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# An Inflation Generation

Commencement Address by Lawrence K. Roos, President, Federal Reserve Bank of St. Louis, to the Graduating Class of 1980, Westminster College, Fulton, Missouri, May 18, 1980

IT was 34 years ago that Winston Churchill came to Westminster and warned his audience and the nation of an ominous threat to our peace and security by enemies from abroad. The course of world events in the intervening years has fully justified his concern.

Today, I would warn you of a different threat of similar gravity — a threat that, in this instance, comes not from abroad but from within our own society. It is a threat so complex and confusing that, to paraphrase John Maynard Keynes, not one man in a million fully comprehends its true nature. The threat I would warn you of is accelerating inflation — a burden which our nation has endured for the past decade and which, unless appropriate counter-measures are promptly taken, is likely to have catastrophic economic, social, and political consequences in the years to come.

Your graduating class, the Class of 1980, is part of an inflation generation. You have already been witnesses to and victims of rapidly increasing prices, record-high rates of interest, a marked decline in the value of the dollar on international exchanges, and the many other manifestations of persistent inflation.

The economic environment you have inherited stands in sharp contrast to that which faced my graduating class some 40 years ago. Unlike what you are experiencing, the Class of 1940 was part of a deflation generation. We had grown up during a time of severe unemployment and major economic recession. In sharp contrast to the spiraling price levels of today, prices in 1940 were actually lower than they had been 10 years earlier. I cite this contrast merely to emphasize that, while the nature of the economic malaise facing your class and mine is in a sense quite different, we have both been confronted with circumstances of critical significance to the survival of our economic and political system.

No challenge facing this Class of 1980 is more compelling than that of breaking the momentum of chronic inflation. Unless this is accomplished, there is no hope of restoring to this nation the economic growth and stability necessary for its continued prosperity and security.

The evils of inflation are many. Some are well known; others are well hidden. Perhaps the best understood are its economic costs. It was not so long ago that "a penny saved" was actually "a penny earned." That principle — that saving will be rewarded — is vital to economic progress. For without saving, investment (that is, the formation of capital) is not possible. Without capital formation, labor is denied the tools with which to increase the production of goods and services. Unfortunately, however, inflation has severely eroded the incentive to save. A person who placed $10,000 in a savings account 15 years ago would by now have accumulated an additional $8,000 in compounded interest. After adjusting for the rise in prices over the past 15 years, however, that $18,000 is actually worth only about $8,000 in "real" value.

This lesson has not been lost on you, nor has it passed unnoticed by millions of other Americans. As a result, there has been a retreat from savings and the associated investment so essential for growth in productivity. In the past five years alone, the rate of personal saving has fallen from more than 7 percent to 4½ percent annually. This, in turn, has resulted in diminished growth of investment in industrial plant and equipment and a serious drop in commitments to research and development, both of which underlie industrial productivity. Since the early part of the 1970s, productivity growth has slowed to about one-half of its former rate. That rising real income is impossible without rising productivity should come as no surprise to you graduates, most of whom, I have been told, are graduating with degrees in economics and business administration. You know that when the pie ceases to grow larger, the portions must grow smaller. In this case, smaller portions mean a declining standard of living for all of us.

Yet, as bad as the economic effects of inflation are, they are less worrisome than another seldom noticed or, at least, seldom mentioned aspect of the problem: that is, the threat to our personal political freedom posed by inflation — the fact that it can destroy the very foundation of our democratic form of government. Inflation erodes our political system by robbing us, as individuals, of the opportunity to approve or disapprove the most basic of government decisions — those of money creation and taxation. Inflation permits government to finance its expenditures in a manner that hides its actions from the scrutiny of its citizens.

Government expenditures, traditionally, have been financed either by taxes levied by Congress or by borrowing from the private sector to finance deficits. These methods have the advantage of forcing Congress to establish, in plain sight of the electorate, a level of spending and to support that spending through direct taxation or borrowing. Citizens are given the opportunity to approve or disapprove of the government's actions at the polls. This is the traditional manner by which elected officials are held accountable for their actions.

In recent years, however, a practice of "backdoor" financing has evolved which enables government to circumvent its traditional accountability. In the past two decades, the federal government, instead of supporting its expenditures by taxation, has come to rely more and more on deficit spending to finance its operations. Now deficit spending, by itself, is not necessarily inflationary, if deficits are financed solely by increased borrowing in private markets. However,

higher interest rates, which are a by-product of government borrowing in private markets, are not popular choices for elected officials. So instead of "facing the music" of increased taxes or higher interest rates, fiscal policymakers have made use of the technique of "hidden financing" — hidden, that is, from the voters.

When it resorts to hidden financing, the government creates money through the monetization or purchase of its debt by the Federal Reserve. When the Fed monetizes federal deficits, it increases commercial bank reserves and thereby expands the supply of money available for spending. Increases in the money supply lead to accelerated inflation, reducing the purchasing power of individuals as assuredly as if taxes had been increased in the first place. In fact, taxes have been increased for inflation is a tax. It is a tax that is neither subject to voter approval nor directly associated with voter-approved government spending decisions. Our founding fathers would have called such an arrangement "taxation without representation" and, indeed, it is truly that.

Hidden financing has enabled the government to expand its role substantially without a specific mandate from the electorate. Whereas in 1940 federal government expenditures amounted to 13.5% of the gross national product, last year they consumed 21% of the resources of the economy. When you include welfare, social security, and debt service costs, the government's share of economic consumption has grown from one-sixth of the total economy in 1940 to one-third today. Would this great expansion in the size of government have occurred had the American people been given the opportunity explicitly to decide the issue at the polls? I doubt it!

In view of the serious nature of the economic and political consequences of inflation, I would be remiss if I did not suggest a workable way of alleviating the problem.

Clearly, inflation is not a self-generating and uncontrollable phenomenon. It occurs only when money growth outstrips the growth of production of goods and services. It can be diminished in one of two ways: either by increasing production or by slowing the rate of money growth. Both of these alternatives merit consideration.

Unfortunately, almost all available options for increasing productivity involve long-range actions and long-run responses. Tax reforms, for example, would increase incentives to save and invest, and thereby increase productivity. A lessening of government regulation would tend to lessen costs of production and

increase output. Reductions in the size of government would free resources for use by the private sector and thereby increase the output of goods and services demanded by consumers. However, all of these are changes of an institutional nature that entail legislative actions as well as a fundamental reordering of expressed national priorities. While highly desirable, it would be unrealistic to believe that they could be brought to fruition quickly enough to have a demonstrable early effect on inflation.

A reduction in the rate of money growth, on the other hand, offers a means of reducing inflation fairly quickly. The Federal Reserve, through its open market operations, can increase or decrease bank reserves almost instantaneously and thereby can quickly expand or contract the amount of spendable money in the hands of the public. By gradually reducing the growth of the money supply, the Fed can bring down inflation over a predictable and reasonably short period of time. In this connection, I would point out that there is no responsible way to reduce the basic rate of inflation instantaneously. To seek an immediate solution by drastically slamming on the money growth brakes would have a shocking effect on the economy in terms of lost output and high unemployment. It would create intolerable conditions of recession which in turn would bring forth pressures for inflationary actions to spend our way out of our distress. However, a gradual reduction in the growth of the money supply, say at a rate of 1 or 2% per year, would exert minimal economic stress and would significantly reduce inflation within a few years.

Although such a policy has been the stated object of the Federal Reserve System for almost a decade, the manner in which the policy was implemented in the past tended to frustrate the Fed's good intentions. Prior to October 6, 1979, the Fed had two incompatible monetary policy goals: the reduction of money growth and the stabilization of interest rates in the short run. The simultaneous achievement of these two objectives was frequently impossible. Whenever money growth targets were incompatible with interest rate targets, the objective of money growth control was abandoned in favor of short-run interest rate stabilization. This not only contributed to rising inflation, but caused the Federal Reserve to lose credibility in the eyes of the public as its record of performance failed to measure up to its stated objectives.

Fortunately, this has changed. There is now solid reason for optimism that monetary policymaking has finally turned the corner and will be a more successful tool in coping with inflation than in the past.

Last October, the Federal Reserve announced new operating procedures which, in effect, eliminate the previous dilemma of concurrently setting interest rate and monetary growth targets. Stabilization of interest rates, in the short run, has been abandoned as a tool of policy, and the goal of reducing money growth has been reaffirmed. What is even more heartening is that evidence to date indicates that the Fed will be successful in achieving its money growth targets. Money growth has been substantially reduced from the inflation-generating levels of the pre-October period. If this trend is continued, there is ample reason to believe that we will experience reduced inflation in the months and years ahead. Interest rates have been permitted to fluctuate freely. Furthermore, the initial dramatic interest rate increases, which were attributable to early doubts about the Fed's ability to achieve its announced goals, have been reversed. As more people become convinced that the rate of growth of money is indeed being controlled and will continue to be reduced, inflationary expectations will recede and interest rates will continue to decline.

If one were to describe the current state of monetary policy-making in terms that the late Winston Churchill might have used, it could be said that "the tide of battle is turning, but the day is not yet won." Significant economic, intellectual, and political barriers must still be overcome before the public can feel truly confident that the Fed's new procedures will be permitted to be carried through to fruition. Interest rates, although easing, are still at relatively high levels, and important parts of the economy such as housing, farming, and other interest-sensitive activities are feeling the effects of credit restraint. Continued restraint will mean a period of softness in the economy, and individuals who are adversely affected can be expected to call vociferously for a return to a more stimulative monetary policy. Moreover, many disciples of interest rate stabilization find it difficult to accept control of money and credit as a legitimate basis for the implementation of monetary policy. Finally, 1980 is an election year, and the bitter medicine of monetary restraint has never been welcomed by candidates for public office. Pressures such as these will undoubtedly continue to test the resolve of policymakers to persist in their efforts to eliminate inflation.

Whether or not yours will continue to be an inflation generation depends directly on our ability, collectively, to resist the pressures of those who, unwilling to tolerate the pain of the moment, will call for a return to the expansive policies that created the current inflation. In their desire for relief in the short run, they would have us believe that a little inflation

is not so bad, that we can adjust to it and learn to tolerate it.

This is simply not true. There is no hope for a persistent "little inflation." Wherever nations have accepted inflation as a way of life, they have discovered that today's 10% inflation becomes tomorrow's 12%, the next year's 15% inflation, and so on.

This trend need not continue here, if we have the discipline to accept a certain amount of temporary pain for the promise of better circumstances in the future. While yours is presently an inflation generation, it need not remain so. Indeed, it must not remain so.

I have described the devastating consequences of a continuation of accelerating inflation, and I have offered what I believe to be a practical and workable way to eliminate the problem. It is up to you as thinking men and women to take the lead in standing for what is in the best interests of the free society of which you are a part. Your generation has a clear choice. It can go down in history as one which tolerated inflation and thus gave witness to the decline of America as a great economic power, or it can leave its mark as the generation which eliminated inflation and restored the foundation of stability and growth so necessary to our national survival. I have full confidence that you will make the proper choice.

# Lagged Reserve Requirements: Implications for Monetary Control and Bank Reserve Management

R. ALTON GILBERT

DEPOSITORY institutions meet reserve requirements imposed by the Federal Reserve by holding vault cash and reserve balances at the Federal Reserve Banks.[1] Until September 1968, member banks calculated their required reserves based on deposit liabilities at the *start* of each day, for the seven days ending on Wednesdays. Reserves held to meet those requirements consisted of vault cash at the *start* of business over the same period, plus reserve balances at Federal Reserve Banks at the *end* of each day, for the seven days ending on Wednesdays.[2] Thus, there was a one-day lag between the period over which deposit liabilities and vault cash were calculated and the period over which member banks held the required reserve balances, since deposit liabilities and vault cash at the start of each day are the same as those at the end of the previous day. This one-day lag allowed member banks to calculate their required reserves and reserves held as vault cash for a week before making the final adjustments to their reserve balances on Wednesdays. This system is called con-

temporaneous reserve accounting (CRA) since, except for the one-day lag, assets and liabilities used in calculating reserves and required reserves are those of the same week.

In September 1968, the Federal Reserve changed the timing of reserve accounting by extending the one-day lag to a two-week lag. Under this lagged reserve accounting (LRA) system, required reserves for each settlement week (seven days ending each Wednesday) are based on deposit liabilities held two weeks earlier. Average vault cash held two weeks earlier is counted as part of reserves in the current week, and vault cash held in the current week is counted as reserves two weeks in the future. By the beginning of each reserve settlement week (Thursday through the following Wednesday), member banks know the average balances they must hold at Reserve Banks to meet required reserves for the current week.[3] Table 1 describes how reserves and required reserves are calculated under both CRA and LRA.

The Federal Reserve Board adopted LRA to simplify the conduct of monetary policy and reserve man-

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[1]Legislation enacted in March 1980 imposes member bank reserve requirements on all depository institutions. Although this paper discusses the effects of reserve requirements on banks, the analysis applies also to nonbank depository institutions that are required to hold reserves with the Federal Reserve.

[2]Before September 1968, country member banks based their calculations of required reserves and vault cash on balances at the start of business over 14-day periods ending every other Wednesday. Reserve balances were calculated as balances at the end of each day over the same 14-day periods. In September 1968, settlement periods for country banks were shortened to one week. Another change in reserve requirements that occurred in September 1968 was a liberalized carryover provision. Before that time, member banks could eliminate reserve deficiencies up to 2 percent of required reserves in one settlement period by holding additional reserves the next settlement period. Since September 1968, member banks may also carry over excess reserves of up to 2 percent of required reserves to meet reserve requirements in the next week. This paper does not consider implications of the carryover provision for monetary policy.

[3]Following the end of each settlement week, member banks send reports to Reserve Banks indicating the amounts of their liabilities subject to reserve requirements and vault cash for each day of the settlement week. These reports, for the week ending each Wednesday, are due at Reserve Banks by the following Monday. Within two days after receiving these reports, Reserve Banks send statements to member banks indicating the average reserve balances they must hold during the period from Thursday through the following Wednesday. To illustrate the timing of these reports, consider the process by which a member bank learns of its required reserve balance for the settlement week June 19-25, 1980. Required reserves for that settlement week are based upon deposit liabilities at the end of business each day June 5-11. The bank sends a report to its Reserve Bank by Monday, June 16, indicating its deposit liabilities and vault cash for the period June 5-11. By June 18, the Reserve Bank sends the member bank a statement of the daily average reserve balance the bank must hold at the end of business June 19-25 to meet reserve requirements for that period.

## Table 1

## Timing of Reserve Requirements Under Contemporaneous and Lagged Reserve Accounting

| Item | Description of relevant period | Relevant days for settlement week of June 19-25, 1980 |
|---|---|---|
| Deposit liabilities subject to reserve requirements | CRA — average balances at the start of each day for seven days ending Wednesday of the current week | 19-25 |
| | LRA — average balances at the end of each day for seven days ending Wednesday two weeks prior to the last day of the current settlement week | 5-11 |
| Vault cash counted as reserves in the current week | CRA — same as for deposit liabilities | 19-25 |
| | LRA — same as for deposit liabilities | 5-11 |
| Reserve balances counted as reserves in the current week | CRA — average balances at the end of each day for seven days ending Wednesday of the current week | 19-25 |
| | LRA — average balances at the end of each day for seven days ending Wednesday of the current week | 19-25 |

agement by individual member banks. Because the total required reserve balances of member banks each week are known in advance under LRA, the Federal Reserve can adjust total reserve balances to the required amount in an orderly fashion throughout the week. Moreover, an individual member bank can manage its reserve position by maintaining its reserve balance at predetermined levels each week. Since LRA allows both the Federal Reserve and individual banks to know with certainty the required reserve balances for each week, it was expected to moderate fluctuations in short-term interest rates near the end of settlement weeks. According to the official statement of the Board of Governors:

"The amendments were designed to facilitate more efficient functioning of the reserve mechanism. They did not represent any change in Federal Reserve monetary policy, but were expected to reduce uncertainties, for both member banks and the Federal Reserve, as to the amount of reserves required to be maintained during the course of any reserve-computation period. Adoption of the amendments was, therefore, expected to moderate some of the pressures of reserve adjustments within the banking system that occasionally develop near the close of a reserve period and produce sharp fluctuations in the availability of day-to-day funds."[4]

This article investigates the impact of the timing of reserve accounting on the conduct of monetary policy and on reserve management by individual banks.

## IMPLICATIONS OF LRA AND CRA FOR MONETARY POLICY

### Effects on Variability of Money Market Conditions and Open Market Operations

Several studies have shown that the variability of money market conditions near the end of reserve settlement periods *increased* after the adoption of LRA. Changes in the federal funds rate from Tuesdays to Wednesdays were greater after LRA was adopted, as were changes in the federal funds rate from week to week. Not only have short-term interest rates fluctuated more under LRA, but open market purchases and sales of securities by the Federal Reserve to stabilize short-term interest rates have also increased.[5] Thus, although the Federal Reserve has undertaken more actions to stabilize short-term interest rates since the adoption of LRA, interest rates

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[4]Board of Governors of the Federal Reserve System, *Fifty-fifth Annual Report of the Board of Governors of the Federal Reserve System*, 1968, p. 82.

[5]Warren L. Coats, Jr., "Lagged Reserve Accounting and the Money Supply Mechanism," *Journal of Money, Credit and Banking* (May 1976), pp. 167-80; William Poole and Charles Lieberman, "Improving Monetary Control," *Brookings Papers on Economic Activity* (1972), pp. 293-342; Albert E. Burger, *The Money Supply Process* (Belmont, CA: Wadsworth Publishing Co., 1971), pp. 52-56.

have been less stable than under CRA, just the *opposite* of the expected outcome.

One reason for the increase in variability of short-term interest rates and in Federal Reserve defensive open market operations is that LRA does not allow the banking system to adjust within a week to a change in total reserves by changing total required reserves. LRA predetermines required reserves for each week, based on deposit liabilities two weeks earlier. Suppose that reserves increase, causing banks to have excess reserves. If banks invest their excess reserves, demand deposit liabilities will rise in the current week, *but excess reserves of the banking system will remain unchanged*. Random changes in reserves under LRA, therefore, will cause either greater fluctuations in short-term interest rates or more defensive open market operations by the Federal Reserve to offset fluctuations in reserves, or both, because excess reserves or deficiencies in the current week remain regardless of actions by banks. Empirical studies indicate that, in fact, both effects have occurred.

Under CRA, if banks invest their excess reserves, their required reserves for the current week will rise as their demand deposit liabilities rise. Thus, unlike the situation under LRA, banks can eliminate a difference between total reserves and required reserves during the week.

The following illustration demonstrates differences in reserve adjustment under CRA and LRA. Suppose banks have combined balance sheets like those presented in table 2. At the beginning of a settlement week, net demand deposit liabilities are $100; they were also $100 two weeks earlier. Reserves of $20 consist of $5 in vault cash and $15 in reserve balances; vault cash was also $5 two weeks earlier (table 2, section A). With a reserve requirement of 20 percent on demand deposit liabilities, banks are initially in equilibrium with zero excess reserves under either CRA or LRA. The remaining bank assets are invested in government securities ($30) and loans to the nonbank public ($50).

Suppose that in the current settlement week demand deposit liabilities rise, as customers deposit an additional $.50 of their currency (table 2, section B). Banks deposit the additional currency in their reserve accounts. Under CRA, banks now have excess reserves of $.40 and have an incentive to purchase securities from the nonbank public (or make additional loans) until excess reserves are reduced to zero. As each bank invests its excess reserves, demand deposit liabilities of the banking system rise by a multiple of the increase in reserves, increasing by $2 to $102.50 (table 2, section C).

Under LRA, banks cannot change their required reserves of $20 in the current week by increasing their demand deposit liabilities, since current reserve requirements are based upon deposit liabilities of two weeks earlier. If the Federal Reserve does not intervene to eliminate the excess reserves, banks will bid up the prices of securities (reducing interest rates) until they are willing to hold excess reserves of $.50. Demand deposit liabilities of the banking system would rise as individual banks invest their excess reserves. Expansion of demand deposits in the current week would be limited by a Federal Reserve policy of stabilizing short-term interest rates. If banks began bidding up the prices of securities to invest excess reserves, the Federal Reserve would eliminate the excess reserves through open market operations.

## Problems in Controlling Bank Reserves

If the Federal Reserve is attempting to control growth of money by controlling bank reserves, LRA creates a more serious problem for the conduct of monetary policy than merely increasing defensive open market operations.[6] The primary determinant of reserves that are supplied each week may be the deposit liabilities that the banking system created two weeks previously, rather than the objectives for money growth.

The Federal Reserve can implement monetary policy by supplying the banking system with the amount of reserves believed to be consistent with objectives for growth of monetary aggregates. Under CRA, the Federal Reserve could rely upon banks to adjust aggregate deposit liabilities to

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[6]One feature of LRA that promotes short-term control of bank reserves is that the vault cash portion of reserves is lagged. Before September 1968, the Federal Reserve did not know the amount of reserves member banks were holding each week as vault cash, since member banks did not report their vault cash holdings to the Federal Reserve until the following week. Under current accounting procedures, the Federal Reserve can calculate the amount of vault cash counted as reserves for the current week, since member banks have reported their vault cash holdings of two weeks earlier. Member bank vault cash fluctuates so much from week to week that to reinstate counting vault cash as reserves for the same week it is held could cause substantial errors by the Federal Reserve in estimating member bank reserves in individual weeks. To illustrate the potential for such error, suppose the Federal Reserve counts vault cash as reserves for the same week in which it is held and assumes that vault cash held in the current week equals that held two weeks ago (the latest information available). Simulating such a method of estimating reserves for each settlement week in 1976-78 indicates that errors in estimating vault cash would be more than 1 percent of total reserves for about 60 percent of the weeks, and more than 2 percent of total reserves for about 30 percent of the weeks.

## Table 2

## Effects of a Currency Inflow on the Banking System

**Section A:** Initial situation

| Banking system | | | | Nonbank public | | | |
|---|---|---|---|---|---|---|---|
| Reserves | $20.00 | Demand deposits | $100.00 | Currency | $ 40.00 | Bank loans | $50.00 |
| Vault cash | $ 5.00 | | | Demand deposits | 100.00 | | |
| Reserve balances | 15.00 | | | Securities | 40.00 | | |
| Securities | | 30.00 | | | | | |
| Loans | | 50.00 | | | | | |

| | Required reserves | Excess reserves |
|---|---|---|
| Contemporaneous reserve accounting | $20.00 | $ .00 |
| Lagged reserve accounting | 20.00 | .00 |

**Section B:** Customers deposit $0.50 in currency

| Banking system | | | | Nonbank public | | | |
|---|---|---|---|---|---|---|---|
| Reserves | $20.50 | Demand deposits | $100.50 | Currency | $ 39.50 | Bank loans | $50.00 |
| Vault cash | $ 5.00 | | | Demand deposits | 100.50 | | |
| Reserve balances | 15.50 | | | Securities | 40.00 | | |
| Securities | | 30.00 | | | | | |
| Loans | | 50.00 | | | | | |

| | Required reserves | Excess reserves |
|---|---|---|
| Contemporaneous reserve accounting | $20.10 | $ .40 |
| Lagged reserve accounting | 20.00 | .50 |

**Section C:** Equilibrium response under contemporaneous reserve accounting

| Banking system | | | | Nonbank public | | | |
|---|---|---|---|---|---|---|---|
| Reserves | $20.50 | Demand deposits | $102.50 | Currency | $ 39.50 | Bank loans | $50.00 |
| Vault cash | $ 5.00 | | | Demand deposits | 102.50 | | |
| Reserve balances | 15.50 | | | Securities | 38.00 | | |
| Securities | | 32.00 | | | | | |
| Loans | | 50.00 | | | | | |

| | Required reserves | Excess reserves |
|---|---|---|
| Contemporaneous reserve accounting | $20.50 | $ .00 |
| Lagged reserve accounting | 20.00 | .50 |

levels consistent with the amount of available reserves. If banks were to create more deposit liabilities than could be supported by available reserves, they would attempt to increase their reserves by selling securities to the nonbank public and thereby reduce deposit liabilities *of the banking system* to a level which could be supported by total available reserves.[7]

[7]The ability of the Federal Reserve to control growth of the money stock by controlling bank reserves may be limited, since banks may borrow reserves at the discount window. If, for instance, demand for credit increases but the Federal Reserve keeps nonborrowed reserves unchanged, banks could accommodate the increase in credit demand by creating additional demand deposit liabilities, and borrow the additional reserves necessary to meet the higher required reserves. This article assumes that the Federal Reserve is capable of controlling total bank reserves weekly; thus the analysis can focus on how the timing of reserve accounting affects the conduct of

## Table 3

## Response of the Banking System to an Increase in Loan Demand

**Section A:** Initial situation

| Banking system | | | | | Nonbank public | | | |
|---|---|---|---|---|---|---|---|---|
| Reserves | | $20.00 | Demand deposits | $100.00 | Currency | $ 40.00 | Bank loans | $50.00 |
| Vault cash | $ 5.00 | | | | Demand deposits | 100.00 | | |
| Reserve balances | 15.00 | | | | Securities | 40.00 | | |
| Securities | | 30.00 | | | | | | |
| Loans | | 50.00 | | | | | | |

| | Required reserves | Excess reserves |
|---|---|---|
| Contemporaneous reserve accounting | $20.00 | $ .00 |
| Lagged reserve accounting | 20.00 | .00 |

**Section B:** Initial response to increase in loan demand

| Banking system | | | | | Nonbank public | | | |
|---|---|---|---|---|---|---|---|---|
| Reserves | | $20.00 | Demand deposits | $102.00 | Currency | $ 40.00 | Bank loans | $52.00 |
| Vault cash | $ 5.00 | | | | Demand deposits | 102.00 | | |
| Reserve balances | 15.00 | | | | Securities | 40.00 | | |
| Securities | | 30.00 | | | | | | |
| Loans | | 52.00 | | | | | | |

| | Required reserves | Excess reserves |
|---|---|---|
| Contemporaneous reserve accounting | $20.40 | $ −.40 |
| Lagged reserve accounting | 20.00 | .00 |

**Section C:** Equilibrium response under contemporaneous reserve accounting

| Banking system | | | | | Nonbank public | | | |
|---|---|---|---|---|---|---|---|---|
| Reserves | | $20.00 | Demand deposits | $100.00 | Currency | $ 40.00 | Bank loans | $52.00 |
| Vault cash | $ 5.00 | | | | Demand deposits | 100.00 | | |
| Reserve balances | 15.00 | | | | Securities | 42.00 | | |
| Securities | | 28.00 | | | | | | |
| Loans | | 52.00 | | | | | | |

| | Required reserves | Excess reserves |
|---|---|---|
| Contemporaneous reserve accounting | $20.00 | $ .00 |
| Lagged reserve accounting | 20.00 | .00 |

Adjustment of the banking system to reserves supplied by the Federal Reserve under CRA is illustrated in table 3. The banking system is initially in equilibrium with zero excess reserves: net demand deposit liabilities are $100 and, with a 20 percent reserve requirement, reserves are $20 (table 3, section A).

Banks respond to a $2 increase in demand for loans by the nonbank public by increasing their loans and demand deposit liabilities by $2 (table 3, section B). Required reserves are now $20.40, whereas available reserves are only $20. The Federal Reserve keeps reserves at $20 to meet the objective for money growth. Banks must eliminate deficiencies that are developing in their reserve positions by reducing required reserves. One approach involves selling securities to the nonbank public to increase their reserves,

monetary policy without lengthy discussion of the Federal Reserve's ability to predict or offset various factors that affect total reserves. One way to minimize changes in bank borrowings from the discount window would be to set the discount rate above short-term market interest rates.

thereby reducing demand deposit liabilities of the banking system. The reserve deficiency is eliminated when banks sell $2 of their securities, because demand deposits are reduced back to $100 (table 3, section C). After making this final adjustment, banks have accommodated the increase in loan demand by selling securities, without changing demand deposit liabilities.[8]

LRA breaks the link between reserves available to the banking system in the current week and the amount of deposit liabilities that banks can create in the current week. If banks increase aggregate demand deposit liabilities in response to an increase in loan demand, they are under no immediate pressure to reduce their deposit liabilities, since excess reserves remain unchanged at zero. Therefore, in the hypothetical situation presented in table 3, LRA permits banks to keep total demand deposit liabilities at $102 in the current week without reserve deficiencies.

Two weeks later, required reserves would equal $20.40, reflecting the $2 increase in demand deposits. If the objective of monetary policy is to keep total reserves unchanged at $20, this situation poses a dilemma for the Federal Reserve. Keeping reserves unchanged at $20 would produce a sharp increase in short-term interest rates, as banks attempt to meet their required reserves. Despite the rise in interest rates, some banks would have deficient reserve positions, since they could not alter their required reserves for the week by selling securities. Unless the Federal Reserve would be willing to permit these large fluctuations in short-term interest rates and reserve deficiencies by some banks, it would have to provide the additional reserves.

The Federal Reserve would also be under pressure to reduce reserves two weeks after a decline in deposit liabilities. Unless the Federal Reserve would reduce reserves when required reserves declined, attempts by the banking system to invest the excess reserves would reduce short-term interest rates to levels at which some banks would be willing to hold the excess reserves.

In summary, the most important implication of the timing of reserve requirements for monetary control is that under CRA the Federal Reserve could pro-

vide the level of reserves each week that would be consistent with targets for monetary aggregates, and *banks would adjust their deposit liabilities to available reserves.* Under LRA, *the Federal Reserve tends to adjust total reserves each week in response to the total deposit liabilities that banks created two weeks earlier.*[9]

If LRA creates such difficulties for monetary control, why has the Federal Reserve tolerated it since 1968? One reason is that many member bankers prefer LRA. The Federal Reserve has been reluctant to initiate an unpopular change that might accelerate membership attrition. This consideration is less important now since recent legislation extends member bank reserve requirements to nonmember depository institutions.

Another reason that LRA has not been abandoned is that it does not create significant problems for monetary control if the Federal Reserve implements monetary policy by targeting on the federal funds rate. Until October 6, 1979, the Federal Reserve conducted open market operations to keep the federal funds rate within ranges that were presumed to be consistent with monetary growth objectives. Monthly ranges for movements of the federal funds rate were rather narrow, generally within 50 to 100 basis points. Many of the influences that could change bank reserves, such as changes in the public's demand for currency or Federal Reserve float, were offset by targeting open market operations on the federal funds rate. The Federal Reserve attempted to control monetary growth by adjusting short-term interest rates to levels at which the amount of money demanded by the public equalled the desired levels for the monetary aggregates.[10] With the emphasis on response of money demand to changes in short-term interest

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[8]A bank can increase its reserves and thereby reduce demand deposit liabilities of the banking system other than by selling securities to the nonbank public. For instance, it can sell certificates of deposit. Customers buying certificates of deposit pay for them with demand deposits. In the process, demand deposit liabilities of the banking system decline. This approach to eliminating reserve deficiencies is more complicated than that described in table 3 (selling securities to the nonbank public), since certificates of deposit are subject to reserve requirements. The example of banks selling securities was selected for expositional convenience only.

[9]There is evidence that the Federal Reserve, since adopting LRA, has adjusted member bank reserves to the deposit liabilities member banks created two weeks earlier. Feige and McGee estimated the relation between the money stock and bank reserves for a period before and a period after September 1968. For the period before September 1968, the money stock (with autocorrelations removed) was most highly correlated with reserves in the same week. However, for the period after September 1968, the money stock was most highly correlated with reserves two weeks in the future. See Edgar L. Feige and Robert McGee, "Money Supply Control and Lagged Reserve Accounting," *Journal of Money, Credit and Banking* (November 1977), pp. 536-51. In another study, using data for a period after September 1968, monthly money stock, with autocorrelations removed, was most highly correlated with reserves in the same month and in the next month. See David A. Pierce, "Money Supply Control: Reserves as the Instrument Under Lagged Accounting," *Journal of Finance* (June 1976), pp. 845-52.

[10]For a description of this approach to implementing monetary policy, see Henry C. Wallich and Peter M. Keir, "The Role of Operating Guides in U.S. Monetary Policy: A Historical Review," Federal Reserve *Bulletin* (September 1979), pp. 679-91.

rates rather than on response of money supply to reserves, difficulty in controlling money by controlling reserves under LRA was not considered an important issue for monetary policy.[11]

Implementing monetary policy by targeting on the federal funds rate has created serious problems for monetary control. Because the Federal Reserve has attempted to moderate changes in short-term interest rates, monetary aggregates have responded positively to changes in demand for money and credit. When credit demand has risen, for instance, the Federal Reserve has not raised its targets for the federal funds rate fast enough to avoid supplying additional reserves, and banks have accommodated increases in credit demand by creating additional demand deposits. Conversely, when demand for credit has declined, the Federal Reserve has attempted to moderate declines in short-term interest rates and, in the process, has reduced the supply of reserves.

Because targeting on the federal funds rate resulted in money growth that was too rapid to stay within desired ranges for money growth, the Federal Reserve adopted a reserve targeting approach to implementing monetary policy on October 6, 1979. The Federal Reserve now establishes targets for growth of a group of bank reserve aggregates that are presumed to be consistent with objectives for growth of monetary aggregates. Under this system, the federal funds rate is allowed to fluctuate within a relatively wide range. Although the Federal Reserve has not completely abandoned the objective of confining fluctuations in short-term interest rates, it is placing more emphasis on controlling bank reserves.[12] Under this recently adopted policy of reserve targeting, problems of controlling growth of bank reserves under LRA are more important for monetary policy.

## IMPLICATIONS OF LRA AND CRA FOR RESERVE MANAGEMENT OF INDIVIDUAL BANKS

### Monitoring Deposit Liabilities

One reason for adopting LRA was to simplify reserve management for individual banks. Under LRA,

each bank is notified before the beginning of a settlement week concerning the daily average reserve balance necessary to meet its reserve requirements for the week. This procedure allows a member bank to focus its attention on holding predetermined levels of average reserve balances. In contrast, under CRA, each bank had to monitor closely its deposit liabilities and adjust its reserves to meet requirements based on those deposits each week. More timely monitoring of deposit liabilities and adjusting reserves to expected required reserves involve some costs to banks under CRA.

### Estimating Required Reserves

Many banks would have difficulty determining their required reserves for each settlement week under CRA, even with more timely monitoring of deposit liabilities. Some banks, particularly those with branches, compile information on their deposit liabilities one or two days after the end of each settlement week. Many small banks have check processing centers perform their accounting functions, and they receive information on their deposit liabilities with a lag of one or two days.

Consequently, these banks' estimates of their required reserves would be based on incomplete information concerning their weekly deposit liabilities. Errors in calculating required reserves due to incomplete information on deposit liabilities would result in excess reserves or deficiencies.

Whether incomplete information would create major problems for reserve management under CRA is an empirical question. Banks may carry over excess reserves or deficiencies, up to 2 percent of required reserves, into the next settlement week without penalties or loss of credit for excess reserves. Estimating required reserves using incomplete information on deposit liabilities would not create serious problems for reserve management if estimated required reserves were always within 2 percent of actual required reserves.[13]

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[11]Kopecky develops a theoretical model in which LRA does not create problems for money stock control if the Federal Reserve implements monetary policy by targeting on the federal funds rate. See Kenneth J. Kopecky, "The Relationship Between Reserve Ratios and the Monetary Aggregates Under Reserves and Federal Funds Rate Operating Targets," Staff Economic Studies No. 100, Board of Governors of the Federal Reserve System, 1978.

[12]Richard W. Lang, "The FOMC in 1979: Introducing Reserve Targeting," this *Review* (March 1980), pp. 2-25.

[13]This section analyzes the magnitude of differences between estimated and actual required reserves for individual banks that would tend to occur on a weekly basis under CRA due to incomplete information on deposit liabilities for each settlement week. This factor would be important under CRA, but not under LRA, since individual banks know their required reserve balances for each settlement period at the start of the period. Another factor that tends to make a bank's reserves differ from required reserves is unpredictable changes in its reserve balances on the last day of the settlement week due to fluctuations in deposit liabilities. In considering the appropriate percentage carryover under CRA, the percentage carryover that would permit individual banks to manage their reserve positions with incomplete information on deposit liabilities should be expanded enough to facilitate reserve management even when unpredictable fluctuations in reserve balances occur late in settlement periods.

## Table 4

## Errors in Estimating Required Reserves with Incomplete Information about Deposit Liabilities

| Percentage error (absolute value) | Percent of banks with the specified error, for estimates based on deposit liabilities for: | | Percent of settlement weeks in which banks had the specified error, for estimates based on deposit liabilities for: | |
|---|---|---|---|---|
| | First six days of each week | First five days of each week | First six days of each week | First five days of each week |
| 2 | 34.33 | 76.12 | 2.31 | 8.46 |
| 3 | 17.91 | 46.27 | 0.79 | 3.25 |
| 4 | 10.45 | 29.85 | 0.38 | 1.76 |
| 5 | 8.96 | 23.88 | 0.29 | 0.91 |
| 6 | 5.97 | 16.42 | 0.20 | 0.56 |
| 7 | 4.48 | 11.94 | 0.12 | 0.32 |
| 8 | 2.99 | 8.96 | 0.09 | 0.23 |
| 9 | 0.00 | 5.97 | 0.00 | 0.18 |
| 10 | 0.00 | 4.48 | 0.00 | 0.15 |

This issue was investigated for 67 Eighth District member banks using 1977 data on deposit liabilities. Their total deposits ranged from about $4 million to just over $1 billion.[14]

Required reserves were *calculated* for each bank based on deposit liabilities for seven days ending each Tuesday (same as deposit liabilities at the start of business for seven days ending on Wednesdays). Required reserves were *estimated* for each week based on deposit liabilities for five days ending each Sunday and for six days ending each Monday. Required reserves were estimated by assuming that average deposit liabilities for the whole week would be what they were for the first five or six days of each week. Differences between actual required reserves for each settlement week, based on complete information, and estimated required reserves were calculated as percentages of actual required reserves. Errors in estimating required reserves can be considered maximum errors, since it was assumed that banks have no information on changes in their deposit liabilities near the end of each week, whereas they may have information

on customer transactions or regular intra-weekly patterns of deposit liabilities that would help them estimate required reserves more accurately.

Results of these calculations, as shown in table 4, indicate that the 2 percent carryover may be too small under CRA. If banks had information on deposit liabilities for only the first five days of each week, 76 percent of them would have estimation errors greater than 2 percent in at least one week. Errors greater than 2 percent would occur in about 8 percent of the settlement weeks.[15] Only three of the 67 banks, however, had estimation errors greater than 5 percent for two or more settlement weeks in the year, even without information on deposit liabilities for the last two days of each week. This result indicates that only a few banks that have especially large fluctuations in deposit liabilities would have difficulty in estimating required reserves within approximately 5 percent of actual required reserves using incomplete information.

Even if individual banks occasionally had large errors in estimating their required reserves, those

[14]These 67 member banks borrowed from the Federal Reserve during 1977 or early 1978. The reason for using these banks was that data on their daily deposit liabilities were compiled for another study, and were available at no additional cost. If use of data for banks that borrowed from the discount window creates any bias, the errors in estimating required reserves would be biased upward; those banks may have borrowed because they had unanticipated reductions in their reserve balances late in some settlement weeks due to declines in deposit liabilities. The size distribution of the 67 banks is as follows: total deposits of $0-$10 million, 9 banks; $10-$25 million, 11; $25-50 million, 21; $50-100 million, 8; $100-$400 million, 9; and over $400 million, 9.

[15]Percentages of settlement weeks in which errors in calculating required reserves for the 67 banks were greater than various percentages of actual required reserves are calculated as follows: There were 51 settlement weeks in 1977. For the 67 banks together there were 3417 (67 x 51) settlement weeks. The total number of weeks during the year in which any of the banks had errors of more than 2 percent was 289, based on information about deposit liabilities for the first five days of each week. For the 67 banks as a group, therefore, errors were greater than 2 percent of required reserves for 8.46 percent (289 as a percentage of 3417) of the settlement weeks.

errors should not create significant differences between total reserves and total required reserves for the banking system. Errors by some banks that underestimate their required reserves in a given week would generally be offset by errors of other banks that overestimate their required reserves. The main reason to expect such errors to be offsetting is that banks that have increases in their deposit liabilities late in a settlement week generally receive them from banks having deposit outflows late that same week.

Effects of offsetting errors in calculating required reserves were examined for the 67 member banks mentioned above. Estimates of their required reserves for each week based on deposit information for the first six days were added for all 67 banks, subtracted from the sum of their actual required reserves, and divided by the sum of their actual required reserves. Differences between the sums of estimated and actual required reserves were less than 1 percent of actual required reserves in each settlement week, and the deviations (in absolute value) averaged 0.26 percent. With information on deposit liabilities for only the first five days of each week, the sum of estimated required reserves deviated from actual required reserves by more than 1 percent in only two of the 51 weeks, and deviations for each week averaged 0.37 percent. Since these results are for only a small group of banks, percentage deviations based upon calculations for all banks would be smaller. Permitting banks to carry over *more* than 2 percent of excess reserves or deficiencies would facilitate reserve management by individual banks under CRA, without affecting substantially the relation between reserves and required reserves for the banking system.

## Size of Adjustments to Reserve Balances in Response to Changes in Deposit Liabilities

Costs of monitoring deposit liabilities and estimating required reserves are only two aspects of reserve management by individual banks that are influenced by the timing of reserve requirements. A third aspect is the size of adjustments a bank must make to its reserve balance to avoid excess reserves or deficiencies when its deposit liabilities change. Under CRA, required reserves change during a settlement week in response to changes in deposit liabilities. Considering only the effects of fluctuations in deposit liabilities on required reserves seemingly implies that adjustments of reserve balances to changes in deposit liabilities would be necessary only under CRA.

However, changes in deposit liabilities have additional effects on the reserve positions of individual banks. A bank that clears checks through its reserve balance at the Federal Reserve has reductions in its reserve balance when its deposit liabilities decline. Suppose the reserve balance of a bank that clears checks through its reserve account initially equals its required reserve balance. Under LRA, a bank must increase its reserve balance by the amount of declines in its deposit liabilities. Under CRA, a bank must increase its reserve balance by some fraction of the decline in deposit liabilities, since required reserves decline as deposit liabilities decline. Therefore, under LRA, a bank that clears checks through its reserve account must make larger adjustments to its reserves per dollar of change in demand deposit liabilities to avoid excess reserves or deficiencies than under CRA.

Under LRA, changes in deposit liabilities during a settlement week do not affect that week's reserves or required reserves for a bank that clears checks through its correspondent accounts.[16] Conversely, under CRA, required reserves change as deposit liabilities change, but for a bank that clears checks through correspondent accounts, reserves are unaffected by changes in deposit liabilities. For that type of bank, therefore, adjustments to reserves necessary to avoid excess reserves or deficiencies are larger under CRA. This conclusion is based upon the assumption that as checks are cleared through a bank's correspondent accounts, its demand balances due from banks change passively in response to changes in its deposit liabilities during each week. Under such a policy, demand balances due from banks decline dollar-for-dollar with reductions in deposit liabilities and increase by the same amount as do deposit liabilities.[17]

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[16]Under recent legislation, all depository institutions offering transactions accounts and nonpersonal time deposits are subject to member bank reserve requirements. Member banks must hold their required reserve balances in reserve accounts at Reserve Banks, whereas, nonmembers may have correspondents hold required reserve balances for them in the reserve accounts of their correspondents. Analysis in this section considers reserve adjustments of a bank that clears checks through its correspondent, but holds its required reserve balances in a reserve account at its Reserve Bank. Results for a bank that clears checks through a correspondent and has the correspondent hold its required reserve balances with the Reserve Bank might be substantially different. The terms under which correspondent banks will offer to hold required reserve balances for nonmembers are not yet known, since reserve requirements will not be imposed on nonmembers until this fall. If correspondents offer this service in a flexible manner, requiring only that demand balances of nonmembers be large enough *on average* over several weeks or months to compensate the correspondents for services provided and reserve balances held, these nonmembers might not adjust their cash balances to week-to-week changes in required reserve balances under either CRA or LRA.

[17]There is evidence that correspondent banks allow respondents this degree of short-term flexibility in cash management. See R. Alton Gilbert, "Access to the Discount Window for All Commercial Banks: Is It Important for Monetary Policy?" this *Review* (February 1980), p. 19.

In contrast, if a bank that clears checks through correspondent accounts keeps its demand balances due from banks equal to a fixed proportion of deposit liabilities on a weekly basis, reserve adjustment pressure due to deposit fluctuations would be greater under LRA than under CRA. When deposit liabilities decline, for instance, a bank with such a cash management policy would sell more assets under LRA to meet reserve requirements and to maintain demand balances due from banks equal to a fixed proportion of deposit liabilities; this occurs because required reserves would not decline as deposit liabilities decline. Under CRA, the bank would transfer some of its reserve balances to demand balances due from banks when deposit liabilities decline, since required reserves would also decline in the same week.

This analysis indicates that it is unclear whether adjustments to reserve positions are larger under CRA or LRA. Adjustments by an individual bank to its reserve position in response to given changes in deposit liabilities are analyzed under various assumptions in the Appendix. The largest adjustment occurs for a bank that clears checks through its reserve balance and is subject to LRA. The smallest adjustment (actually zero) results for a bank that clears checks through its correspondent accounts and is subject to LRA. (The latter example assumes that balances due from banks are allowed to fluctuate passively with changes in deposit liabilities.) Under CRA, adjustments to reserve positions are smaller if the bank clears checks through its correspondent accounts, although the advantage of clearing through correspondent accounts in terms of minimizing reserve adjustments would not be as great as under LRA.

## Risks due to Changes in Interest Rates

A final issue concerns the risks that a bank incurs due to delayed effects of changes in demand for bank credit on interest rates under LRA. A bank increases demand deposits of borrowers when it makes additional loans. If borrowers temporarily hold larger demand deposits before making payments, required reserves of the lending bank will be larger in two weeks. When the borrowers withdraw deposits, the lending bank will lose reserves to other banks and must borrow them back through the federal funds market to meet reserve requirements in the current week. A bank that increases its loans may continue to borrow federal funds for several weeks to finance the increase in loans before arranging longer-term financing.

The cost of financing customer loans, therefore, depends upon interest rates two weeks in the future.

A bank that increases loans to its customers will not know immediately whether there is a general increase in demand for bank loans, or whether the increase in demand is limited to its own customers. Therefore, the bank will base the interest rates it charges in the current week on interest rates prevailing up to the current week.

Under LRA, an increase in loan demand would not drive up short-term interest rates in the first week of increased demand. Thus, banks could accommodate the increased loan demand by creating demand deposit liabilities without experiencing reserve deficiencies in the current week. Pressures on interest rates would occur two weeks after the increased loan demand, when required reserves increase.

If the Federal Reserve kept bank reserves unchanged two weeks after the increase in loan demand, there would be sharp upward pressure on short-term interest rates. Loans that were profitable at the interest rates that prevailed two weeks previously may no longer be profitable because of the increased cost of borrowing reserves.

An increased demand for bank loans has a more immediate effect on short-term interest rates under CRA. As demand deposit liabilities increase, banks begin bidding for additional reserves to meet higher required reserves. These increases in short-term interest rates signal banks that credit demand has risen, and they can adjust their loan terms more quickly.

As stated previously, a primary goal of Federal Reserve policy prior to October 6, 1979 was to moderate fluctuations in short-term interest rates. Effects of this policy on changes in interest rates over two-week periods are shown in table 5. Over a period of 142 weeks from January 1977 through early October 1979, the federal funds rate rose by more than 50 basis points over two-week periods on only five occasions and never rose as much as one percentage point. Banks could accommodate increases in loan demand anticipating that the Federal Reserve would not permit the federal funds rate to rise by more than about 50 basis points during the succeeding two weeks. The Federal Reserve implemented monetary policy under LRA in a manner that minimized interest rate risks to member banks.

Under its new operating procedures adopted in October 1979, the Federal Reserve places less emphasis on stabilizing the federal funds rate and more emphasis on controlling member bank reserves. Consequently, increases in the federal funds rate of more than 50 basis points over two-week periods have been

## Table 5

### Distribution of Changes in the Federal Funds Rate Over Two-Week Periods Before and After October 6, 1979

| Changes in the average federal funds rate over periods of two weeks (in percentage points) | Percentage of weeks when changes were in the following ranges: | |
| --- | --- | --- |
| | 142 weeks ending October 3, 1979 | 34 weeks ending May 28, 1980 |
| 2.000 or greater | | 11.76 |
| 1.000 to 1.999 | | 17.65 |
| 0.750 to 0.999 | 00.70 | 02.94 |
| 0.500 to 0.749 | 02.82 | 02.94 |
| 0.250 to 0.499 | 16.90 | 05.88 |
| 0.100 to 0.249 | 21.83 | 08.82 |
| 0.050 to 0.099 | 14.79 | 02.94 |
| 0.000 to 0.049 | 14.79 | |
| −0.049 to −0.001 | 05.63 | |
| −0.099 to −0.050 | 16.20 | |
| −0.249 to −0.100 | 04.93 | 05.88 |
| −0.499 to −0.250 | 00.70 | 05.88 |
| −0.749 to −0.500 | 00.70 | 02.94 |
| −0.999 to −0.750 | | 05.88 |
| −1.999 to −1.000 | | 11.76 |
| Below −1.999 | | 14.71 |

much more frequent since early October of last year. These results indicate that the Federal Reserve has removed much of the protection that was previously available to banks from effects of changes in short-term interest rates. Thus, in weighing the advantages of LRA relative to CRA, banks should consider whether they prefer LRA or CRA under a policy of reserve targeting, since the option of reserve management under LRA with the former policy of stabilizing short-term interest rates is no longer available.

## CONCLUSIONS

Under lagged reserve accounting (LRA), required reserve balances of individual banks and the banking system are predetermined each week, based upon deposit liabilities and vault cash two weeks earlier. The Federal Reserve Board expected LRA to reduce the variability of short-term interest rates near the end of reserve settlement weeks. LRA has had the opposite effect, primarily because it contains no mechanism for eliminating excess reserves or deficiencies within the current week that result from fluctuations in total reserves. Under contemporaneous

reserve accounting (CRA), which was in effect prior to the adoption of LRA, reactions by banks to excess reserves or deficiencies yielded changes in total required reserves that brought aggregate reserve positions back into equilibrium within the current week.

The *major* problem for the conduct of monetary policy under LRA is that the Federal Reserve has created reserve balances each week based on deposit liabilities that banks created two weeks previously. In essence, the Federal Reserve has tended to supply reserves to accommodate the growth of bank credit, instead of pursuing an independent monetary policy.

LRA was expected to simplify reserve management of individual banks. It is not possible to draw a general conclusion about the realization of this expectation because several aspects of bank reserve management are affected by the timing of reserve accounting.

A return to CRA would require banks to monitor their deposit liabilities on a more timely basis and to adjust their reserve balances each week in response to changes in the week's deposit liabilities. Some banks may have difficulty calculating their deposit liabilities on a timely basis and would have to estimate their required reserves based on incomplete information. Most banks, however, might be able to estimate their required reserves each week within about 5 percent of actual required reserves *even without information on their deposit liabilities for the last one or two days of each settlement week.*

Another aspect of reserve management affected by the timing of reserve accounting is the size of adjustments that banks must make to reserve balances in response to changes in deposit liabilities. Banks that clear checks through their reserve accounts at the Federal Reserve must make larger adjustments in their reserves for a given change in demand deposit liabilities under LRA than under CRA. The opposite result obtains for banks that clear checks through correspondent accounts, since adjustments to reserves are smaller under LRA than under CRA.

A final aspect that must be considered concerns risks associated with changing interest rates. Under LRA, changes in interest rates over the succeeding two weeks influence the profitability of investment and lending decisions made by banks in the current week. Moreover, a change in demand for bank credit tends to affect short-term interest rates, with a two-week lag. Under CRA, changes in demand for bank credit would have more immediate effects on interest rates. In the past, the Federal Reserve minimized these risks by moderating fluctuations in interest rates.

However, the Federal Reserve has recently permitted larger fluctuations in short-term interest rates in an attempt to control money growth by controlling growth of bank reserves. Consequently, banks are now more vulnerable under LRA to making unprofitable investment decisions due to fluctuating short-term interest rates. This problem is reduced under CRA.

# Appendix: Reserve Adjustments Under CRA and LRA

This Appendix analyzes the size of reserve balance adjustments a bank must make to avoid deficiencies caused by a decline in its demand deposit liabilities under CRA and LRA. At the beginning of a settlement week, the bank holds reserves just equal to its required reserves. During the week, demand deposit liabilities decline, and the bank adjusts its reserve balances to equal required reserves. Reserve adjustments depend on whether the bank is subject to CRA or LRA and on whether it clears checks through its reserve account or through accounts at correspondents.[1]

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[1]Results would be symmetrical for an increase in demand deposit liabilities.

## RESERVE ADJUSTMENT PRESSURE UNDER CRA

A bank's gross demand deposits are assumed to equal $100 at the start of business on Thursday (table A1). With demand balances due from other banks of $5 and no uncollected funds, net demand deposits equal $95. The reserve requirement on net demand deposits is 20 percent and, with $2 in vault cash and $17 in the reserve balance, total reserves just equal required reserves. By the end of business on Thursday, gross demand deposits decline to $98 and remain at that level throughout the week. Because the bank prefers to keep its vault cash equal to 2 percent of its gross demand deposit liabilities,

## Table A1

### Effects of a Decline in Deposit Liabilities on the Reserves of a Bank

| | Gross demand deposits | | Vault cash | | Clear checks through reserve account | | | | | |
| | | | | | Demand balances due from banks | | Net demand deposits | | Reserve balance | |
| Day | Start of day | End of day | Start of day | End of day | Start of day | End of day | Start of day | End of day | Start of day | End of day |
|---|---|---|---|---|---|---|---|---|---|---|
| Thursday | $100 | $98 | $2.00 | $1.96 | $5 | $5 | $95 | $93 | $17.00 | $15.04 |
| Friday | 98 | 98 | 1.96 | 1.96 | 5 | 5 | 93 | 93 | 15.04 | 15.04 |
| Saturday | 98 | 98 | 1.96 | 1.96 | 5 | 5 | 93 | 93 | 15.04 | 15.04 |
| Sunday | 98 | 98 | 1.96 | 1.96 | 5 | 5 | 93 | 93 | 15.04 | 15.04 |
| Monday | 98 | 98 | 1.96 | 1.96 | 5 | 5 | 93 | 93 | 15.04 | 15.04 |
| Tuesday | 98 | 98 | 1.96 | 1.96 | 5 | 5 | 93 | 93 | 15.04 | 15.04 |
| Wednesday | 98 | 98 | 1.96 | 1.96 | 5 | 5 | 93 | 93 | 15.04 | 15.04 |
| Sum | | | $13.76 | | | | $653 | | | $105.28 |

| | Gross demand deposits | | Vault cash | | Clear checks through correspondent account | | | | | |
| | | | | | Demand balances due from banks | | Net demand deposits | | Reserve balance | |
| Day | Start of day | End of day | Start of day | End of day | Start of day | End of day | Start of day | End of day | Start of day | End of day |
|---|---|---|---|---|---|---|---|---|---|---|
| Thursday | $100 | $98 | $2.00 | $1.96 | $5.00 | $3.04 | $95 | $94.96 | $17 | $17 |
| Friday | 98 | 98 | 1.96 | 1.96 | 3.04 | 3.04 | 94.96 | 94.96 | 17 | 17 |
| Saturday | 98 | 98 | 1.96 | 1.96 | 3.04 | 3.04 | 94.96 | 94.96 | 17 | 17 |
| Sunday | 98 | 98 | 1.96 | 1.96 | 3.04 | 3.04 | 94.96 | 94.96 | 17 | 17 |
| Monday | 98 | 98 | 1.96 | 1.96 | 3.04 | 3.04 | 94.96 | 94.96 | 17 | 17 |
| Tuesday | 98 | 98 | 1.96 | 1.96 | 3.04 | 3.04 | 94.96 | 94.96 | 17 | 17 |
| Wednesday | 98 | 98 | 1.96 | 1.96 | 3.04 | 3.04 | 94.96 | 94.96 | 17 | 17 |
| Sum | | | $13.76 | | | | $664.76 | | | $119 |

it reduces vault cash to $1.96. Given this reduction in gross demand deposits and adjustment to vault cash, the amount by which the bank has to adjust its reserve balance to avoid a reserve deficiency depends primarily on how the bank clears checks.

### Clearing Checks through Reserve Balances

Some banks receive payment for checks deposited with them by depositing the checks with their Reserve Banks for credit to their reserve accounts. When these banks' demand deposit liabilities decline, their reserve balances decline by the same amounts. This response is illustrated in table A1. During Thursday, the bank's reserve balance declines from $17 to $15.04. That change reflects the $2 decline in gross demand deposits and the $.04 reduction in vault cash, which is deposited in the reserve account. The bank that clears checks through its reserve account is assumed to maintain its demand balances due from other banks at $5, since the bank holds those balances for reasons other than clearing checks.

If a bank is subject to CRA and clears checks through its reserve account, the decline in gross demand deposits reduces required reserves and reserve balances. Suppose this bank waits until the last day of the settlement week (Wednesday) to adjust its reserve balance. The magnitude of the adjustment necessary to avoid a reserve deficiency is calculated in table A2. Required reserves are calculated as the sum of required reserves each day of the settlement week. Under CRA, required reserves are based on deposit liabilities at the start of business on Thursday through Wednesday. The sum of net demand deposits is $653 and, given a 20 percent reserve requirement, required reserves are $130.60. Sum of vault cash over the same period is $13.76. The sum of reserve balances at the end of each day over the week would be $105.28 without an adjustment to the deposit outflow. Thus, the bank would have to increase its reserve balance on Wednesday by $11.56 to avoid a reserve deficiency.

### Clearing Checks through Accounts at Correspondents

Many banks collect checks deposited with them by depositing these checks with their correspondents for credit to their demand balances due from correspondents. For these banks, reductions in deposit liabilities do not affect their reserve balances but reduce their demand balances due from correspondents. In the case presented in table A1, the bank allows its demand balances due from correspondents to decline by the amount of the $2 reduction in gross demand deposits. It then deposits $.04 of vault cash in its demand balances due from correspondents. Thus, net demand deposits are reduced only slightly since the reduction in gross demand deposits is largely offset by the reduction in demand balances due from correspondents.

Calculations in table A2 indicate that the bank would have to increase its reserve balance by only $.192 on Wednesday to avoid a reserve deficiency. These calculations indicate that, even under the same reserve accounting system (CRA), the magnitude of reserve adjustments

| | Table A2 **Increase in Reserve Balances Necessary to Avoid Reserve Deficiences with a Decline in Deposit Liabilities** | | | |
|---|---|---|---|---|
| | Contemporaneous reserve requirements | | Lagged reserve requirements | |
| | Clear checks through: | | Clear checks through: | |
| | Reserve account | Correspondent account | Reserve account | Correspondent account |
| Vault cash | $ 13.76 | $ 13.76 | $ 14.00 | $ 14.00 |
| Reserve balance | 105.28 | 119.00 | 105.28 | 119.00 |
| Total reserves | 119.04 | 132.76 | 119.28 | 133.00 |
| Required reserves | 130.60 | 132.952 | 133.00 | 133.00 |
| Difference between required and total reserves | $ 11.56 | $ .192 | $ 13.72 | $ .00 |

differs greatly for banks that clear checks through their reserve accounts and those that clear checks through correspondent accounts. The important difference is that changes in deposit liabilities change the reserve balances of banks that clear checks through their reserve balances, whereas reserve balances of banks that clear checks through accounts at correspondents are not directly affected by changes in deposit liabilities.

## RESERVE ADJUSTMENT PRESSURE UNDER LRA

Calculation of reserves and required reserves for a bank subject to LRA requires assumptions about the bank's deposit liabilities and vault cash two weeks earlier. Net demand deposit liabilities are assumed to have averaged $95 and vault cash to have averaged $2 during the settlement period two weeks earlier. Under LRA, therefore, the sum of reserve requirements for each day in the current settlement week is $133 ($95 x 7 x 0.20), and the vault cash portion of reserves amounts to $14 ($2 x 7). Therefore, at the start of business on Thursday, reserves equal required reserves.

### Clearing Checks through Reserve Balances

A decline in demand deposits has the same effect on the reserve balance of a bank that clears checks through its reserve balance, whether it is subject to LRA or CRA. Unless the bank adjusts its reserve balance to offset the decline in demand deposit liabilities, the sum of its reserve balances over the current week will be $105.28. If subject to LRA, the bank must increase its reserve balance by $13.72 on Wednesday to avoid a reserve deficiency. Note that this adjustment is larger than that

for the bank subject to CRA that clears checks through its reserve account. The decline in demand deposit liabilities has the same effect on reserve balances in both cases, but the adjustment to the reserve balance necessary to avoid a reserve deficiency is smaller for the bank subject to CRA, because its required reserves decline during the current settlement week as demand deposit liabilities decline, whereas, under LRA, required reserves remain unchanged.

## *Clearing Checks through Accounts at Correspondents*

Changes in deposit liabilities have no effect in the current week on the reserve positions of banks that clear checks through accounts at correspondents. Their required reserves and vault cash portion of reserves are predetermined for the current week, and changes in deposit liabilities do not directly affect their reserve balances in the current week. Therefore, if such a bank begins a settlement week with its reserve balances just equal to required reserve balances, no adjustment of reserve balances is necessary in the current week to avoid excess reserves or deficiencies in response to changes in deposit liabilities.

## SUMMARY

Effects of returning to CRA on the reserve adjustment pressure on a bank would depend upon how the bank clears its checks. For a bank that clears checks through its reserve account, adjustments to reserve balances for given changes in deposit liabilities would be smaller under CRA. For a bank that clears checks through balances at correspondents, reserve adjustment pressure in response to deposit fluctuations would tend to increase from zero to some relatively small amount.

# The "Middleman": A Major Source of Controversy in the Food Industry

CLIFTON B. LUTTRELL

T HE "middleman" in the food industry histori-cally has been the *bête noire* of many farmers and consumers. This legendary person, allegedly respon-sible for the differences between the prices of food products received by farmers and the prices paid by consumers, is depicted as having sufficient power over prices to simultaneously underpay farmers for their products and overcharge food consumers. As evidence of this power, it is often noted that a loaf of bread priced at approximately 40 to 50 cents contains only 6 to 7 cents worth of wheat, or that a sirloin steak served in a restaurant for $10 or more came from a beef animal sold by the farmer for only 70 cents per pound.

The farmer's frustration with the apparent power of the middleman in the depression years of the early 1870s led to a rapid expansion of the cooperative movement, by which the farmer expected to eliminate the middleman and retain the profits.[1] Although farmer-owned cooperatives now operate in almost every stage of farming and food-processing, criticism of the middleman still persists.

Criticism of the role of the middleman in the food processing and marketing industry has appeared in numerous studies, hearings, and reports. For instance, one study in 1967 reported that ". . . allegations of excessive merchandising costs (of farm products) cannot be brushed aside."[2] The U.S. Department of Agriculture in 1979 reported that "the widening (of food price) spreads to the point where there are probably excess returns over costs is an unwel-come development for consumers and inflation fight-

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[1]H. E. Erdman in a study for the University of California, Agricultural Experiment Station; published in Henry C. and Anne Dewees Taylor, *The Story of Agricultural Economics in the United States, 1840-1932,* (Ames: The Iowa State Col-lege Press, 1952), pp. 689-92; and Geoffrey S. Shepherd, et. al., in *Marketing Farm Products,* (Ames: The Iowa State University Press, 1976), p. 252.

[2]Harold F. Breimyer, *Agricultural Policy: A Review of Pro-grams and Needs,* Technical Papers, National Advisory Com-mission on Food and Fiber (August 1967), p. 103. Other examples of such views include: Report of the National Com-mission on Food Marketing, *Food from Farmer to Consumer* (June 1966), pp. iii and 1, and pp. 109-10; *Food Prices,* Hear-ings before the Subcommittee on Production and Stabilization of the Committee on Banking, Housing and Urban Affairs, 93 Cong., 1 Sess., (Government Printing Office, 1973), p. 1; *Food Chain Pricing Activities,* Hearings before the Joint Eco-nomic Committee, 93 Cong., 2 Sess., (Government Printing Office, 1974), p. 1; *The Market Functions and Costs For Food Between America's Fields and Tables,* prepared by Economic Research Service and Agricultural Marketing Serv-ice for the Subcommittee on Agricultural Production, Market-ing and Stabilization of Prices of the Committee on Agricul-ture and Forestry, United States Senate (March 25, 1975); *Prices and Profits of Leading Food Chains 1970-74,* Hearings before the Joint Economic Committee, 95 Cong., 1 Sess., (Government Printing Office, 1977); Ward Morehouse, III, "Food Retailers Say Carter Shares Blame for High Food Costs," *The Christian Science Monitor,* August 10, 1979. Also statements by Senator William F. Proxmire and Joseph L. Alioto in *Food Chain Pricing Activities,* pp. 1 and 22.

ers."[3] President Carter was sufficiently concerned with the food marketing industry that he summoned 16 top industry executives to the White House last August and noted that ". . . last winter (of 1978) when food prices were going up (at the farm level), there was no lag in the food-retail spread. Now that they are going down to the farmer, there is a substantial lag."[4]

Implicit in the criticism of the middleman's role is the view that food prices to consumers are established by the middleman independently of farm commodity price movements.[5]

In contrast to this view, it is shown in this article that:

1. Changes in the portion of retail food costs received by farmers largely result from farm product supply fluctuations that cause changes in the prices of farm commodities rather than from changes in the middleman's share.

2. Changes in the middleman's receipts (gross receipts less the costs of farm products) essentially result from inflation.

3. Changes in farm product prices and inflation are the two primary causes of changes in retail food prices.

4. Retail food prices reflect farm product price changes only after a time lag, and the existence of this lag may account for much of the criticism of the middleman.

## *Farm Product Price Fluctuations Account for Change in Farmer's Share*

The farmer's share of the cost of a market basket of food (see definition, p. 23) has altered only slightly since the 1920s as indicated in table 1. The farmer's share represents the difference between the retail costs to consumers and net receipts of the middleman. It was approximately the same in the 1970s as in the 1920s, averaging 40.9 percent and 40.3 percent in the 1920-29 and 1970-79 decades, respectively. Over the entire period from 1920 to 1979, the farmer's share averaged 41.5 percent.

Despite the overall consistency of the portion of food costs accruing to farmers during 1920-1979, sizeable fluctuations have occurred in one- to five-year periods. These fluctuations reflect changes in

[3]USDA, *Farm Index* (September 1979), pp. 4-5.

[4]"Carter Grills Food Industry Executives on Prices and Profits," *St. Louis Globe Democrat,* August 14, 1979.

[5]Alioto in *Food Chain Pricing Activities,* p. 22.

## Table 1
### Percent of Retail Costs of Food-Farm Products Accruing to Farmers

| Years | Percent |
|-------|---------|
| 1920-29 | 40.9 |
| 1930-39 | 36.5 |
| 1940-49 | 49.9 |
| 1950-59 | 43.2 |
| 1960-69 | 39.2 |
| 1970-79 | 40.3 |
| 1920-79 | 41.5 |

Source: USDA, *Farm-Retail Spreads For Food Products,* Miscellaneous Publication No. 741 (1972); *Agricultural Statistics;* and *Farm Index.*

farm product prices rather than changes in receipts to the middleman. Changes in farm product prices are due primarily to changes in short-run supply. Diverse weather and biological conditions, as well as altered international relationships, contribute to year-to-year changes in the supply of farm products. Because the demand for farm products is relatively inelastic, small changes in the quantity produced — resulting from abnormal weather or other factors — have a relatively large impact on prices.

Some analysts contend that year-to-year changes in production account for the majority of short-run price fluctuations, especially for those crops and livestock products that cannot be stored in large quantities.[6] Over the longer run, however, factors such as changing international trade policies, wars, and domestic monetary policies have had a significant impact on farm product prices through their effects on farm product demand.

Parallel movements in the farmer's share of the market basket of food and in its real farm value are indicated for selected periods in table 2. Changes in the farmer's share moved in the same direction as real farm value during each period of change since 1947. For example, during the major declines in real value in 1947-49, 1951-56, 1958-64, and 1973-76, the farmer's share declined 5, 9, 4, and 7 percentage points respectively; and during 1971-73 when real farm value rose $131, the farmer's share increased 7 percentage points.

[6]See William G. Tomek and Kenneth L. Robinson, *Agricultural-Product Prices,* (Ithica: Cornell University Press, 1972), p. 75.

## Definition of the market basket of food.

"The market basket of food is the average quantity of U.S. farm-originated food purchased annually per household in 1960-61 by families of urban wage earners, clerical workers, and workers living alone. The retail cost is less than expenditures for food by a typical family because:

(1) It does not include costs of food consumed in away-from-home eating establishments.

(2) It is a weighted average of food expenditures by single persons living alone as well as of those by families.

(3) The market basket includes only foods originating on U.S. farms. It does not include fishery products or coffee, bananas, and other imported foods.

"Further, the market basket retail cost is an estimate of the cost of the types and quantities of farm foods purchased by urban wage earners and clerical workers in 1960-61. The types and quantities of food purchased change, at least slightly, from year to year.

"Decreases in the farmer's share are sometimes attributed to substitution of highly processed (convenience) foods for less highly processed or unprocessed foods. The substituted products, it is asserted, have larger farm-retail spreads and higher retail prices relative to their farm values than the foods for which they are substituted. However, changes in the market basket sample are infrequent. When a change occurs, weights are revised so changes in the sample do not alter the total retail cost and farm value. Thus, increased use of convenience foods has not caused the decreases in the farmer's share shown by the present market-basket statistics. The farmer's share, however, has been influenced by changes in marketing services not identified with individual foods. For example, to the extent that more elaborate facilities in supermarkets have increased farm-retail spreads and retail prices, this increase in marketing services has affected the farmer's share."[1]

[1]USDA: *Agricultural Marketing Costs and Changes,* Major Statistical Series (June 1970), p. 3.

## Table 2

## Change in Farmer's Share, Real Retail Cost, Farm Value, and Middleman's Receipts for Market Basket of Food for Selected Periods[1]

| Date | Farmer's share (percentage points) | Retail cost | Farm value | Middleman's receipts |
|------|------|------|------|------|
| 1947-49 | −5 | $ −58 | $ −84 | $ +25 |
| 1950-51 | +2 | +35 | +37 | −2 |
| 1951-56 | −9 | −116 | −153 | +36 |
| 1957-58 | +1 | +33 | +22 | +11 |
| 1958-64 | −4 | −88 | −77 | −10 |
| 1964-66 | +4 | +38 | +52 | −15 |
| 1966-67 | −3 | −42 | −39 | −3 |
| 1968-69 | +2 | −2 | +14 | −16 |
| 1969-71 | −3 | −42 | −42 | +1 |
| 1971-73 | +7 | +124 | +131 | −8 |
| 1973-76 | −7 | −43 | −90 | +47 |
| 1977-78 | +1 | +35 | +35 | +1 |
| 1947-78 |  | −126 | −194 | +67 |

[1]Values adjusted for inflation with the consumer price index. The periods selected include those consecutive years since 1947 during which the farmer's share was either declining or increasing.

Source: USDA, *Farm-Retail Spreads For Food Products,* Miscellaneous Publication No. 741 (1972); *Agricultural Statistics;* and *Farm Index.*

Chart 1
## Real Retail Cost, Farm Value and Farmers' Share of Market Basket of Food

Dollars*

Farmers' Share
Percent

Retail Cost
SCALE

Farmers' Share
SCALE

Farm Value
SCALE

*Deflated by Consumer Price Index.

Source: U.S. Department of Agriculture
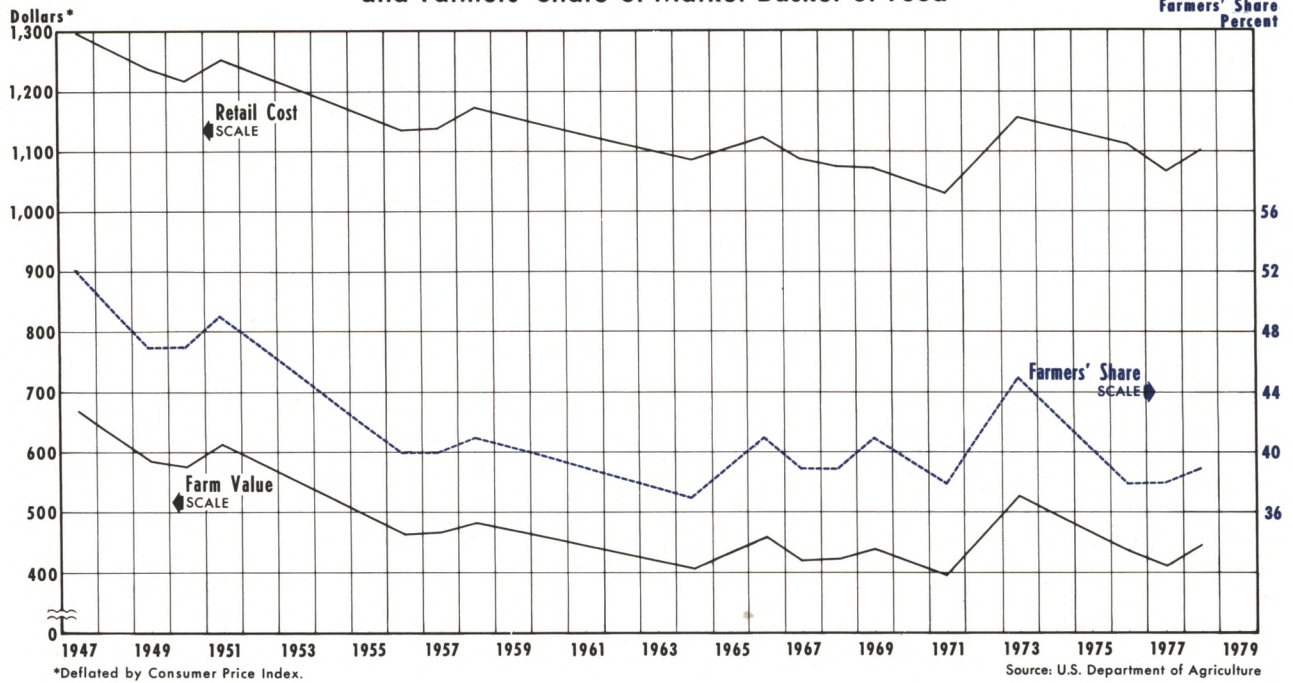
The close relationship between the farmer's share and the real farm value of the market basket of food is illustrated graphically in chart 1. During these selected periods, movement in the farm value of the market basket corresponded to movement in the farmer's share, with sharp changes in farm value associated with sharp changes in the market share accruing to farmers.

### Middleman's Receipts Change with Inflation

The middleman's receipts for the market basket of food are not as variable as the farm value. Weather and other factors that affect the farmer's receipts have less of an effect on the middleman, since changes in demand for resources and output in this sector primarily reflect general inflation rather than weather or other short-run supply or demand disturbances. Consequently, the rate of increase in the middleman's receipts corresponds to the rate of inflation in the overall economy. Table 3 indicates the close relationship between the middleman's return from a market basket of food and the overall rate of inflation as measured by the consumer price index. During some of the periods, namely 1950-55, 1955-60, and 1975-78, the middleman's receipts rose more slowly than the consumer price index. In the periods 1960-65 and 1970-75, however, they rose more quickly than the

consumer price index. The rate of increase in the middleman's receipts over the 28-year period averaged 3.8

## Table 3

### Rate of Change in Middleman's Receipts from Food Sales and Rate of Inflation

| | Rate of change | |
| --- | --- | --- |
| | Middleman's receipts[1] | Consumer price index |
| 1950-1955 | 1.8% | 2.2% |
| 1955-1960 | 1.5 | 2.0 |
| 1960-1965 | 1.4 | 1.3 |
| 1965-1970 | 4.2 | 4.2 |
| 1970-1975 | 8.8 | 6.7 |
| 1975-1978 | 6.4 | 6.6 |
| 1950-1978 | 3.8 | 3.6 |

[1]Farm-retail spread of market basket of farm-food products adjusted for change in quantity of food in market basket.

Source: USDA, *Farm-Retail Spreads for Food Products,* Miscellaneous Publication No. 741 (1972), p. 106; *Agricultural Statistics* (1978), p. 446; *Agricultural Outlook* (December 1979), p. 16; *Economic Report of the President* (January 1979), p. 240; and *Economic Indicators* (December 1979), p. 23.

## Table 4

## Retail Food Costs Closely Related to Farm Value of Food Products and Inflation

| Years | Change in retail food costs | Change in farm value | Impact of inflation on middleman's receipts[1] | Change in farm value plus impact of inflation on middleman's receipts |
|-------|------------------|------------------|------------------|------------------|
| 1950-55 | $    45 | $−36 | $ 52 | $   17 |
| 1955-60 | 73 | 14 | 58 | 72 |
| 1960-65 | 41 | 23 | 39 | 62 |
| 1965-70 | 191 | 62 | 143 | 205 |
| 1970-75 | 648 | 306 | 288 | 594 |
| 1975-78 | 280 | 85 | 232 | 317 |
| 1950-78 | $1,278 | $454 | $812 | $1,267 |

[1]Middleman's receipts from market basket of farm-food products at beginning of period multiplied by the percentage increase in the consumer price index during the period.

Source: USDA, Miscellaneous Publication No. 741 (1972); *Farm-Retail Spreads for Food Products*, p. 106; *Agricultural Statistics* (1978), p. 446; *Agricultural Outlook* (December 1979), p. 16; *Economic Report of the President* (January 1979), p. 240; and *Economic Indicators* (December 1979), p. 23.

percent per year, or 0.2 percent faster per year than the consumer price index. Essentially all of the increase in the middleman's receipts relative to the consumer price index occurred during 1970-75.

The close relationship between the middleman's receipts and inflation is further demonstrated by assessing the statistical relationship between them. The correlation coefficient between the annual rates of change in the middleman's receipts and the consumer price index for the period 1947-78 is .894.

### Food Prices Change With Farm Product Prices and Inflation

Changes in the retail cost of food are closely associated with changes in the farm value of food products plus the rate of inflation. As shown in table 4, the change in the farmer's share of the market basket of food, when added to the impact of inflation on the middleman's receipts, accounts for virtually all the change in retail costs of the market basket of food for the 1950-78 period. For example, from 1955 to 1960, the real retail cost of a market basket of food rose $73, while the farm value of the original products plus the impact of inflation on the middleman's receipts totaled $72. During the more rapid increases in food prices since 1965, the increase in the farm value of the market basket of food products, added

to the impact of inflation on the middleman's receipts, totaled $1,116 or 99.7 percent of the increase in the retail cost of the food. As shown in chart 1, after adjustment for inflation, the retail cost of a market basket of food and the farm value of the original food products move almost identically.

An alternative assessment of the relationship between farm value, the middleman's receipts, and retail food costs is obtained by correlating annual changes in retail food costs with those for farm value and the middleman's receipts for the 1947-78 period. After adjusting for inflation, the correlation coefficient between changes in retail cost and farm value is .922. This value is significantly different from zero at the 5 percent level. In contrast to the significant coefficient of correlation between real retail food costs and the farm value of food, the correlation coefficient between the middleman's receipts and retail food costs is not significantly different from zero at the 5 percent level.

### Effect of Time Lag on Prices

The full impact of farm price changes on food prices occurs only after a substantial time lag. The time lag is related to the timing of food purchases by consumers and the maintenance of food and farm commodity inventories by the middleman. Because

consumers randomly purchase food day-to-day around some average level, retailers, wholesalers, and processors must hold inventories to accommodate these fluctuations. Consider, for example, the retail outlet specializing in high quality beef. The retailer must carry sufficient stocks to accommodate his customers. Orders are placed to packers for shipments at regular intervals to replenish stocks so that a sufficient amount of beef will be avilable for sale at retailers within seven to ten days after shipment. The packer, in turn, must carry an inventory of cattle ready for slaughter and an inventory of beef ready for shipment to avoid losing customers. He must carry an inventory of slaughter cattle in order to avoid day-to-day fluctuations in slaughtering operations that would impair the efficiency of his labor force, plant, and equipment.[7]

The above description shows that a period of time necessarily elapses before a change in farm output of fed cattle has its full impact on retail price. In fact, several days may pass from the time a reduced number of fat cattle are transferred from the farmer's feedlot to packers' before it is recognized that the reduction in the number marketed is not merely a random fluctuation. Only when cattle and beef stocks are reduced to less than desired levels at both packer and retail levels is the price of cattle bid up and higher prices charged for beef purchases.

This time lag was investigated for a number of food commodities in order to determine the length of time required for retail prices to adjust to changes in farm product prices and the extent to which retail prices change in response to a given change in farm product prices. The following distributed lag price equation was estimated:

$$\Delta \ln CP_{j,t} = a + \sum_{i=0}^{m} b_i \, \Delta \ln FP_{j,t-i} + u_{j,t}$$

where $CP_j$ and $FP_j$ are the consumer price and farm price, respectively, of the $j^{th}$ product. The b's are the coefficients which indicate the rates of change in the consumer price over each time lag for each percentage change in the farm price of the $j^{th}$ product, and $u_j$ is the random error term. The "t" subscripts denote the time periods (months).

Thirteen foods or food groups were tested using the Almon polynomial distributed lag technique. The Cochrane-Orcutt procedure was used to correct for serially dependent disturbances.[8] Estimates were made for the time period from January 1950 through December 1978, except for fresh fruit, canned hams, round roast, and sirloin steak. For these commodities, the time periods began in January of 1967, 1964, 1964, and 1961, respectively. Although lags of 12 periods (months) or more were investigated, the results suggested relatively short 4-month lags, with the exception of cereals and bakery products, white bread, and canned hams which produced 20-, 16-, and 7-month lags, respectively.[9]

The relatively high $R^2$s in table 5 indicate that much of the month-to-month change in the retail price of food is explained by a constant term and relatively recent changes in farm price. For example more than 50 percent of the retail price movement of fresh whole chickens and each of the meats, except bacon and canned hams, is explained by the current and past three-month (or less) lagged change in farm prices. Changes in farm prices account for a large percentage of the change in retail egg prices, but for a relatively small percentage of the change in retail prices of items such as fresh fruit, cereals and bakery products, and white bread. The full impact of changes in farm prices over the effective lag periods are shown in table 6.

The percentage of the retail price change explained by a change in farm price is directly related to the share of the retail value accruing to the farmer. As shown in table 7, the farmer's share of the retail value of choice beef is relatively high, and 64 percent of the change in the price of beef and veal and 66 percent of the change in the price of chuck roast is explained by the change in slaughter steer prices. Similarly, the farmer's share of the value of eggs is relatively high, and 71 percent of the change in retail egg price is explained by the change in the farm price. On the other hand, only a small share of the retail value of cereals and bakery products and white bread accrues to farmers who produce the wheat from which these products are made. Consequently, changes in farm commodity prices have much less impact on the changes that occur in the retail prices of these products.

If all of the retail food price changes in the short-run result from changes in farm prices, the sum of the coefficients (table 6) should approximate the farmer's

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[7]About one-half of the cattle marketed from commercial feedlots are owned by packers for eight days or more. See Report of the National Commission on Food Marketing, *Food from Farmer to Consumer* (June, 1966), p. 24.

[8]A third degree polynomial was assumed. No endpoint constraints were used. All data were seasonally adjusted using the X-11 technique.

[9]With the exception of a few instances that did not materially change the results, the coefficients of any lags that extended beyond the time periods designated in tables 5 and 6 were not significantly different from zero.

## Table 5

## Rate of Change of Retail Food Prices as a Function of Current and Lagged Rates of Change of Farm Commodity Prices[1]

| Dependent variable (change in retail food prices) | Independent variable (change in farm product prices) | Constant term | Coefficients | | | | | $R^2$ | Durbin-Watson statistic | Rho | Standard error |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Current | Lagged | | | | | | | |
| | | | | 1 month | 2 months | 3 months | | | | | |
| Fresh vegetables | Fresh market vegetables | .002 (1.31) | .18 (8.83) | .21 (12.43) | .08 (6.39) | [2] | .37 | 2.02 | −.264 | .038 |
| Fresh fruit | Fresh market fruit | .003 (1.83) | .11 (4.67) | .07 (3.23) | .06 (3.83) | .06 (2.70) | .22 | 1.95 | −.008 | .022 |
| Cereals and bakery products | All wheat | .003 (7.81) | .01 (2.60) | .02 (4.27) | .02 (6.10) | .02 (6.85) | .32 | 2.03 | .081 | .006 |
| White bread | All wheat | .003 (6.74) | .03 (4.43) | .03 (6.12) | .02 (6.91) | 0.2 (6.24) | .21 | 1.99 | −.085 | .008 |
| Fresh whole chickens | Broilers | .001 (0.57) | .48 (20.84) | .18 (13.73) | [2] | [2] | .54 | 2.25 | −.449 | .028 |
| Bacon | Slaughter hogs | .001 (1.14) | .13 (6.51) | .28 (16.25) | .17 (12.75) | [2] | .49 | 2.00 | −.030 | .025 |
| Canned hams | Slaughter hogs | .003 2.37) | .04 (2.55) | .07 (7.93) | .09 (8.42) | .08 (9.14) | .45 | 2.00 | −.041 | .015 |
| Meats[3] | Meat animals | .001 (2.36) | .20 (10.40) | .24 (14.62) | .12 (9.66) | [2] | .50 | 2.00 | −.186 | .013 |
| Beef and veal | Slaughter steers | .002 (3.26) | .12 (8.27) | .25 (21.47) | .14 (17.23) | [2] | .64 | 1.98 | −.194 | .011 |
| Chuck roast | Slaughter steers | .001 (1.63) | .13 (6.45) | .39 (23.50) | .22 (18.75) | [2] | .66 | 2.01 | −.259 | .016 |
| Round roast | Slaughter steers | .002 (2.11) | .13 (6.11) | .28 (12.96) | .13 (11.19) | [2] | .55 | 2.13 | −.412 | .014 |
| Sirloin steak | Slaughter steers | .002 (2.38) | .11 (5.60) | .28 (16.45) | .15 (12.69) | [2] | .59 | 2.02 | −.407 | .014 |
| Whole milk | Milk | .001 (3.12) | .19 (5.76) | .14 (4.77) | .11 (5.72) | .08 (2.86) | .34 | 1.99 | −.200 | .007 |
| Eggs | Eggs | .000 (0.07) | .63 (26.73) | .14 (7.02) | [2] | [2] | .71 | 2.26 | −.508 | .028 |

[1]t-statistics are in parenthesis.

[2]Insignificant.

[3]Includes beef, veal, pork, and lamb.

share of the retail food price (table 7). Despite the problem of comparability of some of the food groups, the relationship between the farmer's share and the sum of the coefficients is apparent. For example, the farmer's share of the retail receipts from fresh fruit was 28 percent and the sum of the coefficients for fresh fruit was .32. Similarly, close relationships are noted for pork, meat products, choice beef, and fresh milk. Using the estimated standard error for each sum coefficient, the farmer's share is not significantly different from the sum of the coefficients for five of the nine food groups.

## Time Lag Explains Much of "Middleman" Complaint

The lagged impact of farm commodity price changes on food prices explains much of the criticism of the food processing and marketing sector. In general, such criticism has occurred during periods of falling farm prices, when food prices fail to decline in step with farm prices. A look at the lagged impact of a decline in slaughter steer prices on the price of sirloin steak indicates why such views are held. If slaughter steer prices decline from $1.00 to $.90 per

## Table 6

### Rate of Change in Retail Food Prices and Sum of Lagged Rates of Change of Farm Commodity Prices

| Dependent variable (change in retail food) | Independent variable (change in farm product) | Sum[1] | Mean lag (months) |
|---|---|---|---|
| Fresh vegetables | Fresh market vegetables | .48 (9.41) | 0.9 |
| Fresh fruit | Fresh market fruit | .32 (5.32) | 1.4 |
| Cereals and bakery products | All wheat | .27 (10.52) | 8.2 |
| White bread | All wheat | .25 (9.31) | 5.7 |
| Fresh whole chickens | Broilers | .73 (14.85) | 0.6 |
| Bacon | Slaughter hogs | .62 (14.53) | 1.3 |
| Canned hams | Slaughter hogs | .45 (11.38) | 3.1 |
| Meats[2] | Meat animals | .56 (15.70) | 0.9 |
| Beef and veal | Slaughter steers | .54 (20.67) | 1.2 |
| Chuck roast | Slaughter steers | .73 (20.18) | 1.1 |
| Round roast | Slaughter steers | .50 (11.96) | 1.1 |
| Sirloin steak | Slaughter steers | .57 (14.09) | 1.2 |
| Whole milk | Milk | .54 (13.74) | 1.3 |
| Eggs | Eggs | .79 (19.42) | 0.2 |

[1]Derived from values in table 5. Includes sum of all coefficients for current and lagged months — 4-month lags except for cereals and bakery products, white bread and canned hams where 20-, 16-, and 7-month lags were used, respectively; t-statistics are in parenthesis

[2]Includes beef, veal, pork, and lamb.

pound (10 percent) in the current month, sirloin steak will respond by declining only 1.1 percent (0.11 x 10 percent) during the current month (table 5).[10] Over a three-month period, however, the total drop in the price of sirloin steak would be 5.7 percent.

The immediate impact of a change in the price of wheat on bread, bakery and cereal products and of slaughter hogs on canned ham is even less than that of slaughter steers on sirloin steak prices. Prices of

wheat and hogs can decline gradually over much longer periods of time without having a large impact on the consumer price of these products, as shown by the longer lags involved.

The apparent failure of retail prices in recent years to respond immediately to a decline in farm prices reflects the impact of inflation on the middleman's receipts. With higher rates of inflation, food prices often do not appear to respond at all to a decline in farm product prices. For example, given an inflation rate of 12 percent per year, a 10 percent decline in the price of slaughter steers will result in stable sirloin steak prices in the current month. Although the

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[10]These time lags are averages for the time periods over which the estimates were made. They may have shortened in more recent years if efficiencies in inventory maintenance have been realized.

## Table 7

### Farmer's Share of Retail Price and Sum of Lagged Coefficients of Specified Foods

| Foods | Farmer's share[1] | Sum of coefficients[2] |
|---|---|---|
| Fresh vegetables | 33% | .48 |
| Fresh fruit | 28 | .32 |
| Cereals and bakery products | 12 | .27 |
| Frying chickens | 56 | .73 |
| Pork | 55 | .54 |
| Meat products | 57 | .56 |
| Choice beef | 65 | .59 |
| Fresh milk | 50 | .54 |
| Eggs | 64 | .79 |

[1]Farmer's share and sum of coefficients from table 5 data were calculated for the same years.

[2]In some instances the retail food group for which the coefficients were obtained does not precisely correspond with the group in the farmer's share column. For example, the sum of the coefficients for fresh whole chickens was compared with the farmer's share for frying chickens, the average of bacon and canned ham with pork, and the average of beef and veal, chuck roast, round roast, and sirloin steak with choice beef.

Source: USDA

decline in steer prices will exert a 1 percent downward movement on sirloin steak prices, this will be offset by the impact of inflation on the middleman's cost. This, however, is not evidence that food prices fail to adjust downward in response to declining farm commodity prices. Sirloin steak prices would have risen by 1 percent if the price of slaughter steers had not fallen. Further, there is evidence that food retailers treat increases and decreases in wholesale prices symmetrically — both are passed on fully after the lag between the timing of price changes at the farm and retail levels is taken into account.[11]

### Conclusion

Much of the criticism of the food processing and marketing sector of the economy is based on erroneous perceptions of the food processing and marketing industry. Price movements of farm and retail food products offer no evidence that the middleman manipulates prices.

In the short run, the farmer's share of retail food costs fluctuates quite sharply. However, these fluctuations result almost entirely from changes in farm prices that are caused by changes in short-run supply or demand rather than by changes in the middleman's receipts. The middleman's receipts change at about the same rate and in the same direction as general inflation. Hence, changes in food costs are almost entirely explained by changes in farm prices and in the rate of overall inflation.
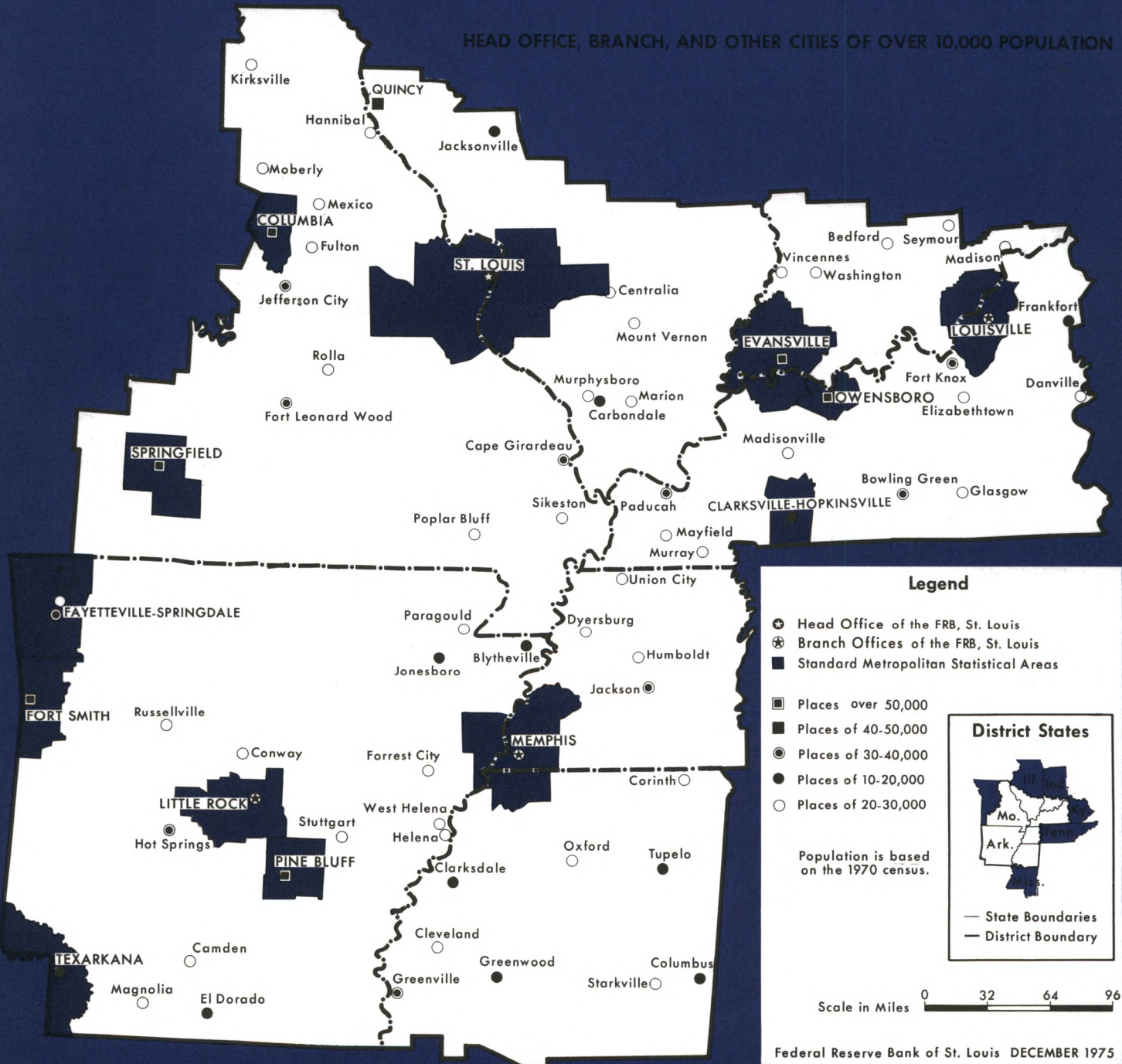
Much of the criticism of the middleman apparently stems from a lack of understanding of the time lag between farm price changes and their full impact on food prices. Food prices do not rise and fall in step with the changes in farm prices. Instead, the period of time between the change in farm prices and the full effect of this change at the retail level varies from about two months for eggs to more than a year and a half for cereals and bakery products. Consequently, retail food prices may remain stable during the first few days following a sharp decline in farm prices, and they may even rise temporarily if general inflation is at a high rate. Nevertheless, retail food prices eventually move either up or down in response to farm price changes and the rate of overall inflation.

[11]Dale Heien, "A Study of the Relationship Between Farm-Level Prices and Retail Food Prices," prepared for the Council on Wage and Price Stability (September 1976). For a discussion of the function of inventories in pricing see Armen A. Alchian and William R. Allen, *University Economics*, 3rd ed. (Belmont, California, Wadsworth Publishing Company, Inc., 1972), pp. 139-41.

# EIGHTH FEDERAL RESERVE DISTRICT

HEAD OFFICE, BRANCH, AND OTHER CITIES OF OVER 10,000 POPULATION

Kirksville
QUINCY
Hannibal
Jacksonville
Moberly
Mexico
COLUMBIA
Fulton
Jefferson City
Rolla
Fort Leonard Wood
SPRINGFIELD
Poplar Bluff
St. Louis
Centralia
Mount Vernon
Murphysboro
Marion
Carbondale
Cape Girardeau
Sikeston
Paducah
Bedford
Seymour
Vincennes
Washington
Madison
Frankfort
EVANSVILLE
LOUISVILLE
Fort Knox
Danville
OWENSBORO
Elizabethtown
Madisonville
CLARKSVILLE-HOPKINSVILLE
Bowling Green
Glasgow
Mayfield
Murray
Union City
FAYETTEVILLE-SPRINGDALE
Paragould
Dyersburg
Humboldt
Blytheville
Jonesboro
Jackson
FORT SMITH
Russellville
Conway
Forrest City
MEMPHIS
Corinth
LITTLE ROCK
West Helena
Stuttgart
Helena
Oxford
Tupelo
Hot Springs
PINE BLUFF
Clarksdale
Cleveland
Camden
Columbus
TEXARKANA
Greenwood
Magnolia
Greenville
Starkville
El Dorado

## Legend

- ✪ Head Office of the FRB, St. Louis
- ✱ Branch Offices of the FRB, St. Louis
- ■ Standard Metropolitan Statistical Areas

- □ Places over 50,000
- ■ Places of 40-50,000
- ◉ Places of 30-40,000
- ● Places of 10-20,000
- ○ Places of 20-30,000

Population is based on the 1970 census.

### District States

Ill. Ind.
Mo. Ky.
Tenn.
Ark.
Miss.

— State Boundaries
— District Boundary

Scale in Miles   0   32   64   96

Federal Reserve Bank of St. Louis   DECEMBER 1975