of savings accounts that may discourage their use as demand deposit substitutes. First, in the case of direct bill paying from savings, the customer does not have a cancelled check as a record of payments. This is significant because studies of consumer attitudes toward electronic fund transfer (EFT) services have found a deep-seated reluctance to give up the record-keeping services that cancelled checks provide. Second, banks and thrift institutions typically levy charges on savings account withdrawals above some monthly or quarterly minimum. These charges can be fairly substantial, running sometimes 25 to 50 cents per transfer, thereby raising a cost barrier to heavy use of savings transfers.

NOW Accounts and Share Drafts NOW's are negotiable drafts written on savings accounts at banks, mutual savings banks, and savings and loan associations. Their use is currently confined to New England, New York, and New Jersey. Share drafts are written on accounts at credit unions and can be either negotiable or nonnegotiable. There are currently no geographic restrictions on the use of share drafts. The use of both NOW's and share drafts is limited by law to individuals only. While both are in practice honored as demand drafts, they are legally time drafts on which financial institutions have the right to delay payment for up to 30 days. NOW's offered by thrift institutions and share drafts are "payable through" instruments, i.e., they are cleared through normal check-clearing channels and are paid by a commercial bank with which the issuing thrift institution maintains a correspondent relationship. Federal law limits interest payments on NOW accounts to a maximum of 5 percent, although credit unions are permitted to pay the regular share account rate on balances subject to draft, currently 7 percent.

NOW accounts have been an important catalytic force causing changes in public attitudes toward cash management. This financial innovation, however, has by no means completely altered the public's money management habits. When it passed legislation in 1974 allowing NOW's throughout New England, Congress in a sense created a test of interest-bearing payment accounts. The results of this test show that the public is receptive to interest-bearing payments balances; and also that pricing policies as well as the degree of competition between financial institutions influence the spread of the new service. For example, in Massachusetts and New Hampshire, the first two states where NOW's were introduced, competition between banks and thrift institutions was keen and consequently low-cost pricing of NOW accounts was common. As a result, use of NOW accounts increased rapidly, with the number of ac-

counts per 100 households reaching about 70 by January 1978. In the other four New England states, where NOW's were introduced somewhat later, thrift institutions are generally less of a force than in Massachusetts and New Hampshire. The number of accounts per 100 households in these other four states was much lower, in the 10 to 20 range, by January 1978 [4]. Therefore, local market characteristics appear important in determining the extent to which NOW's are substituted for more traditional forms of payment.

Total balances in NOW accounts as of June 1979 in six New England states and New York were $5.6 billion. Account data on share draft balances unfortunately are not available, but the National Credit Union Administration indicates that perhaps a little less than $1.0 billion of such balances existed as of mid-1979.

Savings and Loan Remote Service Units A remote service unit (RSU) is defined by the Federal Home Loan Bank Board as an information-processing device, and an RSU account is a savings account accessible through such a device. RSU's can be located directly on sites where frequent payments occur, e.g., the supermarket. Since RSU's are not considered branches, there are few administrative barriers to their establishment by savings and loans.

Money Market Funds Money market funds (MMF's) were first offered to the public in 1972; but their importance, as measured by growth in number of shareholders and balances in shareholder accounts, increased rapidly only after 1974, and especially after 1977. It is estimated that individuals held 55 to 65 percent and businesses about 10 percent of the $24.6 billion in MMF's as of June 1979 [3]. MMF's offer individuals and businesses having relatively small amounts of funds access to open market investments that in the past were available only to large corporations.

It is reasonable to think of MMF's as being at least partial substitutes for demand deposits. Like savings accounts, they offer high liquidity, since fund shares can be purchased or sold on any business day without a sales charge. Moreover, some MMF's offer a checking option that enables shareholders to write checks in minimum amounts of $500. MMF's, however, appear to have more in common with savings than with demand deposit accounts. Evidence of this is the similarity of turnover rates in MMF accounts and bank savings accounts, both of which are very low compared to turnover rates for checking deposits.

Automatic Transfer Services Automatic transfer services (ATS) allow depositors to arrange with their banks the automatic transfer of funds from an interest-bearing savings account to a checking account and are the functional equivalent of NOW accounts and share drafts. ATS is a direct substitute for traditional checking balances and has been authorized on a nationwide basis for all commercial banks.

Automatic transfer services have been priced more conservatively by banks than were NOW accounts as originally offered in New England. It should also be noted that banks, but not thrift institutions, have been authorized to offer ATS. These two factors have been important in determining the growth of ATS accounts, which expanded rapidly when first introduced but which have subsequently grown much more slowly. For example, ATS balances increased from zero in November 1978 to $6 billion in April 1979 but then rose by only another $600 million through June 1979. Rough estimates place the proportion of funds in ATS balances coming from demand deposits at 50 percent, or about $3.3 billion through July 1979. This figure is very small compared to the over $90 billion individuals actually hold in checking accounts and shows that ATS has had only a marginal initial impact on traditional payments arrangements.

A Summary Overview Although the developments reviewed above take various forms, there are some general patterns underlying the changes in the payments system during the past several decades. As noted in Section II, many changes in the payments system have resulted from a combination of regulatory and legal actions, but it appears that private initiative has been the primary force leading to financial innovation. A number of these innovations, including corporate cash management services, negotiable CD's, repurchase agreements, NOW accounts, and money market funds, came into existence without any prerequisite changes in banking regulations or law. Subsequent regulatory or legal action has been important in encouraging the development of some of the newly introduced services, but it is not clear that such official action would have occurred without the impetus provided by private initiative.

Competition in the financial markets explains a large part of the private initiative in the payments system. Given a competitive environment for financial services, financial innovations that are demand deposit substitutes and pay interest, or that pay interest and can be quickly converted to cash, offer

opportunities to aggressive banks and thrifts seeking to increase their shares of the deposit market.

The earliest innovations primarily benefited businesses, since businesses generally operate on a larger scale than do individuals and consequently maintain larger average transactions balances with a significantly greater potential gain from efficient management. Also, in the period following World War II, businesses operated with much higher ratios of transactions balances to total financial assets than did individuals. In 1950, for example, the ratio of currency plus demand deposits to total financial assets was about 60 percent for nonfinancial businesses compared to about 25 percent for households.[7] Having a relatively large share of financial assets tied up in noninterest-earning form, businesses had the greater incentive to find ways of improving cash management procedures. Threatened with the loss of corporate deposits to open market debt instruments, the banking industry responded to these improved cash management practices by providing short-term investment opportunities. Thus, the 1960's witnessed the introduction of two new bank liabilities that provide businesses a positive interest return as well as high liquidity, namely negotiable CD's and RP's.

If the 1960's was the decade of business insofar as cash management is concerned, then the 1970's may have been the decade of the consumer. A number of services designed to facilitate efficient management of liquid balances by households were introduced at banks and thrift institutions in the 1970's. First in this group were telephone and preauthorized third-party transfer services from savings accounts. These were followed by NOW accounts, share drafts, ATS, and money market funds. With the exception of money market funds, all of these services rely on the use of interest-bearing savings accounts for direct third-party payments.

On the whole, the innovations which have been described here, taken both individually and collectively, are needlessly complex. For instance, RP's used by businesses and ATS accounts used by consumers entail constant switching of funds between interest-bearing accounts and noninterest-bearing demand deposit accounts. These two services facilitate the circumvention of the prohibition of interest on demand deposits, but they require a greater investment in management time and data processing than do checking accounts. The ingenuity of the financial markets in developing alternatives to demand deposits has resulted in a bewildering array of new monetary assets. The provision of monetary assets by the financial system could be greatly simplified if the law allowed interest to be paid on demand deposits.[8]

IV.
CHANGES IN BANK LIABILITIES AND THE PUBLIC'S LIQUID ASSETS

To what degree has payments system innovation affected the balance sheets of the banking system and the nonbank public? The paragraphs below present some statistical evidence indicating the extent of change in the nonbank public's total holdings of financial assets and in the composition of bank liabilities.

Changes in the Public's Financial Assets There has been a significant reduction in the relative importance of traditional money balances in the public's holdings of liquid assets. The ratio of demand deposits plus currency and coin to this total plus time deposits and credit market instruments is shown for the household and the nonfinancial business sectors in Chart 1. The chart indicates a more or less steady decline in the relative importance of traditional money balances for both sectors since 1950. For the nonfinancial business sector the decline has been especially sharp since 1970, with traditional money balances falling from 56 percent of the total in that year to 39 percent in 1978.

For the household sector (including personal trusts and nonprofit organizations) the decline has been considerably less sharp. As a matter of fact, the fraction of the total in traditional money declined more sharply between 1950 and 1965 than in the period since the latter year and remained fairly stable until 1974. Since that time, however, a noticeable downtrend appears to have developed. For households, the fraction of financial assets held in traditional money form fell from 25 percent in 1950 to 15 percent in 1965 and 12 percent in 1978. For the period since 1970, it appears that financial innovations have had a greater effect on the composition of the liquid holdings of businesses than on those of households.

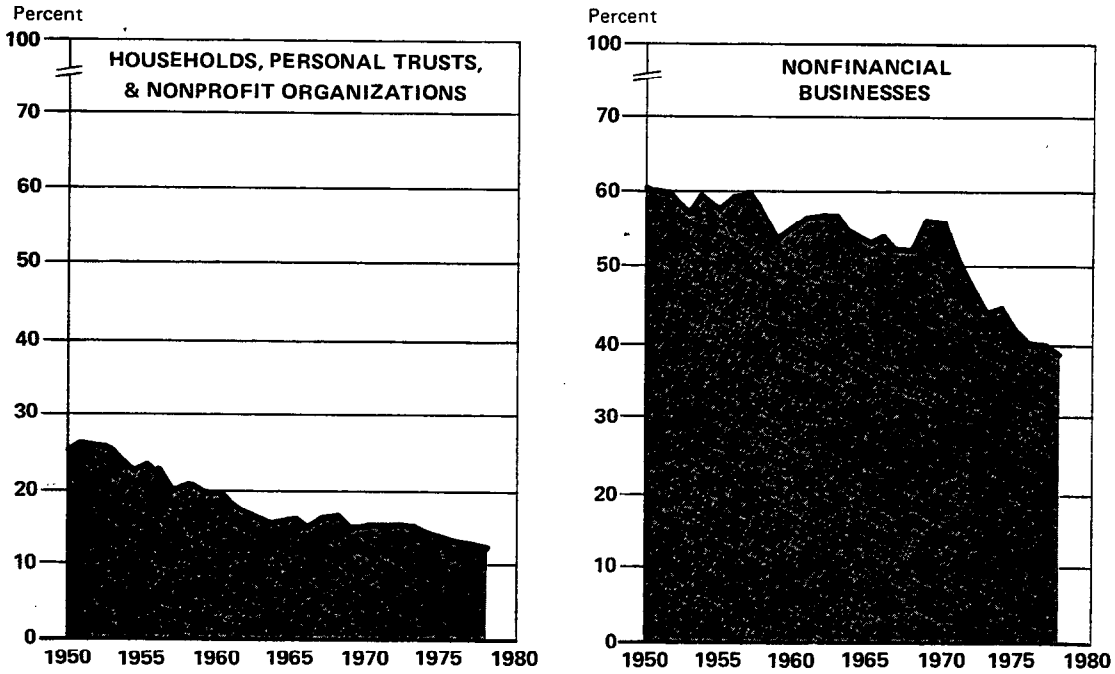
Changes in Bank Liabilities The liabilities structure of the commercial banking system has been

[7] These estimates are derived from **Flow of Funds** data. See Chart 1 on page 23.

[8] The court action declaring ATS illegal has forced Congress to address the question of how far payments system changes should go. As a result, legislation that permits NOW accounts nationwide is actively being considered.

Chart 1

DEMAND DEPOSITS & CURRENCY AS A PERCENT OF TOTAL DEPOSITS, CURRENCY, & CREDIT MARKET INSTRUMENTS



Source: **Flow of Funds.**

significantly altered as a result of the public's efforts to economize on noninterest-earning cash balances. The major change has been a decline in the relative importance of demand deposits compared with net total bank liabilities.[9] For example, private demand deposits declined from 63 percent of net total liabilities in 1960 to just over 31 percent in 1978. This large drop in the ratio of private demand deposits to net total liabilities, which is shown in Chart 2, reflects a major shift in public preferences from noninterest-earning demand balances to time balances and other short-term liabilities such as CD's and RP's. Recalling Chart 1, it appears that since 1970 businesses have economized on money balances more than households. This conclusion is also supported by a comparison of the growth rates in demand deposits held by these two groups. The compound annual rate of growth of household demand deposits over the eight-year period 1970-1978 was 8.3 percent, about a third greater than the 6.2 percent rate for business deposits [5].

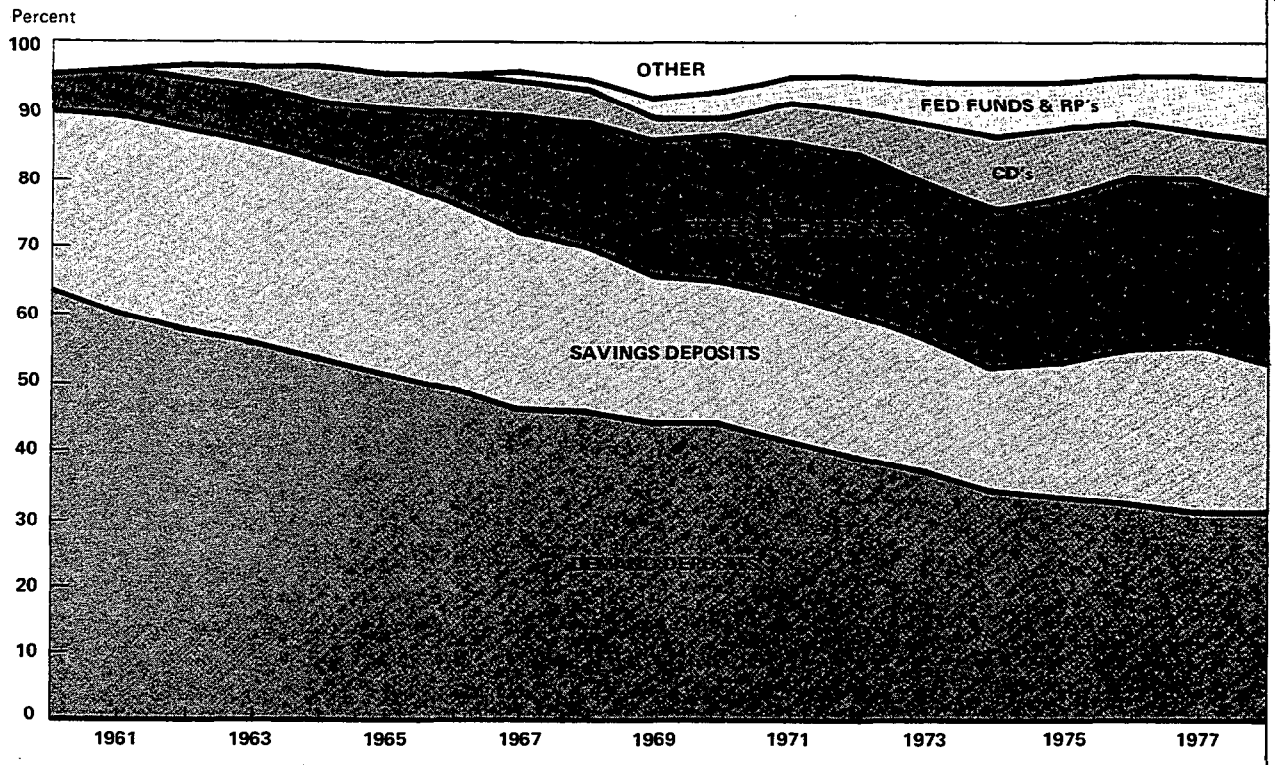
[9] Net total liabilities are defined as total liabilities exclusive of deposits due to other commercial banks.

Chart 2 shows that, as the share of demand deposits to net total liabilities has declined, the shares of time deposits other than negotiable CD's, nonnegotiable CD's, and purchased funds have all increased. From their inception in 1961, negotiable CD's have grown to nearly 10 percent of net total liabilities. Purchased funds, defined to include Federal funds and repurchase agreements, have in only ten years grown to such an extent that they equaled nearly 9 percent of the commercial banking system's liabilities in 1978. Savings deposits declined in importance as a source of funds until 1974, falling from 25 to 18 percent of net total liabilities. After the 1975 regulatory change which allowed businesses to hold savings accounts, however, savings balances gained moderately in importance, reaching 22 percent of net total liabilities in 1978.

The chart shows a steadily increasing concentration of bank liabilities in those forms not subject to Regulation Q interest rate ceilings. Negotiable CD's and purchased funds are largely free of deposit rate regulation and, therefore, offer the public particularly attractive alternatives to holding sterile demand deposit or low-earning savings deposit balances. Demand and savings deposits combined, which at one

Chart 2

SELECTED SOURCES OF FUNDS AS A PERCENT OF THE COMMERCIAL BANKING SYSTEM'S NET TOTAL LIABILITIES *



* Net total liabilities are defined as total liabilities minus interbank deposits.
Source: FDIC, Assets and Liabilities.

time dominated the liabilities side of bank balance sheets, have fallen in relative importance from 90 percent of total liabilities in 1960 to only 53 percent in 1978.

V. FINANCIAL INNOVATION AND MONETARY CONTROL

Roughly speaking, monetary control means management of the supply of money balances held by the public at depository institutions. The Federal Reserve is concerned with the management of aggregate money balances because these balances are a major determinant of aggregate spending. Aggregate expenditure by the public is, in turn, a key determinant of employment and the rate of inflation. The financial innovations described earlier appear to have interfered with the Federal Reserve's ability to control money growth. A simple view of monetary control is set out below to illustrate the channels through which this interference has been felt.

Control Problems Due to Financial Innovation

The Federal Reserve controls the money supply primarily by buying and selling Treasury securities. Payments made by the Federal Reserve when it purchases securities contribute to what is known as the monetary base. The monetary base consists of currency plus the reserves of the banking system. Since banks hold reserves that are only a fraction of their deposits, each dollar of reserves in the banking system supports several dollars' worth of deposits.

The stock of demand deposits in the banking system constitutes the bulk of what is called the basic money supply or M_1. M_1 has historically served as the nation's payments medium or transactions balances, i.e., money held for the purpose of making payments. Because of its relation to expenditure, M_1 is an important monetary aggregate for the Federal Reserve to control.

To provide a framework for analysis of monetary control, M_1 may be thought of as the product of the stock of base money times a coefficient, m, called the money multiplier, i.e., $M_1 = m \cdot$ [base money].

The Federal Reserve cannot control M_1 directly. Instead, it must do so indirectly by buying or selling Treasury securities to manipulate the stock of base money. For example, if the Federal Reserve wants to raise M_1 by $100 and the money multiplier, m, is 10, it would need to buy $10 worth of Treasury securities to bring about the desired $100 increase.

The Federal Reserve can exercise reasonably close control over the supply of transactions balances by operating on the stock of base money, relying on a relatively predictable money multiplier to achieve the desired results on M_1. However, the rapid pace of financial innovation has made the task more difficult. First, growth of interest-bearing substitutes for demand deposits and currency has made M_1 a less accurate measure of total transactions balances; and second, growth of these substitutes is difficult to predict. Moreover, good data coverage is not yet available because not all financial institutions offering transactions balances are required to report to the Federal Reserve. Therefore, the Federal Reserve does not know whether to interpret a change in M_1 as a change in total transactions balances or simply a substitution by the public of some newly created short-term asset for demand deposits. This means that even if the money multiplier were to remain relatively stable, it would be difficult for the Federal Reserve to know how the stock of base money should be manipulated to affect total transactions balances because M_1 has become a less reliable measure of such balances.

Unfortunately, the money multiplier is not even invariant with respect to substitutions from demand deposits into other types of liquid assets. The reason is that current law requires banks to hold reserves against demand deposits (at graduated rates of 7 to 16¼ percent) that are higher than reserve requirements on demand deposit substitutes. Reserve requirements on NOW accounts, for example, are only 3 percent and there is currently an 8 percent marginal reserve requirement on RP's (see footnote 4). This means that if depositors shift from demand deposits to NOW accounts or RP's, excess reserves are created which enable the financial system to expand loans and increase its deposit liabilities. In other words, the money multiplier (for an appropriate measure of transactions balances) can rise with a shift from demand deposits to NOW accounts or RP's because of the different reserve requirements on these liabilities.

If current laws prohibiting the payment of interest on demand deposits are not changed, continuing financial innovation could eventually lead to the elimination of traditional noninterest-bearing demand deposits. If reserve requirements on the substituted liabilities remain low, the money multiplier will become very large. A larger multiplier is likely to have greater prediction error, and therefore is likely to make controlling money growth more difficult.

Even changes in the level of interest rates can induce changes in the money multiplier. Higher interest rates, for example, provide additional incentive for individuals and corporations to take advantage of interest-bearing substitutes for demand deposits. Compounding the problem is the fact that the short-run willingness of the public to substitute into interest-earning assets or alternative transactions balances is uncertain. The speed of substitution most likely depends, for example, on the time horizon over which individuals anticipate interest rates to remain high. Because average required reserves are decreased or increased as a result of these substitutions, the M_1 money multiplier can rise and fall with interest rates. However, because the degree of substitution is uncertain, so is the relationship between interest rates and the multiplier. Greater uncertainty about the multiplier makes it more difficult for the Federal Reserve to control M_1 through control of the monetary base.

The apparent weakening of Federal Reserve control over the volume of transactions balances has spawned a number of proposals for basic reform to improve the quality of the System's money control mechanism. A number of such proposals have been discussed at length in Congressional hearings on financial and banking reform. Some have been incorporated in legislative proposals that are in various stages of consideration by the Congress and might be acted on in 1980. A brief critique of those proposals designed to improve monetary control is presented in the sections that follow.

Extending the Coverage of Legal Reserve Requirements Shifts between deposit instruments with different reserve requirements account for much of the unpredictability in the money multiplier. Extending uniform reserve requirements to all transactions balances at commercial banks would therefore be useful in improving monetary control. However, if regulators continued to impose significantly lower reserve requirements on deposits held outside commercial banks, it would be of only limited value. Deposit institutions whose transactions-type accounts are nonreservable will be able to offer interest rates above those of institutions that must hold a larger portion of their funds in noninterest-earning required reserves. Nonreservable balances would therefore

tend to drive reservable balances out of use. The resulting money multiplier between the stock of transactions balances and the monetary base would consequently be much higher. Controlling the stock of transactions balances with the monetary base would be more difficult, because each dollar error in controlling the base would then have a greater effect on the stock of transactions balances.

Radical expansion in the usual coverage of reserve requirements would appear to be necessary to eliminate different reserve requirements among potential transactions balances while at the same time preventing the money multiplier from increasing. The problem is to devise a law that would allow only those deposits not used as transactions balances to qualify as nonreservable. For example, the law might state that customer orders to transfer funds be delayed at least a week for an account to qualify as nonreservable. But this rule might be circumvented by setting up revolving certificates maturing every eight days, so that one-eighth of the account could be transferred on any business day. This simple example illustrates the potential difficulty in enforcing a law requiring all balances used for transactions purposes to have the same reserve requirements as demand deposits.[10]

Removal of Regulatory Ceilings on Interest Rates If prohibitions against offering competitive rates of interest at depository institutions were eliminated, then interest rates on deposits at these institutions would tend to move more closely with the general level of interest rates. For example, interest differentials between deposits and other liquid assets such as money market mutual funds would become more stable. This would greatly reduce the incentive to switch from transactions type deposits to higher yielding liquid assets when interest rates rise.

Monetary control would be improved for two reasons as a result of this regulatory reform. First, because there would be less switching among liquid assets with changes in the level of interest rates, a given stock of bank reserves would produce a more stable basic money supply, M_1. Second, because the incentive for use of alternative types of transactions balances would be reduced, M_1 would become a more comprehensive measure of transactions balances. The Federal Reserve's data on transactions balances would become more reliable since it would not, as it currently does, depend on an estimate of the extent to which newly created liquid assets such as RP's or MMF's are being used as transactions balances.

Financial intermediation for banks involves longer maturities on assets than liabilities. Consequently, average returns on bank assets that provide income to pay interest on demand deposits change more slowly than short-term interest rates. Therefore, even if deposits were to pay interest, deposit rates may not move perfectly together with other short-term rates. However, the level of interest rates over longer periods of time varies largely because of changes in inflationary anticipations. The effect of anticipated inflation is reflected in all interest rates. Therefore, rates paid on demand deposits would move in line with other rates on a secular basis. As a result, paying interest on demand deposits would greatly improve the secular stability of the money multiplier and facilitate long-run monetary control.

Lowering the Long-run Rate of Money Growth Since the rate of money growth is a major determinant of the long-run rate of inflation, the secular rate of inflation can be lowered if reasonably low secular money growth is maintained. A lower rate of inflation would reduce interest rates. As a result, incentives to substitute new forms of interest-bearing transactions balances for traditional demand deposits would be reduced, even if interest payments on the latter continue to be prohibited. The consequent reduction in financial innovation would greatly facilitate monetary control.[11]

VI. CONCLUSION

This article has highlighted some important causes and consequences of the rapid pace of financial innovation of recent years, especially as it relates to the nation's payments system. First, high market interest rates, different reserve requirements on various types of deposits, and legal restrictions on the payment of interest on demand deposits have together provided increased incentive for the market to create

[10] This illustration is taken from Cagan [2].

[11] This conclusion must be qualified by recognizing that the desire of thrift institutions to offer a greater variety of banking services may be independent of the rate of inflation and level of nominal interest rates. To the extent that this is true and to the extent that relevant prohibitions are relaxed, thrift institutions may behave more like banks in the future. This would mean that even if the rate of inflation is reduced and nominal interest rates come down, thrift institution liabilities may become more like transactions balances and their significance in money supply measurement may have to be reconsidered.

and use new kinds of deposit liabilities. Second, rapid development of computer and communications technology has contributed to this outcome. Third, regulators have allowed greater competition among financial institutions, thereby promoting more rapid innovation.

Because financial innovation involves creation of money substitutes, it causes problems for monetary control. In particular, difficulty in forecasting growth of demand deposit substitutes reduces the predictability of the money multiplier. In addition, since data on demand deposit substitutes are limited, it is hard to know the extent of their use, and consequently, it is hard to estimate the total stock of money.

Fortunately, reforms can ease this monetary control problem. The most important of these include extending the coverage of legal reserve requirements to all deposits used as payments balances and removing restrictions on interest payable on deposits. Adoption of these reforms should go a long way toward improving monetary control.

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