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Agriculture is uniquely susceptible to the interest-rate risks posed by variable-rate loans, but calls for more fixed-rate lending are likely unwarranted. Aggregate agricultural income flows—unlike those in other sectors of the economy—do not appear to move over time in the same direction as interest rates. Further, agriculture seems to be less liquid in the short run than other sectors. But a majority of banks making agricultural loans, at least in the Eleventh District, still offer fixed-rate terms, and farmers are likely to quickly devise strategies for dealing with cash flow variations caused by variable-rate notes.

This article argues that a goal of monetarism can be attained by targeting the ratio of high-powered money to bonds. The goal achieved is simplicity in policy. Targeting the ratio of high-powered money to bonds achieves simplicity because it represents a neutral policy. Neutral policies are policies that do not affect real assets or rates of return. The orthodox monetarist policy of a steady rate of growth of the money stock is not recommended because that policy is neutral only if money demand is stable. The article questions the reasonableness of the latter assumption.

Variable-Rate Loans: Where Does Agriculture Fit In?

Hilary H. Smith

Economist
Federal Reserve Bank of Dallas

The increasing financial stress of many farmers, the rash of failures of both farmers and banks that lend to farmers, and the widely publicized troubles of the Farm Credit System have brought the issue of agricultural debt to the forefront.

The U.S. Department of Agriculture estimates that during 1984 about half of the farms in the United States had negative cash flows and that many areas of agriculture had been marked by varying degrees of financial stress for the previous several years.[1] One of the questions that has been raised before, and is now given new urgency, is whether variable-rate loans are suitable for agriculture or whether they are destabilizing.

The rapid growth in the use of variable-rate loans and the effect such growth may have on agriculture have been analyzed in several recent studies.[2] Most of them conclude that fixed-rate loans should remain the staple for agriculture. They argue that increased interest-rate risk, inherent in borrowing money under variable-interest-rate provisions, translates for farms, unlike for other industries, into higher credit or default risks.[3]

While agriculture is somewhat more vulnerable to the cash flow effects of variable-rate lending, these effects are relatively small and likely will be temporary as farmers become better prepared to deal

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1. U.S. Department of Agriculture, Economic Research Service, *Financial Characteristics of U.S. Farms, January 1985*, Agriculture Information Bulletin no. 495 (Washington, D.C.: U.S. Department of Agriculture, July 1985).

2. See Peter J. Barry, *Current Issues in Agricultural Finance: Inflation, Risk, and Financial Instabilities*, W. J. Myers Memorial Lecture, Department of Agricultural Economics Research Bulletin no. 81-28 (Ithaca, N.Y.: Cornell University, November 1981); David J. Leatham and Timothy G. Baker, *Optimal Choice of Fixed and Variable Rate Loans for Midwest Crop-Livestock Farms: Implications for Agricultural Lenders* (West Lafayette, Ind.: Purdue University, Department of Agricultural Economics, 1984b); Eddy L. LaDue and David J. Leatham, "Floating versus Fixed-Rate Loans in Agriculture: Effects on Borrowers, Lenders, and the Agriculture Sector," *American Journal of Agricultural Economics* 66 (December 1984): 607–13.

3. LaDue and Leatham, "Floating versus Fixed-Rate Loans in Agriculture."

with the interest-rate risks. Moreover, there has been no wholesale switch to variable-rate loans by lenders, though variable-rate terms are certainly more prevalent now than they were previously. Finally, it should be kept in mind that it is more likely that the level of interest costs is the real burden for farm borrowers rather than the frequency of changes in interest rates.

To make a case that agriculture is uniquely affected by variable rates, it would have to be shown that (1) large numbers of farmers have no alternative financing except at variable rates, (2) sufficient risk markets do not exist for farmers to hedge that interest-rate risk, (3) the normal structure of agriculture is characterized by relatively high debt loads and relatively low levels of liquid assets, and (4) agricultural income streams are not correlated with, or are negatively correlated with, movements in interest rates.

To see whether variable-rate loans are well-suited to agriculture, this article, after a general section on variable-rate lending, examines each of the four conditions listed. First, some of the consequences of variable-interest-rate provisions on borrowers and lenders are discussed. Next, the prevalence of variable rates in agricultural lending is examined, followed by a description of risk markets and their shortcomings. After a short look at the financial structure of agriculture, the final section examines the correlation of agricultural income flows and interest-rate movements, both theoretically and empirically. The conclusions are that variable rates do have some uniquely negative effects on agriculture but that a wholesale return to fixed-rate loans is not warranted.

Consequences of variable-rate loan provisions

Variable-rate loan provisions transfer some of the interest-rate risk from the lender to the borrower. In return, the borrower generally pays a lower rate as compensation for the increased risk. Over the long run, according to economic theory, with variable-rate loan provisions the borrowers' interest costs for a given amount of debt are smaller than if the same level of debt had been funded with fixed rates. Total interest costs are smaller with variable rates, but they are more variable (riskier).

In the short run, depending on the amount of the borrowers' leverage, variable-rate loan provisions can have important effects on cash flow. First, if the debt is small relative to income-producing assets, then the borrowers' interest costs are more likely to be small relative to income. In such cases, variations in cash flow caused by variable-rate movements on the debt may be small. If heavily leveraged, however, borrowers such as some farmers in the 1980s could find themselves sorely pressed should interest rates rise rapidly and substantially.

Second, if the borrower is significantly leveraged, but maintains sufficient liquid assets, then the variations in cash flow can be smoothed out by drawdowns of these assets.

Third, if the borrower's income is positively correlated with the movement of interest rates, then some of the outgoing cash flow variation can be offset by incoming cash flow. Thus, the higher the degree of positive correlation, the lower the cash flow variation. Conversely, if the borrower's income flow is negatively correlated with interest rates, then the cash flow squeeze is exacerbated in periods of rising rates.

Variable rates, through their cash flow effects, pass some of the interest-rate risk on to the borrower. With perfect risk markets, the borrower could assume the risk (and reap the long-term return to bearing the risk), or the borrower could pay another party to bear the risk.

Bearing risk and risk markets

In agricultural lending, as in other types of lending, the interest-rate risk may be borne by the lender or the borrower, or both, or if risk markets are developed, can be partially or totally traded by paying some premium. One strategy of bearing risk that a long-term borrower can follow is to buffer cash flow movements with liquid assets. Such a strategy captures the risk premium in variable-rate loans and smoothes out the cash flows. For example, during periods of falling interest rates, the interest cost savings (as compared with the initial contract rate) are withdrawn and added to interest-bearing liquid assets. When interest rates turn up and move beyond the initial contract rate, then some of liquid assets are drawn down to cover increased interest costs.

Over the life of any one short-term loan, the cash flow position is unlikely to balance out, but in the long run overall, the unanticipated interest cost increases will have been substantially matched by the unanticipated interest cost savings.

Risk markets, however, are imperfect for farm borrowers. These markets have been defined as those that allow individuals such as farmers to trade in contingent claims to future consumption—for example, in insurance markets, futures markets, forward markets, and options markets.[4] With perfect borrowing and risk markets, all qualified borrowers would be offered the choice of either fixed-rate or variable-rate provisions on their loans. Those borrowers wishing to earn higher returns for dealing with greater variability in cash flows would opt for variable rates. Those who did not want the cash flow riskiness could pay the risk premium and receive a fixed-rate note.

Farm borrowers are likely to wish to hedge a relatively small amount, sometimes for well in excess of a year, which is not readily handled by financial futures markets. These markets, for example, are currently organized so that the minimum contract is generally at least $1 million, and most contracts are for less than one year. Additional drawbacks to the use of financial futures markets are large costs in terms of acquiring expertise in using the markets, accounting regulations that create some difficulties, and for banks, some regulatory constraints.[5] Because the agricultural sector borrowers are composed mostly of small businessmen, the average farm firm or individual farmer is unable to achieve the economies of scale for using existing interest-rate futures markets efficiently.[6]

In all, the maturity of the existing interest-rate risk markets does not seem to provide as much retail hedging service for dealing with interest-rate risks as for the risk of death. Industries characterized by large corporations are more likely than farmers or farm firms to be able to afford the specialization within their financial planning areas necessary to undertake hedging operations through markets like those for financial futures.

Variable-rate lending in agriculture

For variable-rate lending in the agricultural sector to have a significantly negative effect, a major portion of agricultural loans must have variable-rate provisions, and the borrower's choice between variable- and fixed-rate provisions must be restricted. That is, if only a few agricultural loans have variable-rate provisions, or if farm borrowers could freely choose fixed- or variable-rate loan provisions, then there would be little concern over the effects of variable-rate lending on agricultural borrowers.

It is hard to be precise about the extent of variable-rate lending in agriculture. The total farm debt in 1984 of $213 billion was held by six major groups. The Cooperative Farm Credit System (FCS) held 31 percent; all commercial banks, 24 percent; individuals and others, 23 percent; Farmers Home Administration (FmHA), 12 percent; life insurance companies, 6 percent; and the Commodity Credit Corporation (CCC), 4 percent.[7]

Although commercial banks use variable-rate provisions on loans, not all of the other lenders to agricultural borrowers provide this option. A national quarterly survey of commercial banks recently showed that about three-fourths of all new non-real estate agricultural loans made by large banks (most had at least $500 million in assets) had variable-rate provisions.[8]

At other banks (assets generally less than $100

4. Carlisle Ford Runge and Robert J. Meyers, "Shifting Foundations of Agricultural Policy Analysis: Welfare Economics When Risk Markets are Incomplete," Invited Paper, American Agricultural Economics Association Annual Meeting, Ames, Iowa, August 4-7, 1985.

5. Mark Drabenstott and Peter Heffernan, "Financial Futures: A Useful Tool for Transferring Interest Risk Away From Farm Borrowers or Lenders?" *American Journal of Agricultural Economics* 66 (December 1984): 614-19.

6. In 1983, of the 665,000 farms (more than $40,000 in annual sales) in the United States, only 24,000 had sales above $500,000. See U.S. Department of Agriculture, Economic Research Service, National Economics Division, *Economic Indicators of the Farm Sector: Income and Balance Sheet Statistics, 1983*, Publication no. ECIFS 3-3 (Washington, D.C.: U.S. Department of Agriculture, September 1984).

7. Emanuel Melichar, *Agricultural Finance Databook* (Washington, D.C.: Board of Governors of the Federal Reserve System, Division of Research and Statistics, July 1985).

8. Board of Governors of the Federal Reserve System, Division of Research and Statistics, "Survey of Terms of Bank Lending Made During May 6-10, 1985," Federal Reserve Statistical Release E.2 (Washington, D.C.: Board of Governors, June 26, 1985). The Survey of Terms of Bank Lending (STBL) reporting period is only one to four days each quarter and only 250 banks participate nationwide. Thus, the possibility of a sizeable sampling error should be kept in mind when interpreting STBL estimates.

million), about one-third of the non-real estate agricultural loans had variable-rate provisions, up from almost none before 1979. Thus, around 40 percent of all new non-real estate agricultural loans at all commercial banks now have variable interest-rate provisions.[9]

With reference to some of the other major lenders, the FCS uses average cost pricing which results in rates that are "more like fixed rates than prime-based variable rates."[10] Little is known about the terms of the loans extended by the individuals-and-others category. FmHA does not use variable rates, although the interest subsidy it provides to borrowers is sometimes reduced, which has the same effect as increasing rates.[11]

If some assumptions were made, as outlined below, new agricultural loans with variable-rate provisions could be estimated to be as much as 55 percent of all new agricultural loans.[12]

This total percentage can be derived as follows: New variable-rate non-real estate agricultural loans at commercial banks are estimated to be at least 8 percent of all new agricultural loans. If all new agricultural real estate loans at commercial banks could be assumed to have variable rates, then as much as another 5 percent of new agricultural loans could have variable rates. In this group, however, some of these loans may be short-term fixed-rate production loans, even though secured by real estate. If it is assumed that the new agricultural loans in the individuals-and-others lender category have the same split between fixed-rate and variable-rate as those by commercial banks, then another 9 percent could be added to the variable-rate total. Finally, if all new Farm Credit System loans were considered as essentially having variable-rate provisions, then another 33 percent could be added to the total, for a sum of 55 percent.[13] But if this range of 8 percent to 55 percent of new loans under variable-rate provisions does reflect the *choice* of those farmer borrowers offered both variable- and fixed-rate provisions, then the question of any differential effects of variable-rate lending on agriculture ceases to be important.

The existing data on whether farm borrowers are being restricted in their choice of loan-rate provisions is largely circumstantial. At commercial banks since 1977, three different stages seem to have occurred in the use of variable-rate loan provisions. From 1977 to 1979, about 17 percent of the non-real estate agricultural loans at commercial banks had variable-rate provisions. That percentage jumped to 22 percent in 1980, and to 29 percent in 1981, reaching a plateau of 39–42 percent during the 1982–85 period.[14] Thus, from 1980 to 1985, the proportion of new non-real estate loans with fixed-rate provisions fell by roughly 25 percentage points from the share of the late 1970s.

There are competing reasons why this change has occurred. It may be attributable to a sudden switch in borrowers' preferences. Much of the literature, however, has seemed to emphasize that banks have been shifting some of the interest-rate risks to borrowers.[15] If this risk shift were the reason for the change, then some borrowers would have had to decide whether to accept variable-rate provisions or seek out lenders that provide fixed-rate loans.

In some instances, lenders who have reduced or eliminated fixed-rate lending could make variable-rate terms sufficiently attractive to those farm bor-

9. The percentage of all farm loans with variable rates as estimated by the Survey of Terms of Bank Lending on an annual basis for 1982 was 39 percent; 1983, 42 percent; and 1984, 39 percent. Based on the first two quarterly estimates, 1985 is likely to be much like 1982–84. See Melichar, *Agricultural Finance Databook.*

10. LaDue and Leatham, "Floating versus Fixed-Rate Loans in Agriculture."

11. LaDue and Leatham, "Floating versus Fixed-Rate Loans in Agriculture."

12. The following assumptions were made that (1) the distribution of new agricultural debt by lender is the same as the distribution of existing agricultural debt, (2) the number of loans is distributed the same as the volume of debt, (3) all new farm real estate loans are variable rate, (4) new debt by life insurance companies, the Farmers Home Administration and the Commodity Credit Corporation can be safely ignored, (5) individuals and others make fixed-rate and variable-rate loans in the same proportion as commercial banks, and (6) Farm Credit System loans are considered variable rate.

13. Source of Primary Data: Melichar, *Agricultural Finance Databook.*

14. Melichar, *Agricultural Finance Databook.*

15. Anthony M. Santomero, "Fixed Versus Variable Rate Loans," *The Journal of Finance* 38 (December 1983): 1363–80.

rowers preferring fixed rates that they would continue to borrow from the same institutions. Some evidence from a recent survey of Eleventh Federal Reserve District agricultural banks showed that 23 percent of the banks surveyed (who made 29 percent of the total agricultural loans of the responding banks) offered *only* variable rates to their customers.[16] These variable rates, however, were slightly above, on average, those rates offered by other banks that provided both types of loan provisions. If market imperfections in terms of high transaction and information costs made it more expensive to switch loan accounts to another lender rather than stay and accept the new provisions, then it would be logical for the borrower to accept the new provisions.[17]

From the preceding discussion and the analysis in the present section, it would appear that variable-rate lending has a potential for placing the agricultural sector at a disadvantage in relation to other industries. In the previous section, it was suggested that farm borrowers may be at a disadvantage in the formal but still-developing markets for interest-rate risks. The present section develops two points: First, variable-rate loans are a significant portion of the new agricultural loans made, especially at commercial banks; and second, based on the available data, one can only conjecture the presence of market imperfections in determining the distribution of agricultural loans among types of interest-rate provisions. The circumstantial evidence, however, indicates that market imperfections may indeed have a role.

Whether agricultural borrowers are at a unique disadvantage among those in other industries when it comes to variable-rate loans can be determined by an analysis of debt loads, liquid asset levels, and correlations of income streams with interest-rate movements. The next section examines agriculture and 10 two-digit Standard Industrial Classification (SIC) industries in those three categories to compare agriculture's financial structure with that of other industries.

Ratio analysis

In examining the financial structure of agriculture in relation to other industries, one method is to compute financial ratios. The ratio analysis of income and balance sheets has long been a means of estimating a company's or an industry's financial condition and performance. Although the four most useful types of ratios are those dealing with liquidity, leverage, profitability, and coverage, the focus of this article is on cash flow, not profits. Thus, the profitability ratios can stay in the background.

Because coverage ratio data were not readily available for most industries, liquidity and leverage ratios were left as the primary tools for direct comparison between the agricultural sector and the SIC industries.[18]

Liquidity ratios measure a firm's ability to deal with short-term variations in cash flow by selling or converting assets. One of the preferred short-term liquidity measures is the quick ratio, which is defined as current assets less inventories divided by current liabilities.[19]

Leverage ratios measure the extent that the industry is financed by debt. The debt/equity ratio, an often-used measure of leverage, is the sum of both short-term and long-term debt divided by equity.

16. Federal Reserve Bank of Dallas, "Quarterly Survey of Agricultural Credit Conditions, Eleventh Federal Reserve District, July 1985" (Dallas, 1985). Unpublished data from this survey were used to make the estimates.

17. Economic theory cannot predict the degree to which the farm borrowers' choices between fixed- and variable-rate provisions are restricted by imperfect markets or whether, in fact, they are restricted at all. Such a finding would require an empirical investigation such as a survey of farm borrowers.

18. Coverage ratios, which are designed to compare the interest costs of a firm's debt with its ability to service them, are defined as annual cash flow before interest and taxes divided by the sum of interest and principal payments adjusted for taxes. Although a version of the coverage ratio was constructed for agriculture, coverage ratio data were not readily available for most other industries. Random checking of the following types of standard sources published over the period from 1955 to the present indicated that these sources did not carry coverage ratio series: *Quarterly Financial Report for Manufacturing, Mining, and Trade Corporations* (U.S. Department of Commerce, Bureau of the Census); *Annual Statement Studies* (Robert Morris Associates); and *Industry Norms and Key Business Ratios* (Dun & Bradstreet).

19. James C. Van Horne, *Financial Management and Policy*, 4th ed. (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1977).

Table 1
FINANCIAL RATIOS:
U.S. AGRICULTURE AND 10 TWO-DIGIT SIC INDUSTRIES,
1979 AND 1984

Sector	1979 Coverage ratio	1979 Quick ratio	1979 *D/E* ratio	1984 Coverage ratio	1984 Quick ratio	1984 *D/E* ratio
Agriculture	5.66	0.61	20.2	3.90	—	27.8
Nondurable goods industries						
Food and kindred products	—	0.84	52.2	—	0.83	63.4
Paper and allied products	—	1.18	50.4	—	1.03	54.3
Printing and publishing	—	1.40	38.8	—	1.44	44.9
Chemical and allied	—	1.18	43.4	—	0.98	40.2
Petroleum and coal	—	0.99	25.8	—	0.65	47.8
Durable goods industries						
Primary metals	—	1.03	58.2	—	0.92	76.3
Fabricated metals	—	1.03	42.7	—	1.15	50.4
Machinery, except electrical	—	1.00	37.9	—	1.14	32.9
Electrical and electronic	—	0.94	36.6	—	0.95	32.6
Transportation equipment	—	0.65	26.2	—	0.62	28.3

SOURCES OF PRIMARY DATA: Board of Governors, Federal Reserve System.
CITIBASE: Citibank Economic Database, 1947-.
U.S. Department of Agriculture.
U.S. Department of Commerce, Bureau of the Census.
Federal Reserve Bank of Dallas.

Severe data problems were encountered in the calculation of a quick ratio for agriculture.[20] Consequently, 1979 is the only year for which a measure of the agricultural quick ratio is available. For the SIC industries, however, the quick ratio can be calculated quarterly back for at least 30 years. The year 1979, however, proved adequate for comparisons.

In 1979, aggregate farm operators' real net farm income was the fifth largest in the past 15 years. The 10 SIC industries selected for comparison grew during 1979. The general economy that year grew at a 2.8-percent real rate, corresponding to the long-term growth rate trend. In addition, 1979 was the year before financial deregulation and the year before any consequences of changes in the Federal Reserve's conduct of monetary policy. Thus, 1979 represents a good "before" year to see if there are any significant differences in financial structure between agriculture and the SIC industries. For intertemporal comparisons, ratios using 1984 data are provided when available.

The values for the financial ratios for 1979 and 1984 for agriculture and 10 two-digit SIC codes are shown in Table 1. Taking the quick ratio first, agriculture does appear to be less liquid than the other industries. But given the crudeness of the estimate of the quick ratio for agriculture, such a finding can hardly be definitive. However, in 1979,

20. The problem with calculating the quick ratio for agriculture is the incompleteness of data on financial assets. These assets were approximated by the sum of currency, demand deposits, and other deposits and investments held by farmers. The source for the currency and demand deposits was Melichar, *Agricultural Finance Databook*. Other deposits and investments were estimated by using U.S. Department of Commerce, Bureau of the Census, *1980 Census of Population*. The sum of 1979 interest, dividends, royalties, and net rental income payments to all individuals with the farmer occupation code (473) was divided by the average T-bill rate for 1979. Value of farm inventories (U.S. Department of Agriculture, *Economic Indicators of the Farm Sector*) was subtracted out. Current liabilities were estimated by non-real estate debt (Melichar, *Agricultural Finance Databook*).

agriculture's debt/equity ratio of 20.2 was substantially lower than any of the ratios of the SIC industries. This shows that agriculture, at least in aggregate and by this measure, is not highly leveraged when compared with other industries.

Moving to 1984, the erosion of agriculture's equity position is clearly evident in the movement of the debt/equity ratio to 28.2, up 8.0 from 20.2. Most of the 10 SIC industries did not experience much of a change in their debt/equity ratios. Even though the quick ratio for agriculture could not be computed in 1984 because of data limitations, farm operators would have had to increase their stocks of liquid assets by 43 percent during the period 1979–84 just to keep their quick ratio from falling below the 1979 level.[21] If they had kept their stock of liquid assets constant in nominal terms during 1979–84, then the quick ratio would have fallen by almost half.

It is likely that the quick ratio for agriculture has fallen from the 1979 level. This fall, however, is exactly what could be expected to happen should an industry enter a period of financial stress. The loss of liquidity during the past several years is mirrored in agriculture's coverage ratio, which dropped to 3.90 in 1984 from 5.66 in 1979.

An examination of the data in Table 1 seems to indicate that these financial ratios will not differentiate agriculture from other industries. The debt/equity ratio in agriculture is still signaling relatively low leverage, while the quick ratio, though comparatively small in 1979, does not seem to represent a special case. The final possibility considered in the next section is the correlation of income flows with interest-rate movements.

Correlation of income and interest-rate movements

The relationship over time between movements in interest rates and movements in a borrower's income can have important effects on a borrower's cash flow. With variable-rate loans, as interest rates rise, so do interest costs. If a borrower's income rises at the same time interest rates do, then the cash flow effects of variable-rate loans are mitigated to some degree. Conversely, those projects whose returns are not correlated with movement in interest rates are subject to adverse cash flow effects as interest rates rise. Studies have suggested this result for individuals, for firms, and for banks.[22]

For example, Barry has argued that agriculture is characterized by a zero correlation between nominal returns and interest-rate movements.[23] Changes in domestic aggregate demand, for example, have little effect on the demand for agricultural output. Factoring in the role of exports, however, makes the assertion of zero correlation less certain. The late 1970s was marked by rising interest rates, falling dollar exchange rates, booming agricultural exports, and a healthy agricultural economy.

Applying a model

A simple model can lay out the basic case for paying more attention to the covariance between interest rates and project returns in judging the suitability of variable-rate provisions for a given borrower.

The object of the model is to arrive at a relationship between interest rates and returns to assets. A standard finance model is the expected utility/mean-variance approach to designing the optimal portfolio. This model assumes that investors are primarily motivated by maximizing their expected utility. The expected utility theory hypothesis, along with the assumption of convex indifference curves, can be used to explain risk aversion. The mean-variance model assumes that investors only care about the level of return and the riskiness of a security portfolio. Further, the riskiness of a security portfolio can be measured by the variance of its returns.

With risk established as an undesirable attribute of an investment, and variance of returns established as a measure of risk, a simple model can be used to explain why the covariance between interest rates and returns is important to the decision to borrow.

21. Using the 1984 values of currency, demand deposits, inventories, and non-real estate debt, and the same quick ratio as in 1979, the sum of other deposits and investments was calculated to be 43 percent higher than the 1979 figure.

22. John P. Danforth, "A Case for Variable Rate Mortgages," *Quarterly Review*, Federal Reserve Bank of Minneapolis (Winter 1979): 1–4; James R. Morris, "On Corporate Debt Maturity Strategies," *The Journal of Finance* 31 (March 1976): 29–37; Santomero, "Fixed Versus Variable Rate Loans."

23. Barry, *Current Issues in Agricultural Finance*.

The model begins with a common accounting identity for a firm:

(1) $Assets\ (A) = Equity\ (E) + Debt\ (D)$.

Rearranging terms gives

(2) $E = A - D$.

In a similar vein, the returns to equity (r_eE) is equal to the returns on assets including interest costs ($r_a{}^gA$) less interest costs on the debt (i_dD), or

(3) $r_eE = r_a{}^gA - i_dD$.[24]

Dividing through by equity gives

(4) $r_e = r_a{}^g(A/E) - i_d(D/E)$.

According to the expected utility/mean-variance hypotheses, riskiness is completely captured by the variance of the returns:

(5) $\mathrm{var}(r_e) = \mathrm{var}[r_a{}^g(A/E)] + \mathrm{var}[i_d(D/E)] - 2\mathrm{cov}[r_a{}^g(A/E), i_d(D/E)]$.[25]

An examination of equation 5 shows that for fixed-rate loans, in the polar case where weighted interest rates (hereafter referred to as interest rates) never change over the lifetime of the portfolio, the variance of the returns of equity is attributable all to variation in weighted returns to assets including interest costs (hereafter referred to as gross returns). Interest rates are not a factor.[26]

For variable-rate loans, two additional terms need to be considered: the variance of interest rates and the covariance of interest rates and gross returns. If there is any variation in interest rates, then the variance of returns to equity is larger because, by definition, variances cannot be negative.[27]

Given variable-rate financing, both borrowers and lenders would prefer that gross returns and interest rates move together—that is, a covariance that is large and positive. If covariances are large and positive, income would increase as interest rates move up. Borrowers would experience smaller reductions in cash flow as interest rates rose. Lenders would benefit because of a reduced chance of default if borrowers' incomes rose at the same time interest costs on the loan did. Thus, this covariance could be of importance in determining for farm borrowers the interest-rate riskiness of borrowing under variable-rate provisions.

Estimation and data

For some empirical light on the correlation of income flows and interest rates for agriculture and other industries, covariances and correlation coefficients between returns and interest rates were calculated for both agriculture and the 10 two-digit SIC industries. The manufacturing sector included the five largest durable and the five largest nondurable goods industries, with the size measured in terms of assets in 1984.

Covariance is not often used as a measure of linear correlation. The size of the covariance number depends upon the units used. Instead, the correlation coefficient is a preferred measure, with a range of −1 to +1. The −1 value indicates that the two series being compared are perfectly negatively correlated, while a +1 indicates perfect positive correlation. Values in between the polar cases indicate lesser degrees of correlation or, in the case of zero values, no correlation at all.

The two series to be compared are returns inclusive of interest costs weighted by the ratio of

24. This formulation is based on a model used by Barry, *Current Issues in Agricultural Finance*.

25. The only way that D/E or A/E could be placed outside the variance and covariance operators is if they are constants. The ratios do change, but they are perfectly and positively correlated because they are linked through the identity $A = D + E$. The effect on the covariance term would therefore be small but not zero; thus the ratio terms remain within the variance and covariance expressions.

26. The weights for the interest-rate terms are the ratios of debt/equity for agriculture and the 10 two-digit SIC codes. The weights were multiplied by the interest rates. Similarly for the returns including interest. The weights for the returns are the ratios of assets/equity for agriculture and the same industry groups. The weights were multiplied by the returns including interest. After all series were weighted, the correlation procedure was run.

27. Covariances, however, can be positive, zero, or negative, depending upon the correlation of the variables involved. If the covariance of interest rates and gross returns is large and negative, other terms remaining the same, the total variance of returns to equity increases (because the covariance enters equation 5 with a minus sign). If the covariance is zero, then it obviously adds nothing to the variance of returns to equity. Similarly, if the covariance is large and positive, bespeaking positive correlation between interest rate movements and gross returns, the variance of returns to equity falls.

assets to equity and interest rates weighted by the ratio of debt to equity. For agriculture, the U.S. Department of Agriculture has made detailed estimates of cash flow and returns to factors.[28] Modifications of those data were used for the present study.[29] The data selected to construct the gross returns measure included income from assets (which is inclusive of interest), assets, and equity. For the 10 SIC industries, the measure of returns was quarterly after-tax profits. This series is *net* of interest. After-tax profits, stockholders' equity, and assets are collected quarterly by the U.S. Department of Commerce.[30] The desired measure (after-tax returns from assets, including interest costs) could not be formed from the available data. The interest costs were netted out and not noted separately. It was decided to use the net of interest costs measure. Although this measure created a serious bias in the estimates, the empirical results could still be interpreted satisfactorily because the direction of the bias was known.[31]

The interest rates used were the prime rate, the three-month Treasury bill rate, and one long rate, the corporate AAA bond rate.[32] The time period used was 1955–84. Agricultural data are available back to 1940, and the industrial data were published beginning in 1947. Industrial data before 1955, however, are not readily available. Both agricultural and industrial returns were not adjusted for capital gains or losses because the focus in this article is on cash flow.

Results

The empirical evidence, at least in this crude test, does not contradict the maintained hypothesis that agricultural returns are uncorrelated with movement in interest rates, and that most other industries exhibit positive correlation of interest rates and returns.

For agriculture, the lack of correlation between gross returns and interest-rate movements, regardless of the definition of interest rates (see Table 2), is evident in the empirical results. The correlation coefficients are tiny, and all the levels of *t*-statistic significances indicate that the estimates are statistically no different than zero.

For nondurable goods industries, however, the picture is quite different (see Table 2). All the correlation coefficients are positive. For the short-term rates, all but one of the coefficients are significant at the 5-percent level. The magnitude of the coefficient estimates ranges from a modest 0.28 in the case of food to a more robust 0.55 for printing and publishing.

For durables, the problems with using net returns surfaces. For example, the primary metals and transportation industries showed negative correlations between gross returns and interest-rate movements. The actual correlations are likely much more in the positive direction, though reasons peculiar to those industries could cause their income streams move in the opposite direction to interest rates. For the three remaining durable goods industries, however, the results are much like those obtained with the nondurable goods.

28. U.S. Department of Agriculture, *Economic Indicators of the Farm Sector.*

29. Melichar, *Agricultural Finance Databook.*

30. U.S. Department of Commerce, Bureau of the Census, *Quarterly Financial Report for Manufacturing, Mining, and Trade Corporations*, Series QFR (Washington, D.C.: Government Printing Office, 1955–84). Various quarters, various years were used.

31. Interest costs are naturally highly correlated with interest rates. With agriculture as an example (because separate interest cost data are available), the correlation for agriculture between interest costs and the AAA corporate bond rate is +0.97. Returns net of interest costs therefore have lost much potentially significant *positive* correlation. For agriculture, when interest costs are subtracted from returns gross of interest, the net returns measure is *highly* but *negatively* correlated with interest-rate movements. Addition of interest costs to net returns moves the correlation statistics in the *positive* direction, turning them positive, as would be expected, but not significant. Thus, using the returns measure net of interest costs for the 10 SIC industries seriously biases the correlations with interest-rate movements in a *negative* direction.

32. Interest rates and the corporate AAA bond rate were taken from *CITIBASE: Citibank Economic Database, 1947-* (New York: Citibank, N.S., 1978). *CITIBASE* is a machine-readable magnetic data file which provides subscribers with on-line data retrieval from about 5,000 time series of U.S. aggregate economic data.

Table 2
CORRELATIONS OF RETURNS TO ASSETS WITH INTEREST RATES: AMERICAN AGRICULTURE AND 10 TWO-DIGIT SIC INDUSTRIES (SIMPLE CORRELATION COEFFICIENTS)

Sector	Prime rate	AAA corporate bond rate	3-month Treasury bill rate
Agriculture	0.12	0.06	0.04
Nondurable goods industries			
Food and kindred products	0.28**	0.20*	0.30**
Paper and allied products	0.29**	0.20*	0.31**
Printing and publishing	0.51**	0.55**	0.55**
Chemical and allied	0.20*	0.13	0.24**
Petroleum and coal	0.30**	0.20*	0.30**
Durable goods industries			
Primary metals	-0.31**	-0.46**	-0.29**
Fabricated metals	0.39**	0.36**	0.43**
Machinery, except electrical	0.32**	0.27**	0.36**
Electrical and electronic	0.37**	0.29**	0.41**
Transportation equipment	-0.35**	-0.27**	-0.30**

* Significant at the 5-percent level.
** Significant at the 1-percent level.
SOURCES OF PRIMARY DATA: *CITIBASE: Citibank Economic Database, 1947-*. Federal Reserve Bank of Dallas.

Caveats

As is true with any empirical study, some cautions should be expressed. The profits, equities, and assets data for two-digit industries are not directly comparable year to year. Data continuity is a problem because the Bureau of the Census, which publishes the data, reclassifies companies into different industrial groups once a year. Despite this definitional variation, because the data are always used in ratio form, the reclassification is assumed to have only minor distorting effects.

Taxes seem to have made a big difference for some industries, but hardly any for most others. For instance, the correlations between *before*-tax returns to equity for the chemical and allied group is strongly negative and statistically significant—the reverse of the *after*-tax relationship. Part of this problem can be attributed to the previously discussed use of net returns instead of gross returns. The remainder may be caused by accounting or tax law differences.

Though the question remains whether these aggregate results hold for the individual farm or industrial firm, certainly it is expected that some farms and firms would not fit the aggregate results.[33] However, this article has examined the aggregate comparisons as a means for determining the significance of variable-rate lending to the agricultural sector. And as Grunfeld and Griliches put it, "aggregation is not necessarily bad if one is interested in the aggregates."[34]

33. Some examples of papers dealing with the aggregation problem are L. M. Eisgruber and L. S. Schuman, "The Usefulness of Aggregated Data in the Analysis of Farm Income Variability and Resource Allocation," *Journal of Farm Economics* 45 (August 1963): 587-91; Dennis J. Aigner and Stephen M. Goldfeld, "Estimation and Production from Aggregate Data When Aggregates Are Measured More Accurately Than Their Components," *Econometrica* 42 (January 1974): 113-34.

34. Yehuda Grunfeld and Zvi Griliches, "Is Aggregation Necessarily Bad?" *The Review of Economics and Statistics* 42 (February 1960): 1-13.

Summary and conclusions

Variable-rate loans, when interest rates rise, could create adverse cash flow effects in the short run for agricultural borrowers. However, for variable rates to have serious overall negative effects on agriculture, several factors must hold. First, a significant amount of new debt undertaken by farm borrowers must have variable-rate provisions. Second, the existing distribution of fixed- and variable-rate provisions would have to be very different from what would obtain if *all* borrowers were freely offered the choice between fixed and variable rates on their loans. Third, the normal financial condition for agriculture would have to be one of high debt levels, low levels of liquid assets, and agricultural income streams having zero or negative correlation with the movement of interest rates.

To conclude, then, that variable-rate loan provisions are ill-suited to agriculture appears to be too strong. Variable rates do seem to have some uniquely negative effects on agriculture. From the evidence presented here, however, one can conclude that a significant portion of new agricultural lending likely is being made with variable-rate provisions. One of the critical questions raised is whether farmers have the same interest-rate provisions on their loans that they would if both fixed- and variable-rate provisions were freely available. Circumstantial evidence indicates that some farm borrowers, because of market imperfections, may find it too costly to seek lenders offering the provisions that they prefer. However, at least in the Eleventh District, substantial numbers of commercial bank lenders do offer both types of interest-rate provisions.[35] Even though the agricultural sector does appear to be less liquid than most other industries in the short run, the debt/equity ratio shows that both relatively and in aggregate, agriculture is not heavily leveraged.[36] Agricultural income flows do not seem to be correlated with interest-rate movements. Thus, the negative cash flow effects caused by rising interest rates will not be automatically offset by rising income.

One of the questions that remains is whether the cash flow problems for farmers caused by variable rates are structural and long term or whether they are temporary and part of an adjustment process. If the cash flow problems are long term, then the enlistment of third parties (other than banks and farm borrowers) to take on the interest-rate risk deserves more consideration.[37] If temporary, however, then the development of new risk-bearing institutions, instruments, or strategies may be unwarranted.

In this article, I have chosen to argue that the cash flow problems generated by variable-rate loans and experienced by the agricultural sector are relatively short term and are confounded by other events.

First, there has not been a wholesale switch from mostly fixed-rate provisions to mostly variable-rate provisions. There has been a transition from a situation where fixed rates predominated to one where variable rates are more prevalent. In addition, at some banks only variable- or fixed-rate loans are now offered. But if the Eleventh District survey data can be generalized for the nation, a majority of banks that lend to farmers are offering both fixed- and variable-rate provisions.

Second, the shift to greater variable-rate lending, which was instituted during a period of rising rates, was largely unanticipated by the agricultural sector. Because of the timing of this shift, the initial short-run effects of variable-rate financing were adverse for many agricultural borrowers. But as farm borrowers have gained experience with variable rates, formal or informal strategies for dealing with the increased variability in cash flow have been (or are

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35. Federal Reserve Bank of Dallas, "Quarterly Survey ..., July 1985."

36. This is not to say that many farmers are not heavily leveraged. The USDA estimates that as of January 1, 1985, 36 percent of commercial farmers (those with more than $40,000 in sales per year) had debt/asset ratios above 40 percent. The USDA has indicated that debt/asset ratios above 40 percent could impair the financial health of a farm. Moreover, although commercial farms are only 34 percent of all farms, they account for 90 percent of cash receipts. See U.S. Department of Agriculture, *Financial Characteristics of U.S. Farms, January 1985*, and *Economic Indicators of the Farm Sector*.

37. See David J. Leatham and Eddy L. LaDue, *The Effects of Variable Interest Rates on Agriculture and Opportunities for the Reintroduction of Fixed Rate Alternatives*, Departmental Information Report no. 85-2 (College Station, Tex.: Department of Agricultural Economics and the Texas Agricultural Experiment Station, Texas A&M University, 1985).

likely to be) put in place. Further, farm borrowers have reaped the advantages of variable-rate provisions during interest-rate declines. In the Eleventh District, for example, the national decline in interest rates during the first half of 1985 translated into a fall of 59 to 65 basis points for agricultural loans.[38]

Third, the effects of the increase in variable-rate lending tend to be confounded by the increase in farm debt and the rapid run-up in the level of interest costs. Between 1978 and 1984, real farm debt has increased about 10 percent while real interest costs on that debt have increased 49 percent.[39] If all new or refinanced debt during that time had been fixed-rate loans, economic theory suggests that the interest-cost increase would have been still larger. Thus, it follows that the mean level of interest costs over time relative to income available to service them is more important to farm financial stability than the interest-cost variation.

With experience and knowledge gained in the early 1980s, farm borrowers should not find variable-rate loan provisions as much of a burden as it may have been for some in the past.

38. Federal Reserve Bank of Dallas, "Quarterly Survey ..., July 1985."

39. Melichar, *Agricultural Finance Databook.*

Monetarist Objectives Versus Monetarist Prescriptions

John Bryant

Fox Professor of Economics
Rice University

Consultant
Federal Reserve Bank of Dallas

The monetarist policy prescription is well known: the central bank should use open market operations to ensure a constant growth rate of the money stock. The implication is that monetary policy is not to be influenced by fluctuations in economic growth or by the government's deficits.

The theory and objectives behind this policy prescription are less familiar. If everyone were comfortable with the policy prescription, perhaps the lack of familiarity with its justification would be unimportant. Central banks have not consistently followed the policy prescription for extended periods, however. Money growth has often depended on government deficits and the pace of economic growth. In the case of the United States, the current large deficits make pressing the issue of whether monetary growth should really be uninfluenced by fiscal policy.

The policy prescription of targeting monetary aggregates is but one component of monetarism. It is convenient to divide "monetarism" into three components. First, there is the monetarist *theory* of how policy influences the economy. Second, there is the monetarist policy *objective* of how the economy should behave. The monetarist theory and policy objective together imply the third component of monetarism, its policy *prescription*. If the monetarist theory is correct and the monetarist policy prescription is followed, then the monetarist policy objective is met.

Monetarist theory does not seem to have achieved the same degree of acceptance as the monetarist policy prescription of targeting monetary aggregates. We have at times, then, endorsed the policy prescription of a controversial theory. From this observation a natural question arises. What is the implied policy *prescription* if one accepts the monetarist policy *objective* but has a different monetary theory?

The views expressed are those of the author and do not necessarily reflect the positions of the Federal Reserve Bank of Dallas or the Federal Reserve System. This article expands on ideas presented in John Bryant and Neil Wallace, "Monetary Policy in the Presence of a Stochastic Deficit," Federal Reserve Bank of Minneapolis Research Department Staff Report no. 42 (Minneapolis, 1979), and "A Price Discrimination Analysis of Monetary Policy," Review of Economic Studies *51 (April 1984): 279–88.*

The policy prescription follows easily after the monetarist policy objective has been specified and a nonmonetarist theory is chosen. The objective can be inferred from interpretation of the monetarist literature and analysis of some monetarist models. Picking an alternative to monetarist theory is a thorny problem, however, because there are many alternatives to choose from. Fortunately, for a broad class of departures from monetarist theory, it is possible to generate policy prescriptions that achieve the monetarist objective. In the class of nonmonetarist models selected for deriving the policy prescription, money is neutral only when money and government bonds vary in proportion.

The prescription derived from nonmonetarist models focuses attention on the ratio of money to government bonds. Achieving the objective requires that this ratio be a function solely of contemporaneous exogenous forces affecting the economy. The ratio should not be affected by past exogenous events or policies.

The objective achieved by this strategy and advocated by monetarists is simplicity: monetary policy will not complicate an already complex world. The adoption of simplicity as the monetarist objective follows from examination of the literature. Exercises with a few monetarist models generate a precise definition of simplicity—that relative prices and real rates of return depend only on current states of the world. The money-bonds ratio emerges as the variable meriting the attention of policymakers because the conditions for simplicity can be met when the neutrality property of money holds. Money is said to be neutral when relative prices are independent of the nominal stock of money in circulation.

Simple policy

While the popular wisdom is that monetarist policy is supposed to generate simplicity, for our purposes it is necessary to have a precise version of what simplicity entails.[1] A precise version of the monetarist policy objective can be inferred from the monetarist policy prescription and monetarist theory. The objective must be one that is achieved by the policy prescription if the theory is correct. Identifying the monetarist policy objective in this way requires that the monetarist theory be specified. As is argued next, when this step is accomplished, simplicity acquires a precise meaning. Its exact meaning depends, however, on whether one assumes that velocity is constant or variable. Each case is examined, and a precise meaning of simplicity deduced.

There is no single, concise version of monetarist theory. The common characteristic of monetarist models seems to be that the demand for money is, in some sense, stable.[2] The original, and simplest, version of a stable demand for money is the classical quantity equation. While the classical quantity equation has few (if any) modern adherents, as a first step in identifying the monetarist policy objective, it is useful to treat the classical quantity equation as the monetarist theory. That is, if the classical quantity equation were the correct model of the economy, monetarists would not change their policy prescription of targeting monetary aggregates. Therefore, the monetarist policy objective must be met if monetary aggregate targets are followed and if the classical quantity equation is correct.[3]

The quantity equation. In the classical case, as is demonstrated next, inflation should be a function only of deviations of output from its growth path. The classical quantity equation is

$$MV = PX, \tag{1}$$

where M is money supply, V is velocity of money, P is the price level, and X is real gross national product (GNP). As it stands, this equation is a tautology that merely serves to define velocity. The substantive content comes with the assumption that velocity, V, is a constant.

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1. Allusions to simplicity can be found in many monetarist writings, including Milton Friedman, *A Program for Monetary Stability* (New York: Fordham University Press, 1960), 90, 99, and "The Role of Monetary Policy," *American Economic Review* 58 (March 1968): 11–14; Robert E. Lucas, Jr., "Expectations and the Neutrality of Money," *Journal of Economic Theory* 4 (April 1972): 103–24; and Henry C. Simons, "Rules Versus Authorities in Monetary Policy," *Journal of Political Economy* 44 (February 1936): 1–30.

2. See David Laidler, *Monetarist Perspectives* (Cambridge: Harvard University Press, 1983), vii.

3. Indeed, given Henry Simons' conjecture that targeting monetary aggregates is justified only if velocity is constant, the quantity theory is the only noncontroversial starting point for this investigation. See Simons, "Rules Versus Authorities in Monetary Policy."

Having defined our "proxy" for monetarist theory to be the classical quantity equation with constant velocity, we can infer the monetarist policy objective. At this point, some formalization is helpful. Define the level of output in each period as

$$X_t = (\bar{X} + \tilde{X}_t)(1 + \beta)^t, \tag{2}$$

where t is time, $\bar{X}(1 + \beta)^t$ is the growth path of real GNP (β is the average growth rate), and $\tilde{X}_t(1 + \beta)^t$ is the deviation in the tth period from the growth path of real GNP. Assume a constant growth rate of money, γ, as the monetarist policy prescription. Then

$$M_t = \bar{M}(1 + \gamma)^t \tag{3}$$

is the monetarist policy prescription for some $\bar{M}$ (equal to money supply in time "zero"). Plugging the policy prescription (3) and equation 2 into the classical quantity equation (1) yields

$$\bar{M}(1 + \gamma)^t V = P_t(\bar{X} + \tilde{X}_t)(1 + \beta)^t. \tag{4}$$

This equation can be rearranged to yield

$$P_t = \bar{M}(1 + \gamma)^t V/[(\bar{X} + \tilde{X}_t)(1 + \beta)^t], \tag{5}$$

which further implies

$$P_{t+1} = \bar{M}(1 + \gamma)^{t+1} V/[(\bar{X} + \tilde{X}_{t+1})(1 + \beta)^{t+1}]. \tag{6}$$

Dividing (5) by (6) and canceling yield

$$\frac{P_t}{P_{t+1}} = \frac{(1 + \beta)}{(1 + \gamma)} \frac{(\bar{X} + \tilde{X}_{t+1})}{(\bar{X} + \tilde{X}_t)} \equiv f(\tilde{X}_{t+1}, \tilde{X}_t). \tag{7}$$

The growth rate of the price level (inflation) depends on the growth rate of real GNP and the growth rate of money. Moreover, given β and γ, deviations of the price level from its growth path depend on deviations of output from its growth path alone. Therefore, for the monetarist policy objective to be met, variations in inflation in a given policy regime should be a function of deviations of output from its growth path alone.

Variable velocity. This monetarist policy objective for inflation can be further elaborated for an economy with variable velocity. Monetarists and Keynesians alike have challenged the assumption that velocity is constant.[4] These economists object on the grounds that velocity is influenced by many variables, particularly interest rates and inflation. Moreover, both interest rates and inflation are, in turn, influenced by fiscal and monetary policy. Critics of the classical quantity equation believe that not only is velocity a function of interest rates, inflation, and other variables but real output is a function of these variables as well. Accordingly, the critics would modify the quantity equation to read

$$M_t V(i_t, P_t/P_{t+1}, \ldots) = P_t X(i_t, P_t/P_{t+1}, \ldots), \tag{8}$$

where i_t is the interest rate in period t.

Let us suppose that, aside from interest rates and inflation, the other variables influencing velocity and output are "states of nature." These states of nature are factors in the underlying economy that inherently influence velocity and output but which themselves are not influenced by fiscal and monetary policies. Rainfall in an agricultural economy with dirt roads is an example. Perhaps war or peace is another. "States of nature" are exogenous, while interest rates and inflation are endogenous.

In the classical quantity equation, real GNP is acting as an external driving force. Money supply is the policy variable, velocity is constant, output is generated by the private sector, and price reconciles the force from policy and the force from the private sector. The constant growth rate of money ensures that price fluctuations reflect only the force from the private sector, fluctuations in real GNP. This we have taken to be a simple policy.

In the variable velocity formulation, states of nature are the external driving force, and real GNP is endogenous. Therefore, a simple policy is now one in which price fluctuations reflect only the external driving force of states of nature.

If states of nature in period t are labeled S_t, then the quantity equation becomes

$$M_t V(i_t, P_t/P_{t+1}; S_t) = P_t X(i_t, P_t/P_{t+1}; S_t). \tag{9}$$

The modified monetarist policy objective is

$$P_t/P_{t+1} = f(S_t, S_{t+1}). \tag{10}$$

Variations in inflation should be a function of states of nature.

Equation 10 implies two things about the rate of inflation. First, in a given policy regime, variations in the inflation rate depend only on states of nature,

4. See, for example, Allan H. Meltzer, "The Demand for Money: The Evidence from the Time Series," *Journal of Political Economy* 71 (June 1963): 219–46.

not on other variables. Second, this dependence on states of nature is "history-forgetting." Past states of nature do not influence the current rate of return.

It is not really true, however, that, aside from interest rates and inflation, the only variables influencing velocity and output are current "states of nature." Past events may inherently affect the present, or the economy may have a driving force or inherent dynamism of its own. As long as the underlying environment is unchanging, this inherent dynamism may be ignored (assuming it is damped) or can possibly be treated as a growth path.

With the underlying environment constantly being subjected to shocks, an inherent dynamism need not fade away. Rather, it is constantly renewed. For example, existing capital stock and inventory stock are influenced by past states of nature. As long as the inherent dynamism is itself history-forgetting, this complication can be handled by augmenting the state-of-nature variables appropriately. One can, for example, add capital stock and inventory stock to the state-of-nature list. In each period the existing stocks of capital and inventories are given and unalterable facts of life, even though they were determined by past decisions. For the sake of simplicity of exposition, the following analysis assumes a no-growth, but fluctuating, economy without inherent dynamism (or with the states of nature appropriately augmented).

An immediate generalization of the modified monetarist policy objective implies that interest rates are one policy *objective*.[5] All rates of return, not just those of money, depend only on states of nature, and that dependence is history-forgetting.[6] Only the current state of nature should drive the economy.

The monetarist policy objective that rates of return depend on current states of nature only is not automatically achieved. Rates of return may be influenced by fiscal and monetary policy, which, in turn, may depend on more than just the current state of nature. In other words, the question remains whether this monetarist policy objective is attainable if velocity is not constant and, if so, how.

Neutrality

The monetarist policy objective is that real rates of return should depend on the current state of nature and not on past states of nature. Therefore, in every period in which a particular state of nature occurs, the same rates of return should be observed. Supplies of and demands for assets are equated at the same rates of return.

Government obligations and assets of the government are of particular interest because they are not "states of nature" but policy variables. For simplicity, government obligations are assumed to come in two forms, high-powered money and bonds. High-powered money is non-interest-bearing and comprises currency and bank reserves.

The supply of government obligations will not necessarily be the same in every period in which a particular state of nature occurs. At any point in time, the nominal stocks of government obligations outstanding depend on the government deficits and surpluses incurred in the past. In turn, past deficits or surpluses may be expected to depend on past states of nature. So, while the policy objective is to make rates of return independent of past states of nature, the nominal supplies of government obligations depend on past states of nature.

To attain the monetarist policy objective, the policymaker can exploit a venerable property of monetary economics—namely, neutrality of money. Neutrality reconciles the policy objective and the previous observation on supply conditions in the securities market. Therefore, it is useful to understand what neutrality is and when neutrality holds.

An increase or decrease in money supply is neutral if all prices and nominal assets rise or fall in proportion, leaving all real variables—all real assets and all rates of return—unchanged. If a particular policy change is neutral, then it does not influence welfare.[7]

Besides its direct importance for welfare, neutrality is a property the policymaker can use to obtain the monetarist policy objective. Consider any two

5. Interest rates are the rates of return on nonmoney financial assets. If we assume money to be non-interest-bearing, then the rate of return on money is the negative of the inflation rate.

6. The generalization does require that existing stocks of private assets are included in "states of nature" as described above.

7. This proposition assumes that people are influenced only by the purchasing-power value of assets, not by their dollar return. If a purely nominal change in asset values affected behavior, this welfare proposition would not hold. Neither would neutrality hold, however, because absence of money illusion is a necessary condition for neutrality.

periods with the same state of nature obtaining. Suppose the money supply is different in the two periods. If neutrality holds, this means that prices rise or fall in proportion to all nominal supplies of assets (which all rise or fall in the same proportion as money supply does). In particular, prices rise or fall in proportion to the rise or fall in the nominal stock of government obligations, which are assets to the private sector. That is, prices rise or fall in proportion to the accumulated deficits or surpluses in the intervening years, leaving all real variables uninfluenced. Nominal demands for assets also rise or fall in proportion to prices and nominal supplies of assets. This process should ensure achieving the policy objective of unchanged rates of interest. Neutrality is, then, sufficient for the monetarist policy objective to be attained.

Neutrality is not, however, a property that automatically obtains but one that must be purposefully implemented. Whether a change in money supply is neutral or not depends on the sort of policy change causing it. In many models in which velocity and output depend on interest rates and inflation, a necessary condition for neutrality is that money supply and government bonds rise or fall in proportion.[8] The intuition behind this result is simple. If money and government bonds do not change in proportion, no change in price level can return the ratio of real quantities of money and government bonds to its previous level. Therefore, relative real quantities of money and government bonds must be changed, which, all else equal, implies changed relative rates of return.[9]

From the previous paragraph it might seem to be purely a matter of definition that neutrality obtains only if money and government bonds rise or fall in proportion. This is not the case, however. For example, suppose money and bonds are perfect substitutes. Then their sum is the nominal asset, and the breakdown of that composite government obligation as to money and bonds is not important. (Of course, money and bonds are not perfect substitutes, for if they were, bonds would always sell at par.) A more important example of neutrality not depending on appropriate bond issue appears in the accompanying box.

If neutrality does depend on appropriate bond issue, the policy prescription for attaining the monetarist policy objective is to make the ratio of money to government bonds a function of the current state of nature alone. Consider any two periods with the same state of nature obtaining. Under this policy prescription the ratio of money to government bonds is the same in the two periods. Therefore, money and government bonds rose or fell in the same proportion between the two periods. The condition necessary for neutrality in many models is met.

Targeting the ratio of money to government bonds is not quite a monetary policy prescription, however, because monetary aggregates are not under the direct control of the monetary authority. The aggregates include liabilities of the private banking sector. Besides, there is the question of which monetary aggregate to try to influence. Nevertheless, high-powered money is under the direct control of the monetary authority. Targeting the ratio of high-powered money to government bonds is, therefore, possible. Moreover, by neutrality, targeting the ratio of high-powered money to government bonds amounts to targeting the ratio of any particular monetary aggregate to government bonds. That is, for any desired ratio of a monetary aggregate to government bonds, there is an appropriate (lower) ratio of high-powered money to government bonds that can be set by the monetary authority. (This ratio may depend on states of nature though.) Liabilities of the banking system, however measured, will grow or shrink in proportion to high-powered money between any two periods with the same state of nature. Indeed, all one loses by targeting any monetary aggregate is the ability to differentiate between states of nature generating the same value for the monetary aggregate.

Coordination of fiscal and monetary policies

The policy prescription of targeting the ratio of high-powered money to government bonds is not sufficient to guarantee that neutrality obtains. In other words, this policy prescription does not guarantee that the monetarist policy objective is attained. Since reaching the monetarist policy objec-

8. See, for example, Don Patinkin, *Money, Interest, and Prices: An Integration of Monetary and Value Theory*, 2d ed. (New York: Harper & Row, 1965).

9. Therefore, by extension, if there are multiple forms of government obligations, all must change in proportion.

Ricardian Analysis of Public Debt

In Ricardian models in which government bonds are not wealth, neutrality does not require that money and government bonds move together. Suppose that government bonds and private capital are perfect substitutes and that government bonds imply a foreseen appropriate future lump-sum tax liability. Government bonds then are not truly assets at all. While an individual bondholder treats the bond as an asset, he or she also treats the future tax as a "negative asset." A bond and its associated implicit tax liability sum to zero. A changed ratio of money to bonds does not influence real assets or real rates of return because bonds are not assets. Bonds and taxes are just legal fictions tying the individual to his or her purchasing agent, the government. The analysis here does assume that the bonds and associated taxes do not redistribute wealth.

Notice that in this Ricardian analysis, monetary aggregate targets really amount to a long-run fiscal policy prescription. Bonds cannot finance a permanent deficit as long as they imply future surpluses. Such bond financing can alter the timing of the deficit but not the long-run average deficit. A 3-percent money growth rule implies a 3-percent average growth rate of the deficit.

There are two possible interpretations of this Ricardian analysis. One is that governments do not choose to finance permanent deficits by bond issue. The second is that governments cannot finance permanent deficits by bond issue because such unbacked bonds would be valueless.

In any case, the working assumption in this paper is that the nonmonetarist critic rejects such Ricardian analysis. Instead, the critic believes that neutrality requires money and bonds to move together, but he accepts the monetarist policy objective of simplicity.

tive involves fiscal policy as well as monetary policy, the two policies must be coordinated.

Critics of the quantity equation believe that interest rates and inflation are influenced by both fiscal and monetary policies. With this theory in mind, let us consider one example of a possible conflict between fiscal and monetary policies. Suppose fiscal policy depends on past states of nature or on variables other than states of nature.[10] Then, even if the above monetary policy prescription of targeting the ratio of high-powered money to government bonds is followed, neutrality need not obtain.

Such a fiscal policy brings past states of nature, or other variables, into the picture. Because fiscal policy can be different in two periods with the same state of nature obtaining, interest rates can be different, and realized inflation can be affected by more than the state of nature in the next period. Therefore, even if the monetary authority targets the ratio of high-powered money to government bonds, fiscal policy can keep neutrality from obtaining when the same state of nature occurs. To be consistent with targeting the ratio of high-powered money to government bonds, fiscal policy too should depend only on the current state of nature.

Let us consider another case of a conflict between monetary policy and fiscal policy. For simplicity, suppose that the monetary policy is to have high-powered money grow at a constant rate. This is one version of the monetarist policy prescription. Suppose also that fiscal policy depends on the current state of nature. The surplus or deficit of the Treasury depends, then, on the current state of nature. The accumulated deficit, the sum of past surpluses and deficits, depends on all past states of nature. The accumulated deficit equals the sum of high-powered money and government bonds outstanding. Consequently, the sum of high-powered money and government bonds depends on all past states of nature.

At the same time, however, high-powered money is growing at a constant rate. Thus, the ratio of high-powered money to government bonds depends on all past states of nature. Finally, this dependence typically implies that rates of return on money and government bonds depend on all past states of nature. This result is a direct violation of the monetarist policy objective of simplicity as inter-

10. The existence of government bonds implying a future tax liability is an example of fiscal policy depending on past states of nature. A bond issued today based on today's state of nature implies a future tax liability, which is to say that it affects future fiscal policy.

preted above: rates of return do not depend only on the current state of nature.

Concluding comments

At first blush, targeting the ratio of high-powered money to government bonds seems rather far removed from the current monetary policy debate. On further consideration, however, this policy prescription does not appear so foreign. For example, consider the most obvious such policy—namely, holding the ratio of high-powered money to government bonds fixed. This rule implies that the central bank will be completely inactive except during Treasury financing. During Treasury financing, the central bank purchases a fixed percentage of the bonds issued.[11]

Targeting the ratio of high-powered money to government bonds amounts to making interest rates a function of the current state of nature. Thus, the monetarist policy objective implies the old "Keynesian" prescription of targeting interest rates. However, the revised policy prescription involves using an unchanging known rule rather than discretion. Perhaps, after all, as suggested by Milton Friedman and Henry Simons, the fundamental divide between monetarists and Keynesians is in whether one advocates policy rules or discretion, not in whether one advocates a constant money growth rule.[12]

While conceptually simple, the revised policy prescription may seem difficult to apply. In particular, this prescription requires the identification and measuring of states of nature. Fortunately, another implication of the analysis is that one can make the ratio of high-powered money to government bonds a function of, for example, real GNP. Ignoring lags in the reporting of GNP, the Federal Reserve could simply announce $H/B = h(GNP)$ for some function h, where H is high-powered money and B is government bonds, and then act accordingly. By neutrality, this amounts to using the underlying states of nature themselves. All one loses thereby is the ability to differentiate between states of nature generating the same level of real GNP.

It is worth stressing that the revised policy prescription does not suggest one particular policy. Rather, a whole class of policies is implied. The ratio of high-powered money to government bonds can be any function of the current state of nature. Choice between those policies depends on criteria other than the monetarist policy objective.

No defense of the monetarist policy objective of simplicity has been made in this analysis. It has just been taken as a given. Naturally, to make this analysis more than a logical exercise, one needs a defense of that policy objective. Presumably the defense would involve minimizing costly errors on the part of private economic agents. Making that defense rigorous would be a substantial undertaking.

Monetarists may object to the above analysis on the grounds that their policy prescription of targeting monetary aggregates does not depend solely on economic theory but also on empirical observation of how economies have fared under alternative policies. However, the above analysis does not address whether monetarists are right or wrong. It addresses the question of appropriate policy *if* monetarists are wrong in their economics but have their hearts in the right place.

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11. Indeed, in 1948 Friedman advocated one such easy policy—namely, that the Federal Reserve should monetize the entire debt. See Milton Friedman, "A Monetary and Fiscal Framework for Economic Stability," *American Economic Review* 38 (June 1948): 245–64.

12. See Friedman, "A Monetary and Fiscal Framework for Economic Stability," and Simons, "Rules Versus Authorities in Monetary Policy."

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