FEDERAL RESERVE BANK OF ST. LOUIS

JULY 1977

REVIEW

CONTENTS

Vol. 59, No. 7

The Nature and Origins of the U.S. Energy Crisis

JAI-HOON YANG

AGGREGATIVE economic policy is designed to stabilize the general price level and the growth in output and employment. Monetary policy, as a general tool of aggregate demand management, seeks to achieve these goals by affecting the volume of total spending in the economy. Whether ultimate goals of this policy are achieved depends to a large extent upon the external shocks to which the economy is subjected. Regardless of the sources of these shocks — weather, foreign actions, or changes in institutional conditions — they must be taken into consideration in the process of monetary policy planning and execution. One of the recent shocks has been the sudden and dramatic increase in the relative price of energy, which has significantly affected U.S. productive capacity.[1] This article traces and analyzes the underlying factors which were instrumental in rendering the U.S. economy vulnerable to the energy shock.

In the wake of the Arab oil embargo in 1973-74 and the weather-induced natural gas crisis in the winter just passed, concern about an energy crisis has spread across the U.S. The crisis often has been identified as an *energy gap* manifested as shortages of gasoline in 1974, and of heating oil and natural gas last winter. The emergence and the prospective persistence of such an energy gap often have been diagnosed as being the result of rising demand for energy and dwindling supplies of oil and natural gas. However, such a perception of the nature and the roots of the energy crisis is based on an uncritical acceptance of the "lump-of-energy" conception and on a denial of the laws of demand.

An alternate view of the energy crisis rejects the identification of the energy problem as a growing imbalance between the absolute quantity of energy demanded and supplied. Rather, the energy problem is diagnosed as the apparent "failure" of the energy market to accommodate the amount of energy demanded at policy-mandated prices, and the seemingly progressive deterioration in the capacity of the energy market to adjust to man-made and weather-induced shocks.

The history of U.S. energy markets reveals that the roots of the current crisis have been nurtured by past public policy measures. These policies were adopted in response to demands by segments of the energy industry for protection from the rigors of market competition. The crisis is rooted in the supplanting of the market mode of competition by the political mode. From this perspective, it is difficult to avoid the conclusion that past public policies (pursued to shelter some segments of the energy industry) have been, in large measure, responsible for the energy crisis.

THE NATURE AND ROOTS OF THE U.S. ENERGY CRISIS: TWO VIEWS

A Prevalent View

A widely accepted diagnosis of the nature of the U.S. energy crisis is one of growing imbalance in the nation's energy budget. Such a diagnosis is based on the premise that the amount of energy demanded will continue to increase, while the amount of oil and natural gas supplied will diminish.[2] The "crisis" the U.S. faces is often said to be a grave threat to the nation's economic security and the American way of life.

This conception of the energy crisis is, thus, that of an inexorable emergence and worsening of an *energy gap,* unless dependence on nonrenewable fossil fuel in general, and on oil and natural gas in particular, is not reduced. In estimating the length of the "grace period" during which plans for an oilless future must be made, the projections of energy "demands" are based upon alternative assumptions of the rate of growth in energy usage in the form of oil consumption. Such projections are typically made by extrapolating the historical

[1]Robert H. Rasche and John A. Tatom, "The Effects of the New Energy Regime on Economic Capacity, Production, and Prices," this *Review* (May 1977), pp. 2-12 and "Energy Resources and Potential GNP," this *Review* (June 1977), pp. 10-24.

[2]S. David Freeman, Director, *A Time to Choose,* Final Report by the Energy Policy Project of the Ford Foundation (Cambridge: Ballinger Publishing Co., 1974).

rates of growth in energy usage and by assuming different (lower) rates of growth under alternative conservation plans.[3] Then, given geological estimates of potentially recoverable oil reserves, the computation of the grace period becomes routine.

For example, some estimates of the grace period use as a benchmark the estimate of about 2 trillion barrels of total world recoverable oil. Even using a "conservative" projection of a 3 percent rate of growth in oil demand, as contrasted to the 8 percent rate of growth in the 1960s, the world's presently estimated recoverable oil resources would be exhausted before 2020. The arithmetic is unassailable and, hence, the spectre of freezing in the dark arises if the U.S. is not weaned away from its dependency on oil in time.[4]

The policy prescriptions that often follow from such a view of the energy problem are mandated conservation and the pursuit of technical energy efficiency during the transition into a new energy regime.[5] Such a transition is deemed to be facilitated by a mix of standby and regular excise and consumption taxes on energy, subsidies, tax credits, "reform" of the utility rate-making procedures, a system of incentive pricing for *new* oil and natural gas, and by a set of mandatory allocations and conversions to coal — the more plentiful "interim" fuel.

An Alternate Market-Based View

The essence of the energy problem from the alternate view is that the problem is one of apparent (or potential) "malfunction" in the market for energy. This view focuses squarely on the capacity of the energy market to respond to unforeseen shocks, such as the recent oil embargo and severe weather, and to accommodate foreseeable changes in the quantity of energy demanded. When the energy problem is framed in this manner,[6] the accumulated stock of knowledge regarding the functioning of markets can be used to diagnose the nature and the origins of the energy problem.

Despite its importance, energy must be viewed as a commodity not unlike any other commodity that competes for a share of limited budgets. Hence, the amounts of energy demanded and supplied are both determined by laws that govern consumer and producer behavior.

According to the *first law of demand,* the lower the price (that is, the lower the sacrifice incurred in terms of other goods that have to be given up to purchase energy), the higher is the quantity demanded, other things being equal.[7] And, according to the *second law of demand,* the longer the elapsed time after a price fall, the greater will be the extent of substitution toward the commodity which has become cheaper. As prices fall, increases in the quantity demanded occur, first, because more is demanded by the *present* users and, second, because *new* users enter the market.

Such an adaptive behavior on the part of consumers is mirrored in a similar behavior on the part of producers in an exchange system organized within a general private property framework. Thus, a greater quantity of energy will be supplied as prices rise because more energy will be supplied by the *present* producers and *new* (higher-cost) producers will be enticed to enter the market.

The nature of the energy problem from the market view is the "inadequate capacity" of the energy market to adjust to unexpected shocks, such as the man-made oil embargo and nature-induced severe weather conditions. Such a conception of the nature of the energy problem leads one to heed Santayana's dictum that, "those who do not learn from history are condemned to repeat it," and to study the history of energy markets in the U.S. for a clue to the roots of the current energy crisis.

Such a study of the history of energy markets, especially the markets for oil and natural gas, reveals some general characteristics of the energy market which have circumscribed its adjustment capacity, such as the exceptionally long (three-to five-year) lead

[3]Ibid., pp. 19-25.

[4]For a graphic illustration of the apocalytic vision of the dismal energy future evoked by the recent discussions of the energy crisis, see Isaac Asimov, "Essay," *Time* (April 25, 1977), p. 33.

[5]Such a regime is characterized by renewable and essentially inexhaustible energy sources, such as solar and wind energy, and viable nuclear fusion technology.

[6]For a statement of this approach, see Armen A. Alchian, "An Introduction to Confusion," in *No Time to Confuse* (San Francisco: Institute for Contemporary Studies, 1975). Also see Edward J. Mitchell, *U.S. Energy Policy: A Primer* (Washington, D.C.: American Enterprise Institute (AEI), 1974); Hendrick S. Houthakker, *The World Price of Oil* (Washington, D.C.: AEI, 1976), Washington, D.C.; and Douglas R. Bohi, Milton Russel, and Nancy McCarthy Snyder, U.S. Congress, House of Representatives, Committee on Banking, Currency, and Housing, *The Economics of Energy and Natural Resource Pricing,* A Compilation of Reports and Hearings, 94th Congress, 1st Session, Parts 1 and 2, March 1975, pp. 1-230.

[7]Armen A. Alchian and William R. Allen, *University Economics,* 3rd. ed. (Belmont, California: Wadsworth Publishing Company, 1972), pp. 60-66.

times for end-use delivery and the common pool problem.[8] More importantly, a historical inquiry, which will be discussed in greater detail in later sections, also reveals that deep government involvement in the past has greatly attenuated the adjustment capacities of the energy market.

For example, the legacy of the demand prorationing system,[9] which arose in the 1920s, and the subsequent voluntary and mandatory import quotas on oil products (on national security grounds) in the 1950s, is evident in the current problem. Indeed, the formation of the oil producers' cartel (OPEC) in 1960 was proximately caused by the imposition of mandatory import quotas in the U.S. in 1959.[10] The Supreme Court's ruling on the Phillip's case in 1954 also was one of the roots of the current energy problem.[11] The more recent price controls on energy imposed in mid-1971 also have had adverse effects.

The unifying thread in the apparently disparate set of causes of the energy problem, is the replacement of the market mode of competition by the political mode of advocacy politics. The more successful were those who sought relief from the rigors of competition through political means, the less robust became the adjustment capacity of the energy markets to unforeseen shocks.

Comparison of the Two Views

The market-based view of the energy crisis denies the usefulness of the prevalent conception of the energy crisis as that of an ever accelerating shortfall in the amount of BTUs (British Thermal Units) embodied in finite and nonrenewable oil and natural gas. The fatal flaw in the prevalent view is the failure to perceive the fundamental distinction between (1) rising prices in response to changes in underlying schedules of demand and supply, and (2) the phenomenon of rising shortages in quantity supplied relative to quantity demanded, because prices *do not* or *are not allowed* to adjust fast enough to equate the quantity demanded to quantity supplied.

According to the market view, the adherents of the prevalent view, in advancing their various scenarios of impending disaster, ignore adaptive human behavior under perceived changes in scarcity and opportunities. They base their scenarios instead on the arbitrary projections of quantity demanded relative to estimates of fixed "recoverable" reserves of oil and gas.[12] Such a mechanistic conception of the problem neglects the roles which changes in price and technology play in inducing revisions in the estimates of recoverable reserves, as well as in altering the quantity demanded of oil and gas *and* the quantity supplied of alternate sources of energy. Such neglect reflects two underlying false premises.

The first premise is that energy is an "essential resource." According to this premise, the demand for energy is insensitive to changes in its price. The premise, in essence, denies the fundamental laws of demand. This premise is falsified by the available evidence which indicates that the quantity demanded of energy is sensitive to both its price and consumer income.[13] More importantly, the price sensitivity of demand for energy is greater in the long run than in the short run.

---

[8]The common pool problem is similar to the fishery problem in that both arise due to the ill-defined property rights over the common resource at issue. Typically, the applicable law with regard to property rights is the rule of capture. That is, the exclusive property rights are created at the instant of capturing fish or drawing oil from the pool. There exist, therefore, incentives for co-owners of the pool to extract as much of the oil as they singly can. Such an unrestrained behavior on their part, however, tends to reduce the ultimate amount of oil recoverable by drilling, relative to the more paced rate of drilling known as the "maximum efficient rate of production (MER)." Hence, the logic of joint maximization would call for a rate of production not to exceed MER. The problem involved in striking an agreement to promote joint maximization is similar to the one in forming a cartel of producers to coordinate production decisions. See U.S. Congress, Senate, Committee on the Judiciary, *Governmental Intervention in the Market Mechanism: The Petroleum Industry,* Hearings before the Subcommittee on Antitrust and Monopoly, 91st Congress, 1st Session, Part 2, 1969, pp. 1070-71.

[9]Market demand prorationing refers to the system of allocating production quotas to individual oil producers. It arose in response to the common pool problem in the production of crude oil. Since the transaction costs (inclusive of negotiation and enforcement costs of agreed upon output shares) involved in determining the oil to be drawn from a common pool by co-owners are substantial, such determination was done through the mediation of various state regulatory commissions. Rationing of the quota was specified in terms of the allowable percentage of MER (maximum efficient rate of production), with a view to controlling total production such that the targeted market price of oil could be sustained. Ibid., pp. 1069-73.

[10]See Kenneth W. Dam, "Implementation of Import Quotas: The Case of Oil," *The Journal of Law and Economics* (April 1971), pp. 1-60.

[11]The Supreme Court ruled that the Federal Power Commission *must* regulate the wellhead price of natural gas flowing in interstate commerce. Phillips Petroleum Company V. Wisconsin, 347 U.S. 622, 1954. See Edmund W. Kitch, "Regulation of the Field Market for Natural Gas by the Federal Power Commission," *The Journal of Law and Economics* (October 1968), pp. 243-80.

[12]For a discussion of various concepts of (mineral) reserves and the problems in estimating them, see U.S. Congress, House of Representatives and Senate, Joint Economic Committee, *Adequacy of U.S. Oil and Gas Reserves,* 94th Congress, 1st Session, 1975, pp. 14-27.

[13]Dale W. Jorgenson, ed., *Econometric Studies of U.S. Energy Policy* (Amsterdam: North-Holland, 1976); Also Houthakker, *The World Price of Oil*, p. 8.

The second premise is that the reserves of oil and gas in particular, and other nonrenewable energy resources in general, are a predetermined, fixed "lump" which is independent of both price and technology. This premise ignores the fact that reserves are essentially adjustable inventories which the energy producers hold in order to safeguard their market positions. The amount of reserves (inventories) producers want to hold, then, is dependent upon the perceived cost of holding them relative to the expected returns from such holdings.

The prevalent view of the nature and origins of the energy crisis is, thus, based on twin fallacies: the lump of energy fallacy and the denial of the fundamental laws of demand. Such a view tends to ignore the following facts: (1) that the demand for energy is a derived demand,[14] (2) that energy produces valued output in conjunction with other scarce factors of production (such as labor and capital), (3) that other factors are substitutable for energy in the production process (hence other factors are valuable, as is energy), and (4) that the substitution of one form of energy for another depends on the relative cost of alternative forms of energy.[15]

Underlying the prevalent view is a concept that could be characterized as the "BTU theory of value." A strict BTU theory of value would hold that energy is the *only* scarce resource and, as such, is as fallacious as the Marxian labor theory of value, which holds that labor is the sole source of value. If the issue is presented so starkly, one would be hard put to find an advocate of such a BTU theory of value. However, the theory, at least in its applied forms, appears to have substantial adherents.

A variant of the BTU theory of value imputes an inherent, independent value to a specific source of BTUs, such as oil or natural gas. This variant denies the proposition that a dollar's worth of energy (in whatever form) is equal in value to a dollar's worth of labor or capital. Therefore, a question regarding the cost of conserving energy in terms of non-energy factors of production is seldom raised explicitly in assessing the comparative merits of various energy programs.

For example, some proposals to conserve the BTUs embodied in natural gas would use taxation and other measures to induce conversion to coal of electric power and industrial plants, designed to operate on natural gas. The question of cost-effectiveness in terms of the *total* resource use, relative to the desired output forthcoming from the production process, is seldom fully addressed. Implicit in this view is either a belief in the inherent value of the BTUs embodied in natural gas and the denial of the scarcity value of other cooperating factors, *or* a lingering belief that the price of natural gas does not, or will not be permitted to, reflect its true scarcity value.[16]

The market-based interpretation of the energy problem implies that the urgent task of public policy is to make the energy market *more* responsive to *unexpected* shocks and *expected* changes in market demand and supply conditions. Such a goal is likely to be achieved only if tinkering in the energy market by self-serving domestic power groups, acting through the government, is effectively curtailed.[17] Public pol-

[14]Demand for energy is a derived demand in the sense that an energy resource is not wanted for its own sake but for the output of the objects of more immediate consumption, such as comfortable temperatures and transportation services, which energy helps to produce.

[15]For recent articles which document the "abundant" availability of energy at higher market prices (from such sources as untapped natural gas reservoirs, Devonian shale and geopressured methane), see *The Wall Street Journal* editorial pages, 27 April 1977 and 14 June 1977. For an account of a series of substitutions of alternate fuels used for illuminants as the price of whale oil (the dominant lighting fuel in the U.S. in the early 1800s) rose drastically, see Murray L. Weidenbaum and Reno Harnish, *Government Credit Subsidies for Energy Development* (Washington, D.C.: American Enterprise Institute, 1976), pp. 4-5.

[16]Should the price indeed reflect the true scarcity value of natural gas, and, even given that, should some industrial users decide to use natural gas in conjunction with the natural gas powered capital goods already put in place (presumably because the total resource cost is lower than the alternative of enforced capital replacement), the only basis for questioning such a decision appears to be a BTU theory of value.

[17]In case of a discrepancy between direct private costs and total social cost of using energy resources in the presence of pollution externalities, an intervention through excise taxes could be appropriate. It may also be appropriate to attempt to induce changes in the discount rate that market participants use to optimize the time distribution of extraction and consumption of energy resources, if a demonstrable basis exists for a bias in the market interest rate. For a classic discussion of the problem of social cost, see Ronald H. Coase, "The Problem of Social Cost," *The Journal of Law and Economics* (October 1960), pp. 1-44. For a voluminous literature inspired by the Coase work, see William J. Baumol, "On Taxation and the Control of Externalities," *The American Economic Review* 62 no. 3 (June 1972), pp. 307-322 and various comments on the article together with "Reply," *The American Economic Review* 64 no. 3 (June 1974), pp. 462-92. For a discussion of the "proper" social discount rate for capital deepening decisions, see Kenneth J. Arrow, "Discounting and Public Investment Criteria," in *Water Research*, A. V. Kneese and S. C. Smith, eds. (Baltimore: Johns Hopkins Press, 1966), pp. 28-30; Jack Hirshleifer, James C. DeHaven, and Jerome W. Milliman, *Water Supply* (Chicago, The University of Chicago Press, 1960), pp. 139-41; Stephen A. Marglin, "The Social Rate of Discount and the Optimal Rate of Investment," *The Quarterly Journal of Economics* 77 no. 1 (February 1963), pp. 95-111; Gordon Tullock, "The Social Rate of Discount and the Optimal Rate of Investment: Comment," *The Quarterly Journal of Economics*, 78 no. 2 (May 1964), pp. 336-45.

icy becomes questionable if it is based exclusively on conserving particular forms of energy, such as oil and natural gas, without an explicit regard to the total cost of that policy, including the capital cost, relative to the demonstrable total benefits.

PAST PUBLIC POLICIES AS THE ROOTS OF THE ENERGY CRISIS

The Natural Gas Market

The controls on the wellhead price of natural gas, which were imposed in the 1960s, were below the market clearing level in the 1960s. According to the first law of demand, mentioned above, the expected result was an increase in the quantity of natural gas demanded by existing users of natural gas. According to the second law of demand, as the lower price persisted, there entered a new class of users, such as electric utilities. At first glance, it would appear that there should have been a "shortage" of natural gas, as the quantity demanded outstripped the quantity supplied when prices are held down artificially. This was not the case, however.

It appears paradoxical that an "artificially" low price of natural gas led to an *actual* increase in consumption, rather than to a mere increase in *attempted* consumption. Why did producers supply enough gas to accommodate the increase in quantity demanded at the artificially low price? The resolution of this puzzle holds a key to unravelling the nature of the fallacy imbedded in the prevalent view of the energy problem.

The technological nature of the natural gas (and oil) industry is such that the industry maintains a relatively high inventory-to sales ratio.[18] The inventories are held in the form of *proved reserves*. The existence of inventories helps to dampen fluctuations in the current price and facilitates quantity adjustments to fluctuations in demand. The amount of reserves (inventories) sellers want to hold is systematically related (1) to the expected future market price relative to the current price, and (2) to the cost of holding inventories.

To understand what we observed in the 1960s — (1) the simultaneous lowering of the regulated price of natural gas below the market clearing level *and* increased consumption and production of natural gas, and (2) the conversion to natural gas by utilities and industrial users — it is necessary to review the history of regulatory control on the wellhead price of natural gas since the Phillips case of 1954.

The Federal Power Commission (FPC) approached its Supreme Court mandated task of regulating the wellhead price of natural gas on a case by case basis until the early 1960s. The case by case approach, however, put such a strain on the FPC's resources that the commission itself estimated that its 1960 case load would not be completed until the year 2043.[19] Faced with such a backlog of case load, the FPC introduced in 1961, the Permian Basin method of area-wide rate-making.[20]

Under the Permian Basin methodology, the FPC would establish a "just and reasonable" ceiling price for all natural gas produced within a broadly defined producing area such as the Permian Basin in Texas or Southern Louisiana. This method of price control resulted in the practice of basing the permitted price on the historical cost of a low cost producer in a given area. Therefore, the new method was instrumental in inducing a downward revision in the expected *future* price of natural gas.

Chart I indicates that the hypothesized downward revision in the expected price was in fact borne out by the actual price behavior. The relative price of natural gas declined on balance in the post-Permian 1960s, in sharp contrast to its rising trend between the late 1940s and the early 1960s. Chart I also shows that the actual thrust of regulation after the Phillips case of 1954 and prior to the Permian Basin proceedings, was such that the price of natural gas was permitted to continue its rise relative to both the price of oil and other prices in general.

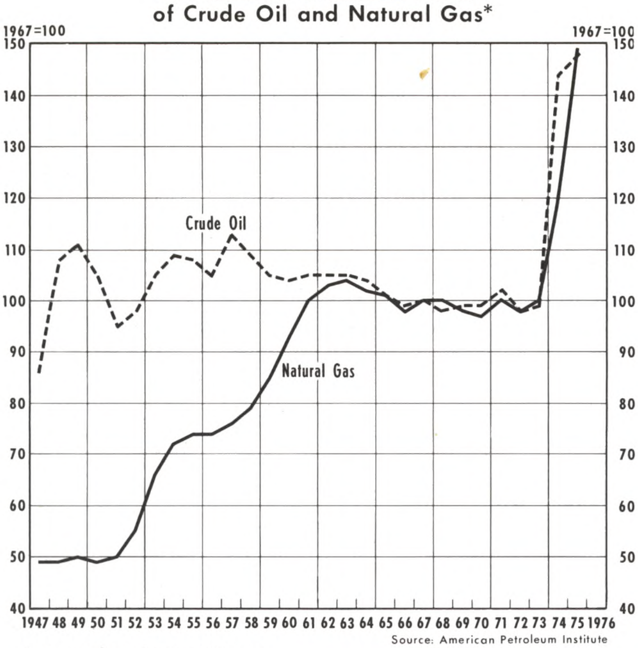
In terms of the interpretation offered above of reserves as business inventories, one would expect that the downward revision in the expected future price of natural gas would have induced an accelerated

[18]This is because of the long lead time between exploration and production. See Paul W. MacAvoy and Robert S. Pindyck, *Price Controls and the Natural Gas Shortage* (Washington, D.C.: American Enterprise Institute, 1975), pp. 16-19.

[19]Ibid., p. 12.

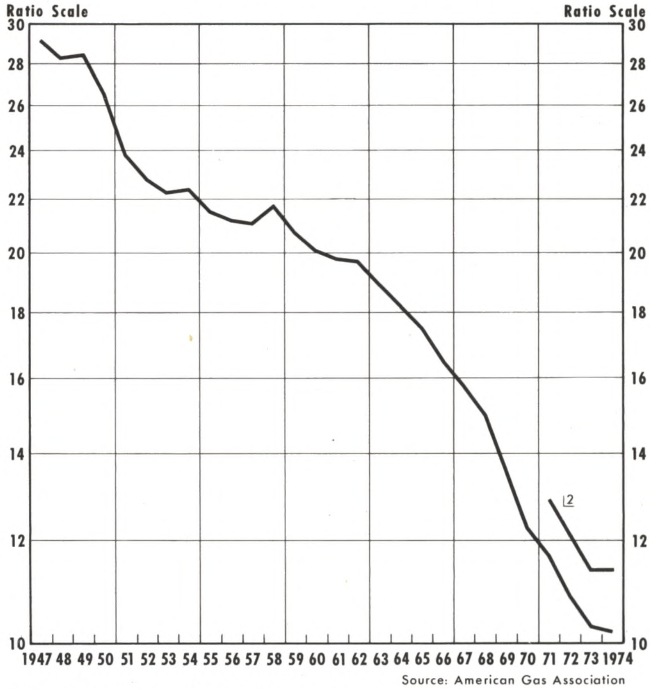
[20]The area-wide rate making procedure, based on an adaptation of the public utility rate-making approach, tended to impart a downward bias to the regulated wellhead price. The FPC attempted to arrive at an area-wide composite average cost estimate based on a survey of cost data. Confronted with the logically impossible problem of joint cost allocation between oil and gas, the FPC systematically chose the figures at the lower end of the choice set. The Supreme Court once again ruled, in 1968, that it was within the discretion of the FPC to adopt the area-wide rate-making procedure, however arbitrary the rate may be. Permian Area Rate Cases, 390 U.S. 747 (1968).

Chart I
The Relative Wellhead Prices of Crude Oil and Natural Gas*



*Data are indicies of constant (1967) prices.

Chart II
Ratio of Natural Gas Reserves to Production [1]



[1] Measured as the ratio of: the beginning and end of year figures for proven reserves of natural gas to the production of natural gas during that year.
[2] Includes 26 trillion cubic feet at 14.72 psia and 60°F in Prudhoe Bay, Alaska.

downward revision in the desired reserve-to-production ratios. Such an expectation is borne out by the behavior of the reserve-to-production ratios shown in Chart II. The chart shows that the reserve-to-production ratio was falling even before the Permian Basin proceedings in the early 1960s, indicating that the actual ratio was above the desired ratio. However, the downward adjustment proceeded at a slower rate of 1.8 percent per year after the Phillips case of 1954 but prior to the Permian proceedings in 1961, compared to the 3.7 percent per year rate in the earlier 1947-54 period. Such behavior is consistent with the earlier finding that regulation permitted a relative increase in the price of natural gas prior to the early 1960s.

The decline in the reserve-to-production ratio accelerated after the Permian proceedings began early in the 1960s. The ratio fell at the rate of 6 percent per year from 1963 to 1970. Such an acceleration in the decline of the ratio reflects the downward adjustment in the desired reserve-to-production ratio induced by the adoption of the Permian methodology.

Chart III indicates that the accelerated downward adjustment in the reserve-to-production ratio in the 1960s took the form, first, of decelerating growth of reserves, and then of outright reduction in reserves since 1968. Chart IV indicates that this slowing in reserve accumulation and the eventual reduction in reserves, can be attributed squarely to the slowing in the search for reserves as a direct consequence of policy-induced souring in the prospective returns on exploration and development activities. The Chart shows that there has been a secular improvement in the success ratios in exploratory and development efforts, possibly due to technological progress.[21] Therefore, the marked reduction in the number of successful gas well drillings since 1962, as shown in Chart IV, is primarily due to the reduction in the search activities. Production of natural gas, however, did not start decreasing absolutely until 1973.

The drawing down of reserves (inventories) by producers reconciles the apparent puzzle of an "artificially" low, controlled price and the observed increases in the quantity supplied. It is ironic that the peculiarities of the market for natural gas masked the policy-induced disequilibrium in the market, so that many new industrial and electric utility users switched over to natural gas from coal. They were attracted to natural gas because of its apparent "bargain" price

[21]The conclusion regarding the success ratios also holds individually for new-field wildcats, total exploratory wells and development wells.

Chart III

Changes in Natural Gas Reserves*

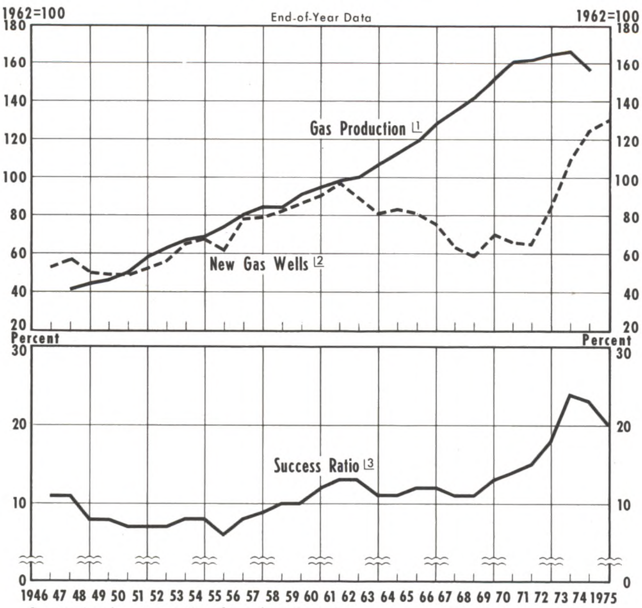
Source: American Gas Association

*This series is generated by subtracting estimated production of natural gas during the year from the reserve revisions, extentions, and discoveries during the same year.

and the higher cost of using coal occasioned by the passage of various environmental legislations.

Chart IV

Natural Gas Drilling and Production



Sources: American Association of Petroleum Geologists, American Petroleum Institute, and the American Gas Association.

[1] Based on 13.638 quadrillion cubic feet of gas produced in 1962.

[2] Based on 5,848 new gas wells in 1962. This figure includes exploratory and development wells.

[3] Measured as the ratio of new gas wells to total wells drilled.

In view of the eventual emergence *at the controlled price* of a shortage in the market for natural gas, which led to supply curtailments, the decisions of new users to convert to natural gas must be judged with hindsight to have been ill-advised. It is doubly ironic that these victims of the unintended side-effects of public policy could now become targets of elaborate tax and administrative measures.

The Oil Market

The preceding analysis of the nature and origins of the natural gas crisis is applicable to the market for oil, the other endangered specie of energy. The adjustment capacity of the market for oil also has been attenuated as a consequence of past public policy. In contrast to the unintended shortage policy followed in the market for natural gas, a deliberate surplus policy was followed in the market for oil. As noted earlier, various state regulatory agencies followed a demand pro-rationing policy to cope with the common pool problem in the industry, which arose from the rule of capture doctrine in existence. This, in turn, arose from incompletely defined property rights over oil in the ground.[22]

In the absence of a demand pro-rationing system and of consolidation of an oil field under one or joint control, violent fluctuations arose in the price of crude oil that producers received as developed fields were intensively mined and new discoveries made.[23] The demand pro-rationing system evolved to protect the joint interests of the producers.[24] Under the demand pro-rationing system the state regulatory agencies, such as the Texas Railroad Commission, sought to alleviate this condition by setting total production targets for the particular state, and by distributing the production quotas according to a formula which favored small and usually higher-cost producers. The ever-present stripper wells — producing less than 20 barrels per day — were usually exempted from quota regulation altogether. The economic consequence of this form of allocation was higher than necessary

---

[22] Since oil is mobile in underground reservoirs, it is difficult to define and enforce property rights when the field is owned jointly.

[23] Morris A. Adelman, "Efficiency of Resource Use in Crude Petroleum," *Southern Economic Journal* 31 (October 1964), pp. 101-22.

[24] This system is a classic case of "acquired regulation." In such a situation, regulation is supplied by the state in response to the demand by the incumbents (mainly to restrain entry). For the original statement of the hypothesis of acquired regulation, see George Stigler, "The Theory of Economic Regulation," *The Bell Journal of Economics and Management Science* (Spring 1971), pp. 3-21.

resource costs of domestic oil, as higher-cost producers were rewarded.

Prior to 1948, the U.S. was a net exporter of oil, holding 31 percent of the then proven world reserves. Thus, the U.S. occupied a position of dominance, even greater than the position of Saudi Arabia today. But an accelerated pace of discovery and development by the major international oil companies of low-cost reserves in the Persian Gulf states began to make inroads into the U.S. position. Threatened by the competition from low-cost foreign oil imported mainly by the U.S. based major integrated international oil companies, other domestic oil producers and refiners, who had not developed foreign sources of oil, succeeded in persuading the government to institute a voluntary oil import program in 1957.[25]

The voluntary program failed, mostly due to the attempts of non-major U.S. producers to import from their recently developed wells in the Persian Gulf area. Unlike the international majors, which had already developed extensive networks of markets outside the U.S., these late-comers from the U.S. seized the opening under the voluntary import program to increase their market share at home. As a consequence, total imports as a percent of domestic production jumped from 19.7 percent in 1957 to 22.4 percent by 1959. Yielding to the intense pressure by a coalition of domestic producers and refiners, who demanded protection from cheap foreign oil on "security of supply" and other grounds, the voluntary import program became a mandatory import quota system in 1959.[26] As a result, a segment of the domestic oil industry was insulated from the rigors of competition in the market place. The mandatory program was to last until April 1973.

Under the Mandatory Oil Import Program, the overall import quota was set so as to freeze the share of imports at the level achieved in 1959. The distribution of import licenses among refiners was skewed in favor of smaller refiners. Such refiners received a disproportionately larger share of import licenses (in effect, subsidies), which had a market value per barrel equal to the difference between the higher-priced, regulated domestic oil and the cheaper, market-priced foreign oil.

The conventional method of arriving at the cost of the mandatory quota system is to add the estimated additional consumer costs of oil products to the cost of domestic resources unnecessarily used up to produce oil that could have been imported more cheaply. The real cost of the Program, however, would far exceed the conventionally estimated sum. The Program had sown the seed of the current energy crisis by sharply reducing the capacity of the oil market to respond to external shocks such as the effective cartelization of the Organization of Petroleum Exporting Countries (OPEC), and the Oil Embargo of 1973.

The Program set in motion a chain of events that culminated in the birth of OPEC in September 1960. The imposition of the U.S. import quota, based on a fixed share of the U.S. oil market, meant that imports could grow only at the rate of growth of U.S. production. This meant that the increased production that was just coming on stream from foreign wells developed by non-major U.S. producers had to be diverted away from the U.S. market. Precipitous price declines ensued in the world oil market and price competition forced the major international oil companies (majors hereafter) to match the decline.

It so happened, however, that the profit-sharing arrangement which the majors had with the oil producing countries was on the basis of the *posted price* rather than on the *market price*.[27] Therefore, in order to lighten the squeeze on their profits, the majors unilaterally cut posted prices in 1959 and once again in August 1960, despite strenuous protests and explicit warnings from the exporting countries.[28] The quota-induced cut in posted prices by the majors provided the spark for the exporting countries to form an organization to safeguard their common interest.

It is a moot point whether such an organization would have formed in the absence of the Mandatory Oil Import Quota Program. The point is that the quota system adopted in 1959 had a direct causal effect on the formation of OPEC, and such an untoward effect should be considered as a significant component of the cost of import programs.

The surplus policy on domestic oil, pursued by both state and Federal authorities at the instigation of some segments of the industry, reduced the incentives of the oil industry to improve efficiency and to add to

[25]See Dam, *Implementation*, pp. 5-8. Also see Morris A. Adelman, *The World Petroleum Market* (Resources for the Future, Inc.; Baltimore: The Johns Hopkins University Press, 1972), pp. 150-55.

[26]Dam, *Implementation*, pp. 9-14 and pp. 58-60.

[27]Yoon S. Park, *Oil Money and the World Economy* (Boulder: Westview Press, 1976), pp. 27-35.

[28]Bohi, Russel, and Snyder, *Economics of Energy*, p. 47, (p. 57 of the *Compilation*).

its stock of oil reserves. Public policy then delivered another blow to the oil market in the form of a series of price freeze and control programs instituted in 1971 to fight inflation. The domestic oil price control program had the unintended effect of killing off the mandatory import quota system. While the domestic price was being held down, the foreign price of oil increased and surpassed the U.S. level, thus wiping out the value of import licenses.

The familiar scenario of one control begetting another, in order to deal with the unintended distortions produced by the previous control, was repeated many times.[29] For example, under Phase IV of the price control program, the Cost of Living Council (CLC) adopted the technique of "vintaging" to the pricing of crude oil. A two-tier price system, with a ceiling price on "old" crude and a market-determined price on "new" and "released" domestic crude oil, was designed to encourage new exploration and production.[30] The program, while encouraging domestic exploration and development, created predictable problems of its own, due to the fact that not every refiner had equal access to *old* and *new* domestic crude oil, nor to domestic and imported crude oil.

Complaints of discrimination and charges of evading the two-tier pricing system through tie-in-sales, were often raised.[31] As a consequence of the two-tier pricing, substantial price differentials appeared in refined products reflecting different access to lower and higher-priced crude oil. The crude oil program was instrumental in creating artificial, policy-induced competitive advantages and disadvantages where none existed. A coalition of refiners, who had not developed their own domestic sources of old crude oil, lobbied actively for a crude oil allocation program under which they would receive their "equitable share" of lower-priced old crude oil.[32]

When the OAPEC (Organization of Arab Petroleum Exporting Countries)[33] embargo unexpectedly hit the U.S. in October 1973, the energy markets, particularly those of oil and natural gas, were tied up in knots due to the effects of the past policies, such as demand pro-rationing, the mandatory import quotas, and price controls on oil and natural gas. The U.S. dependence on foreign oil was to become larger than that which would have resulted in a world of open markets for natural gas and oil.[34]

The public policy response to the embargo exacerbated the adjustment problem. The Federal Energy Office — instead of focusing on the level of stocks of crude oil and refined products (which was the technique used to allocate production quotas by the Texas Railroad Commission) — focused on an anticipated reduction in U.S. oil imports, which was repeatedly overestimated. The amount of oil allocated for consumption consistently fell below the sum of domestic production and imports. As a consequence, the U.S. ended the embargo period with a higher stock of petroleum products than it started.[35]

In the wake of the embargo and the quadrupling of the crude oil price, a coalition of refiners without access to cheaper domestic old oil finally succeeded in having the newly organized Federal Energy Administration adopt the crude oil cost equalization program in December 1974.[36] The program was designed to allocate lower-priced domestic crude oil subject to price controls proportionately among refiners, and was adopted in response to the pressures to allow *all* refiners to have the equal access to cheaper domestic oil.

The principal part of the program was designed to distribute low-cost "old" domestic crude oil proportionately to *all* U.S. refiners through the issuance of tickets or entitlements. The entitlements represented rights to purchase lower-priced "old" domestic crude just as the import licenses during the mandatory oil import quota period represented rights to purchase the then cheaper foreign oil. Although the situation is reversed, the principle of resorting to political com-

[29]For an authoritative and revealing account of the utter frustration experienced by a former Federal Energy Office (FEO) administrator, see William A. Johnson, "The Impact of Energy Controls on the Oil Industry: How to Worsen an Energy Crisis," in *Energy: The Policy Issues,* edited by Gary D. Eppen (Chicago: University of Chicago Press, 1975), pp. 99-121.

[30]Ibid., pp. 109-110.

[31]Ibid., pp. 110-111.

[32]U.S. Congress, House of Representatives and Senate Subcommittee on Consumer Economics of the Joint Economic Committee, *The F.E.A. and Competition in the Oil Industry,* 93rd Congress, 2nd. Session, 1974, p. 17 and pp. 52-53.

[33]OAPEC was founded in 1967 by the Arab members of the OPEC.

[34]The price control on natural gas was having a delayed impact on the quantities supplied relative to the quantities demanded by then. Hence, the excess demand for natural gas spilled over into the market for oil. Bohi, Russel, and Snyder, *Economics of Energy,* pp. 81-7.

[35]Richard B. Mancke, *Performance of the Federal Energy Office* (Washington, D.C.: American Enterprise Institute, 1975), pp. 4-7.

[36]See "Allocations: F.E.A. Adopts Regulations Designed to Equalize Crude, Fuel Oil Costs," *Energy Users Report* no. 69 (Washington, D.C.: The Bureau of National Affairs, Inc., 5 December 1974), p. A-7. Hereinafter, *Energy Users Report.*

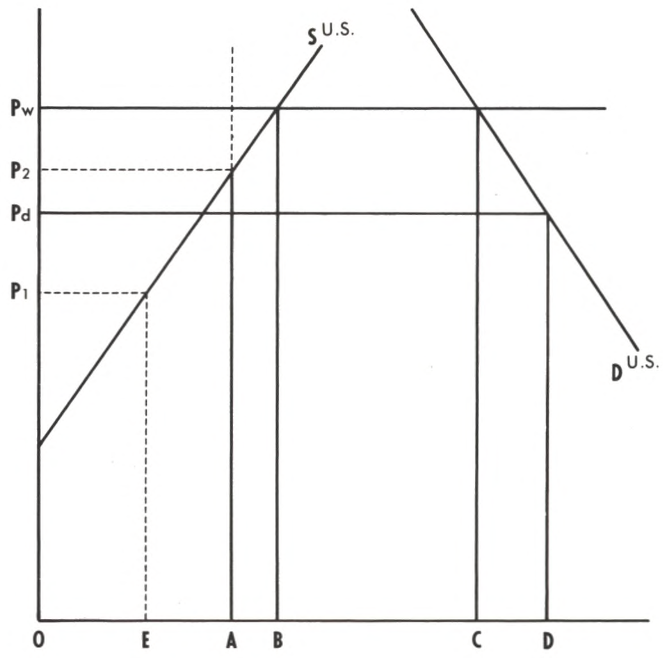
petition to alter economic outcomes remained invariant. Once again, as in the import licensing and the demand pro-rationing systems, smaller refiners (with less than a 175,000 barrel per day capacity) were to receive proportionately more entitlements than larger refiners.[37]

The system of entitlements, in conjunction with the multi-tier pricing of crude oil that was introduced earlier, had the unintended effect of increasing U.S. dependency on foreign oil.[38] The increase in foreign dependency was due to the joint effects of the "uncontrolled" price of "new" domestic oil being set below the world (the OPEC cartel) price, and the entitlement program. The former reduced the domestic production below the level that would otherwise have been attained under free (open) market pricing, while the entitlement program had the perverse effect of encouraging imports by, in effect, taxing domestic production and subsidizing imports.[39]

Figure I illustrates how a public policy, designed to deal with one set of problems through intervention in the market place, created another problem. The rise in the world (cartel) price of oil and the domestic price control on crude oil led to a demand by some refiners for crude oil allocation and cost equalization programs. Such a demand was eventually answered by the Emergency Petroleum Allocation Act of 1973 and Crude Oil Equalization Program of 1974. In Figure I, one can contrast the amount of imports that would have prevailed under free market pricing and the entitlement programs as evolved. Pw denotes the "world" price set by OPEC.[40] OPEC is assumed ready to supply all the "residual" oil demanded by the U.S. at Pw. In the absence of any domestic price control, the domestic production would be OB and the imports BC. However, under the price controls on both the "old" and the "new" domestic oil at P1 and P2 respectively, the U.S. producers would supply OE of "old" oil and EA of "new" oil. The total domestic production would now be OA and the amount of imports would be AC, which are purchased at price Pw. The dependence on foreign oil increases by AB.

Figure I

The Effects of Price Controls and Entitlements



Pw: World Price (set by OPEC)

P1: U.S. "Old" Oil Prices

P2: U.S. "New" Oil Price

Pd: Weighted Average of Domestic and Foreign Oil *

*Assume Controls on End-Product Prices Using Pass-Through Provisions

The introduction of the entitlement system worsens the situation further, especially when one assumes the existence of controls on end-product prices through pass-through provisions, for example, on utility rates. If we assume that the pricing of oil products is based on the weighted average price, denoted by Pd, of domestic and foreign oil, imported oil now increases to AD whereas the domestic production is still at OA. In view of the avowed objective at that time to achieve energy self-sufficiency by 1985 (Project Independence), it is indeed ironic that the policies chosen militated against the professed goal.

Aside from the adverse effect on foreign dependency, the crude oil cost equalization program raises a fundamental question regarding the role of public policy in the market place. Those who first asked for allocation and, then, for cost equalization of crude oil were those refiners who had not integrated backward

[37] *Energy Users Report*, p. A-8.

[38] See Hans H. Helbling and James E. Turley, "Oil Price Controls," this *Review* (November 1975); Also Robert E. Hall & Robert S. Pindyck, "The Conflicting Goals of National Energy Policy," *The Public Interest* no. 47 (Spring 1977), p. 3.

[39] See Milton Friedman, "Subsidizing OPEC Oil," *Newsweek* June 23, 1975, p. 75, and Hall and Pindyck, "The Conflicting Goals," p. 3 and p. 5.

[40] The analysis abstracts from the question of how the Pw has been chosen. Presumably, if the objective is to maximize the joint profits (or wealth) of the OPEC members, a dominant-firm price leadership model would be relevant.

to production of crude oil.[41] Their argument was that it was unfair for them to be deprived of the supply of crude oil by the integrated producers in times of crude oil "shortage." They argued that the price to society of impending failures, due to their inability to secure crude oil in times of "tight" supply, would be a reduction of competition in the market. They sought, through political actions, access to crude on the same terms as the integrated producers.

However, the reasoning advanced above for political intercessions runs counter to the concept of competition in the market place. The cardinal rule of competition is that individual participants in the market place bear the full consequences of their own market decisions, inclusive of those decisions regarding the future supply of raw materials. One possible strategy for an oil refiner, regarding the future source of raw materials, is to depend on the spot market for a supply of crude oil. This tends to be a higher risk strategy than the alternative one of integrating backward to the production of crude oil. A higher risk strategy is associated in the long run with a higher expected return than the alternative lower risk strategy.

In terms of this "new view" of industrial organization, then, the demands of some refiners for equal access on competitive ground is difficult to defend.[42] Furthermore, expected accommodations of their pleas tend to have effects beyond the mere redistribution of wealth from the integrated companies to those who were not integrated. It would tend to reduce the integrated oil companies' incentives to explore and develop new reserves of crude oil.

An exploration into the history of two major energy markets in the U.S. reveals that the overriding uncertainty regarding the thrust and direction of public policy on energy has shrouded the energy markets. Under these circumstances, decision-makers in the energy industry were distracted from the business of securing, processing and marketing energy products in response to the perceived "energy consumption policies" of individual consumers and "energy supply policies" of fellow competitors. Instead, they have had to play the socially unproductive game of trying to anticipate and influence shifts in public policy.

CONCLUSIONS

The growing concern about an energy crisis has resulted in a repeated call for a national energy policy. Unfortunately, there are widespread misconceptions about the nature and origins of the U.S. energy problem. Past attempts by various segments of the energy industry to avoid the rigors of competition have resulted in public policies which have emasculated the energy market's ability to adjust to man-made and nature-induced shocks. It is ironic that those who now call for deregulation of the energy market are the ones that had successfully sought most of the existing regulations.

We are now faced with a "crisis," which calls for policy-mandated conservation measures that may be costly in terms of economic utilization of existing capital resources. And we seem to forget that an unfettered energy market could, and still can, bring forth ever expanding supplies of energy from higher-cost conventional sources and more exotic, alternate sources. Also, an unencumbered energy market could, and still can, induce effective conservation on the part of consumers, through the working of the first and second laws of demand. The question that remains, however, is whether the various elements of the energy industry will accept competitive market outcomes in totality or demand protection from the rigors of competition when the sledding gets tough.

---

[41]See Eppen, *Energy*, pp. 106-107.

[42]For a systematic statement of the "new view" of industrial organization, see Oliver E. Williamson, *Markets and Hierarchies* (New York: The Free Press, 1975). For an application of the new view to the U.S. oil industry, see David J. Teece, "Vertical Integration in the U.S. Oil Industry," in *Vertical Integration in the Oil Industry,* edited by Edward J. Mitchell (Washington, D.C.: American Enterprise Institute, 1976).

Revision of the Monetary Base

ALBERT E. BURGER and ROBERT H. RASCHE

Due to space constraints, a detailed mathematical formulation of the derivation of the reserve adjustment magnitude was omitted from the presentation here. As an Appendix to this article, such material will be made available upon request.

THE monetary base, as published by the Federal Reserve Bank of St. Louis, consists of member bank deposits at Federal Reserve Banks, vault cash held by member and nonmember banks, and currency held by the public *plus* an adjustment referred to as the reserve adjustment magnitude (RAM). On the basis of an analysis of the purpose for which RAM is to be used and its historical behavior, it was decided to change the method by which RAM is computed. Consequently, monetary base has been revised to reflect this new method of computing RAM.

This article explains the purpose of a reserve adjustment magnitude and illustrates its computation under the method used in the past (RAM1), an alternative method (RAM2), and the new method (RAM3), which is an approximation to RAM2. After the method of computing the new RAM is explained, the old and revised monetary base series are compared. Revised monetary base data are presented in Appendix I.

Purpose of a Reserve Adjustment Magnitude

In the "monetary base - money multiplier" framework the relationship between the base and the money stock can be expressed as

$$M = mB$$

where the multiplier (m), is equal to

$$\frac{1 + k}{r(1 + t + g) + k}$$

In this formulation of the multiplier, r represents the reserve ratio,[1] t is the ratio of time deposits to private demand deposits (demand deposits included in M_1), g is the ratio of U.S. Government demand deposits at commercial banks to private demand deposits, and k is the ratio of currency held by the nonbank public to private demand deposits.

In a "monetary base - multiplier" framework there are two ways to capture the effects of changes in reserve requirement ratios on the money stock. One way is to allow all the effect of changes in reserve requirement ratios to appear in the r-ratio and, hence, as fluctuations in the money multiplier. In this method the amount of base remains unchanged and the money multiplier rises when reserve requirement ratios are lowered, indicating that a given amount of base held by banks can now support a larger amount of demand deposits. When reserve requirement ratios are raised, the money multiplier falls, indicating that a given amount of base held by banks can now support a smaller amount of demand deposits.

An alternative method of isolating the effect of changes in the reserve requirement ratio is to make an adjustment to the base and to the money multiplier. This adjustment is called the reserve adjustment magnitude (RAM). The effect of this adjustment is to locate the primary impact of reserve requirement ratio changes in fluctuations of the base.

Since changes in the base are dominated by actions of the Federal Reserve System, such as open market operations and lending to member banks, the base is a useful summary measure of the net effect of Federal Reserve actions on the growth of the money stock. The rationale for making a RAM adjustment to the base is that legal reserve requirement ratio changes are also under the complete control of the Federal Reserve. Therefore, if one is interested in a variable that summarizes the effect of Federal Reserve actions on the monetary aggregates, it is appropriate to include these effects in movements of the monetary base.

[1]The reserve ratio consists of legal reserve requirement ratios plus an excess reserve ratio and a nonmember bank vault cash ratio.

Alternative Methods of Computing RAM

This section presents three ways in which the base could be adjusted to include the effect of changes in reserve requirement ratios on the money stock. The examples are kept very simple to illustrate the basics of the process. It is assumed that required reserves are based on current week deposits. Introduction of lagged reserve accounting makes the example more involved, without changing the basic results. The computation of RAM under a system of lagged reserve accounting is discussed at the end of this paper. The actual procedure by which RAM is computed is somewhat more complicated than in the first example because reserve requirement ratios differ by size of deposit. Some of these complications are discussed after the basic examples.

A very simplified representation of the banking system is used to illustrate the alternative computations of the reserve adjustment magnitude. The following assumptions are used:

(1) The only type of deposits that banks hold are demand deposits (D).

(2) There is no currency, hence, the money stock (M) is equal to demand deposits (D).

(3) Since there is no currency, the source base (B) in this example is equal to bank reserves.

(4) The only type of bank reserves (R) are required reserves. Banks always adjust so that excess reserves are zero.

(5) There is only one reserve requirement ratio that applies to all demand deposits at all banks regardless of the amount of deposits held by the bank.

The following notation is used:

RAM = reserve adjustment magnitude

MB = monetary base = B + RAM

$L = \frac{RAM}{D}$

$r = \frac{R}{D}$ = reserve ratio

$r + L = \frac{R}{D} + \frac{RAM}{D}$ = adjusted reserve ratio

E = bank earning assets

In the above simplified example, the money stock (D) can be expressed as:

$$\frac{1}{r} R = D$$

The process of making a reserve adjustment to the source base involves adding RAM to the base and adjusting the reserve ratio by a factor L. Hence:

$$\frac{1}{r+L}(R + RAM) = D$$

$$L = \frac{RAM}{D}$$

The current procedure for computing RAM (denoted as RAM1) consists of accumulating the amount of reserves liberated or absorbed by changes in reserve requirement ratios from some initial starting point (under the current procedure, 1929). This method was originally developed by Karl Brunner and Allan Meltzer.[2] Starting from an initial time period t, RAM1 is computed as follows:

$$RAM1_t = (r_{t-1} - r_t)\, D_{t-1}$$

$$RAM1_{t+1} = RAM1_t + (r_t - r_{t+1})\, D_t$$

$$RAM1_{t+2} = RAM1_t + RAM1_{t+1} + (r_{t+1} - r_{t+2})\, D_{t+1}$$

Under this procedure RAM1 changes only when there is a current change in the reserve requirement ratio. For example, if the reserve requirement ratio in t+1 (r_{t+1}) equals the reserve requirement ratio in the previous period (r_t), then $RAM1_t = RAM1_{t+1}$.

In the case of RAM1, the adjustment (L) to the multiplier depends upon the growth of deposits. For example, suppose that reserve requirement ratios are lowered and then are unchanged thereafter. If deposits continue to grow, say as a result of open market operations expanding bank reserves, then, since RAM1 is constant and D rises, L falls. The multiplier $\frac{1}{r + L}$ drifts upward.

An alternative method (RAM2) is based on the objective of holding the multiplier invariant with respect to reserve requirement ratios. Under this procedure, using the simplified example above, RAM would be computed as follows:

$$RAM2_t = (r_o - r_t)\, D_t$$

$$RAM2_{t+1} = (r_o - r_{t+1})\, D_{t+1}$$

In this method the current reserve requirement ratio is compared to the reserve requirement ratio (r_o) in some fixed initial period. The deposits used to compute RAM2 are current period deposits, instead of lagged deposits as in RAM1. Also, unlike RAM1, the reserve adjustments are not accumulated. The

[2] A discussion of the procedure developed by Brunner and Meltzer and the objective of this procedure is presented in the Appendix which is available upon request. For another discussion of the RAM adjustment see: Peter A. Frost, "Short-Run Fluctuations in the Money Multiplier and Monetary Control," *Journal of Money, Credit and Banking*, Part 2 (February 1977), p. 167.

only factor that determines whether RAM is equal to zero in any period is whether *in that period* the reserve requirement ratio is equal to the reserve requirement ratio (r_o) in the initial period.

This method of computing RAM makes the multiplier invariant with respect to reserve requirement ratios.[3] The computation of RAM2, however, has one serious practical defect. Its computation requires knowledge of current period deposits. If the monetary base is to be used as a control variable, this is a serious deficiency. For example, the Trading Desk would not be able to measure this week's monetary base until it had this week's deposits. Consequently, a third method of computing RAM was developed. The objective of RAM3 is to "approximate" as closely as possible a constant multiplier with respect to reserve requirement ratios, while permitting RAM in the current week to be calculated using data available at the start of the week.

In this example we will assume that at the start of the current week the Federal Reserve knows what deposits were in the previous week. Using the above simplified banking system, RAM3 is defined in the following manner:

$$RAM3_t = (r_o - r_t)\, D_{t-1}$$

The reader will notice that RAM3 is very similar to RAM2; it is based on a comparison of the current period reserve requirement ratio and some initial reserve requirement ratio (r_o), and it is not cumulative. The basic difference between RAM2 and RAM3 is that RAM3 is computed using lagged and, hence, known deposits, instead of current period deposits.

RAM3 is an "approximation" to an invariant multiplier because lagged deposits are used in its computation. In any period t, under RAM3, the adjustment to the multiplier is:

$$L = (r_o - r_t)\frac{D_{t-1}}{D_t}$$

To the extent that D_t and D_{t-1} are about the same size, then:

$$\frac{1}{r_t + L} \text{ under RAM3 is approximately the same as } \frac{1}{r_o}$$

Examples of Use of Alternative RAM Adjustments

Let us now turn to a simple numerical example to further illustrate the behavior of the three methods of adjusting the base. This example is based on the simplified model of the banking system outlined in the previous section. We begin by assuming that the legal reserve requirement ratio (r) equals 12.5 percent, and banks hold 200 of source base (reserves (R) in our example). Hence, the multiplier (m) is $\frac{1}{r} = 8$. Each dollar of base held by banks supports 8 dollars of deposits. *In the first period it will be assumed that RAM = 0.* Therefore, in period I the balance sheet of our simplified banking system would appear as follows:

Period I

Banking System

R = 200	D = 1600
E = 1400	

Where: $r = .125$ = ratio of reserves to deposits[4]

$m = \frac{M}{B} = \frac{1}{r} = 8$ = money multiplier

$RAM = 0$

$B = R = 200$

In period I the banking system is in equilibrium in the sense that banks hold the amount of reserves they desire to hold given their legal reserve requirement ratio of .125 and the amount of their deposit liabilities. If banks held more than 200 of reserves, then they would expand their holdings of earning assets and consequently, through the multiple expansion process, demand deposits would rise.

Let us now assume that the Federal Reserve lowers the required reserve ratio from .125 to .10. With deposit liabilities of 1600 and a new, lower reserve requirement ratio of .10, required reserves fall from 200 to 160. Therefore, in period II the banks find themselves with excess reserves. Consequently, under

---

[3]If $\frac{1}{r_o}$ is the multiplier in the initial period, then at any time period t the reserve ratio (r_t) is equal to:

$$r_t = r_o + (r_t - r_o)$$

Since the adjustment factor L is defined as:

$$L = \frac{RAM}{D}$$

under RAM2,

$$L = (r_o - r_t)$$

Consequently, the adjusted multiplier at any time t is equal to:

$$\frac{1}{r_t + L} = \frac{1}{r_t + r_o - r_t} = \frac{1}{r_o}$$

[4]In this simple example, required reserves are always assumed to equal total reserves. In actual practice total reserves (R) consist of required reserves and excess reserves.

Table I

Effects of Policy Actions on the Money Multiplier

	PERIODS						
	I	II	III	IV	V	VI	VII
Policy action	None	Lower reserve requirements	None	Increase bank reserves	None	Raise reserve requirements	Reduce bank reserves
r	.125	.10	.10	.10	.10	.125	.125
RAM1	0	40	40	40	40	−22.5	−22.5
RAM2	0	50	50	62.5	62.5	0	0
RAM3	0	40	50	50	62.5	0	0
B	200	200	200	250	250	250	200
MB1	200	240	240	290	290	227.5	177.5
MB2	200	250	250	312.5	312.5	250	200
MB3	200	240	250	300	312.5	250	200
D	1600	2000	2000	2500	2500	2000	1600
m	8	10.000	10.000	10.000	10.000	8.000	8.000
m1	8	8.333	8.333	8.621	8.621	8.791	9.014
m2	8	8.000	8.000	8.000	8.000	8.000	8.000
m3	8	8.333	8.000	8.333	8.000	8.000	8.000

MB = monetary base
B = source base = required reserves in this example
MB1 = B + RAM1
MB2 = B + RAM2
MB3 = B + RAM3

$m = \frac{D}{B}$ $m2 = \frac{D}{MB2}$

$m1 = \frac{D}{MB1}$ $m3 = \frac{D}{MB3}$

the stated assumptions, banks expand their holdings of loans and securities, and deposits expand, until at the end of period II the banking system's balance sheet appears as follows:

Period II

Banking System

R = 200	D = 2000
E = 1800	

We notice that even though the amount of base held by banks (reserves) has not changed (R = 200 in period I and period II) the money stock has risen. Essentially, lowering the reserve requirement ratio has "liberated" 40 of reserves to support more deposits. Deposits expand to 2000 at which point the 40 of reserves have again been absorbed in the sense that they are being used to support deposits.

The reserve adjustment magnitude would be computed, using the three alternative methods, in the following manner:

$RAM1 = (.125 - .10)\ 1600 = 40$
$RAM2 = (.125 - .10)\ 2000 = 50$
$RAM3 = (.125 - .10)\ 1600 = 40$

where: $r_o = .125$
$r_t = .10$
$D_{t-1} = 1600$
$D_t = 2000$
$RAM_{t-1} = 0$

The monetary base (MB) in period II is then computed by adding the selected RAM adjustment to the source base (reserves in our example) in period II:

$MB1 = 200 + 40 = 240$
$MB2 = 200 + 50 = 250$
$MB3 = 200 + 40 = 240$

In all three cases, the monetary base is increased by the RAM adjustment. Most of the effect of lowering the reserve requirement ratio is now reflected in a movement of the monetary base. However, as shown in Table I, only in RAM2 is all the effect located in the base; this is the only case where the multiplier remains constant. Using either RAM1 or RAM3 the multiplier rises, although much less than in the case where all the effect appears in the multiplier (m). This result occurs because lowering reserve requirement ratios has two effects: (1) an initial effect resulting from reserves being liberated to support a larger volume of deposits, and (2) a continuing effect that lasts as long as the lower reserve requirement ratio prevails, because each dollar of reserves supports a

Table II

Explanation of Computation of RAM in Table I

Period III

RAM1 = (.10 — .10) 2000 + 40 = 40
RAM2 = (.125 — .10) 2000 = 50
RAM3 = (.125 — .10) 2000 = 50

Period IV

RAM1 = (.10 — .10) 2000 + 0 + 40 = 40
RAM2 = (.125 — .10) 2500 = 62.5
RAM3 = (.125 — .10) 2000 = 50

Period V

RAM1 = (.10 — .10) 2500 + 0 + 0 + 40 = 40
RAM2 = (.125 — .10) 2500 = 62.5
RAM3 = (.125 — .10) 2500 = 62.5

Period VI

RAM1 = (.10 — .125) 2500 + 0 + 0 + 0 + 40 = -22.5
RAM2 = (.125 — .125) 2000 = 0
RAM3 = (.125 — .125) 2500 = 0

Period VII

RAM1 = (.125 — .125) 2000 — 62.5 + 0 + 0 + 0 + 40 = -22.5
RAM2 = (.125 — .125) 1600 = 0
RAM3 = (.125 — .125) 2000 = 0

larger volume of deposits than previously. Only RAM2 captures both of these effects in period II. It should be noted that the difference between RAM3 and RAM2 in this example is somewhat exaggerated because of the large change in deposits in the example. In actual practice the week-to-week or month-to-month change in deposits would be much smaller and, hence, RAM3 would be a closer approximation of RAM2.

In period III, RAM1 and RAM2 would be unchanged. However, RAM3 would change, rising to 50. This would result because RAM3 is computed using lagged deposits. In period III, RAM3 would be computed using the new, higher level of deposits (2000). Consequently, after the initial period, the multiplier associated with the monetary base, MB3, would again return to the value that existed prior to the policy change. These results are shown in Tables I and II.

The main difficulty with computing the reserve adjustment as RAM1 (the current procedure) is that (1) it does not capture the full effect of changing legal reserve requirement ratios and (2) it imparts a drift to the money multiplier as other policy actions, such as open market operations, take place. These results are illustrated in Table I, where the results of a series of policy actions are outlined. In this set of examples, the legal reserve requirement ratio is first lowered and the banking system is allowed to adjust to this change. Then, bank reserves are increased, for example through open market operations, and the banks are allowed to adjust to this change. Then, through a series of steps, the reserve requirement ratio is raised to its initial level and bank reserves are reduced to their initial level. Although the range of variation of the money multiplier (m1) associated with a RAM1 adjusted monetary base (MB1) is much less than with no adjustment (m), there is still a noticeable drift in m1 over time.

The multiplier (m2) associated with the monetary base (MB2) with the reserve adjustment RAM2 is unaffected by policy actions, remaining at 8 throughout the whole process of adjustment to the policy changes. The multiplier (m3) also shows some variation. However, the variation in m3 is only of a short-term nature associated with the fact that m3 is computed using lagged deposits. Aside from this short-term variation, m3 remains invariant with respect to the legal reserve requirement ratio. Consequently, RAM3 has essentially the same properties as the adjustment factor RAM2, plus the additional advantage that it is computed using lagged and, hence, known deposits.

RAM With A Fully Specified Multiplier

Let us now examine the properties of the RAM adjustment in the context of a complete money multiplier specified as follows:

$$m = \frac{1 + k}{r\,(1 + t + g) + k}$$

The objective of the reserve adjustment magnitude (RAM3) is to hold the multiplier invariant with respect to changes in legal reserve requirement ratios to the nearest approximation possible while allowing RAM to be computed using lagged and, hence, known data.

Therefore, with this goal in mind, RAM3 is specified as:

$$\text{RAM3} = (r_o^D - r_t^D)\,(D_{t-2}^P + D_{t-2}^G) + (r_o^T - r_t^T)\,T_{t-2} = [(r_o^D - r_t^D)\,(1 + g_{t-2}) + (r_o^T - r_t^T)\,t_{t-2}]\,D_{t-2}^P$$

It should be noted that *RAM3 is now defined using deposits two weeks earlier,* rather than only the one week lag that appeared in the earlier, simplified examples. A two week lag on deposits is used because this is the most recent deposit data available to the Federal Reserve. On Thursday each week the Federal Reserve has deposit data for the statement week ended one week ago. For example, on Thursday June

16, 1977 the Federal Reserve had preliminary deposit data for the statement week ended Wednesday June 8, 1977. This would be the deposit data used to compute the RAM adjustment for the week ended June 22, 1977.

In the complete form of the money multiplier the reserve ratio r is defined:

$$r = r^D \left(\frac{D^P + D^G}{D^P}\right) + r^T \left(\frac{T}{D^P}\right) + e + v$$

where: r^D = legal reserve requirement ratio on demand deposits
r^T = legal reserve requirement ratio on time deposits
D^P = private demand deposits
D^G = U.S. Government demand deposits at commercial banks
T = time deposits
e = excess reserve ratio
v = nonmember bank vault cash ratio

The purpose of the RAM adjustment is to make the multiplier invariant to changes in legal reserve requirement ratios. Let us ignore the lag on deposits to simplify the notation. This objective can then be stated in mathematical notation as follows:

$$r_o^D \left(\frac{D_t^P + D_t^G}{D_t^P}\right) + r_o^T \left(\frac{T_t}{D_t^P}\right) = r_t^D \left(\frac{D_t^P + D_t^G}{D_t^P}\right) + r_t^T \left(\frac{T_t}{D_t^P}\right) + L$$

Consequently: $L = (r_o^D - r_t^D)\left(\frac{D_t^P + D_t^G}{D_t^P}\right) + (r_o^T - r_t^T)\frac{T_t}{D_t^P}$

This expression can be rewritten in the following manner:

$$L = (r_o^D - r_t^D)(1 + g) + (r_o^T - r_t^T)\,t$$

It can be seen from this formulation of the adjusted reserve ratio that the reserve ratio (r) is not held invariant with respect to all factors influencing it. For example, changes in the member bank excess reserve ratio (e), and the nonmember bank vault cash ratio (v) will change the total reserve ratio (r). Because legal reserve requirement ratios on demand deposits are set at different levels from those on time deposits, a shift of deposits between demand and time deposits will also affect the reserve ratio. Further, to the extent that there are different legal reserve requirement ratios on the same type of deposits, as is the current case where reserve requirement ratios are applied in a graduated manner by size of bank deposits, shifts in deposits between different reserve categories will change the r-ratio. The RAM adjustment is not intended to hold the reserve ratio invariant in the face of these types of changes. Also, it is apparent that an adjustment factor designed to hold the multiplier invariant with respect to reserve requirement ratios will depend upon the g- and t-ratios that appear in the multiplier.

Computation of RAM

The new reserve adjustment magnitude is computed taking the reserve requirement ratios that existed in 1929 as the initial values for the reserve requirement ratios. In 1929 these ratios were set as follows:

	Net Demand Deposits	Time Deposits
Central Reserve City Banks	13%	3%
Reserve City Banks	10	3
Country Banks	7	3

These ratios correspond to the r_o used in the simplified example presented in the previous section. They are the ratios that are used each period, along with the current ones, to compute RAM. If current period reserve requirement ratios are equal to the 1929 ratios, RAM is equal to zero.[5] If current period ratios are larger (smaller) than 1929 ratios, then RAM is negative (positive).

Changes in the structure of legal reserve requirement ratios were relatively minor until 1972. The major time deposit change was in mid-1966 when deposits were split into savings deposits, other time deposits of $0-5 million and over $5 million.

On net demand deposits the legal reserve requirements were originally established for three classes of banks — central reserve city, other reserve city and country banks. The central reserve city classification was eliminated in 1962, and in January 1968 the requirement on net demand deposits by class of bank was split into $0-5 million and over $5 million. The major change came in late 1972 when member banks' required reserves were computed on net demand deposits of $0-2, $2-10, $10-100, $100-400, and over $400 million.

As an example of how RAM was computed for the structure of legal reserve requirement ratios in mid-1972, we begin with the following distribution of demand deposits:

	$0-5 million	Over $5 million
Reserve City Banks in N.Y. and Chicago[6]	$ 110 million	$32,015 million
Other Reserve City Banks	779	51,968
Country Banks	21,006	44,075

[5]Since reserve ratios were fixed by law until 1935, RAM is zero up to this date. The first change in legal reserve requirement ratios took place in August 1936.

[6]Formerly central reserve city banks.

The reserve adjustment magnitude associated with demand deposits is then computed by multiplying the deposits in each category by the appropriate difference between current reserve requirement ratios and those that existed in 1929. The structure of legal reserve requirement ratios on demand deposits in mid-1972 was as follows:

	$0-5 million	Over $5 million
Reserve City Banks	.170	.175
Country Banks	.125	.130

Consequently, the reserve adjustment magnitude for demand deposits (RAMD) equals:

$$\begin{aligned} RAMD &= (.13 - .17)\ 110 + (.13 - .175)\ 32{,}015 \\ &+ (.10 - .17)\ 779 + (.10 - .175)\ 51{,}968 \\ &+ (.07 - .125)\ 21{,}006 + (.07 - .13)\ 44{,}075 \\ &= -\$9{,}197 \text{ million} \end{aligned}$$

The next step in computing the reserve adjustment magnitude is to compute the part associated with time deposits (RAMT). This procedure is essentially the same as that used for RAMD. In 1972, this is somewhat easier than RAMD, because there are fewer deposit categories to consider. All banks faced a reserve requirement ratio of 3 percent on savings deposits and 3 percent on the total amount of other time deposits up to $5 million, and 5 percent on the amount of other time deposits in excess of $5 million. Given the following distribution of time deposits in mid-1972:

Savings	$ 92,686 million
Other Time	
$0-5 million	21,177
Over $5 million	117,776

the reserve adjustment magnitude on time deposits was computed in the following manner:

$$\begin{aligned} RAMT &= (.03 - .03)\ 92{,}686 + (.03 - .03)\ 21{,}177 \\ &+ (.03 - .05)\ 117{,}776 = -\$2{,}356 \text{ million} \end{aligned}$$

As can be seen in this example, the only difference between required reserve ratios on time deposits in mid-1972 from those that existed in 1929 is that reserve requirements on the volume of other time deposits in excess of $5 million are 5 percent in 1972, compared to 3 percent in 1929. Hence, the RAM adjustment on savings and other time deposits up to $5 million is zero, and since the reserve requirement ratio on other time deposits in excess of $5 million is greater in 1972 than 1929, this adjustment is negative.

In November 1972 there was a major change in the method by which legal reserves on demand deposits were calculated. The previous division of banks into reserve city and country banks was eliminated. Beginning in November 1972 graduated reserve requirement ratios were applied against the volume of deposits held by a bank. For example, at the end of November 1972 the following set of legal reserve requirement ratios on net demand deposits was in effect:

$0-2 million	8%
$2-10	10
$10-100	12
$100-400	13
Over $400	17½

Since no such reserve requirement categories existed in 1929, this change made it necessary to construct a set of reserve requirement ratios that would have been comparable to the 1929 set. What reserve requirement ratios in 1972, based on the net demand deposit categories, would have been equivalent to the 1929 ratios? The distribution of deposits in November 1972 was used to construct these base period ratios. The proportion of deposits in each category held by: (1) New York and Chicago banks (the former central reserve city banks), (2) other reserve city banks, and (3) country banks was determined. This distribution is given in the table below.

Proportion of Deposits by Deposit Category

Bank Location	$0-2	$2-10	$10-100	$100-400	Over $400 Million
N.Y. & Chicago	.00028	.00112	.01251	.03352	.16212
Other Reserve City	.00198	.00787	.08136	.13708	.12495
Country	.06606	.13468	.18558	.04908	.00180
Sum	.06832	.14367	.27945	.21968	.28887

The numbers in each of the cells were computed by dividing total deposits in that category held by that class of banks by total deposits. For example, country banks holdings of demand deposits in the $0-2 million category were 6.6 percent of total demand deposits subject to reserve requirements. The number at the bottom of each column gives the proportion of total deposits in that category. For example, 27.9 percent of total demand deposits subject to reserve requirements fell in the $10-100 million category.

To compute the appropriate base period (1929 equivalent) reserve requirement ratio for each deposit category, the proportion of deposits in each cell is multiplied by the 1929 ratio applicable to that category of banks. Then this total is divided by the number at the bottom of the column. For example, the 1929 equivalent reserve requirement ratio applicable to deposits in the $0-2 million category is computed in the following manner:

$$\frac{(.00028)\ (.13) + (.00198)\ (.10) + (.06606)\ (.07)}{.06832} = .0711$$

The new set of 1929 equivalent reserve requirement ratios is as follows:

$0-2 million	.0711
$2-10	.0721
$10-100	.0814
$100-400	.0979
Over $400	.1167

As an example of the computation of RAMD under the new reserve requirement categories, in early 1973 the distribution of demand deposits subject to reserve requirements was approximately as follows:

$0-2 million	$10,773 million
$2-10	22,749
$10-100	45,533
$100-400	36,400
Over $400	51,010

Hence, RAMD was computed as follows:

$$\begin{aligned} RAMD = & (.0711 - .08)\ 10{,}773 + (.0721 - .10)\ 22{,}749 \\ & + (.0814 - .12)\ 45{,}533 + (.0979 - .13)\ 36{,}400 \\ & + (.1167 - .175)\ 51{,}010 = -\$6{,}630 \text{ million} \end{aligned}$$

Additional Factors in the Computation of RAM

To complete the computation of the reserve adjustment magnitude requires consideration of some additional factors: (1) vault cash, (2) special reserve requirements imposed on selected bank liabilities, (3) special waivers of penalties for reserve deficiencies, (4) the reserve carryover privilege, and (5) the lag on deposit data and vault cash.

Vault cash — Between mid-1917 and November 1959 member banks could use only their deposits at Federal Reserve Banks to meet their legal reserve requirements. In a series of stages beginning December 1, 1959 member banks were allowed to count part of their vault cash as legal reserves, and after November 23, 1960 they were allowed to count all their vault cash toward meeting legal reserve requirements. This action by the Federal Reserve is viewed in the computation of RAM as a reduction in reserve requirement ratios.[7] Consequently, after November 23, 1960, all current vault cash holdings of member banks are treated as part of RAM.

This method of treating vault cash has an important effect on the level of RAM and some effect on the variability of RAM. Under the old method of computing RAM, the early 1960 release of vault cash to meet required reserves was treated as a one time permanent event. RAM was increased by $2.492 billion, the amount of vault cash released by the end of 1960, and, thereafter, this was unchanged. Under the new procedure, as banks' holdings of vault cash varies, RAM varies. For example, the vault cash adjustment to RAM rose from about $2.5 billion in December 1960 to about $6.5 billion in January 1973, and then increased an additional $2.5 billion by January 1977.

Special reserve requirements — Beginning in October 1969 the Federal Reserve introduced reserve requirements against special classes of bank liabilities.

> Since Oct. 16, 1969, member banks have been required under Regulation M to maintain reserves against foreign branch deposits computed on the basis of net balances due from domestic offices to their foreign branches and against foreign branch loans to U. S. residents. Since June 21, 1973, loans aggregating $100,000 or less to any U. S. resident have been excluded from computations, as have total loans of a bank to U. S. residents if such loans do not exceed $1 million. Regulation D imposes a similar reserve requirement on borrowings from foreign banks by domestic offices of a member bank. The reserve percentage applicable to each of these classifications is 4 per cent. The requirement was 10 per cent originally, was increased to 20 per cent on Jan. 7, 1971, was reduced to 8 per cent effective June 21, 1973, and was reduced to 4 per cent effective May 22, 1975. Initially certain base amounts were exempted in the computation of the requirements, but effective Mar. 14, 1974, the last of these reserve-free bases were eliminated. . . .
>
> A marginal reserve requirement was in effect between June 21, 1973, and Dec. 11, 1974, against increases in the aggregate of the following types of obligations: (a) outstanding time deposits of $100,000 or more, (b) outstanding funds obtained by the bank through issuance by a bank's affiliate of obligations subject to existing reserve requirements on time deposits, and (c) beginning July 12, 1973, funds from sales of finance bills. The requirement applied to balances above a specified base, but was not applicable to banks having obligations of these types aggregating less than $10 million.[8]

There were no reserve requirement ratios in 1929 that corresponded to these special reserve requirements. However, these special requirements absorbed bank reserves in the same manner as an increase in regular reserve requirement ratios. Consequently, these actions are included in RAM by entering, as a negative item, the volume of required reserves generated by these special reserve requirement ratios. This

[7]See the technical Appendix to this article which is available upon request.

[8]Board of Governors of the Federal Reserve System, *Annual Statistical Digest 1971-1975* (Washington, D. C.: Board of Governors of the Federal Reserve System, 1976), p. 328.

negative adjustment to RAM amounted to about $400 million from late October 1969 through March 1970. This adjustment reflected required reserves on bank Eurodollar borrowings. Over the next six months the amount of this adjustment declined, reaching about $100 million in mid-September 1970. Then, for about three months there was a rise in required reserves resulting from the introduction of graduated reserve requirements against funds obtained by member banks through issuance of commercial paper by their affiliates.

Initially this raised the adjustment factor to about $300 million. However, after a few months, the amount of required reserves associated with these special reserve categories had fallen below $100 million, at which level they remained until about mid-1973. With the introduction of the "over the base period" reserve requirements on time deposits and a reserve requirement on the funds from sales of finance bills along with the increased use of Eurodollars by banks, the amount of this adjustment rose sharply, reaching about $1.5 billion in August 1974. In December 1974, with the removal of the "over the base period" requirement on time deposits, the size of this adjustment began to decrease sharply, falling to around $300 million in January 1975. By mid-1975 it amounted to only about $100 million where it has remained.

Waiver of penalties for reserve deficiencies — In November 1972, and again in November 1975, the Federal Reserve instituted a practice of allowing, under certain conditions, Federal Reserve Banks to waive penalties for member bank reserve deficiencies. Beginning with the week ended November 15, 1972, Federal Reserve Banks were allowed to waiver penalties for a transition period in connection with bank adaption to Regulation J, as amended November 9, 1972.[9] These allowable deficiencies averaged $330 million in November, $428 million in December 1972 and then declined through June 1974 after which they were eliminated. Starting with the reserve settlement week of November 19, 1975 a policy of allowable reserve deficiencies was reinstituted in accord with Board policy of permitting transitional relief when a nonmember bank merges with an existing member bank, or when a nonmember bank joins the Federal Reserve System. These waivers averaged $135 million in January 1976, rose to a peak of $160 million in June 1976, and since then have fluctuated between about $150-$160 million.

These actions by the Federal Reserve were essentially the same as an increase in member bank reserves. Instead of directly increasing member bank deposits at Federal Reserve Banks, the Federal Reserve gave the banks an "overdraft privilege." The banks appear to have treated this "overdraft privilege" exactly the same as an increase in deposits at Federal Reserve Banks. For example, the level of excess reserves of member banks, computed to include the allowable deficiencies, remained at about the same level during the period from late 1972 to mid-1974 as in the previous 4 year period. Consequently, the total of these allowable deficiencies are included in RAM for each month in which they were in effect.

The Board of Governors includes these allowable reserve deficiencies in total member bank reserves. Hence, the amount of this item can be computed by subtracting from total member bank reserves the sum of member bank reserves with the Federal Reserve Banks and member bank currency and coin. For historical data these items are available in the Federal Reserve *Bulletin* table entitled "Member Bank Reserves, Federal Reserve Bank Credit, and Related Items," and for current data Table 1.12 "Reserves and Borrowings Member Banks."

Reserve Carryover Privilege

In the September 1968 revision of Regulation D the Federal Reserve also instituted a reserve carryover privilege under which either an excess or deficiency of reserves of up to 2 percent of average required reserves could be carried forward to the next week. In one sense it could be argued that this carryover privilege should be treated as a regulatory change supplying reserves and, hence, should be part of RAM. However, the size of the carryover is determined, within limits, by the banks. Hence, we have chosen not to include this factor in RAM. Instead, its influence remains in the money multiplier where it appears as a factor influencing the variance of the excess reserve ratio. On balance, the influence of the reserve carryover has been very small, remaining at about $100 million with little variation since late 1968.

Lag on Deposit and Vault Cash Data

In any week the most recent deposit and vault cash data are those on deposits and vault cash held by member banks two weeks earlier. Consequently, the RAM adjustment for any class of deposits is com-

[9]Effective November 9, 1972 banks were required to pay cash items presented by a Federal Reserve Bank on the day of presentation in funds available to the Federal Reserve Bank on that day.

Chart I
Monetary Base

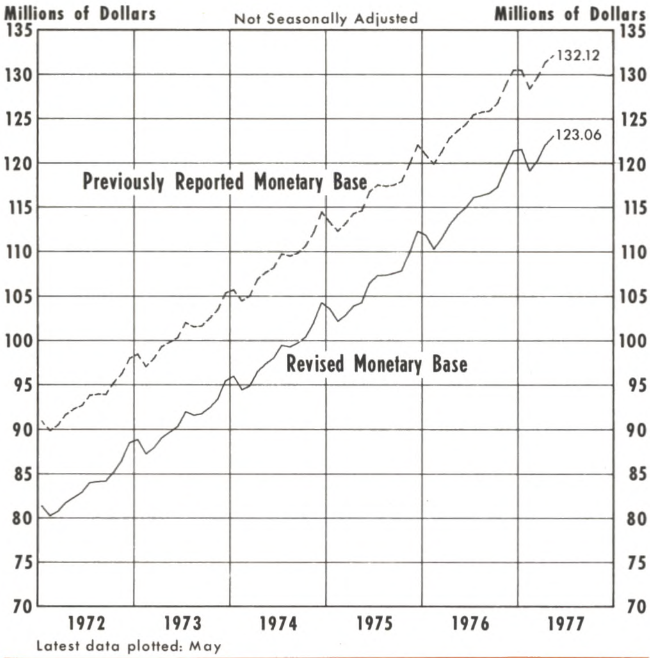
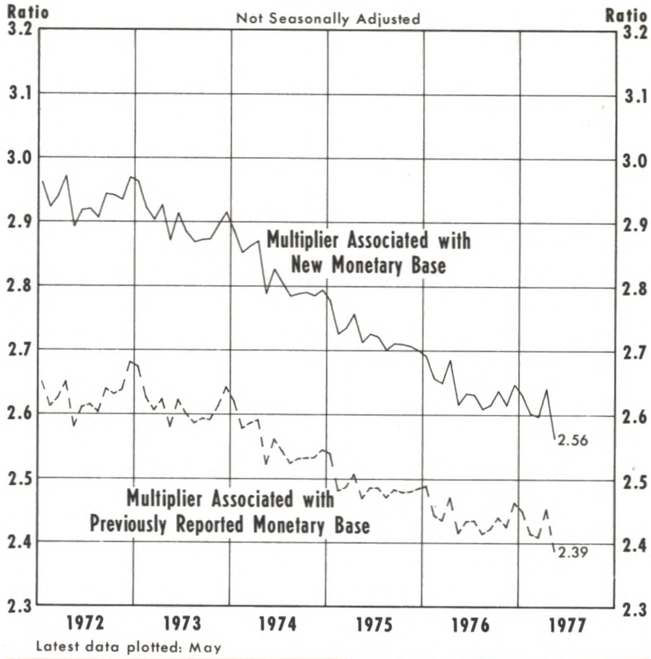


Chart II
Multiplier



puted by taking the difference between the currently effective reserve requirement ratio on the class of deposits and the base period reserve requirement ratio applicable to that class of deposits and multiplying this result by deposits of two weeks earlier. The RAM associated with the i^{th} class of deposits in period t is:

$$RAM_{i,t} = (r_{i,o} - r_{i,t}) D_{i,t-2}$$

Likewise, the vault cash added to RAM in the current week is vault cash held two weeks earlier.

Summary of the Computation of RAM

The new RAM adjustment is, therefore, computed in the following steps:

(1) Determine the distribution of member bank deposits subject to reserve requirements according to reserve requirement categories two weeks earlier.

(2) Compare the current reserve requirement ratio for each reserve requirement category with the corresponding 1929 equivalent reserve requirement ratio for the category. Multiply the difference between the 1929 equivalent ratio and the current ratio by the amount of deposits in that category two weeks earlier. If the current reserve requirement ratio exceeds the 1929 ratio, this reduces RAM. If the current ratio is less than the 1929 ratio, this amount is a positive entry to RAM.

(3) Follow steps (1) and (2) for demand deposits and time deposits.

(4) Subtract from RAM the amount of required reserves on all deposits subject to special reserve requirements.

(5) Add to RAM the amount of waiver privileges.

(6) Add to RAM the amount of vault cash held by member banks two weeks earlier.

Comparison of the Old and New Monetary Base Series

Table III and Charts I and II present a comparison of the old and new RAM, old and new monetary

Table III

Comparison of OLD and NEW Monetary Base Data: January 1972 - May 1977 (Nonseasonally Adjusted Monthly Data)

	Mean
Old Monetary Base	$110.415 billion
New Monetary Base	$100.592
Old RAM	$ 7.039
New RAM	$ –2.784
Old Multiplier	2.535
New Multiplier	2.788

Table IV

January 1972 - May 1977
Not Seasonally Adjusted Data

	Time	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	Const.
$\ln m_1$	−.001688	−.001805	−.018704	−.018114	−.007138	−.028525	−.015979	−.017531	−.022746	−.015864	−.013939	−.011306	1.001846
	(−13.35)	(− .89)	(−7.27)	(−6.21)	(−2.28)	(−8.74)	(−4.73)	(−5.18)	(−6.93)	(−5.18)	(−5.19)	(−5.55)	(176.79)
					$\bar{R}^2 = .98$	SE = .0043	DW = 2.39	$\hat{\rho} = .768$					
$\ln m_1^*$	−.001678	−.001670	−.018605	−.017944	−.006757	−.028125	−.015526	−.016823	−.022013	−.015109	−.013104	−.011143	1.000114
	(−14.29)	(− .83)	(−7.36)	(−6.27)	(−2.20)	(−8.81)	(−4.69)	(−5.08)	(−6.85)	(−5.03)	(−4.96)	(−5.55)	(189.31)
					$\bar{R}^2 = .98$	SE = .0042	DW = 2.37	$\hat{\rho} = .755$					
$\ln m_1^{**}$	−.002392	−.003430	−.015481	−.013501	−.001858	−.024407	−.013000	−.014951	−.019805	−.013315	−.009555	−.008581	1.117275
	(−16.70)	(−1.76)	(−6.27)	(−4.80)	(− .61)	(−7.71)	(−3.97)	(−4.56)	(−6.25)	(−4.51)	(−3.71)	(−4.42)	(175.15)
					$\bar{R}^2 = .99$	SE = .0042	DW = 2.42	$\hat{\rho} = .802$					

NOTES: Numbers in parentheses are t-statistics
m_1 = M1 ÷ Previously reported monetary base
m_1^* = M1 ÷ (Previously reported monetary base + reserves released by waiver privilege)
m_1^{**} = M1 ÷ New monetary base series based on revision of method of computing RAM
D1, . . ., D11 are dummy variables for January through November

base, and the multipliers (money stock divided by base) for the period January 1972 through May 1977. All data are on a nonseasonally adjusted basis. As shown in Table III, the difference between the mean value of the old RAM and the new RAM is about $10 billion over the last 5 years.[10] Consequently, the old monetary base averaged about $10 billion more than the base using the new method of computing RAM. Correspondingly, the mean of the new money multiplier is about 10 percent higher than the mean value of the old multiplier (2.788 vs. 2.535).

To examine whether the revision of RAM had an effect on the relationship between the monetary base and money (Ml), the money multiplier was regressed on a time trend. These results were compared to similar regressions using the previously reported monetary base and the previously reported monetary base with a RAM adjustment that included the waivers that are incorporated in the new RAM. The results of these regressions are reported in Table IV. Nonseasonally adjusted monthly data was used in all the regressions and each regression included seasonal dummy variables.

Since $\ln m = \ln M - \ln B$, the regressions reported in Table IV indicate how much of the variance of the difference between the growth rate of the money stock and the monetary base is not explained by a time trend in the multiplier, seasonal variation, or autocorrelation in the errors. There have been several changes in reserve requirement ratios in the last five years and, consequently, if there was a major effect resulting from our revision of RAM we would have expected to observe its effects in the last five years. As shown by a comparison of the standard errors associated with the three equations, the revision of the base resulting from changing the method of computing RAM has had essentially no effect on the residual variance in the relationship between the base and Ml.

(Appendix I follows on next page.)

[10]Since the new RAM is not a cumulative sum of past changes in RAM, the level of RAM is not influenced by the starting point for computation of RAM.

APPENDIX I

Revised Weekly Monetary Base

(Billions of Dollars)

Week Ended	Nonseasonally Adjusted			Seasonally Adjusted
	Source Base	Total RAM	Monetary Base	Monetary Base
1/ 7/76	113.5	-0.5	113.0	110.5
1/14/76	111.9	0.7	112.6	110.6
1/21/76	111.6	0.4	112.0	110.9
1/28/76	110.2	0.4	110.6	111.1
2/ 4/76	110.2	0.3	110.5	111.5
2/11/76	109.5	0.5	110.1	111.2
2/18/76	111.3	-0.1	111.2	111.9
2/25/76	110.4	-0.3	110.1	111.7
3/ 3/76	110.4	0.2	110.7	112.5
3/10/76	110.1	0.6	110.7	112.4
3/17/76	111.3	0.1	111.5	112.5
3/24/76	111.7	-0.4	111.3	112.7
3/31/76	111.8	0.0	111.8	113.0
4/ 7/76	111.6	0.3	111.8	112.8
4/14/76	112.6	0.5	113.1	113.5
4/21/76	114.3	-0.4	113.9	114.1
4/28/76	113.2	0.1	113.4	114.1
5/ 5/76	114.0	0.3	114.3	114.6
5/12/76	112.7	1.0	113.7	114.0
5/19/76	113.8	0.3	114.2	114.4
5/26/76	113.3	0.3	113.7	114.3
6/ 2/76	113.7	0.7	114.4	114.9
6/ 9/76	113.5	1.0	114.5	114.9
6/16/76	114.7	0.7	115.4	115.4
6/23/76	114.3	0.4	114.7	115.1
6/30/76	115.0	0.7	115.7	115.7
7/ 7/76	115.4	0.9	116.3	115.5
7/14/76	115.3	1.1	116.4	115.3
7/21/76	116.4	0.1	116.5	115.4
7/28/76	115.0	0.8	115.8	115.6
8/ 4/76	115.6	0.9	116.4	116.3
8/11/76	114.8	1.2	116.0	115.9
8/18/76	116.2	0.7	116.9	116.7
8/25/76	115.6	0.4	116.0	116.6
9/ 1/76	115.2	0.9	116.0	116.7
9/ 8/76	115.1	1.3	116.3	116.6
9/15/76	115.6	1.4	117.0	117.3
9/22/76	115.8	0.4	116.2	117.2
9/29/76	115.5	1.1	116.5	117.6
10/ 6/76	115.8	1.1	116.8	117.8
10/13/76	115.8	1.4	117.2	117.7
10/20/76	117.7	0.1	117.8	118.0
10/27/76	116.4	0.7	117.1	118.2
11/ 3/76	116.9	1.1	118.0	118.7
11/10/76	116.8	1.4	118.2	118.6
11/17/76	118.8	0.9	119.7	119.3
11/24/76	118.9	0.5	119.3	119.1
12/ 1/76	119.4	1.1	120.5	119.5
12/ 8/76	118.7	1.4	120.1	119.0
12/15/76	120.0	1.6	121.6	119.6
12/22/76	120.8	0.8	121.6	119.2
12/29/76	121.3	1.2	122.5	119.4
1/ 5/77	121.1	1.5	122.6	119.6
1/12/77	120.0	1.9	121.9	119.9
1/19/77	120.1	1.7	121.8	120.0
1/26/77	119.0	1.7	120.7	120.9
2/ 2/77	117.6	1.8	119.5	120.4
2/ 9/77	117.3	2.0	119.3	120.6
2/16/77	117.8	1.8	119.6	120.5
2/23/77	118.2	1.0	119.3	120.6
3/ 2/77	117.5	1.6	119.2	121.1
3/ 9/77	117.6	1.8	119.3	121.2
3/16/77	118.5	2.0	120.4	121.5
3/23/77	119.4	1.0	120.3	121.9
3/30/77	119.3	1.6	120.9	122.4
4/ 6/77	119.3	1.9	121.2	122.2
4/13/77	119.9	2.3	122.1	122.8
4/20/77	121.9	0.9	122.8	123.1
4/27/77	120.9	1.6	122.4	123.0
5/ 4/77	121.0	2.0	123.0	123.4
5/11/77	120.5	2.4	122.8	123.3
5/18/77	121.4	1.9	123.3	123.4
5/25/77	120.5	1.8	122.3	123.0
6/ 1/77	121.1	2.1	123.2	123.7

Revised Monthly Monetary Base

(Billions of Dollars)

Month	Nonseasonally Adjusted			Seasonally Adjusted
	Source Base	Total RAM[1]	Monetary Base	Monetary Base
1/47	44.9	-7.1	37.9	37.5
2/47	44.3	-7.0	37.3	37.7
3/47	44.3	-6.9	37.4	37.8
4/47	44.1	-6.8	37.3	37.8
5/47	44.1	-6.8	37.3	37.8
6/47	44.4	-6.9	37.5	37.8
7/47	44.6	-6.9	37.7	37.8
8/47	44.7	-7.0	37.7	37.8
9/47	45.5	-7.1	38.4	38.2
10/47	45.7	-7.2	38.5	38.2
11/47	45.6	-7.3	38.3	38.0
12/47	46.2	-7.3	38.9	38.0
1/48	45.8	-7.4	38.4	38.0
2/48	44.9	-7.4	37.5	37.9
3/48	45.0	-7.7	37.3	37.7
4/48	44.7	-7.6	37.0	37.6
5/48	44.7	-7.6	37.1	37.6
6/48	45.2	-7.9	37.3	37.6
7/48	45.5	-8.1	37.4	37.5
8/48	45.7	-8.1	37.6	37.6
9/48	46.7	-8.8	37.8	37.6
10/48	48.0	-10.2	37.8	37.5
11/48	48.1	-10.3	37.9	37.5
12/48	48.4	-10.3	38.1	37.2
1/49	47.8	-10.4	37.5	37.1
2/49	47.1	-10.3	36.8	37.1
3/49	46.9	-10.2	36.7	37.1
4/49	46.6	-10.1	36.5	37.1
5/49	45.6	-8.9	36.6	37.1
6/49	45.5	-8.8	36.7	36.9
7/49	45.0	-8.0	37.0	37.1
8/49	44.3	-7.1	37.1	37.2
9/49	43.5	-6.3	37.2	37.0
10/49	43.6	-6.4	37.2	36.9

Month	Nonseasonally Adjusted Source Base	Nonseasonally Adjusted Total RAM[1]	Nonseasonally Adjusted Monetary Base	Seasonally Adjusted Monetary Base
11/49	43.6	-6.4	37.2	36.8
12/49	44.0	-6.5	37.6	36.6
1/50	43.7	-6.5	37.2	36.9
2/50	43.2	-6.6	36.6	37.0
3/50	43.1	-6.5	36.6	36.9
4/50	43.0	-6.5	36.5	37.1
5/50	43.0	-6.4	36.5	37.1
6/50	43.2	-6.4	36.8	37.0
7/50	43.4	-6.5	36.9	36.9
8/50	43.3	-6.6	36.7	36.8
9/50	43.8	-6.6	37.2	37.0
10/50	44.0	-6.7	37.3	37.0
11/50	44.1	-6.7	37.4	37.1
12/50	45.2	-6.8	38.4	37.4
1/51	45.4	-7.7	37.7	37.4
2/51	46.1	-9.0	37.1	37.5
3/51	46.4	-8.9	37.5	37.8
4/51	46.5	-9.0	37.5	38.1
5/51	46.2	-9.0	37.2	37.8
6/51	46.9	-8.9	38.0	38.1
7/51	47.1	-9.0	38.1	38.1
8/51	47.1	-9.0	38.1	38.2
9/51	47.6	-9.0	38.6	38.5
10/51	48.3	-9.1	39.2	38.9
11/51	48.4	-9.2	39.2	38.8
12/51	49.4	-9.3	40.2	39.1
1/52	49.1	-9.5	39.6	39.3
2/52	48.4	-9.5	38.9	39.3
3/52	48.6	-9.4	39.3	39.6
4/52	48.2	-9.4	38.8	39.5
5/52	48.3	-9.3	39.0	39.6
6/52	49.0	-9.3	39.7	39.8
7/52	49.6	-9.4	40.1	40.1
8/52	49.4	-9.7	39.7	39.8
9/52	49.9	-9.6	40.3	40.2
10/52	50.2	-9.6	40.6	40.3
11/52	50.6	-9.7	40.9	40.5
12/52	51.7	-9.8	41.9	40.8
1/53	50.9	-10.0	40.9	40.6
2/53	50.2	-9.9	40.4	40.8
3/53	50.2	-9.7	40.5	40.8
4/53	49.8	-9.7	40.1	40.8
5/53	49.8	-9.5	40.3	40.8
6/53	50.3	-9.4	40.9	41.1
7/53	49.8	-8.5	41.3	41.3
8/53	49.7	-8.5	41.2	41.3
9/53	49.9	-8.6	41.3	41.2
10/53	49.9	-8.6	41.3	41.1
11/53	50.3	-8.5	41.7	41.3
12/53	50.9	-8.6	42.2	41.1
1/54	50.5	-8.7	41.7	41.5
2/54	49.5	-8.7	40.7	41.2
3/54	49.4	-8.6	40.8	41.1
4/54	49.1	-8.6	40.6	41.1
5/54	49.3	-8.5	40.8	41.4
6/54	49.5	-8.4	41.2	41.3
7/54	49.1	-7.9	41.2	41.2
8/54	48.4	-7.1	41.3	41.4
9/54	48.4	-7.2	41.2	41.2
10/54	49.0	-7.2	41.8	41.6
11/54	49.5	-7.4	42.1	41.6
12/54	50.0	-7.5	42.6	41.4
1/55	49.2	-7.5	41.7	41.5
2/55	48.6	-7.5	41.1	41.7
3/55	48.4	-7.4	41.0	41.4
4/55	48.6	-7.3	41.3	41.8
5/55	48.6	-7.4	41.2	41.7
6/55	48.8	-7.4	41.4	41.5
7/55	49.1	-7.4	41.7	41.7
8/55	49.0	-7.4	41.6	41.7
9/55	49.1	-7.4	41.8	41.7
10/55	49.4	-7.4	42.0	41.8
11/55	49.7	-7.5	42.2	41.8
12/55	50.5	-7.5	43.0	41.9
1/56	49.8	-7.6	42.2	42.0
2/56	48.9	-7.6	41.4	42.0
3/56	49.2	-7.4	41.8	42.2
4/56	49.1	-7.4	41.6	42.1
5/56	49.1	-7.4	41.6	42.1
6/56	49.5	-7.4	42.0	42.1
7/56	49.6	-7.5	42.1	42.0
8/56	49.4	-7.4	42.0	42.1
9/56	49.8	-7.4	42.4	42.3
10/56	49.8	-7.5	42.3	42.1
11/56	50.4	-7.5	42.9	42.5
12/56	51.3	-7.6	43.8	42.6
1/57	50.3	-7.7	42.7	42.5
2/57	49.4	-7.6	41.8	42.4
3/57	49.5	-7.4	42.0	42.5
4/57	49.7	-7.5	42.2	42.7
5/57	49.5	-7.6	41.9	42.4
6/57	49.9	-7.5	42.4	42.5
7/57	50.2	-7.5	42.7	42.6
8/57	49.9	-7.6	42.3	42.4
9/57	50.1	-7.4	42.7	42.6
10/57	50.1	-7.5	42.7	42.5
11/57	50.3	-7.6	42.7	42.4
12/57	51.4	-7.5	43.8	42.7
1/58	50.4	-7.7	42.7	42.5
2/58	49.6	-7.6	42.0	42.7
3/58	49.3	-6.9	42.4	42.9
4/58	49.0	-6.5	42.6	43.0
5/58	49.0	-6.2	42.8	43.2
6/58	49.6	-6.3	43.4	43.4
7/58	49.9	-6.4	43.5	43.3
8/58	49.8	-6.4	43.4	43.5
9/58	49.8	-6.4	43.4	43.3
10/58	49.9	-6.4	43.5	43.4
11/58	50.3	-6.4	43.8	43.5
12/58	51.3	-6.5	44.8	43.7
1/59	50.4	-6.6	43.8	43.6
2/59	49.7	-6.6	43.2	43.8
3/59	49.7	-6.5	43.2	43.7
4/59	50.0	-6.4	43.5	43.9
5/59	50.1	-6.5	43.5	43.9
6/59	50.3	-6.5	43.8	43.9
7/59	50.7	-6.5	44.2	44.0
8/59	50.6	-6.5	44.1	44.1
9/59	50.6	-6.5	44.1	44.1
10/59	50.6	-6.5	44.1	44.0
11/59	50.8	-6.5	44.3	44.0
12/59	51.4	-6.5	44.9	43.8

Month	Nonseasonally Adjusted Source Base	Nonseasonally Adjusted Total RAM[1]	Nonseasonally Adjusted Monetary Base	Seasonally Adjusted Monetary Base
1/60	50.6	-6.3	44.3	44.0
2/60	49.5	-6.3	43.3	43.8
3/60	49.4	-6.1	43.3	43.8
4/60	49.6	-6.1	43.5	43.9
5/60	49.7	-6.1	43.6	44.0
6/60	49.9	-6.1	43.8	43.9
7/60	50.4	-6.1	44.3	44.1
8/60	50.2	-6.1	44.1	44.1
9/60	49.8	-5.9	43.9	43.9
10/60	50.0	-5.5	44.6	44.5
11/60	50.2	-5.6	44.6	44.3
12/60	49.7	-5.3	44.4	43.4
1/61	49.0	-4.0	44.9	44.7
2/61	48.4	-4.1	44.3	44.8
3/61	48.3	-4.1	44.1	44.6
4/61	48.4	-4.2	44.2	44.6
5/61	48.4	-4.2	44.3	44.6
6/61	48.8	-4.2	44.6	44.8
7/61	49.1	-4.1	45.0	44.8
8/61	49.3	-4.1	45.1	45.2
9/61	49.5	-4.2	45.3	45.4
10/61	49.9	-4.2	45.7	45.7
11/61	50.4	-4.3	46.1	45.8
12/61	51.2	-4.3	46.9	45.9
1/62	50.5	-4.2	46.3	46.0
2/62	49.8	-4.1	45.6	46.1
3/62	49.9	-4.2	45.7	46.2
4/62	50.3	-4.3	46.0	46.5
5/62	50.4	-4.3	46.1	46.5
6/62	50.8	-4.3	46.5	46.7
7/62	51.3	-4.3	47.0	46.8
8/62	51.1	-4.3	46.8	46.9
9/62	51.2	-4.2	47.0	47.0
10/62	51.5	-4.2	47.3	47.2
11/62	51.3	-3.6	47.7	47.4
12/62	52.2	-3.5	48.7	47.6
1/63	51.5	-3.4	48.1	47.7
2/63	51.0	-3.4	47.5	48.0
3/63	51.1	-3.5	47.6	48.1
4/63	51.4	-3.6	47.8	48.2
5/63	51.6	-3.5	48.1	48.6
6/63	52.1	-3.5	48.6	48.7
7/63	52.7	-3.5	49.2	49.0
8/63	52.5	-3.5	49.0	49.1
9/63	52.8	-3.5	49.4	49.4
10/63	53.0	-3.5	49.6	49.5
11/63	53.7	-3.5	50.2	49.9
12/63	54.9	-3.5	51.4	50.2
1/64	54.1	-3.3	50.7	50.4
2/64	53.4	-3.4	50.0	50.5
3/64	53.8	-3.5	50.3	50.8
4/64	54.0	-3.6	50.4	50.8
5/64	54.2	-3.5	50.7	51.2
6/64	54.9	-3.5	51.4	51.5
7/64	55.3	-3.5	51.8	51.6
8/64	55.4	-3.5	51.9	52.0
9/64	55.8	-3.5	52.3	52.4
10/64	56.1	-3.5	52.6	52.5
11/64	56.7	-3.6	53.2	52.9
12/64	57.7	-3.6	54.1	52.8
1/65	57.0	-3.4	53.6	53.1
2/65	56.5	-3.5	53.0	53.4
3/65	56.6	-3.5	53.1	53.7
4/65	57.0	-3.5	53.4	53.9
5/65	57.1	-3.6	53.6	54.0
6/65	57.7	-3.6	54.1	54.2
7/65	58.3	-3.6	54.7	54.5
8/65	58.2	-3.6	54.6	54.8
9/65	58.5	-3.5	55.0	55.0
10/65	59.1	-3.5	55.6	55.5
11/65	59.6	-3.6	56.1	55.8
12/65	61.0	-3.5	57.5	56.2
1/66	60.4	-3.4	57.0	56.4
2/66	59.7	-3.5	56.2	56.6
3/66	59.8	-3.5	56.3	56.9
4/66	60.4	-3.5	56.9	57.4
5/66	60.6	-3.6	57.0	57.5
6/66	61.0	-3.6	57.4	57.5
7/66	62.0	-3.7	58.3	58.1
8/66	61.6	-4.0	57.6	57.8
9/66	62.3	-3.9	58.3	58.5
10/66	62.5	-4.2	58.3	58.3
11/66	63.0	-4.3	58.7	58.4
12/66	64.1	-4.1	60.0	58.7
1/67	63.7	-4.1	59.6	59.0
2/67	63.2	-4.2	59.0	59.4
3/67	63.1	-4.1	59.0	59.6
4/67	63.2	-3.6	59.6	60.0
5/67	63.3	-3.7	59.6	60.1
6/67	64.0	-3.7	60.3	60.5
7/67	64.7	-3.6	61.1	60.9
8/67	64.6	-3.7	60.9	61.0
9/67	65.2	-3.7	61.5	61.6
10/67	65.8	-3.8	62.0	62.0
11/67	66.4	-4.0	62.5	62.2
12/67	67.8	-3.9	63.8	62.5
1/68	67.6	-4.1	63.5	62.8
2/68	67.1	-4.3	62.9	63.3
3/68	67.5	-4.5	63.0	63.7
4/68	67.8	-4.6	63.2	63.7
5/68	68.1	-4.5	63.6	64.0
6/68	68.8	-4.5	64.4	64.6
7/68	69.6	-4.6	65.0	64.7
8/68	69.8	-4.6	65.3	65.3
9/68	70.0	-4.7	65.4	65.5
10/68	70.8	-4.8	65.9	66.0
11/68	71.7	-4.9	66.8	66.5
12/68	73.1	-4.8	68.3	66.9
1/69	72.8	-4.9	67.9	67.2
2/69	71.9	-5.0	66.9	67.4
3/69	71.7	-4.9	66.8	67.6
4/69	72.3	-5.2	67.1	67.5
5/69	73.3	-5.7	67.6	68.1
6/69	73.5	-5.4	68.0	68.2
7/69	73.6	-5.3	68.3	68.1
8/69	73.8	-5.2	68.6	68.6
9/69	73.7	-5.1	68.6	68.7
10/69	74.3	-5.4	68.9	69.0
11/69	75.5	-5.6	69.9	69.6
12/69	76.7	-5.5	71.1	69.7
1/70	76.3	-5.6	70.7	70.0
2/70	75.2	-5.6	69.6	70.2

Month	Nonseasonally Adjusted			Seasonally Adjusted
	Source Base	Total RAM[1]	Monetary Base	Monetary Base
3/70	75.2	-5.6	69.6	70.4
4/70	76.2	-5.7	70.4	70.9
5/70	76.6	-5.6	71.0	71.4
6/70	76.8	-5.3	71.5	71.7
7/70	77.9	-5.5	72.4	72.1
8/70	78.1	-5.6	72.6	72.6
9/70	78.7	-5.6	73.1	73.3
10/70	78.7	-5.2	73.5	73.7
11/70	79.3	-5.1	74.2	73.9
12/70	80.9	-5.1	75.9	74.4
1/71	81.1	-5.3	75.8	75.0
2/71	80.5	-5.4	75.0	75.7
3/71	80.7	-5.4	75.3	76.1
4/71	81.5	-5.5	76.0	76.5
5/71	82.4	-5.5	76.9	77.2
6/71	82.8	-5.4	77.4	77.6
7/71	84.1	-5.5	78.6	78.2
8/71	84.0	-5.4	78.6	78.6
9/71	84.4	-5.5	78.9	79.1
10/71	84.6	-5.5	79.1	79.3
11/71	85.4	-5.5	79.9	79.7
12/71	86.7	-5.5	81.2	79.8
1/72	87.2	-5.8	81.4	80.5
2/72	86.1	-5.8	80.2	81.0
3/72	86.7	-5.9	80.8	81.6
4/72	87.9	-6.1	81.7	82.2
5/72	88.5	-6.2	82.3	82.6
6/72	88.9	-6.0	82.9	83.1
7/72	90.0	-6.0	84.0	83.6
8/72	90.2	-6.0	84.1	84.2
9/72	90.1	-5.9	84.2	84.4
10/72	91.5	-6.3	85.2	85.5
11/72	90.2	-3.6	86.5	86.3
12/72	90.9	-2.4	88.5	86.9
1/73	91.5	-2.6	88.8	87.9
2/73	90.0	-2.8	87.2	88.1
3/73	90.9	-3.0	87.9	88.8
4/73	92.3	-3.3	89.0	89.4
5/73	92.9	-3.2	89.7	89.9
6/73	93.4	-3.1	90.3	90.5
7/73	95.6	-3.6	92.0	91.4
8/73	95.8	-4.2	91.6	91.6
9/73	96.1	-4.4	91.7	92.1
10/73	97.4	-4.9	92.4	92.8
11/73	98.2	-4.8	93.4	93.1
12/73	100.0	-4.5	95.5	93.8
1/74	100.4	-4.4	96.0	95.0
2/74	99.0	-4.6	94.4	95.4
3/74	99.5	-4.7	94.9	95.8
4/74	101.6	-5.1	96.5	96.9
5/74	102.7	-5.3	97.4	97.6
6/74	103.4	-5.4	98.0	98.2
7/74	105.1	-5.6	99.5	98.9
8/74	105.0	-5.7	99.3	99.3
9/74	105.3	-5.5	99.7	100.1
10/74	105.6	-5.2	100.4	100.8
11/74	106.9	-4.9	102.0	101.6
12/74	108.7	-4.5	104.2	102.3
1/75	107.5	-3.9	103.6	102.6
2/75	105.5	-3.3	102.2	103.4
3/75	105.6	-2.8	102.9	103.9
4/75	106.6	-2.7	103.9	104.3
5/75	106.7	-2.4	104.3	104.5
6/75	108.6	-2.1	106.5	106.6
7/75	109.2	-1.8	107.4	106.7
8/75	109.0	-1.6	107.4	107.4
9/75	109.1	-1.5	107.6	108.0
10/75	109.5	-1.6	107.9	108.3
11/75	111.0	-1.1	109.9	109.4
12/75	113.0	-0.7	112.3	110.2
1/76	111.6	0.2	111.9	110.9
2/76	110.2	0.1	110.3	111.6
3/76	111.4	0.1	111.5	112.6
4/76	112.9	0.1	113.0	113.5
5/76	113.6	0.5	114.2	114.4
6/76	114.3	0.7	114.9	115.1
7/76	115.4	0.7	116.1	115.4
8/76	115.5	0.8	116.4	116.5
9/76	115.6	1.0	116.6	117.2
10/76	116.4	0.9	117.3	117.9
11/76	118.4	1.0	119.4	118.9
12/76	120.2	1.2	121.4	119.3
1/77	119.8	1.7	121.6	120.5
2/77	117.5	1.6	119.1	120.6
3/77	118.7	1.6	120.3	121.5
4/77	120.4	1.7	122.1	122.6
5/77	121.0	2.0	123.1	123.3

Components of Revised RAM

(Billions of Dollars)

Month	Nonseasonally Adjusted				
	RAM on Net Demand Deposits	RAM on Time Deposits	Other Ram[2]	Vault Cash	Total Ram[3]
1/72	-9.5	-2.1	-0.1	5.9	-5.8
2/72	-9.2	-2.1	-0.1	5.5	-5.8
3/72	-9.1	-2.1	-0.1	5.4	-5.9
4/72	-9.3	-2.1	-0.1	5.4	-6.1
5/72	-9.4	-2.2	-0.1	5.5	-6.2
6/72	-9.2	-2.2	-0.1	5.5	-6.0
7/72	-9.4	-2.2	-0.1	5.7	-6.0
8/72	-9.4	-2.3	-0.1	5.7	-6.0
9/72	-9.3	-2.4	-0.1	5.8	-5.9
10/72	-9.5	-2.4	-0.1	5.7	-6.3
11/72	-7.3	-2.4	0.3	5.8	-3.6
12/72	-6.4	-2.5	0.4	6.1	-2.4
1/73	-6.8	-2.6	0.2	6.5	-2.6
2/73	-6.4	-2.6	0.2	6.0	-2.8
3/73	-6.3	-2.7	0.2	5.9	-3.0
4/73	-6.4	-2.9	0.1	5.8	-3.3
5/73	-6.4	-2.9	0.1	6.0	-3.2
6/73	-6.2	-3.0	0.0[4]	6.1	-3.1
7/73	-6.8	-3.0	-0.2	6.3	-3.6
8/73	-7.0	-3.1	-0.4	6.3	-4.2
9/73	-6.9	-3.3	-0.6	6.4	-4.4
10/73	-7.1	-3.3	-1.0	6.4	-4.9
11/73	-7.1	-3.2	-0.8	6.4	-4.8
12/73	-7.2	-3.2	-0.7	6.6	-4.5
1/74	-7.8	-3.3	-0.5	7.2	-4.4
2/74	-7.2	-3.4	-0.7	6.6	-4.6

	Nonseasonally Adjusted				
Month	RAM on Net Demand Deposits	RAM on Time Deposits	Other Ram[2]	Vault Cash	Total Ram[3]
3/74	-7.1	-3.4	-0.7	6.5	-4.7
4/74	-7.3	-3.5	-0.8	6.4	-5.1
5/74	-7.3	-3.6	-1.0	6.6	-5.3
6/74	-7.1	-3.7	-1.3	6.7	-5.4
7/74	-7.4	-3.7	-1.3	6.8	-5.6
8/74	-7.1	-3.9	-1.5	6.8	-5.7
9/74	-7.1	-3.9	-1.4	6.9	-5.5
10/74	-7.2	-4.0	-0.9	6.8	-5.3
11/74	-7.2	-4.0	-0.7	6.9	-4.9
12/74	-7.4	-3.8	-0.4	7.2	-4.5
1/75	-7.4	-3.9	-0.3	7.8	-3.9
2/75	-6.4	-3.7	-0.3	7.1	-3.3
3/75	-5.9	-3.5	-0.2	6.8	-2.8
4/75	-6.0	-3.4	-0.2	6.9	-2.7
5/75	-6.0	-3.2	-0.2	6.9	-2.4
6/75	-6.0	-3.0	-0.1	7.0	-2.1
7/75	-6.1	-2.8	-0.1	7.2	-1.8
8/75	-6.0	-2.8	-0.1	7.3	-1.6
9/75	-6.0	-2.8	-0.1	7.4	-1.5
10/75	-6.0	-2.8	-0.1	7.3	-1.6
11/75	-6.1	-2.2	-0.1	7.4	-1.1
12/75	-6.2	-2.2	-0.1	7.8	-0.7
1/76	-6.5	-1.8	0.0[4]	8.4	0.2
2/76	-6.2	-1.4	0.1	7.6	0.1
3/76	-6.1	-1.4	0.1	7.5	0.1
4/76	-6.2	-1.3	0.1	7.6	0.1
5/76	-6.2	-1.2	0.1	7.8	0.5
6/76	-6.1	-1.2	0.1	7.9	0.7
7/76	-6.2	-1.2	0.1	8.1	0.7
8/76	-6.2	-1.1	0.1	8.0	0.8
9/76	-6.2	-1.0	0.1	8.1	1.0
10/76	-6.3	-1.0	0.1	8.0	0.9
11/76	-6.4	-0.9	0.1	8.2	1.0
12/76	-6.4	-0.9	0.1	8.5	1.2
1/77	-6.3	-1.0	0.1	8.9	1.7
2/77	-5.8	-0.9	0.1	8.3	1.6
3/77	-5.7	-0.9	0.1	8.1	1.6
4/77	-5.9	-0.8	0.1	8.4	1.7
5/77	-5.9	-0.8	0.1	8.6	2.0

[1]Monthly averages of weekly totals.

[2]Includes reserves required against Eurodollar borrowings, commercial paper, ineligible acceptances, waiver privileges, and "over the base period" requirements on certain time deposits.

[3]Sum of monthly averaged weekly components.

[4]Less than $50 million.