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Agricultural Productivity: Trends and Implications for the Future

By Marvin Duncan and C. Edward Harshbarger

At a time when the U.S. economy is bedeviled by persistent price inflation, productivity increases can play a salutary role in dampening increases in production costs. Unfortunately, growth in productivity in the United States has slowed considerably in the past decade. During 1978, output per hour of all persons in the nonfarm business sector increased by a disappointing 1.1 per cent.

The situation in agriculture is somewhat brighter in that labor productivity continues to grow in excess of 6 per cent annually. However, labor productivity is increasingly regarded as an inadequate measure of productivity change in agriculture. A measure of total resource productivity is generally considered more appropriate. On this basis, overall productivity in agriculture has been growing at only 1 to 1.5 per cent annually in the past five years—less rapidly than the 2.6 per cent average annual growth rate for the past 25 years. Slower productivity growth not only contributes to domestic food price inflation, but also may result in U.S. farm products being priced out of export markets. Thus, a slowdown in productivity growth is a matter of considerable concern for policymakers and farmers alike.

Marvin Duncan and C. Edward Harshbarger are assistant vice presidents and economists, both with the Federal Reserve Bank of Kansas City.

WHAT IS AGRICULTURAL PRODUCTIVITY?

When productivity in the nonagricultural business sector is discussed, it is customary to refer to changes in the output-to-labor ratio, often in the form of a productivity index which measures the goods and services produced per hour by all persons employed. Productivity used to be measured the same way in agriculture, as well. However, such a measure is now of limited usefulness because the labor input in agriculture has become much less important while other inputs have become much more important—chemicals and equipment, for example. Total labor used in U.S. farmwork declined from a high of 24.1 billion hours in 1918 to only 4.7 billion hours in 1977. Conversely, fertilizer use increased from 890,000 tons in 1918 to 22.1 million tons in 1977, while tractor numbers increased from 85,000 to 4.4 million during the same time period.[1]

Individual measures of productivity—such as farm real estate, farm labor, machinery,

[1] Actually, tractor numbers peaked at about 4.8 million units in 1965 and have declined since then. However, total tractor horsepower has continued to increase and in 1977 was 3.5 per cent greater than in 1965.

chemicals, and feed, seed, and livestock purchases--can still serve specialized uses since they illustrate quite vividly the substantial changes in resource mix that have occurred in agriculture over the past several decades (Chart 1 plots these trend lines for the 1930-1977 period). Although the amount of farm real estate used has remained relatively constant for several decades and the amount of labor used has declined dramatically, the amount of machinery, agricultural chemicals, and feed, seed, and livestock purchases has greatly increased.

Total inputs used in agriculture have increased 20 per cent since 1910, while total output has increased 179 per cent during the same period. Clearly, the advances in output are due to more than just an increase in the amount of inputs used. Rather, the inputs have been changed and have been used in more productive combinations. Thus, on balance, the most appropriate measure of productivity in agriculture is one that shows how effectively farmers are able to combine all the inputs of production to produce food and fiber. This measure will be more meaningful than those that represent the productivity levels of individual resources.

To measure changes in overall productivity, a comprehensive index of farm inputs and an index of farm outputs were developed by the U.S. Department of Agriculture.[2] The index of farm inputs measures the volume of inputs used in farm production each year and applies a constant price factor. The inputs used in constructing the index include all farm production expenses except for the interfarm sales of farm products and the farm value of feed, seed, and livestock purchases. The index of farm output measures the level of all farm output produced in agriculture within a given calendar year, but does not include certain farm products consumed on farms or goods produced on farms and used in further farm production.[3]

There are, of course, some limitations to the two indexes.[4] The input index is constructed entirely from secondary data and, consequently, is only as reliable as that data. The output index is based on data that are incomplete and subject to revision. Neither index adequately takes into account quality changes in the items being measured. Finally, due to lack of data, some minor farm products—perhaps as much as 5 per cent of farm output—are not included in the output index. Nonetheless, the indexes probably represent the best achievable figures given the data limitations.

The ratio of the index of output to the index of inputs yields a productivity measure that indicates the efficiency with which total inputs are used in the production of agricultural products—information which is of great importance to policymakers (Chart 2). Changes in productivity growth rates signal future changes in public welfare. To the extent that these signals are recognized and acted upon, the level of public welfare can be maximized over time.

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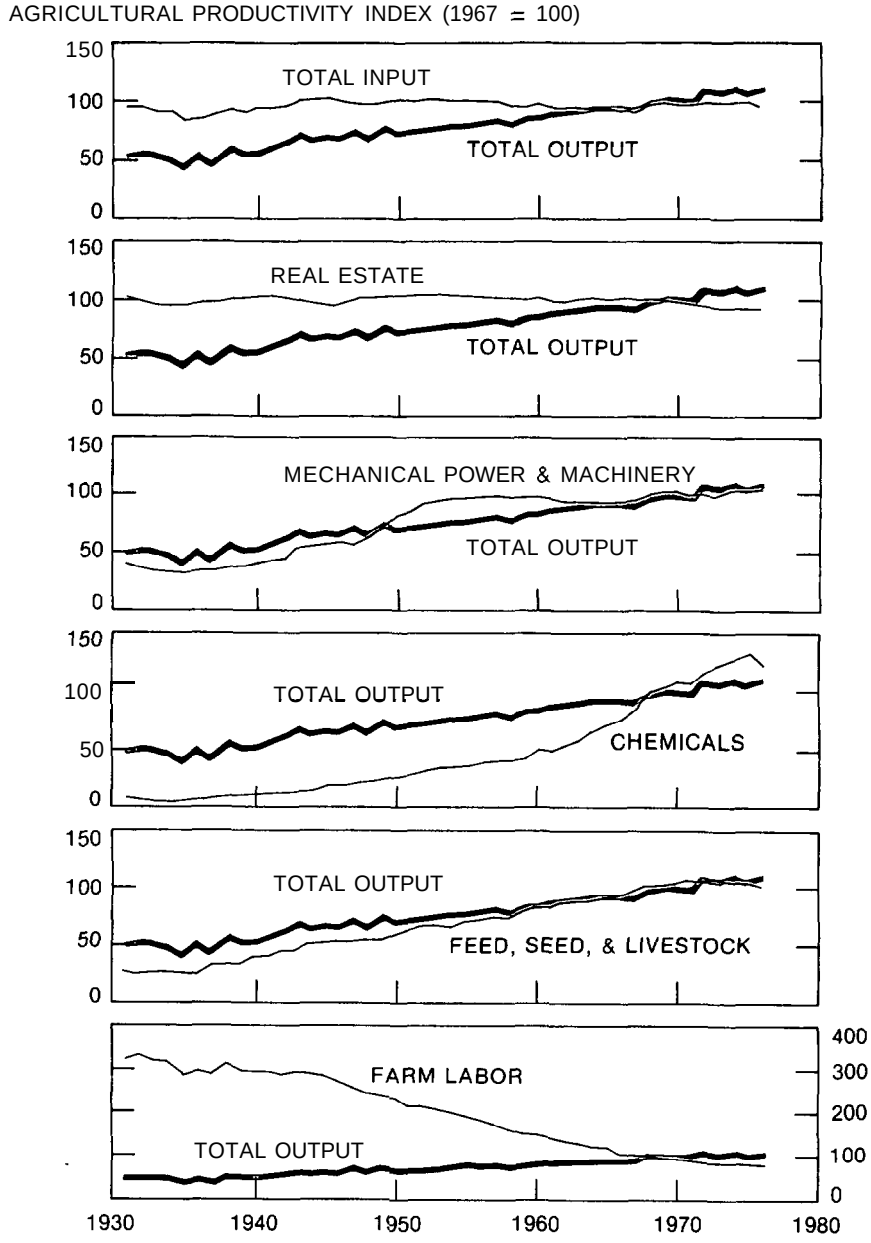
2 Ralph A. Loomis and Glen T. Barton, *Productivity of Agriculture. United States. 1870-1958,* Technical Bulletin No. 1238, U.S. Department of Agriculture, Washington, D.C., 1961.

3 *Major Statistical Series of the U.S. Department of Agriculture.* Vol. 2, Agricultural Handbook No. 365, U.S. Department of Agriculture, Washington, D.C., April 1970, pp. 15-20.

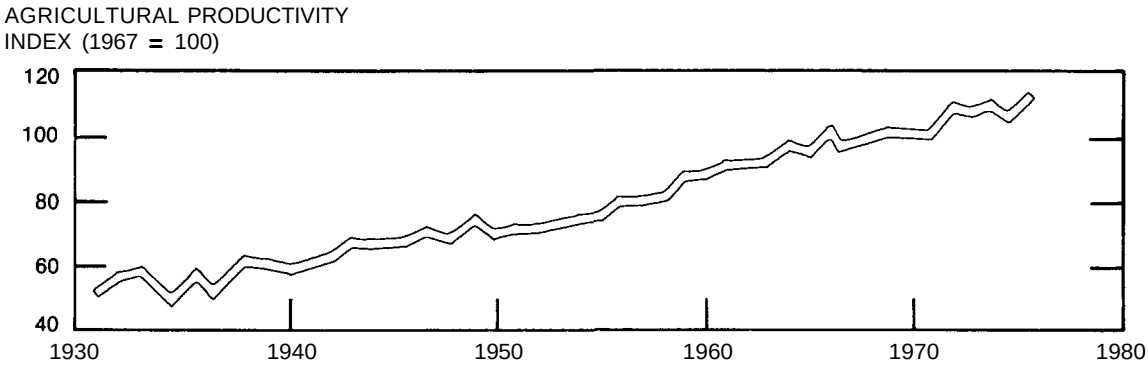
4 The indexes are calculated using a "weighted aggregate method." Quantities of inputs and outputs are multiplied by the average prices paid during a "weight base period." The indexes, then, combine inputs and outputs arithmetically, adding individual quantities weighted by their prices. Aggregate yearly totals are in constant dollars. In computing the index, yearly index numbers are expressed as a percentage of the index value in the base period. Separate indexes are also computed for a number of major farm input and output classifications.

Chart 1
INDEXES OF MAJOR FARM INPUTS COMPARED TO TOTAL FARM OUTPUT, 1930-1977



SOURCE: U.S. Department of Agriculture.

Chart 2
AGRICULTURAL PRODUCTIVITY, 1930-1977



SOURCE: U.S. Department of Agriculture.

FACTORS CAUSING PRODUCTIVITY CHANGES

Productivity gains do not materialize out of thin air; they usually are only forthcoming some time after appropriate public and private policies are adopted. Productivity gains are also typically not smooth and continuous. Public and private investment may be required for some time prior to a payoff from such investment, as in the case of hybrid corn. Thus, while capital investment in efforts to achieve productivity increases must be substantial and continuous, the return on investment will typically be realized only after a delay.

Increases in agricultural productivity have been positively related to progress in the entire U.S. economy, but the causation runs both ways. A dynamic and prospering U.S. economy also benefits agriculture by providing healthy markets for agricultural goods, the technological and marketing innovations for both the inputs and products of agriculture, the resources with which to increase agriculture's productivity, and an attitudinal climate conducive to such activity.

Investment in basic and applied research also provides the technological breakthroughs that result in productivity increases. No other factor is so essential to increasing agricultural productivity as research. Substantial investment in basic research—often over a period of several years—is usually required before technological breakthroughs with practical applications are achieved. Agricultural pesticide and herbicide development, in which lead time of a decade or more is common, illustrates the need for long-term investment in research.

The rate of adoption of new technology is another important determinant of productivity change. New technology is of little value until put to a productive use. Both basic and applied education of the extension type are important facilitators of change because they tend to increase this adoption rate. The economic environment in which agricultural production takes place affects technology adoption rates, and profit opportunities spur input changes that either increase output or reduce cost. At the farm level, relative price changes among inputs can also result in rapid adoption of new technology.

A trend toward larger farms in the United States has played a role in productivity increases as well. Much of the new technology in agriculture has been adapted to meduim or larger sized farms, with the causation running in both directions. New technology has also increased labor productivity and enabled a farmer to handle more acres or head of livestock. Additionally, a larger scale of agriculture has permitted specialization in management and labor, another development aided by technology.

The pace of technological innovation by agribusiness firms on the input and product side of the market—as well as the adoption rate of new technology by farmers—is influenced by some additional factors. Profit opportunities are a powerful spur to the innovation and adoption of new tech-nology. Insufficient profits frequently mean decreased research efforts by many business firms as they tighten their belts. Reduced research and development budgets are likely to result in lower future growth in productivity. Environmental constraints, Government regulation, and product liability risk may cause the agribusiness industry to concentrate less of its budget on new product research. These same constraints may also slow the adoption rate of technology by farmers. On balance, present and future growth in productivity is heavily dependent upon a supportive economic, legislative, and regulatory climate.

Price inflation in the U.S. economy has likely had an adverse effect on productivity growth in and out of agriculture. Milton Friedman, in his Nobel lecture, contended that inflation makes a market economy less efficient by reducing the effectiveness of market prices in coordinating economic activity.[5] As investment patterns are distorted and savings rates decline, less financial commitment in real terms is typically made to research and development. In the past, public sector institutions have provided much of the basic research for agriculture. To the extent that inflation limits the capacity of these institutions to continue such research, slower productivity growth in agriculture will likely be forthcoming.

THE TRACK RECORD OF AGRICULTURAL TECHNOLOGY

While the productivity growth trend in agriculture has generally been accelerating since about the time of the Civil War, the major impetus for such growth has changed from time to time. After the introduction of new technology, productivity increases tend to be quite rapid, followed by a slowing in the growth rate after widespread adoption. Thus, new technology or innovation is required from time to time to spur productivity growth. Chart 3 illustrates total agricultural productivity growth during the past 200 years, which may be divided into four periods according to major sources of productivity increases: **1776** to the Civil War—human power, the Civil War to World War I—horsepower, World War I to World War 11—mechanical energy, and World War **II** to the present--early science power.[6]

Until the Civil War, productivity changes were principally related to making human labor more productive. A number of innovations occurred, such as the cotton gin, cast iron plows, and mechanical reapers, but there were no major technological breakthroughs. As a result, productivity grew rather slowly, leveling off about **1830** with little further growth until

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5 Milton Friedman, "Nobel Lecture: Inflation and Unemployment," *The* Journal of Political Economy, Vol. 85, 1977, pp. 466-67.

6 Yao-Chi Lu and Leroy Quance, "Outlook for Technological Change and Agricultural Productivity Growth Through the Year 2000," *The* Future of Productivity. National Center for Productivity and Quality of Working Life, Washington, D.C., Winter 1977, pp. 37-49.

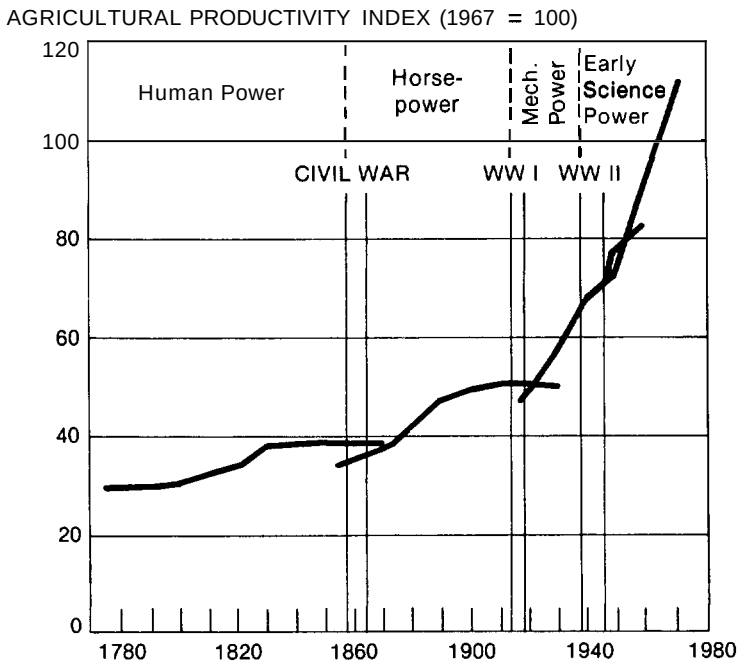
the Civil War.

Manpower shortages and high food prices, induced by the war, stimulated widespread adoption of horsepower machinery after 1860. Though much of the machinery had been invented earlier, the war resulted in economic conditions conducive to adoption of the new technology. Horsedrawn reapers, grain drills, corn shellers, and cultivators came into general use between the Civil War and the turn of the century. During the same period, public policy actively supported the generation of new farming knowledge and its distribution to farmers. The U.S. Department of Agriculture was established in 1862, along with land grant colleges in each state. The Hatch Act of 1887 established experiment stations in each state to develop new knowledge and technology, and the Smith-Lever Act of 1914 formed the Cooperative Extension Service to disseminate that knowledge and technology to farmers.

The mechanical power revolution got underway during World War I with the wider acceptance of gasoline-powered tractors by farmers. But it was not until the country began to climb out of the Great Depression that farm economics became favorable for a widespread surge in mechanization that lasted into the 1950s. This mechanization freed vast numbers of people from agriculture, and, as a result, both labor productivity and overall productivity soared.

Prior to widespread use of mechanical energy in agriculture, each new wave of technology

Chart 3
U.S. AGRICULTURAL PRODUCTIVITY GROWTH DURING THE PAST 200 YEARS



SOURCE: **The Future of Productivity,** National Center for Productivity and Quality of Working Life, Washington, D.C., Winter 1977.

had resulted in rapid productivity growth followed by declining growth rates as adoption neared completion. However, after World War II, a series of overlapping innovations continued to spur rapid productivity gains. Widespread use of improved hybrid corn and disease-resistant, highly productive cereal grain varieties were factors in the early science power revolution, as was the increased use of fertilizers and the beginning of chemical control of weeds and insects.

Nor were technological innovation and the dissemination of knowledge limited to crop production. Animal genetics, health, and nutrition advances, coupled with equipment innovations, meant that livestock production shared in productivity gains as it had not done previously. Hydraulic control, diesel power, and engineering improvements opened new opportunities for productivity gains as new equipment enabled even fewer farmers to perform their work in a more timely fashion than had previously been possible.

PROSPECTS FOR THE FUTURE

A Limit to Productivity Growth

Productivity gains in the early science power era of U.S. agriculture have been impressive. Yet, in recent years, agricultural productivity has slowed in comparison with the levels achieved in earlier periods when major technological breakthroughs were occurring. This slowdown is disturbing to policymakers because of the obvious implications for economic growth and inflation. If the trend should continue, not only would the welfare of the nation's farmers be reduced, but consumers could expect to pay even higher prices for food. Thus, many segments of the American economy have a strong interest in the future prospects for agricultural productivity.

The sources of future gains in agricultural productivity are not likely to differ greatly from those of the past. New technology has propelled agricultural productivity to ever higher levels during the last several decades. As before, the development and adoption of these new techniques depended heavily upon publicly supported research and extension programs for agriculture. Once the technology became available and farmers learned about its cost saving features, the transition to the new methods moved rather rapidly.

If the U.S. farmer is to continue increasing his productivity, essentially growing two blades of grass where one grew before, significant increases in public expenditures for research and extension programs will have to occur. According to one study, a 1 per cent increase in such expenditures will raise agricultural productivity by .037 per cent over a 14-year period.[7] Moreover, Lu and Quance show that between 1967 and 2000, agricultural productivity might rise 42 per cent if research and extension expenditures are increased 3 per cent per year, and 48 per cent if expenditures rise 10 per cent per year.[8] While the response to the added outlays may appear small, it must be remembered that a one-point gain in agricultural productivity is equivalent to almost $1 billion in agricultural output in today's economy. Another important point is that if new environmental, institutional, and legal constraints are introduced in the agricultural sector, even more research will be needed to maintain and improve current productivity levels.

Tomorrow's Technology: Any Surprises?

In 1975, the National Academy of Sciences

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7 Lu and Quance, p. 43.

8 According to Lu and Quance, public expenditures for agricultural research and extension amounted to about $740 million in 1971.

reported that a major scientific breakthrough similar to hybrid corn or DDT was not likely to occur within the next 10 to 20 years.[9] This observation suggests that agricultural productivity will continue to grow slowly in the years ahead. However, emerging technologies could have a significant impact on the productivity picture by the year 2000. In recent years, researchers have been working on a number of projects which promise to produce gains in productivity. These new ideas range from better management practices for crop and livestock production to weather modification and a controlled growing environment.

While much of the emerging technology may simply maintain the present productivity trend, four prospective developments have been identified as the type which could help boost agricultural productivity before the year 2000. These potential developments are: (1) improving the process by which plants form carbohydrates through photosynthesis, (2) applying natural and synthetic compounds known as bioregulators to hasten ripening and facilitate mechanical harvesting of some fruits and vegetables, (3) genetic changes that will enable non-legume crops to extract from the air part of their nitrogen requirements, and (4) multiple births in beef cattle. If these new practices come on stream as expected, the additional gain in productivity by the year 2000 could be almost 10 percentage points above the preliminary levels projected by Lu and Quance, which would mean savings of several billion dollars to farmers and consumers.[10]

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9 "Agricultural Production Efficiency," National Academy of Sciences, Board on Agriculture and Renewable Resources, Washington, D.C., 1975.

10 Lu and Quance, pp. 45-46.

Policy Considerations

Although higher productivity levels are beneficial to society, these gains are seldom achieved without cost. As noted, many of the improvements in agriculture have evolved from publicly supported research and extension programs. Also, because the demand for farm products is inelastic, gains in output frequently cause prices to decline enough to reduce total revenue in the farming sector.

Why would farmers adopt new technology if total revenue is likely to decline? The answer to this question requires considering the microeconomic effects of a technological change separately from the macro effects. As individuals, farmers are constantly looking for new ways to improve their operations and reduce costs. When new technology is introduced, the innovative farmer who adopts it first frequently realizes substantial savings in cost. Consequently, his profits go up, which is the incentive that the farmer needs to expand the farm operation. However, as additional farmers begin to adopt the new methods and expand their operations, total output in the farming sector will rise, causing market prices to fall. If demand for the commodity is inelastic, total revenue at the new market equilibrium will be lower than it was before the new technology was introduced. The net effect from this adjustment process is that the innovative farmers are able to grow and realize higher incomes by adopting the new techniques. But the farmer who is slow to adopt the new method, or does not adopt it at all, loses out on the opportunity to increase his income. Eventually many of these farmers are forced out of business, representing another cost to society unless they find new employment quickly.

The technological revolution — which has greatly improved productivity — has also dramatically changed the structure of

agriculture. From a peak of 6.8 million in the late 1930s, 'the number of farms has dwindled to fewer than 3 million today. While average farm size has risen sharply, the disparity between small and large farms has actually widened over the years, as evidenced by the trend toward a relatively small but increasing number of large farms producing a growing proportion of total output. In 1977, for example, farms with annual sales of $100,000 or more — representing 6 per cent of all farms— were responsible for producing almost 50 per cent of total output. In 1960, fewer than 1 per cent of the farms in the United States had sales exceeding $100,000 per year, and their share of total output was about 17 per cent.

The future structure of agriculture may strongly influence the rate at which new technology is adopted. Research findings suggest that the degree of innovation in a farming operation is often related to farm size.[11] At the smallest farms, innovation is virtually impossible because the risk of failure threatens their survival, and the reward for successful innovation may be small. At somewhat larger scales of operation, however, new technology tends to be adopted more quickly because the risk of failure is smaller. Over the years, medium-scale, family-sized farms have been responsible for the rapid diffusion of technological change in agriculture. On the other hand, the very large, industrial-sized farms tend to resist change. Because of their huge capital investments and the contractual arrangements that many of them have with other business institutions, large farms cannot always adopt new methods and techniques very quickly. In time, though, changes will be made if the economic incentives are strong enough.

Thus, the future prospects for agricultural productivity seem to hinge partly on the structure of farming. If, indeed, family farms are more efficient in promoting and adopting technological change, the recent trends toward large-scale farming may need to be reversed. Hence, perhaps government policies for agriculture should be redirected toward supporting a mix of farm sues that will permit the rapid adoption of cost-saving technology.

While farm structure may be an important factor for future productivity growth, concerns about the availability of energy and the attendant costs are looming ever larger on the horizon. From 1920 to the early 1970s, declining real' prices for energy shaped the mix of resources used in agriculture, as well as much of the growth in productivity. If energy prices in real terms continue to escalate, major research emphasis and funding may shift from agricultural technologies to the development of energy-saving technologies. As a result, agricultural productivity growth could be relatively slow for the rest of the century. Should export demand remain strong as well, competition for U.S. foodstuffs could intensify between domestic and foreign consumers. Thus, it may not be possible to rely on productivity growth in U.S. agriculture to dampen the inflationary effects on food prices.[12] On the contrary, substantially higher food prices, in real terms, may be on the horizon. If this scenario develops, the nation may not avoid substantial resource transfers from the nonagricultural to the agricultural sectors. Indeed, Vernon Ruttan has suggested that the U.S. economy may be past the time when transfers of resources from agriculture to the rest of the economy — through either the

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11 Philip M. Raup, "Some Questions of Value and Scale in American Agriculture," *American Journal of Agricultural Economics.* Vol. 60, May 1978, pp. 305-6.

12 Edward G. Schuh, "The New Macroeconomics of Agriculture," *American Journal of Agricultural Economics,* Vol. 8, 1976, pp. 802-11.

labor or product markets — an significantly enhance national productivity growth.[13] Thus, the last two decades of this century may bring slower productivity growth rates for the non-agricultural sector of the economy, as well as for the agricultural sector.

CONCLUSION

The gains in agricultural productivity have been a phenomenal success story in American economic history. Unfortunately, productivity growth has slowed in recent years. Moreover, the gains in productivity are not likely to increase, and may even decrease, during the balance of this century, particularly if public expenditures for research and extension continue to lag in real terms. In the years ahead, it is unlikely that agricultural productivity will much exceed the recent gains of 1 to 1.5 per cent per year.

The future growth path for agricultural productivity may be bumpy. Unexpected shocks such as an energy embargo or a prolonged drought could cause sharp downward deviations from the trend line. Or an unexpected technological breakthrough of significant proportions could cause a major upward shift in productivity. On balance, though, productivity gains in agriculture are not likely to return to the high levels achieved from the late 1940s through the early 1970s.

Public policies can have a strong influence on the future structure of agriculture and thus on the growth of agricultural productivity. If the adoption of new technology and future productivity gains are related to farm size, policymakers will need to give careful attention to the manner in which new farm program benefits are distributed. Presently, most of the benefits flow to the larger farmers, which explains in large part the growing importance of big farms in the United States. It may be that medium-sized farms, rather than the very small or the very large farms, provide the most fertile ground for rapid adoption of technology.

The nation's response to higher-cost energy may result in a reordering of research priorities, especially in public institutions. To the extent that this occurs, productivity gains in agriculture will likely suffer. If domestic and export demand for foodstuffs continues to grow, higher real food prices can be expected. For the rest of this century, it may be unrealistic to assume that events in the agricultural sector will dampen U.S. price inflation.

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13 Vernon W. Ruttan, "Inflation and Productivity," a paper presented at the annual meeting of the American Agricultural Economics Association, Pullman, Washington, August 1, 1979.

Pledging Requirements and Bank Asset Portfolios

By *Ronald A. Ratti*

Under state and Federal law, commercial banks are required to hold government securities as a reserve against government deposits. While these pledging requirements are potentially important links between the asset and liability sides of a bank's portfolio, they have largely been ignored in the professional literature. This omission cannot be justified even if pledging requirements have no effect on bank demand for Government securities, because locking up Government securities as a pledge against public deposits forecloses their use as a source of bank liquidity and reduces flexibility in the management of bank assets. Moreover, if pledging requirements do have an impact on bank holdings of Government securities, fluctuations in the growth of government deposits will have important implications on the ability of banks to meet credit demands and on bank profitability.[1]

The purpose of this article is to examine the role of pledging requirements and to determine their impact on the asset portfolio of banks and on bank profitability. The first section of the article reviews the pledging requirements on both Federal and state and local government deposits, with particular emphasis on the requirements of the seven states in the Tenth District. In the second section, the arguments —both favorable and critical--concerning the role of pledging requirements are presented, and possible alternative procedures are discussed. The third section summarizes the empirical evidence on the effectiveness and likely consequences of pledging with regard to bank profitability and asset composition.

STATUTORY PLEDGING REQUIREMENTS

Federal Government Deposits

Under Federal law, Federal Government deposits in excess of those insured by the Federal Deposit Insurance Corporation (FDIC) must be backed by eligible collateral at least

Ronald A. Ratti, associate professor of economics at the University of Missouri-Columbia, was formerly a visiting scholar at the Federal Reserve Bank of Kansas City. The views expressed are the author's and do not necessarily reflect those of the Federal Reserve Bank of Kansas City or the Federal Reserve System.

[1] As of November 2, 1978, Treasury tax and loan account depositories may administer their accounts under either a note option or a remittance option. Both options require the pledge of acceptable collateral. The Treasury projects that there will be an average of around $8 to $8.5 billion in TT&L balances at depositories, compared with average balances of about $1.5 billion in recent years. This anticipated sharp upward swing in government funds at depositories can be expected to have an impact on bank asset portfolios.

equal to this amount.[2] Eligible collateral consists of obligations issued or insured by the U.S. Government or agencies at face value, obligations of the states at 90 per cent of face value, and obligations of other political subdivisions that are not in default at 80 per cent of face value.' All assets accepted as satisfactory collateral for Federal Government deposits are required to be physically located with a Federal Reserve Bank or its branches or with a custodian prescribed by the Federal Reserve.

State and Local Government Deposits

Thirty-eight states have similar pledging requirements for the deposits of state and local governments.[4] These laws and regulations differ widely regarding the proportion of government deposits that must be covered by eligible collateral, what constitutes eligible collateral, how that collateral is valued, and its appropriate physical condition. For example, about half of these states have a uniform pledging requirement for state and local deposits that ranges from 5 per cent in South Dakota and New Jersey to 110 per cent in California, Minnesota, Mississippi, and Oklahoma.[5] Five states have no pledging requirements on county or municipal deposits but require a pledge against state deposits;[6] two states have no requirements on municipal deposits but do have them on state and county deposits;' and one state, North Dakota, has no pledging requirements on state deposits but does have them on county and municipal deposits. The remaining states that allow pledging have differential nonzero requirements on state, county, and municipal deposits. In these states the maximum pledging requirement is 120 per cent on state deposits and 110 per cent on county and municipal deposits.[8]

As to eligible collateral, direct obligations of the U.S. Government satisfy pledging requirements in all states. Obligations guaranteed by the United States and those of U.S. Government agencies are accepted by most states. Also widely accepted are state bonds, notes and certificates of indebtedness, county and municipal securities, and revenue bonds. It is very common, though, for states to restrict eligibility to obligations issued within their own jurisdiction. The method of valuation of eligible collateral for pledging purposes is either at par or at market value (usually not to exceed par value). In some jurisdictions it is at par value

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2 The provisions are included in the National Bank Act of 1919, the Second Liberty Bank Act of 1917, and U.S. Treasury Circulars Nos. 92, 176, and 848.

3 Other eligible collateral, as set out in Treasury Circular No. 92, would be 1) the obligations issued or guaranteed by the International Bank for Reconstruction and Development, the Interamerican Development Bank, or the Asian Development Bank at face value; 2) loans to students which are insured by Federal insurance, a state agency, or nonprofit institutions or organizations, at face value; 3) obligations of domestic corporations, at 80 per cent of face value; or 4) commercial and agricultural paper and bankers' acceptances having a maturity of less than one year, at 90 per cent of face value. As of October 16, 1978, the acceptable maturity on this last category has been extended to two years. However, the items have also been restricted to obligations of domestic corporations. In the future, the obligations of individuals and partnerships and of foreign borrowers will not be acceptable.

4 The states without laws requiring the pledging of assets for government deposits or where pledging is not practiced are Arkansas, Connecticut, Delaware, Indiana, Iowa, Maine. Massachusetts, New Hampshire, Rhode Island, Utah, Vermont, and Wisconsin.

5 The other states with a uniform pledge for state and local deposits are Arizona, Colorado, Kansas, Louisiana, New Mexico, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Virginia, and Wyoming.

6 These are Georgia, Michigan, South Carolina, Vermont, and West Virginia.

7 Hawaii and West Virginia.

8 The above summary on state pledging ratios was drawn from Appendix C, "Pledging Assets for Public Deposits," American Bankers Association, Washington, D.C. (1976).

for some eligible items and market value for other eligible items. The market value criteria tend to be the most frequently applied.

Most state statutes require the physical transfer of pledged assets to a custodian. The designated custodian is usually either a Federal Reserve Bank or branch or a large correspondent bank. For member banks of the Federal Reserve System the custodian is the relevant regional Federal Reserve Bank or branch. Typically, prior approval of the custodian is required before additions or subtractions may be made in the pledged collateral.

Requirements in Tenth District States

The great variation in pledging requirements among states is illustrated by the requirements of states in the Tenth District, as summarized in Table 1. Six of the states have a uniform pledging ratio for various categories of local government deposits, varying from 50 per cent in New Mexico, through 70 per cent in Kansas and 100 per cent in Colorado, Missouri, and Wyoming, to 110 per cent in Oklahoma. In Kansas, however, if a bank is successful in obtaining government funds and its bid is in excess of the rate on 3-month U.S. Treasury bills, the requirement becomes 100 per cent. Also, a resource pooling option is available to banks in Colorado that would lower their ratio to 50 per cent. In Nebraska, the ratio is 110 per cent on state funds and 100 per cent on county and municipal funds. All these pledging ratio requirements refer to government funds in excess of those insured by the FDIC.

Table 1
PLEDGING REGULATIONS OF TENTH DISTRICT STATES

	Pledging Ratios on Deposits			Eligible Collateral	Valuation
	State	County	Municipal	Includes*	Method
	(In per cent)				
Colorado	100†*	100†	100†	First Mortgages	Market
Kansas	70*	70*	70‡	First Mortgages	Par
Missouri	100§	100	100	Other State Bonds	Market#
Nebraska	110	100	100	Other State Bonds ‖	Market*"
New Mexico	50	50	50		Mixed††
Oklahoma	110	110	110		Par
Wyoming	100	100	100		Market

*A blank indicates eligible security in that state is limited to obligations issued or guaranteed by the United States or its agencies, its own state bonds, and its own state subdivision obligations. An entry indicates the acceptability of the entry in addition to the preceding.
†A resource pooling option is available to the banks in Colorado that would lower the ratio to 50 per cent. To date it has not been utilized.
‡If the bank obtaining public funds placed a bid in excess of the current 3-month U.S. Treasury bill rate, the ratio rises to 100 per cent.
§The ratio on state funds in Missouri had been 110 per cent until 1975.
‖Restricted to those states whose bonds are purchased by the Board of Education Lands and Funds. This means virtually all states.
#Statutes silent. Market valuation method widely used.
**The statutes on state and county funds are silent regarding the valuation method, and market value criteria have come to be used. The statute regarding municipal deposits explicitly states face value to be the appropriate valuation method, but apparently market value is used.
††Par value for obligations of state of New Mexico and its subdivisions, market value for other obligations.

Each of the Tenth District states accepts as eligible collateral the obligations issued or guaranteed by the United States or its agencies, their own state bonds, and their own state subdivision obligations. Missouri and Nebraska are the only states that find the bonds of other states acceptable, and Colorado and Kansas allow first mortgages as eligible collateral. Eligible collateral is valued on the basis of market value in Colorado and Wyoming, and face value in Kansas and Oklahoma. In New Mexico, the obligations of the state and its subdivisions are valued at face value, and other acceptable obligations are valued at market value. In Missouri and Nebraska, the statutes are silent regarding the method of valuing securities, and market value criteria have been adopted. Acceptable custodians for pledged securities are the Federal Reserve Bank of Kansas City, its branches, or a large correspondent bank. Also, subject to the approval of the state banking commissioner, banks in Nebraska, New Mexico, Oklahoma, and Wyoming that are not members of the Federal Reserve System may retain on their own premises the securities pledged against state and local government deposits.

THE ROLE OF PLEDGING REQUIREMENTS

The basic reason for the imposition of pledging requirements is to ensure the safety of government deposits in banks.[9] That is, a political entity whose deposits are backed entirely by securities is guaranteed no loss if the bank holding its deposits should fail. Pledging requirements thus serve to ensure that the political community with funds deposited in a failed bank will not endure any particular financial hardship. However, some observers have argued that the banking system is now much more regulated and stable than it was during the time pledging requirements were introduced, so that the argument concerning the safety of government deposits is not as valid. Moreover, some believe that the safety of these deposits can be guaranteed by alternative means within the existing regulatory framework.

A second argument used to support the use of pledging requirements is that they strengthen the market for Government securities. Most states rule ineligible for pledging purposes the obligations issued by other states or political subdivisions not in their jurisdiction. This has the effect of improving the market for their own debt and for that of their political subdivisions. If the argument concerning the strengthening of the market for Government securities is valid, however, the demand on the part of banks for other asset items, primarily loans, is reduced. This implies that bank credit becomes available on less favorable terms following imposition of the requirements. Thus, funding of government projects at lower costs has to be weighed against the increased cost of obtaining credit for private borrowers at commercial banks.

A third argument suggested in favor of pledging requirements is that they cause banks to hold more Government securities than would otherwise be the case, thereby making bank portfolios safer. However, if the existence of pledging requirements causes a bank to hold a larger quantity of Government securities, it is by no means obvious that the bank has a less

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9 The National Bank Act of 1864 contained a provision requiring that U.S. deposits in national banks be secured by a pledge of U.S. bonds or other securities. Prior to this act, Congress had required (since 1779) that the United States be first satisfied in the event of the insolvency of a debtor, including banks. In 1930, pledging by national banks was authorized for state and local government deposits, and shortly thereafter most states passed laws allowing state banks to pledge assets not only against state and local government deposits but also against deposits of the United States. Before this time, government deposits were secured by alternative means such as surety bonds.

risky portfolio than before.[10] Indeed, to the extent that holdings of nonpledged short-term securities are reduced, bank liquidity may be reduced as a result of the requirement.[11]

Another potential problem with pledging requirements is that they may lead to suboptimal portfolio behavior. That is, if the management of government deposits is subject to more restrictions than that of nongovernment deposits, the former can be expected to be less profitable. Hence, banks may not hold a portfolio of assets that would maximize either long-run profits or the well-being of their shareholders. This potential problem is complicated by an additional factor: since state laws on pledging differ widely regarding the fraction of government deposits that needs to be secured, there is a differential incidence of pledging requirements between states and differential regulatory burdens on banks in different states.

Possible Alternatives

Alternative proposals are usually designed to meet some of the problems referred to above. To be considered practical, however, the proposals must also ensure the security of government funds. One proposal that meets this requirement to some extent would grant preferred but unsecured status to government deposits.[12] The experience of the FDIC suggests that government funds would invariably be recoverable under this option, although only after a delay. A second proposal that would not involve such delays would be a state government insurance system.[13] Under this proposal, the insurance rates paid by commercial banks could be determined by the level of government funds on deposit and the characteristics of the depository institution. Insurance coverage up to some specified limit could be provided on government deposits, with the balance secured by a pledge of government securities with the FDIC.

A final category of proposals involves standardizing pledging requirements by extending the role of the FDIC. These proposals vary from advocating 100 per cent FDIC insurance for all government funds to advocating the present insurance coverage plus the pledge of acceptable collateral equal to 100 per cent of the uninsured balances secured with the FDIC.

THE IMPACT OF PLEDGING REQUIREMENTS

Effect on Security Holdings

Changes in deposits of any type will normally cause banks to alter their Government security

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10 This argument is similar to one concerning reserve requirements and bank solvency. In this connection it is widely recognized that if the existence of the reserve requirement results in a level of excess reserves smaller than what the level of reserves would be in the absence of the requirement, bank liquidity has been reduced.

11 In Appendix A of "The Pledging of Bank Assets: A Study of the Problem of Security for Public Deposits" (Chicago: Association of Reserve City Bankers, 1967), Charles F. Haywood reports the results of a survey of pledged assets at insured commercial banks in mid-1966. The survey revealed substantial immobilization of the security portfolio. It was found that 50 per cent of direct U.S Government and almost 40 per cent of state and local governments were set aside.

12 Adopted in Mississippi in addition to pledging reauirements.

13 State insurance schemes for government monies are run by the Public Deposit Protection Commission in Connecticut, by the State Treasurer's Sinking Fund in Iowa, the State Deposit Guarantee Fund in Wisconsin, and the Insurance Fund for Public Deposits in Indiana. An alternative to state insurance would be a private scheme involving the use of surety bonds. Its major drawback, however, is that it involves indirect pledging—i.e., acceptable collateral has to be pledged with the private company supplying the insurance. Since the use of surety bonds in lieu of pledging is allowable in most states, and banks typically do not elect this option, it cannot be considered a viable option.

holdings. However, to the extent that pledging requirements influence security holdings, the impact of changes in government deposits will differ quantitatively from the impact of changes in private deposits.[14] The material below presents results of an empirical investigation into the effects of pledging requirements on holdings of Government securities by banks. In particular, the investigation focuses on the extent that pledging requirements cause banks to alter their holdings of Government securities in response to changes in the funds that governments deposit with them.

The impact of changes in government deposits was examined by applying regression analysis to data on member banks in the Tenth Federal Reserve District reported on call reports for 1977. The regression analysis was used to measure the impact on holdings of Government securities of various factors--such as changes in government deposits and changes in other deposits at banks.[15] From the analysis, estimates were derived of the extent that holdings of Government securities change due to changes in particular types of deposits.

The results of the regression analysis are presented in Table 2.[16] They show the impact on bank holdings of governments of a $1 increase in various types of deposits, under the assumption that all other deposits and total resources do not change. For example, a $1 increase in total deposits leads to an increase of $.382 in holdings of U.S. Government securities and a decline of $.222 in holdings of state and local securities. These results can be explained in terms of general liquidity considerations. As deposits increase relative to bank capital, the bank compensates on the asset side by moving into items that are readily marketable, such as U.S. Government securities, and out of items such as state and local securities.

The results of the regression analysis indicate that pledging requirements do affect bank holdings of state and local government securities. As shown in Table 2, banks increase their holdings of state and local government

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14 It should be borne in mind that other factors, such as different rates of turnover or interest rate payments between government and nongovernment deposits, could also cause a difference in impact.

15 In order to obtain a single call report number for assets and liabilities for 1977, a weight of one-eighth was given to the December 1976 call, weights of one-quarter each to the March, June, and September 1977 calls, and a weight of one-eighth to the December 1977 call. It should be emphasized that the empirical results are based on data drawn from member banks of the Tenth Federal Reserve District. Although results for other banks during the same period are unlikely to be different, it is possible that results for other time periods may yield different conclusions. In particular, a major weakness of any cross section study is the absence of factors, such as interest rates, that change over time. A more elaborate study combining time and cross section data would allow an evaluation of these qualifications.

16 The regression equations underlying the results in the table are:

$$\text{US Sec/TA} = -301 + 382D/TA + 475T/TA + 473S/TA + 369(1/TA)$$
$$(-3\ 52)\quad 13\ 43)\quad (5\ 10)\quad (4\ 881\quad 18.091$$
$$+ 051GD/TA + 034GTS/TA + \text{State Dummy Variables}$$
$$(\ 29)\quad (.43)\quad R^2 = 200.\ F = 15\ 12.\ N = 740,$$

$$\text{SPS Sec/TA} = 276 - 222D/TA - 187T/TA - 030S/TA - 220(1/TA)$$
$$(5\ 04)(-3\ 11)\quad (-3\ 131\quad (-\ 48)\quad (-7\ 54)$$
$$+ 462GD/TA + 003GTS/TA + \text{State Dummy Variables}$$
$$(4\ 121\quad (\ 06)\quad R^2 = 168,\ F = 12\ 24,\ N = 740,$$

$$\text{Total Loans/TA} = 663 - 184D/TA - 071T/TA - 102S/TA - 132(1/TA)$$
$$(6\ 88)(-1\ 471\quad (-\ 67)\quad (-\ 931\quad 1-2\ 58)$$
$$- 410GD/TA - 055GTS/TA + \text{State Dummy Variables}$$
$$(-2\ 08)\quad (-\ 61)\quad R^2 = 179.\ F \approx 13\ 21.\ N = 740.$$

$$\text{Cash Due/TA} = 132 + 152D/TA - 123T/TA - 079S/TA - 040(1/TA)$$
$$14\ 90)\quad (4\ 32)\quad (-4\ 20)\quad (-2\ 57)\quad (-2\ 77)$$
$$- 151GD/TA + 055GTS/TA + \text{State Dummy Variables}$$
$$(-2\ 73)\quad 12\ 171\quad R^2 = 377,\ F \approx 36\ 61,\ N = 740.$$

where U.S. Sec. = U.S. Government securities, SPS Sec. = state and political subdivision securities, TA = total assets, D = total demand deposits, T = total time deposits, S = total savings deposits, GD = government demand deposits, GTS = government time and savings deposits.

Table 2
REGRESSION RESULTS: IMPACT ON HOLDINGS OF GOVERNMENT SECURITIES OF A $1 INCREASE IN DEPOSITS

Deposits	U.S. Government Securities	State and Local Securities	Loans	Cash
Total Demand	.382	–.222	–.184*	.152
Total Time	.475	–.187		
Total Savings	.473	–.030*		
Government Demand	.051*	.462	-.410	–.151
Government Time and Savings	.034*	.003*		

'Statistically insignificant variables. All others are statistically significant at the .005 level of confidence.

securities by $.462 in response to a $1 increase in government demand deposits. This is the net effect of the pledging requirement, since if government demand deposits increase by $1 and total demand deposits remain fixed, non-government demand deposits decline by $1. In the absence of pledging requirements, the effect of this change in the private-government composition of deposits would be zero. Table 2 also shows that changes in government time and savings deposits have no impact on holdings of state and local securities. The regression analysis indicates that the impact of a $1 change in the private-government composition of time and savings deposits leads to an increase in holdings of state and local securities of only $.003, an amount that is too small to be statistically significant.''

The analysis also indicates that pledging requirements do not affect holdings of U.S. Government securities by banks. The estimated changes in holdings of U.S. Government securities resulting from a $1 change in the ownership of both demand deposits and time and savings deposits are too small to be statistically significant. However, changes in total deposits do result in changes in holdings of U.S. Government securities. For example, an increase of $1 in demand, time, and savings deposits results in increases in U.S. security holdings of $.382, $.475, and $.473, respectively. Thus, the results suggest that banks use as a pledge against government deposits the U.S. Government securities they would have held anyway in the absence of pledging requirements.

Effect on Other Assets

The above results indicate that because of pledging requirements, the security portfolio of banks is $.462 larger for every dollar of government demand deposits than it would be with no pledging requirements. For a given level of total bank resources, this means that holdings of other assets—such as cash and loans—are lower. Regression analysis, similar to the above, was conducted to examine the impact on cash and total loans. As shown in Table 2,

[17] However, if the security portfolio is broken down by remaining maturity classes, the existence of the pledge on government time and savings deposits will cause banks to hold a significant, but small, extra amount of short-term state and local securities. These results are not reported here.

pledging requirements meant a reduction of $.410 in loans and $.151 in cash for each dollar in government demand deposits. That is, if total demand deposits remain fixed, and a change in the ownership of demand deposits occurs so that government deposits increase by $1 and nongovernment demand deposits fall by $1, loans would fall $.410 and bank cash would fall $.151.

Effect on Liquidity

Pledging requirements also may have an effect on bank liquidity. The extent of the effect, though, depends upon the definition of liquidity and the effectiveness of pledging requirements. The broadest definition of liquidity, which is employed here, is the sum of cash plus the security portfolio in excess of required reserves and pledged securities. The effect of the pledging requirement is assumed to be the differential impact on assets of a change in government deposits compared to a change in nongovernment deposits.

As summarized in Table 2, a shift in the ownership of $1 of demand deposits from the private to the government sector results in an increase in state and local securities of $.462 and a reduction in cash of $.151. That is, the sum of cash and the security portfolio rises by $.311 ($.462 minus $.151) as a result of the shift. However, the effect on liquidity is not simply $.311—it will be $.311 minus any change in required reserves and pledged securities. Since government and nongovernment deposits are subject to the same reserve requirements, there is no effect on required reserves resulting from a change in the ownership of deposits. The situation is obviously different, however, for the amount of securities that must be pledged. For states in the Tenth District, as shown in Table 1, the smallest pledging ratio on state and local deposits is 50 per cent, and for five of the states at least 100 per cent. This observation, coupled with the 100 per cent pledging ratio on Federal Government deposits, implies that an increase in government demand deposits of $1 and a reduction in nongovernment demand deposits of $1 results in an increase in the amount of securities that needs to be pledged of at least $.50. These results imply that bank liquidity is reduced as a result of pledging.[18]

Effect on Profitability of Government Deposits

The existence of pledging requirements also may be expected to reduce profits because they are a restriction on the operating activities of banks. To examine this issue, an empirical investigation was made of the relative profitability of government and nongovernment deposits. Three alternative measures of net income were employed—net operating income (that is, net income before taxes, securities gains or losses, and loan loss provision), income before taxes, and net income after taxes.[19] These income measures were regressed in turn on asset and liability items drawn from consolidated reports of condition for member

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18 If the definition of liquidity is restricted to cash due plus securities with a maturity of less than five years less required reserves and pledged securities, the negative effect on liquidity of the pledging requirement is even larger. According to results not reported in the text, a shift of $1 in the ownership of demand deposits from the private to the government sector results in an increase of about $.20 in cash due and securities with a maturity of less than five years. This value is far below the increase in the value of the securities that needs to be pledged.

19 Net income before taxes, securities gains or losses, and loan loss provision is essentially the value of services sold, minus operating costs exclusive of loan loss provision. From the Consolidated Report of Income form for 1977 it would be given by "income before taxes and securities gains or losses" plus "provision for possible loan losses." Net income before taxes is calculated from the 1977 Consolidated Report of Income by adding "securities gains (losses), gross" to "income before taxes and securities gains or losses."

banks of the Tenth Federal Reserve District for, 1977.[20]

The results indicate that pledging requirements raise the cost of government time and savings deposits by $.012 in terms of net operating income, $.030 in terms of net income before taxes, and $.020 in terms of net income after taxes. The effect of pledging on the cost of each dollar of government demand deposits is $.013, $.017, and $.015 in terms of net operating income, net income before taxes, and net income after taxes, respectively. These results are consistent with the view that government deposits are less profitable than private deposits.[21]

The Variability of Government Deposits

Given a stable and predictable relationship between government deposits and various asset items, pledging requirements will only result in shifts in the asset portfolio if government deposits grow at a different rate than nongovernment deposits. The extent of any difference in the growth rates of government and nongovernment deposits can be examined by considering the fraction of total deposits owned by the government sector. If the fraction rises, government deposits are growing faster; if the ratio falls, private deposits are growing faster. In Chart *1*, the behavior of government deposits relative to total deposits is recorded separately for member and nonmember banks of the Tenth District from *1969* to *1977.* As the chart shows, there have been substantial shifts in the relative rates of growth of government and private deposits.[22]

CONCLUSION

A major conclusion of this study is that demand by banks for state and local securities is greater as a result of the presence of pledging requirements. However, this strengthening in the demand side for state and local securities necessarily implies a weakening in banks' demand for other asset items. The item bearing the principal burden of this displacement was found to be private loans. Therefore, any argument advocating the use of pledging requirements on the grounds that they make government borrowing easier has to be tempered with the realization that they also make borrowing by the private sector more difficult.

Another conclusion is that pledging

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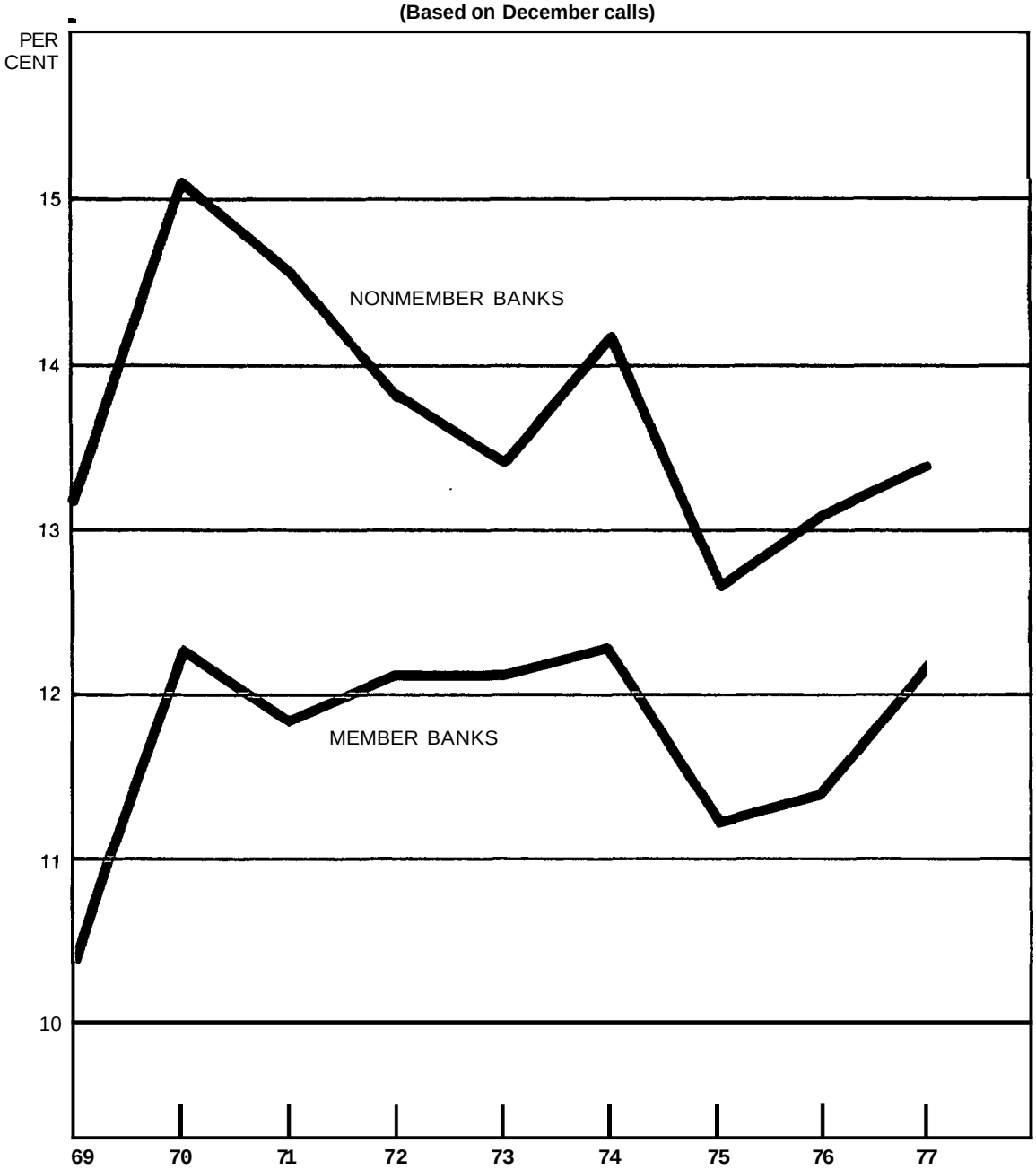
20 The asset items were taken to be gross loans, U.S. securities (sum of U.S. Treasury, U.S. agency and corporations' securities), the securities of state and political subdivisions, demand deposits at U.S. banks, and other noncash assets (a residual item amounting to total assets less loans, all government securities, and cash due from banks). The liability items were taken to be total demand deposits, total time deposits, total savings deposits, other liabilities (total liabilities minus deposits), government demand deposits, and government time and savings deposits. A scale variable (the inverse of total assets) and state dummy variables were also included.

21 Strictly speaking, this conclusion only follows with any degree of confidence with regard to time and savings deposits. The effect of the pledging requirement on the cost of government demand deposits is not statistically significant.

22 In late 1978, moreover, there was a substantial shift in the ownership of liabilities at commercial banks due to a change in Treasury and Federal Reserve policy. As of November 2, 1978, Treasury tax and loan account depositories were allowed to administer their accounts under either a note option or a remittance option. See Footnote 1. Although the options have a differential impact on reserve requirements, they do not have a differential impact on holdings of acceptable collateral. Both options require that balances be secured by the pledge of acceptable securities. For a summary of these changes and an analysis of their likely impact on Federal Reserve management of bank reserves, see Joan E. Lovett, "Treasury Tax and Loan Accounts and Federal Reserve Open Market Operations," Federal Reserve Bank of New York, *Quarterly* Review, Summer 1978, pp. 41-46.

Chart 1
GOVERNMENT DEPOSITS AS A PERCENTAGE OF TOTAL DEPOSITS AT TENTH DISTRICT BANKS
(Based on December calls)



requirements tend to reduce the liquidity of banks below levels that would exist in their absence. Although the demand for government securities was increased as a result of pledging requirements, the increase was found to be less than the value of securities that needed to be pledged. This result, together with the finding concerning the displacement of cash, means that pledging requirements reduce bank liquidity, when the latter is defined as cash plus securities held in excess of pledging requirements. Therefore, the adverse effect of pledging requirements on bank liquidity should be carefully considered by those advocating the pledging of eligible collateral as a means of securing government funds.

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