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**Trimming the hedges: Regulators, banks and financial futures**

**The bucks stop elsewhere: The Midwest's share of federal R&D**

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# Trimming the hedges: Regulators, banks, and financial futures

*G. D. Koppenhaver*

The regulation of banks, savings and loan associations, and other depository financial intermediaries stresses the prevention of insolvency and failure. This traditional emphasis has caused regulators to worry about the development and growth of financial futures contracts in recent years. Financial futures contracts represent an effective vehicle for hedging interest rate risk, but the fear is that institutions will use them to speculate on interest rate changes in order to increase earnings rather than to reduce risk.

In the current institutional setting, the possibility of a market or nonregulatory solution to this problem is doubtful. Because margin requirements for futures trading are low, the availability of funds is not a barrier to entry into the futures market; a depository institution can assume a risk well beyond the value of its equity. Insured depositors are unlikely to monitor and penalize a depository institution for assuming speculative positions. Little market discipline can be imposed through deposit insurance premiums because they are currently independent of the institution's risk exposure. Finally, in the particular case of savings and loan associations, many of which are organized as mutuals, there are no stockholders to impose market forces on those that take excessive risks through financial futures trading. This leaves only uninsured depositors and debtholders to impose a market discipline, and they are not in a position to monitor futures trading developments effectively under current accounting disclosure requirements.

With a nonregulatory solution unlikely, the question of whether or not regulation can control the use of futures contracts by banks and thrifts becomes important.[1] If regulatory control is possible, hedging with financial futures should be allowed and speculation should be prohibited. If regulatory control is not possible, the benefits of futures contracts as a risk management tool must be weighed against the potential costs of futures speculation. If the latter are too great, futures trading by financial intermediaries should be disallowed altogether.

This article outlines the current regulations and mechanisms used to control and monitor trading by some depository institutions—specifically commercial banks and bank holding companies—in financial futures contracts.[2] The article then examines several regulatory problems with emphasis on the definition of interest rate risk exposure and interest rate futures accounting. Concluding the article are suggestions on alternative control mechanisms.

## Institutional aspects

Futures market institutions have evolved to facilitate the volume of trade in commodity markets and to contribute to the efficiency with which commodity markets operate. They act as parallel markets to those in which physical commodities are traded.

In general, goods may be exchanged according to: 1) agreements specifying transfer of title and delivery on the spot, called spot or cash market contracts; 2) agreements specifying transfer of title on the spot and delivery at some future date, called forward market contracts; and 3) agreements permitting frequent transfer of title and liability until a future delivery date, called futures market contracts. Cash and forward con-

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[1]Throughout the remainder of this paper, the term "thrift" refers to any depository financial intermediary that is a savings and loan association or credit union.

[2]For other treatments of these regulations, see Franklin R. Edwards, "The Regulation of Futures and Forward Trading by Depository Institutions: A Legal and Economic Analysis." *Journal of Futures Markets*, Summer 1981, 201-218; Robert C. Lower and Scott W. Ryan, "Futures Trading by National Banks," *Banking Law Journal*, March 1981. 239-256; and John H. Strassen, "The Regulators-An Overview," Chapter 20 in *The Handbook of Financial Futures*, edited by Nancy H. Rothstein and James M. Little, New York, McGraw-Hill Book Company, 1984.

tracts trade on the "actuals" markets, established to trade physical commodities.

A futures market agreement can be viewed as a forward market contract with special characteristics that facilitate the transfer of title and liability. Several contract attributes serve to separate trading in futures markets from trading in spot and forward markets. For example, the terms of an actuals market contract are not standardized but rather are tailored to meet the needs of the buyers and sellers involved with respect to commodity grade, quantity, and place and time of delivery. To reduce the costs of exchange, a futures contract is highly standardized in each of these respects.

Another major difference between contracts in futures and in actuals markets concerns the settlement of monetary obligations. In actuals markets, contracts are settled by any mutually agreeable method. Futures contract settlements are managed by a clearing house interposed between the contract principals, which assumes the opposite position to each of the parties required to make a contract. The clearing house mechanism expedites contract settlement by allowing the elimination of a position through offsetting contracts, by protecting against default risk with required deposits of initial and subsequent margin monies to the extent that prices move adversely to buyer or seller, and by organizing delivery of commodities on open contracts during the delivery month.

Futures market participants can be characterized as either hedgers or speculators. Hedging involves making a contract to buy or sell as a temporary substitute for a cash market transaction of equivalent or greater size. The purpose of hedging is to offset the price risk incidental to cash or spot market operations. Hedging can take two different forms. One is a hedge of an existing cash market position; the other, an anticipatory hedge, is a hedge of a cash market position expected to be taken in the future.

Speculation involves a single market purchase or sale with the intention of resale or repurchase. In this case, the uncertainty about the future transaction price is a source of both risk and potential return. In most futures markets, the volume of short (sell) hedging is different from the volume of long (buy) hedging; this market imbalance necessitates the presence of speculators to absorb the excess contracts.

As the example in the box illustrates, interest rate futures contracts widen the options available to banks making decisions in a risky environment. Futures markets are a mechanism for sharing and shifting risk among participants. Hedgers shift interest rate risk to speculators; they trade the risk of interest rate change for the risk of changes in the rate spread between the

**A Hedging Example**

As a simple example of the risk-shifting potential of interest rate futures contracts, suppose on December 1, 1981, a bank holds $7 million in 26-week U.S. Treasury bills and wants to hedge the value of these securities over the next 13 weeks until March 1, 1982. The bank plans to sell these securities in March to help fund its other operations. To hedge the interest rate risk associated with this cash Treasury bill position, the bank's management decides on December 1 to sell 90-day Treasury bill futures contracts worth $7 million (face value), maturing in March 1982, and trading at an annual rate of 10.81 percent. This futures transaction requires an initial margin deposit of approximately $14,000 [= 7 contracts at $2,000 per contract]. On March 1, 13-week Treasury bill interest rates have risen to 12.49 percent from 10.93 percent on December 1 and the bank's cash Treasury bill position now has a value of $7,173,000. If interest rates had not changed over the 13-week period, the cash Treasury bill position would be valued at $7,203,000. The rise in interest rates over the 3-month period had decreased the value of the Treasury bills by $30,000. However, interest rates in the Treasury bill futures market have risen 160 basis points over the same three-month period. The loss in market value of the cash Treasury bills is offset by a gain of $28,000 [= (.1241-.1081) (90/360) $7,000,000)] in the Treasury bill futures market before the return of margin. By hedging the Treasury bill futures market, the bank limits its net loss to only $2,000.

cash and futures market instruments, i.e., they substitute basis risk for interest rate risk. The existence of basis risk explains why the gain from futures hedging in the example does not exactly offset the loss in the cash Treasury bill position. Perfect futures market hedges exist only by coincidence. The advantage of futures market hedging is that basis risk is usually much less than interest rate risk and this risk substitution can be accomplished at low transaction costs.

### Current regulations

Any depository institution's strategy for participation in financial futures markets must take account of the restrictions placed on trading by the federal and state regulatory agencies. Regulatory jurisdictions over bank and thrift futures trading is the responsibility of federal and state banking agencies, the Federal Home Loan Bank Board, and the National Credit Union Administration. The jurisdiction of the Commodity Futures Trading Commission does not extend to trading by depository financial institutions on their own account except to require the reporting of large positions, prohibit market manipulation, and subject positions to the emergency powers of the commission. The primary focus in this article is on the policies instituted by the federal regulators of banks and bank holding companies.

In general, regulators disapprove of futures trading that increases an institution's risk exposure. The federal regulatory agencies are in agreement, however, that financial futures contracts, properly used, can effectively hedge interest rate risk and that institutions should hedge only the net interest rate exposure in the overall balance sheet. This is called macro hedging, and makes the balance sheet insensitive to unexpected interest rate changes.

A micro hedge, on the other hand, makes a well-defined individual asset or liability insensitive to unexpected interest rate changes. A series of micro hedges coordinated so as to reduce the maturity mismatches or to manage the spreads between assets and liabilities appearing on the bank's balance sheet may comply with public policy, if these micro hedges are tantamount to a macro hedge. Although micro hedging strategies can be initiated on a decentralized, profit center basis with an area manager making decisions, the general requirement that futures hedging should reduce overall risk exposure implies that the trading strategy must be implemented at a high level in the organization, where all relevant information can be centralized.

It is not necessarily true that a micro hedging strategy automatically reduces an institution's risk exposure and accomplishes the same goal as a macro hedging strategy.[3] For this reason, policy proscribes micro hedges placed without considerations of their effect on the net interest rate exposure in the institution's balance sheet.

### Banks and bank holding companies

On November 20, 1979, the Board of Governors of the Federal Reserve System, the Federal Deposit Insurance Corporation, and the Office of the Comptroller of the Currency jointly adopted—effective January 1, 1980, and amended March 12, 1980—a policy statement governing bank participation in the interest rate futures markets for U.S. government and agency securities.[4] This joint pronouncement recognized that hedging interest rate risk is a legally appropriate activity for commercial banks because it is incidental to the business of banking. On August 21, 1980, the Board of Governors adopted a policy statement governing the futures trading activities of bank holding companies and their nonbank subsidiaries.[5] Subsequently, on September 18, 1981, the Board of Governors issued an interpretation of existing policy statements that applied the regulations then in place to financial

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[3]For a discussion of why this is true, see Robert W. Kolb, Stephen G. Timme, and Gerald D. Gay, "Macro Versus Micro Futures Hedges at Commercial Banks," *Journal of Futures Markets,* Spring 1984, 47-54.

[4]For supplementary information on these guidelines, see Banking Circular No. 79 (3rd Revision) issued by the Office of the Comptroller of the Currency (April 19, 1983); 45 Reg. 18120-22 (March 20, 1980), and 45 Fed. Reg. 18116-18 (March 20, 1980).

futures contracts on bank certificates of deposit.[6] These policy statements are applicable specifically to commercial banking activities and do not pertain to bank trust accounts. Futures contracts are not considered to be investment securities by the regulators.

As always, the regulators held that banks that engage in financial futures should do so only in accordance with safe and sound banking practices. Further, futures activity should be at a level reasonably related to the bank's business requirements and its capacity to fulfill the contractual obligations. Banks should evaluate their overall interest rate risk exposure resulting from asset and liability positions to ensure that the futures position reduces their total risk.

Financial futures positions in practice may be used to hedge interest rate risk exposure associated with undesired mismatches between interest-sensitive assets and liabilities. Long futures positions can be used when funding variable-rate assets with fixed-rate sources of funds; short futures positions can be used when funding fixed assets with variable rate liabilities.

Futures are viewed as a temporary risk management tool to aid the restructuring of the bank's portfolio rather than a permanent income generating device. Within this view, distinctions can be drawn between the federal regulators. The Comptroller of the Currency is unwilling to accept the substitution of a futures hedge for a prudent banking decision that can be made with available cash market instruments.[7] The Comptroller also suggests that, where practicable, futures contract gains be used to offset losses resulting from cash security sales undertaken to upgrade the yield on portfolio holdings.[8] On the other hand, the Board of Governors views futures hedging as an alternative to cash market transactions, treating futures as one possible tool for asset-liability management.

[6]See 46 Fed. Reg. 46386 (September 18, 1981).

[7]See Owen Carney, "Comments on 'The Regulation of Futures and Forward Trading by Depository Institutions: A Legal and Economic Analysis,' " *Journal of Futures Markets*, Summer 1981, 219-223.

[8]See Banking Circular no. 79 (3rd Revision) issued by the Office of the Comptroller of the Currency, April 19, 1983.

**Regulations for futures trading by commercial banks**

The Board of Governors has established the following as minimal guidelines to be followed by banks authorized to participate in financial futures. Similar guidelines have been established by the Federal Deposit Insurance Corporation and the Office of the Comptroller of the Currency.

1. Prior to engaging in futures transactions, a bank should obtain an opinion of counsel or its state banking authority concerning the legality of its activities under state law.

2. The board of directors should consider any plan to engage in futures trading and should endorse specific written policies in authorizing these activities. Policy objectives must be specific enough to outline permissible contract strategies and their relationship to other banking activities, and record keeping systems must be sufficiently detailed to permit internal auditors and examiners to determine whether operating personnel have acted in accordance with authorized objectives. Bank personnel are expected to be able to describe and document in detail how the positions they have taken in futures contribute to the attainment of the bank's stated objectives.

3. The board of directors should establish limitations applicable to futures contract positions; and the board of directors, a duly authorized committee thereof, or the

The regulation of futures trading by banks emphasizes the importance of self-policing behavior rather than strict adherence to specific externally imposed controls. (See box for a detailed outline of commercial bank regulations.) All open futures positions must be reviewed and market values determined at least monthly. Banks have the option of valuing futures

bank's internal auditors should review periodically (at least monthly) contract positions to ascertain conformance with such limits.

4. The bank should maintain general ledger memorandum accounts or commitment registers to adequately identify and control all commitments to make or take delivery of securities. Such registers and supporting journals should at least include:

   (a) the type and amount of each contract;

   (b) the maturity of each contract;

   (c) the current market and cost of each contract; and

   (d) the amount of money held in margin accounts.

5. With the exception of contracts described in item 6, all open positions should be reviewed and market values determined at least monthly (or more often, depending on volume and magnitude of positions), regardless of whether the bank is required to deposit margin in connection with a given contract. Underlying security commitments relating to open futures contracts should not be reported on the balance sheet. Margin deposits and any unrealized gains or losses are the only accounting entries recorded. All futures contracts should be valued on the basis of either market or the lower of cost or market, at the option of the bank. All losses resulting from monthly contract value determination should be recognized as a current expense item; those banks that value contracts on a market basis would recognize gains as a current income item. In the event the above described futures contracts result in the acquisition of securities, they should be recorded on a basis consistent with that applied to the contracts (either market or lower of cost or market).

6. Futures contracts associated with *bona fide* hedging of mortgage banking operations, i.e., the origination and purchase of mortgage loans for resale to investors or the issuance of mortgage-backed securities, may be accounted for in accordance with generally accepted accounting principles applicable to such activity.

7. Bank financial reports should disclose in an explanatory note any futures contract activity that materially affects the bank's financial condition.

8. To assure adherence to bank policy and prevent unauthorized trading and other abuses, banks should establish other internal controls including periodic reports to management, segregation of duties, and internal audit programs.

contracts on the basis of either market or the lower of cost or market, with futures losses recognized as a current expense item. (As discussed below, this treatment is usually contrary to the bank's treatment of cash market investments.) Bona fide hedging of mortgage banking operations with futures contracts is exempt from this accounting treatment; these transactions may be valued using the generally accepted practices of accounting.

All three federal bank regulators monitor bank transactions in futures contracts. National banks and bank holding companies are requested to notify their respective regulator(s) at the inception of futures trading activities, indicating the type and purpose of the activity. Monitoring

is also conducted through the bank examination process, although the timing and quality of this information is sometimes criticized. In light of what is learned through this continued review, the regulators may institute supervisory action in individual cases.

Trades by security dealer and trading departments at state member banks may be treated more liberally than futures trading to manage overall balance sheet risk. In this, they are similar to foreign bank exchange operations.[9] On the other hand, futures trading by trust departments, trust subsidiaries, and trust companies is viewed more conservatively by both federal and state regulators. The Federal Reserve Board's policy statement dealing with bank holding company participation in financial futures reflects the view that bank holding companies should be a source of strength for their subsidiary banks and should not speculate in financial futures. Any positions that bank holding companies or their nonbank subsidiaries take in financial futures should reduce risk exposure, not increase it. (See box for a detailed outline of bank holding company regulations.) The bank holding company regulations are consistent with the commercial bank regulations in that the primary regulatory initiative must come from within the organization itself. The parent holding company may not, however, consider the interest rate exposure of its bank subsidiaries in formulating holding company policies with respect to futures. This is consistent with the Board of Governors' belief that the final responsibility for futures transactions that reduce the interest rate risk exposure of an affiliated bank resides with the management of that bank. In contrast to the commercial bank regulations, no accounting treatment for bank holding company futures transactions is mandated.

Although the parent holding company cannot execute financial futures transactions for its bank affiliates and carry the transactions on the parent company's books, Board policy does not preclude it from centralizing the futures transactions of its bank affiliates for execution. As long as all transactions are passed through to its bank affiliates for the purposes of record keeping and those transactions reduce the net interest rate risk exposure of the bank affiliate, the centralization of futures trading by the parent may reduce the risk exposure of the entire organization.

Overall, the three federal regulators have adopted a policy stance that is quite liberal. A variety of futures positions can be taken by banks as long as it can be documented that the positions reduce the institution's net interest rate risk exposure. Because banks have had mixed results in matching the maturities of assets and liabilities, the guidelines on futures trading must be general enough to permit banks with a variety of balance sheet exposures to hedge their interest rate risk. Finally, the lower-of-cost-or-market accounting treatment of futures hedges is viewed as a deterrent to speculation because speculative losses cannot be hidden for long periods of time.

## Problems and questions

Policing bank behavior so that it conforms with the policy statements, defining an institution's undesired interest rate risk exposure, and accounting for financial futures transactions are three problem areas in the current regulations. The policy statements of the three federal banking agencies establish a framework for the self-regulation of futures activities subject to review by bank examiners. Because the effectiveness of a futures hedging strategy can only be known ex post, periodic monitoring of futures activity through the examination process seems appropriate. But this policy relies heavily on examiner judgment in determining the acceptability of an individual institution's futures transactions.

Do examiners have the expertise to make such a judgment? If depository institutions are still learning how to use financial futures, how much more informed can examiners be? In addition, given the speed with which futures markets move and the level of trader sophistication, a more frequent monitoring of bank and thrift futures transactions by the regulators would be advisable.

The appropriate definition of an institution's

[9]See Federal Reserve Board document AD82-24 (FIS) Manual for Examination Concerning Bank and Bank Holding Company Use of Interest Rate Futures and Forward Contracts (July 26, 1982).

**Regulations for futures trading by bank holding companies**

In addition to the guidelines in items 2, 3, and 4 with respect to individual commercial banks (Box), bank holding companies should follow these additional guidelines.

1. In formulating its policies and procedures, the parent holding company may consider the interest rate exposure of its nonbank subsidiaries, but not that of its bank subsidiary. As a matter of policy, the Board believes that any financial contracts executed to reduce the interest rate exposure of a bank affiliate of a holding company should be reflected on the books and records of the bank affiliate (to the extent required by the bank policy statements), rather than on the books and records of the parent company. If a bank has an interest rate exposure that management believes requires hedging with financial contracts, the bank should be the direct beneficiary of any effort to reduce that exposure. The Board also believes that final responsibility for financial contract transactions for the account of each affiliated bank should reside with the management of that bank.

2. The joint bank policy statements of March 12, 1980 include accounting guidelines for banks that engage in financial contract activities. Since a special task force of the American Institute of Certified Public Accountants is presently considering accounting standards for contract activities, no specific accounting requirements for financial contracts entered into by parent bank holding companies and nonbank subsidiaries are being mandated at this time. The Board expects to review further developments in this area.

3. The Board intends to monitor closely bank holding company transactions in financial contracts to ensure that any such such activity is consistent with maintaining a safe and sound banking system. In any cases where bank holding companies are found to be engaging in speculative practices, the Board is prepared to institute appropriate action under the Financial Institutions Supervisory Act of 1966, as amended.

4. Bank holding companies should furnish written notification to their District Federal Reserve Bank within 10 days after financial contract activities are begun by the parent or a nonbank subsidiary.

undesired interest rate risk exposure is related to the issue of policing compliance. If an examiner judges that futures activity lowers net interest rate risk exposure, such activity is acceptable to the regulators. But how should a depository institution's overall exposure be measured and how much of this exposure is deemed undesirable? The overriding standard by which futures transactions are judged—the reduction in net interest rate risk exposure—can be measured only subjectively. None of the policy statements offer guidance as to the measurement of risk exposure. In a sense, the implied flexibility in the measurement of bank risk exposure is consistent with flexibility in the implementation of a hedging program. The most widely used measure of the exposure of net interest income to changes in interest rates is the maturity gap approach, which involves classifying all asset and liability accounts by their term to maturity (or first permissible repricing whichever comes first.)[10] Maturity mismatches or gaps between assets and liabilities are calculated for subintervals in the predetermined horizon or over the entire horizon

[10]As one possible approach to developing a gap analysis model, see Appendix 8 of the manual referenced in note 7.

to assess the interest rate risk exposure.

The overall horizon and the subinterval cutoffs are determined subjectively; changing these limits can alter the evaluation of interest rate risk exposure appreciably.[11] Cumulating the subinterval gaps to measure overall risk exposure is of limited value because it hides the differences in asset and liability repricing and maturity that occur within the horizon. The maturity gap approach does not generate a single index number of interest rate risk exposure that the bank or thrift could use to assure that its futures transactions reduce overall net exposure.[12] The maturity gap measure also encourages a depository institution to use futures to hedge specific cash market instruments at specific subinterval maturities (micro hedging) to the possible detriment of regulatory objectives (macro hedging).

In addition, regulators realize that most types of normal banking activities are speculative to some degree, based on expectations of future interest rate movements. Thus, it seems plausible that banks and thrifts will want to carry some cash market interest rate risk even while engaging in futures transactions. Hedges may be selective or partial rather than complete and may be placed and lifted according to expectations of interest rate changes and futures gains.[13] Because banks and thrifts use interest rate forecasts in their cash market activities, it seems natural to use these forecasts in futures position-taking. The drawback with such selective hedging is that the risk-reduction potential of futures is sacrificed for a futures return greater than can be earned with complete risk exposure hedging. The success of a selective hedging program depends on consistent forecasting accuracy, which may be beyond the abilities of most bank managements.

Whether or not a bank selectively hedges just the undesired portion of its interest rate risk exposure, the jointness of cash and futures market transactions can also have an effect on the underlying risk exposure of the institution. The policy statements of the regulators suggest that futures transactions should occur after cash transactions because the latter are needed to calculate its net interest rate risk exposure. But suppose an institution's cash and futures market decisions are made simultaneously rather than sequentially. For example, a bank may decide to make more long term, fixed-rate loans when it has authorization to engage in futures transactions than it would without such authorization.[14] Net cash market interest rate risk exposure may then be greater with futures than without them. Depending upon its objectives, it may be optimal for the bank to make simultaneous cash and futures decisions to attain its desired level of risk bearing.[15] Should institutions be required to make futures decisions without regard to other cash market decisions and vice versa? If so, the gains from preventing joint decisions must be greater than the losses from the possibly suboptimal allocation of financial resources resulting from sequential decisions.

Another major issue concerns the accounting treatment applied to financial futures transactions.[16] As already indicated, commercial

[11]Bank examiners are requested to review an institution's gap analysis model to see if the assumptions are realistic and reasonable.

[12]The disadvantages of the maturity gap approach to interest rate risk exposure measurement are summarized by Alden L. Toevs, "Gap Management: Managing Interest Rate Risk in Banks and Thrifts," *Economic Review*, Federal Reserve Bank of San Francisco, Spring 1983, 20-35; and George G. Kaufman, "Measuring and Managing Interest Rate Risk," *Economic Perspectives*, Federal Reserve Bank of Chicago, January/February 1984, 16-29. These authors also offer an alternative risk exposure measure based on a duration approach.

[13]The Federal Reserve Board's instructions to examiners caution them to watch for excessive opening and closing of futures positions to guard against speculative activity.

[14]This result is shown theoretically by G. D. Koppenhaver, "A T-Bill Futures Hedging Strategy for Banks," *Economic Review*, Federal Reserve Bank of Dallas, March 1983, 15-28.

[15]In the situation where banks set deposit rates and take futures positions to hedge the risk of core deposit withdrawals, simultaneously, it has been estimated that such behavior significantly increases the variability of bank profits. See G. D. Koppenhaver, "Managing Deposit Flows with Cash and Futures Market Decisions," Unpublished paper, Research Department, Federal Reserve Bank of Chicago, 25 pages.

[16]For another discussion of the federal bank regulators' accounting prescriptions, see Michael R. Asay, Gisela A. Gonzalez, and Benjamin Wolkowitz, "Financial Futures, Bank Portfolio Risk, and Accounting," *Journal of Futures Markets*, Winter 1981, 607-618.

banks have the option of carrying futures transactions on a mark-to-market basis or a lower-of-cost-or-market basis. The rationale for this policy is that futures losses cannot be deferred and must be realized as a current expense item as they occur. The issue, however, is the extent to which this policy also discourages legitimate hedging activity. The financial effects of futures transactions can be deferred as long as the futures are "right" in the sense of favorable price movements relative to the futures position taken. If the futures trades are "wrong" such that the futures market moves against the position, the bank is disciplined by having to report losses.

In and of itself, this treatment seems innocuous, but financial institutions have traditionally applied an amortized cost basis to account for their nondealer cash market transactions. That is, the cash items hedged with futures are usually not marked to market but are carried at amortized cost. Even though the bank's risk exposure is correctly hedged and its balance sheet made less risky, reporting futures losses as they are marked to market while deferring cash market gains results in greater volatility in reported earnings. This inconsistent accounting treatment of futures relative to cash transactions does not recognize and reflect the basic intent of futures hedging: to reduce the net interest rate risk associated with an institutions's cash market transactions.

At the time the three federal banking regulators issued their policy statements, no accepted accounting treatment was in practice in the industry, and the accounting profession itself differed as to what the appropriate standard should be. In order to prevent unsafe and unsound banking practice, the regulators considered the prescription of accounting standards for bank futures transactions to be within their statutory responsibility. In August 1984, the Financial Accounting Standards Board (FASB) issued a statement of accounting standards for futures hedging transactions that differ from those authorized by the federal bank regulators and from those proposed by the American Institute of Certified Public Accountants, issued in December 1980.[17]

Since hedge or deferral accounting merely dictates when futures gains or losses are to be recognized as income and does not affect the accounting treatment of the hedged item, FASB outlines three criteria which must be satisfied before deferral accounting can be applied to futures transactions. If a transaction satisfies these criteria, deferred gains or losses are classified as an adjustment to the carrying amount of the existing hedged item and amortization of interest income or expense begins at the termination of the futures contract. The FASB criteria for hedge accounting treatment of futures are summarized as follows:

1. The item being hedged must expose the institution to interest rate risk such that futures hedging reduces the overall interest rate risk exposure of the institution (macro hedging). Risk can be assessed on a business unit basis when the decentralized nature of operations makes it impossible to consider the relevant positions and transactions of the entire enterprise.

2. At the inception of the hedge and throughout the hedge period, changes in the market value of the futures position must have a high (probable) correlation with the fair value of, or interest income or expense associated with, the hedged item so that the futures result will substantially offset the effects of price or interest rate changes on the hedged item (micro hedging). The futures contract(s) must be identified with a specific cash item or an identifiable group of essentially similar items.

3. If the hedged item is an anticipated cash transaction, the significant characteristics and expected terms of the anticipated transaction must be identified, and the anticipated transaction must be likely to occur.

[17]See *Statement of Financial Accounting Standards No. 80.* Financial Accounting Standards Board, Stamford, Connecticut (August, 1984).

In sum, these criteria fit with the principles and objectives underlying the federal regulators' policy statements. Commercial banks may have some marginal difficulty in decomposing their overall interest rate risk exposure into item by item components, as required by criteria 1 and 2, but the problem is not insurmountable. In light of the regulators' willingness to modify their prescribed accounting procedures, it would seem reasonable to authorize deferral accounting for futures transactions satisfying the FASB criteria to correct this technical impediment to banks' use of futures. A market discipline on bank futures transactions can be imposed more effectively in other ways.

**Suggestions**

There may come a time when an institution's *failure* to use the risk-shifting potential of financial futures is an unsafe and unsound banking practice. Until then, it is likely that bank regulators will continue to neither openly encourage or discourage bank participation in financial futures. As a risk management tool, financial futures hedging can be an effective device for reducing the net interest rate risk exposure of a depository institution's overall balance sheet until a restructuring can take place. Given the current and ongoing deregulation in the banking industry, an institution's environment is likely to become more uncertain, not less; to avoid a powerful risk management tool in such an environment only exposes financial intermediaries to more interest rate risk.

Before the time of "mandated" futures trading by banks arrives, much needs to be done to educate the institutions and regulators alike about the benefits and dangers associated with financial futures. Such an education effort requires an ongoing research effort as well. The rapid innovation of new futures contracts, especially financial futures contracts, makes both research and the education process continuous and more complicated.

As regulatory policy governing bank use of financial futures now stands, some refinements are possible within the context of primary regulation by the market and through self-policing activity.

First, the regulators should specify definite measures of interest rate risk exposure to be used by classes of institutions engaging in financial futures transactions. This would aid management as well as examiners in monitoring compliance with stated policy. If it is within the regulators' statutory responsibility to specify accounting treatments for futures, it would also seem to be within their statutory responsibility to specify how risk exposure should be measured.

Second, the regulators should authorize deferral accounting for futures transactions to remove the bookkeeping impediment to futures use that exists in current bank policy.[18] Tying accounting procedures to the intent and purpose of hedging will reduce the variability of reported earnings and help correct any inaccurate notions of what constitutes hedging and speculation.

Third, as a substitute for the market discipline imposed by the current policy on futures accounting, consideration should be given to the institution of a system of either risk dependent deposit insurance premiums or risk dependent futures margin requirements, over and above the exchange and brokerage requirements, based on the institution's past futures hedging results. In the latter case, liquid funds similar to loan loss reserves could be earmarked in the event an institution's past hedging results reveal a misuse of futures. Either system would raise the cost to the institution of making unsound banking decisions with respect to futures. Since it is unlikely that insured depositors will penalize a bank or thrift for assuming speculative futures positions, restricting the availability of funds for futures transactions through increased insurance premiums or margins can be used to inhibit an institution's use of futures contracts.

Regulatory control of futures use by banks is possible but current policy should be fine-tuned so that legitimate hedging activity is not discouraged. As bank participation in financial futures becomes more widespread, the benefits of such regulatory changes should become much more apparent.

[18]In view of *Statement of Financial Accounting Standards, No. 80*, this authorization is currently being studied by the Board of Governors.

# The bucks stop elsewhere: The Midwest's share of federal R&D

*Eleanor Erdevig*

Research and development (R&D) activities are generally regarded as the basis for technological innovation and are important to improving the competitive position of many U.S. industries through increased productivity and the development of new products and services. R&D spending is also important to the competitive position of industries in the different regions of the country.

The federal government is a major source of financing for R&D. According to the *Special Analyses Report* on R&D in the proposed United States budget for 1985, the federal government supports R&D to meet the direct needs of the government where the principal users of the results are the supporting agencies, and to assist in meeting broad national needs, particularly where the private sector lacks incentives for adequate investments, to assure long-term growth and continued improvement in the quality of life. R&D for national defense purposes is an example of the first category, and basic research across all fields of science is epitomized in the second. Federal dollars represent about one-half of all such funds spent in the country. In fiscal year 1985, the proposed total federal funding for R&D, including R&D facilities by all departments and agencies, represents approximately 6 percent of total federal obligations.

Federal R&D expenditures provide direct benefits to an area through increased employment and the development of scientific personnel. The research results and the trained labor force can provide the basis for the growth of existing and new industries in the area. In the long run, however, the benefits may be more widespread as the results of the R&D become available to other regions of the country. This article discusses the extent to which disparities exist among the regions in federal government obligations for R&D and the R&D outlook for Seventh District states, where economic problems have raised serious concerns about the future of many industries.

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## R&D and productivity

During the past 20 years an increasing amount of economic research has been devoted to the relationship of R&D to increases in productivity, technological change, and economic growth. This research has generally found a pervasive relationship between R&D and productivity gains although the amounts and timing may be uncertain.

The strongest relationship between R&D and productivity has been found in privately funded R&D, with government-funded R&D in some studies showing little or insignificant effects on productivity.[1] Much of this research, however, has focused on the relatively short-run effects of federally-funded R&D, and some economists have suggested that the benefits of government-sponsored R&D may be more long-term and diffuse. Privately funded R&D may tend to be more directly related to the problems of the individual firm and thus have more explicitly recognized benefits.

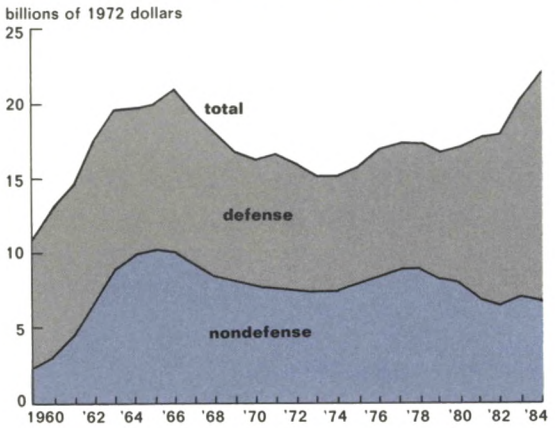
## Trends in federal funds for R&D

Total federal obligations for R&D in constant dollars rose sharply during the early 1960s, almost doubling from 1960 to 1967 (see Figure 1). Four-fifths of this increase was for non-

[1]Rolf, Piekarz, "R&D and Productivity Growth: Policy Studies and Issues," *American Economic Association Papers and Proceedings*, Vol. 73 (May 1983), pp. 210-214.

Nestor E. Terleckyj, "What Do R&D Numbers Tell Us About Technological Change?" *American Economic Association Papers and Proceedings*, Vol. 70 (May 1980), pp. 55-61.

Figure 1. **Federal R&D spending by purpose**




defense purposes, the result of the buildup in space R&D. After reaching an all-time high in 1967, real R&D spending declined 28 percent by 1974-1975, as a result of the cutbacks in both defense and space R&D. Subsequently, total real R&D obligations increased only gradually until 1980.

R&D, whether private or governmental, is generally broken down into three major categories: basic research, applied research, and development. (Definitions of the categories are summarized in the accompanying box.) These three categories are frequently considered to represent a continuous process: Knowledge gained from basic research leads to the application of results by means of applied research and finally to commercialization through development.

Real expenditures for basic research rose sharply during the sixties until 1967, but declined only about 9 percent by 1970. Real basic research expenditures remained about constant until 1977 before again rising (see Figure 2). Federal expenditures for applied research in constant dollars have followed a somewhat different pattern, doubling from 1960 to 1966, but then declining one-fifth by 1969. They recovered about half of this loss by 1978, but have since returned to the levels of the early 1970s. Real development expenditures rose about two-thirds to a high in 1967, declined about a third by the early 1970s, and have risen sharply only in the last two years.

Since 1980, real total federal obligations for R&D have risen sharply. Proposed fiscal year 1985 R&D expenditures are 31 percent above the 1980 level. Although real nondefense obligations are expected to be down 18 percent between 1980 and 1985, defense R&D is estimated to be up 70 percent. Real expenditures on basic research, which represent 15 percent of the total, are expected to be up about 27 percent during this period.

### Categories of R&D

**Basic research.** For the federal government, universities and colleges, and other nonprofit institutions, basic research is directed toward increases of knowledge in science with ". . . a fuller knowledge or understanding of the subject under study, rather than practical application thereof." To take account of an individual industrial company's commercial goals, the definition for industry funding is modified to indicate that basic research projects represent ". . . original investigations for the advancement of scientific knowledge . . . which do not have specific commercial objectives, although they may be in fields of present or potential interest to the reporting company."

**Applied research.** The NSF states: "Applied research is directed toward practical application of knowledge." Here again, the definition for the industry survey through which NSF collects private-sector data takes account of the characteristics of industrial organizations. It covers " . . . research projects which represent investigations directed to discovery of new scientific knowledge and which have specific commercial objectives with respect to either products or processes."

**Development.** The NSF's survey's concept of development may be summarized as " . . . the systematic use of the knowledge or understanding gained from research directed toward the production of useful materials, devices, systems or methods, including design and development of prototypes and processes."

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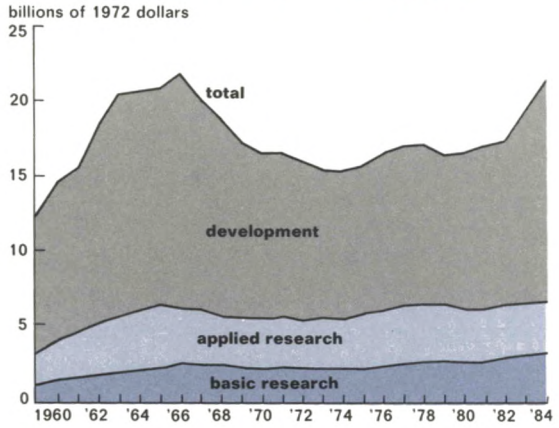
SOURCE: National Science Board, *Science Indicators 1980* Government Printing Office), p. 254.

Figure 2. **Federal R&D spending by type**




## Priorities in the eighties

Federal R&D spending during the eighties reflects two major policy decisions. The first and most important is the commitment to increased defense spending, including defense-related R&D. The second is the increased reliance on the private sector to fund many R&D activities that were formerly considered the government's responsibility and the limiting of government support of nondefense R&D primarily to basic research.

As a result of current policies, significant changes have taken place in federal government R&D spending patterns since 1980. Federal government R&D spending in real terms declined 3 percent from 1980 to 1982, the first full-year budget of the current administration. During this period real defense R&D spending grew by 26 percent, with most of the gain in development expenditures. Real nondefense R&D expenditures, on the other hand, were down 28 percent, and almost all of that loss was in funds for applied and development research.

From 1982 to 1984, real overall R&D spending rose 13 percent, but the patterns established in the 1982 budget continued. All of the increase was in defense-related R&D, and most of this was for development. Although there was little change in total real nondefense R&D expenditures, nondefense development funds declined 30 percent and basic research funds were up 23 percent.

Recent trends in government R&D spending continue in the 1985 budget request. Total overall spending on R&D is proposed at $52.8 billion, an increase of 13 percent in constant dollars. Only defense-related development and nondefense basic research funds show gains in real terms, with defense development funds up 23 percent and nondefense basic research up 3 percent. In nominal terms, the gains are $7.4 billion and $0.6 billion, respectively. In 1985, defense-related government R&D spending will represent almost 70 percent of all government spending on R&D, the highest proportion since 1962.

The emphasis on defense-related R&D and basic research in nondefense R&D has shifted the proportions of government R&D spending in the three traditional categories of basic research, applied research, and development. Despite the decrease in nondefense development expenditures, development funding has grown from 63 percent of the 1980 federal R&D request to 69 percent of the 1985 budget request because it dominates defense-related R&D. Basic research accounts for about 15 percent of total R&D spending, almost the same as in 1980, and applied research has fallen from 22 percent in 1980 to 16 percent in 1985.

Increased government support for basic research in the proposed 1985 budget is directed toward the physical and engineering sciences. The agencies that support primarily physical sciences and engineering, e.g., the Department of Defense (DOD), the National Aeronautics and Space Administration (NASA), the National Science Foundation (NSF), and the Department of Energy (DOE), will increase their basic research funds 8.7 percent in real terms. As shown in Table 1, these departments and agencies will account for more than 56 percent of all federal spending for basic research in 1985, up 2.7 percentage points from 1981. The more rapid growth in spending on basic research in the physical sciences and engineering is largely the result of the substantial increase by the Department of Energy.

**Table 1**

**Federal obligations for conduct of basic research by major departments and agencies: 1981 and 1985**

| | 1981 actual | | 1985 estimate | | 1981-1985 | |
|---|---|---|---|---|---|---|
| | Amount ($mil) | Percent of total | Amount ($mil) | Percent of total | Amount ($mil) | Change Percent |
| Agencies supporting primarily physical sciences and engineering[1] | | | | | | |
| National Science Foundation | 898 | 17.6 | 1330 | 16.8 | 432 | 48.1 |
| Energy | 591 | 11.6 | 1230 | 15.5 | 639 | 108.1 |
| Defense-Military functions | 603 | 11.8 | 939 | 11.8 | 336 | 55.7 |
| National Aeronautics and Space Administration | 532 | 10.4 | 828 | 10.4 | 296 | 55.6 |
| Other agencies[2] | 106 | 2.1 | 122 | 1.5 | 16 | 15.1 |
| Subtotal | 2730 | 53.4 | 4449 | 56.1 | 1719 | 63.0 |
| Agencies supporting primarily life and other sciences[3] | | | | | | |
| Health and Human Services (National Institutes of Health) | 1955 (1767) | 38.3 (34.6) | 2914 (2738) | 36.8 (34.5) | 959 (971) | 49.1 (55.0) |
| Agriculture | 314 | 6.1 | 420 | 5.3 | 106 | 33.8 |
| Other agencies[4] | 109 | 2.2 | 142 | 1.8 | 33 | 30.3 |
| Subtotal | 2378 | 46.6 | 3476 | 43.9 | 1098 | 46.2 |
| Total | 5108 | 100.0 | 7925 | 100.0 | 2817 | 55.1 |

[1]Include mathematics and computer sciences.

[2]Includes the Corps of Engineers, the Federal Emergency Management Agency, the Tennessee Valley Authority, and the Departments of Transportation, Commerce, and the Interior.

[3]Includes psychology and social sciences.

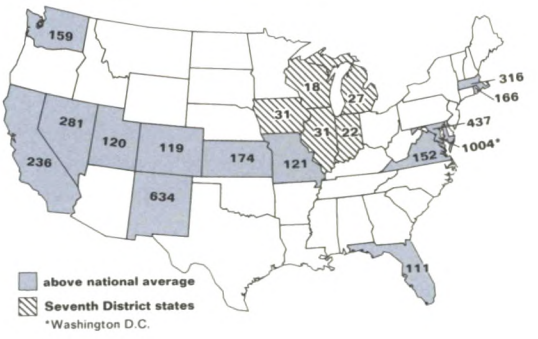
[4]Includes the Departments of Education, Labor, Justice, and Treasury, the Smithsonian Institution, the Environmental Protection Agency, the Veterans Administration, and the Agency for International Development.

SOURCE: *Special Analyses, Budget of the United States Government, 1985*, "Research and Development," Superintendent of Documents, U.S. Government Printing Office, Washington, D.C.; *Special Analysis, The Budget of the United States Government, 1983*, "Research and Development," Superintendent of Documents, U.S. Government Printing Office, Washington, D.C.

## Regional impact of departmental R&D funding

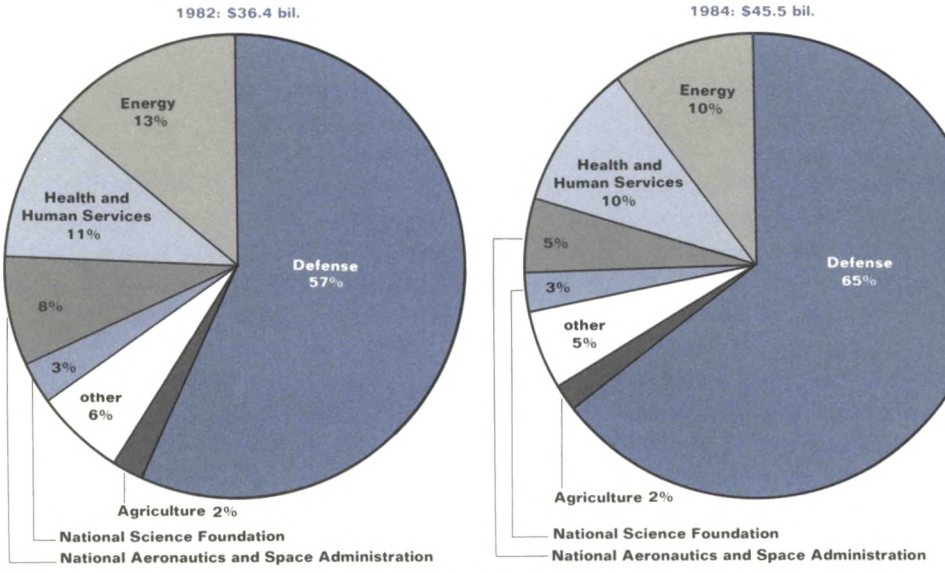
The Seventh District is not a major recipient of federal R&D funding. On a per capita basis the five states of the Seventh District received from 18 to 31 percent of the national average of total federal obligations for R&D in 1982. The states benefiting most from federal R&D spending are located primarily in the West, Southwest, New England, and near Washington D.C., as shown in Figure 3.

Figure 3. **Total Federal R&D spending: 1982**
(per capita, percent of national average)



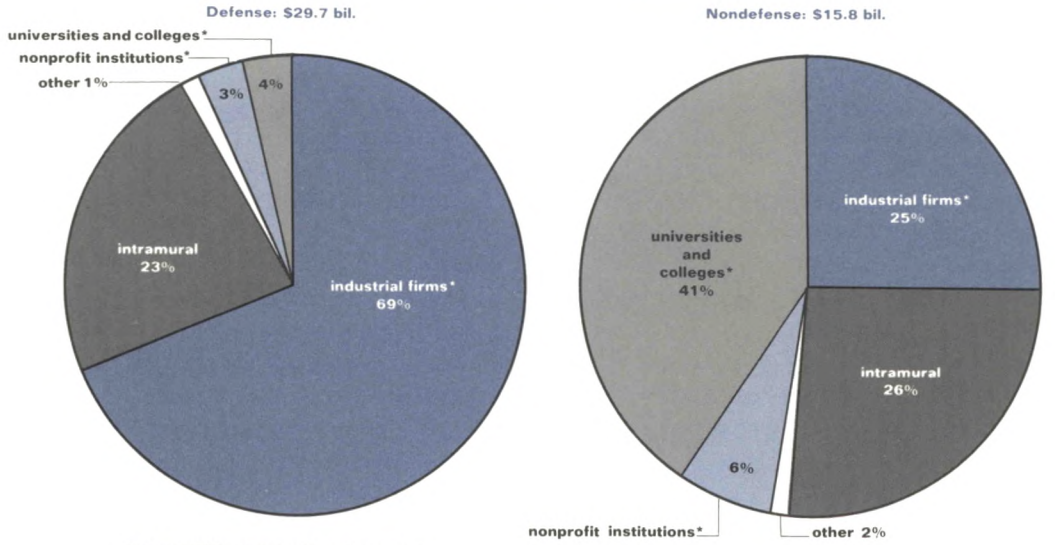
**Defense.** The Department of Defense (DOD) is the major source of federal R&D funds. In 1984, DOD provided about $29.7 billion, about two-thirds of all federal R&D obligations (see Figure 4). The dominant share (88 percent) of defense R&D is for development as opposed to 3 percent for basic research. Industrial firms are the primary performers of defense-related R&D, receiving 69 percent of such funds (see Figure 5). Most of the balance is used

Figure 4. **Department or agency sources of Federal R&D funds**




SOURCE: **Federal Funds for Research and Development: Fiscal Years 1982, 1983, and 1984,** Volume XXXII, NSF 83-319, National Science Foundation, Washington, D.C.

Figure 5. **Performers of Federal R&D: 1984**




*Includes FFRDCs administered by performer group.

SOURCE: **Federal Funds for Research and Development: Fiscal Years 1982, 1983, and 1984,** Volume XXXII, NSF 83-319, National Science Foundation, Washington, D.C.

directly by DOD or another federal department or agency, i.e., intramurally, and only a small portion is received by universities and colleges and nonprofit institutions.

The poor showing of Seventh District states in the per capita receipt of federal R&D funds relative to the national average is largely the result of the limited amount of defense R&D funds obtained by firms and institutions in the area. Per capita DOD obligations for R&D for District states in the aggregate were only 15 percent of the national average in 1982 and ranged from 2 percent of the national average in Wisconsin to 26 percent in Michigan. In contrast to this, six states (Massachusetts, New Mexico, Maryland, Kansas, California, and Rhode Island) received over twice the national average of per capita obligations for defense R&D.

DOD obligations for R&D performed by industry where the emphasis is on development are part of and closely related to defense procurement contracts and tend to be concentrated in a few states. In 1982, three states (California, Massachusetts, and Missouri) accounted for just over half of all defense R&D obligations to industry, and over three-fourths of such defense R&D is performed in only ten states. On a per capita basis, the primary beneficiaries of defense-related R&D are Maryland and Virginia in the Washington, D.C. area and a few states with major defense plants. None are Seventh District states. Based on past experience, therefore, and without a major diversion of defense R&D awards to firms in the Seventh District, industry in this area is not expected to benefit directly as a result of increased federal expenditures for defense R&D.

Obligations for R&D by the DOD to universities and colleges, nonprofit institutions, and university-administered and independent federally-funded research and development centers (FFRDCs) represent a small fraction of the total DOD budget. During 1984, only about 7.4 percent of the total DOD funds for R&D went to these institutions. About three-fifths of these funds will go to universities and colleges or university-sponsored FFRDCs, and the balance to independent nonprofit institutions.

FFRDCs are exclusively or substantially financed (70 percent or more) by the federal government, usually from one agency, either to meet a particular R&D objective or, in some instances, to provide major facilities at universities for research and associated training purposes. Most or all of the facilities are owned by, or are funded under contract with, the federal government.

Almost half of the funding by the DOD for the conduct of R&D at universities and colleges in 1981 (the latest year for which these data are available), was at schools located in the South Atlantic region. This is largely the result of the substantial support provided to Johns Hopkins University at Baltimore, which in 1981 received $280 million, or about 40 percent of the total. (The Applied Physics Laboratory, a university-administered FFRDC funded by the Navy became part of Johns Hopkins University in 1978.) The only other region in which the universities and colleges received above average per capita DOD funding for R&D is the New England area. Massachusetts received 7.5 percent of all DOD funding at universities with the Massachusetts Institute of Technology receiving just over half of this amount. About half of all DOD support of R&D at universities and colleges is concentrated at four schools—Johns Hopkins, MIT, Georgia Institute of Technology, and Stanford University. Ten schools received almost two-thirds of the DOD support for R&D; none are located in the Seventh District.

Schools in the Seventh District received only 4.3 percent of DOD funding for R&D at universities and colleges in 1981. A review of budget requests since 1981 indicates that DOD funding for R&D at District universities and colleges has not changed significantly.

In 1982, the DOD supported R&D at six FFRDCs, of which two were administered by universities and four by other nonprofit institutions. Total support by the DOD was $510 million and the three largest FFRDCs accounted for over 90 percent of this form of DOD support for R&D.

**Energy**. The second largest source of federal R&D funds is the Department of Energy (DOE), which in 1984 provided roughly $4.5 billion or 10 percent of total federal funding for the conduct of R&D. About three-fifths of DOE's

R&D is for development, and the balance is about evenly divided between basic and applied research. In addition, the DOE is the largest supplier of funds for R&D facilities and fixed equipment, such as reactors, wind tunnels, and radio telescopes for use for R&D activities at federal or non-federal installations. In 1984, it supplied about $900 million, or 56 percent of all federal funding for R&D facilities. Almost all of the R&D funded by the DOE is performed outside the federal government, with only about 3 percent of the funds used intramurally.

About two-thirds of the DOE's R&D in 1984 was performed by 20 FFRDCs. Of the 20, eight are administered by industrial firms, ten by universities and colleges, and two by nonprofit institutions. The type of R&D performed by the individual FFRDCs, whether basic or applied research or development, depends to a large extent upon who administers the facility. Those FFRDCs administered by industrial firms devote, in the aggregate, about four-fifths of their federal R&D funds to development and only 6 percent to basic research. FFRDCs administered by universities, on the other hand, spend only about two-fifths of their R&D funds on development and the balance is about equally divided between basic and applied research.

The 20 FFRDCs currently sponsored by DOE are located in twelve states (see Figure 6). Two FFRDCs in New Mexico receive about 27 percent of the federal obligations for the conduct of R&D and facilities at DOE FFRDCs, and four in California receive 21 percent. Other individual states with DOE-sponsored FFRDCs receive 10 percent or less of the funds.

Among the Seventh District states, only Illinois had per capita DOE obligations for R&D above the national average in 1982. This was the result of two large FFRDCs located there—Fermi National Accelerator Laboratory, Batavia, Illinois, administered by Universities Research Association, Inc., and Argonne National Laboratory, Argonne, Illinois, administered by the University of Chicago and Argonne Universities Association. Together these two FFRDCs received $363.7 million from the DOE for R&D and R&D plant support in 1982. The only other FFRDC located in the Seventh District is Ames Laboratory, Ames, Iowa, administered by Iowa State University of Science and Technology, which received $15.6 million in 1982.

Figure 6. **Department of Energy obligations for R&D to FFRDCs*: 1982**
($ millions)


1. E.O. Lawrence Livermore National Laboratory ($590)
2. Sandia National Laboratories ($559)
3. Los Alamos National Laboratory ($490)
4. Hanford Engineering Development Laboratory ($288)
5. Bettis Atomic Power Laboratory ($283)
6. Knolls Atomic Power Laboratory ($232)
7. Argonne National Laboratory ($224)
8. Oak Ridge National Laboratory ($201)
9. Brookhaven National Laboratory ($164)
10. Idaho National Engineering Laboratory ($144)
11. Fermi National Accelerator Laboratory ($140)
12. E.O. Lawrence Berkeley Laboratory ($131)
13. Princeton Plasma Physics Laboratory ($125)
14. Savannah River Laboratory ($95)
15. Pacific Northwest Laboratory ($91)
16. Stanford Linear Accelerator Center ($71)
17. Solar Energy Research Institute ($53)
18. Energy Technology Engineering Center ($36)
19. Ames Laboratory ($16)
20. Oak Ridge Associated Universities ($9)

*FFRDCs are federally funded research and development centers.

Industrial firms perform most of the balance of the R&D (23 percent) funded by DOE. About 84 percent of this is for development and the balance is almost all for applied research. Only about 6 percent of DOE R&D is performed at universities.

**Health and Human Services.** The Department of Health and Human Services (HHS) is the largest supporter of R&D at universities and colleges and independent nonprofit institutions, largely through the National Institutes of Health (NIH). In 1984, HHS provided about $4 billion, or 10 percent of total federal funding for the conduct of R&D. Of this amount 56 percent went to universities and colleges and 13 percent to nonprofit institutions, primarily hospitals. This represents almost half of all federal support for R&D at universities and colleges and at nonprofit institutions. Most of the balance was used intramurally by HHS.

HHS funds primarily basic and applied research in the life sciences, notably the biological and medical sciences and the social sciences. In 1985, about seven-eighths of the Department's funds for the conduct of R&D is proposed

to be used by the National Institutes of Health for biomedical research in the prevention, diagnosis, and treatment of disease.

As a result of the administration's increased emphasis on federal funding for basic research, all of the increase in the HHS budget for the conduct of R&D since 1981 has been for basic research. HHS obligations for the conduct of basic research are up 49 percent in nominal terms (23 percent real) between 1981 and 1985, but obligations for applied research and development are nominally unchanged and down 17 percent in real terms. Consequently, basic research will represent 59 percent of the Department's R&D budget in 1985 compared with 49 percent in 1981.

Although the geographic distribution of HHS support for R&D at universities and colleges might be expected to be roughly proportional to the distribution of population, such does not appear to be the case. As shown in Figure 7, HHS obligations for academic R&D on a per capita basis ranges from highs of 406 and 275 percent of the national average in the District of Columbia and Massachusetts, respectively, to less than 10 percent in Idaho, Alaska, Maine, and Nevada, which do not have major medical research centers.

On a per capita basis, none of the Seventh District states were among the top ten in obligations to schools for R&D by HHS in 1982. Only Wisconsin and Iowa were above the national average and ranked 13th and 15th, respectively. The other three states, Illinois, Michigan, and Indiana were all below the national average.

Among the individual universities, the nine schools receiving the largest amounts in 1981 were either on the East or West Coast (see Table 2). Seventh District schools receiving the largest amounts were the University of Michigan, University of Wisconsin-Madison, and the University of Chicago, which ranked 12th, 13th, and 16th, respectively.

The state distribution of HHS funding for R&D at nonprofit institutions, primarily hospitals, is even more unevenly distributed, as shown in Figure 8. Four-fifths of such HHS support goes to nonprofit institutions located in just ten states, and three states, Massachusetts, California, and New York, receive over half. Illinois is the only Seventh District state represented among the top ten. On a per capita basis, Massachusetts received 935 percent of the national average in 1982 followed by the District of Columbia at 820 percent (see Figure 8). None of the Seventh District states received above the national average, and Indiana received only 6 percent and Iowa 1 percent.

**Air and space.** The National Aeronautics and Space Administration (NASA) is currently the fourth largest supporter of federal R&D. R&D accounts for about two-fifths of the total NASA budget. In 1984, NASA provided roughly $2.5 billion, 5 percent, of total federal funds for

Figure 7. **Department of Health & Human Services obligations for R&D to universities and colleges: 1982**
(per capita, percent of national average)

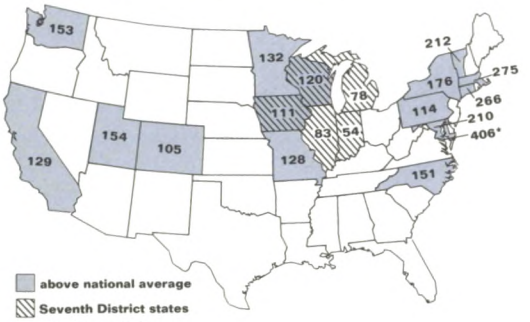



Figure 8. **Department of Health & Human Services obligations for R&D to nonprofit institutions: 1982**
(per capita, percent of national average)

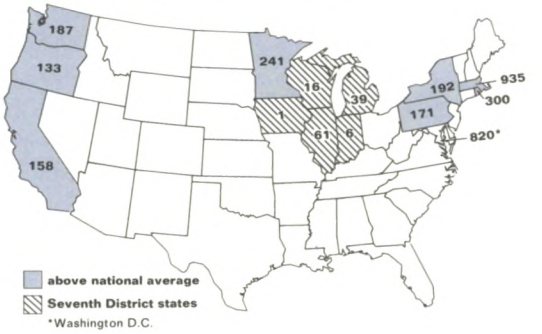


**Table 2**

**Federal obligations to universities and colleges for R&D by Department of Health and Human Services: 1981**

| Rank | University or college | Amount ($mil.) | Percent of total |
|---|---|---|---|
| 1 | John Hopkins University (Maryland) | 66.5 | 3.1 |
| 2 | Harvard University (Massachusetts) | 63.4 | 3.0 |
| 3 | University of California Los Angeles | 63.0 | 3.0 |
| 4 | University of California-San Francisco | 59.7 | 2.8 |
| 5 | Yale University (Connecticut) | 56.1 | 2.7 |
| 6 | Columbia University Main Division (New York) | 53.8 | 2.5 |
| 7 | University of Pennsylvania | 53.4 | 2.5 |
| 8 | University of Washington | 52.9 | 2.5 |
| 9 | Stanford University (California) | 52.5 | 2.5 |
| 10 | University of Minnesota | 47.1 | 2.2 |
| 11 | Washington University (Missouri) | 46.6 | 2.2 |
| 12 | University of Michigan | 44.7 | 2.1 |
| 13 | University of Wisconsin-Madison | 43.8 | 2.1 |
| 14 | Yeshiva University (New York) | 41.3 | 2.0 |
| 15 | Duke University (North Carolina) | 36.9 | 1.7 |
| 16 | University of Chicago (Illinois) | 35.1 | 1.7 |
| | Subtotal | 816.8 | 35.5 |

SOURCE: *Federal Support to Universities, Colleges, and Selected Nonprofit Institutions: Fiscal Year 1981*, NSF 83-315, National Science Foundation, Washington, D.C., Table B-16, pages 68-69.

the conduct of R&D. About one-third of the funds were used for development, about two-fifths for applied research, and the balance for basic research.

Almost one-half of NASA R&D was performed intramurally in 1984 with three-fourths of these expenditures for personnel costs. About 80 percent of the work is in basic and applied research.

Industrial firms perform about one-third of the R&D funded by NASA with almost one-half of the funds devoted to development. Universities receive only about 8 percent of NASA R&D funds with emphasis on basic research. NASA also sponsors an FFRDC, Jet Propulsion Laboratory at Pasadena, California, which is administered by California Institute of Technology and is primarily devoted to development.

California is the primary location for industry performing R&D for NASA. In 1982, firms located in California received 46 percent of the NASA R&D funds allocated to industry. Other important states with industrial firms performing NASA R&D are Florida, Texas, Maryland, and Louisiana. Very little NASA R&D is done by industry in Seventh District states.

**National Science Foundation.** The other agency that is a major source of federal R&D funds is the National Science Foundation (NSF) which supports primarily basic research through grants to scientists and engineers in academic institutions. Emphasis is currently being placed on strengthening support for the physical sciences such as mathematics, physics, and chemistry, for engineering, and for molecular and cell biology. In 1984, NSF funds for R&D were about $1 billion, or 3 percent of total federal obligations for R&D. Nearly all of this amount was for basic research and the balance for applied research.

Universities and colleges received $914 million, or 74 percent of NSF R&D funds in 1984, and six FFRDCs administered by universities received an additional $103 million or 8 percent. Other nonprofit organizations, along with industrial firms, received 7 percent. Only about 11 percent of NSF R&D funds are used intramurally.

Four of the Seventh District states, Illinois, Indiana, Michigan, and Wisconsin, are among the top ten in the receipt of funds from NSF for R&D by universities. On a per capita basis, however, only Indiana, Illinois, and Wisconsin received such funds above the national average (see Fig-

ure 9). Nationally, universities in three states, Rhode Island, Alaska, and Massachusetts, receive NSF funds for R&D over four times the national per capita average.

In summary, the DOD is the largest and fastest growing source of federal R&D funding. Almost all the funds are for development rather than basic or applied research, and industry is the primary performer of defense-related R&D. Generally, development funds are a prelude to procurement. Consequently, a large part of federal R&D expenditures follow the same regional patterns as defense procurement. California dominates defense procurement, and it also is the largest recipient of federal R&D funding. Seventh District states receive below average defense R&D expenditures.

Basic research represents less than one-sixth of federal R&D funding. From the major federal departments and agencies that support basic research, other than the Department of Defense, Seventh District states receive above average funding for R&D in certain instances. The two FFRDCs in Illinois make the state a major recipient of energy-related funds. Only Wisconsin and Iowa are above the national average in per capita R&D funds to universities and colleges by the Department of Health and Human

## Where to base the biggest machine?

Some economic benefits of R&D funding for basic science are more immediate than the nature of the research itself might suggest. Besides the initial construction costs, for an observatory, say, or a national laboratory, the ongoing ripple of research funds can be a boon to local economies. So state and local competition for such installations can be intense. A case in point is the superconducting super collider (SSC) proposed by U.S. high-energy physicists.

The SSC, with which scientists would investigate the nature of matter and energy by slamming beams of protons at energy levels of 20 trillion electron volts against each other, would be the largest machine ever built. Present designs call for a tunnel, 200 - 300 feet underground, describing a circle 60 to 80 miles in diameter. The tunnel would contain 10,000 to 20,000 supercooled magnets, which would provide the magnetic field needed to contain the proton beams. Ancillary equipment and facilities include cooling equipment, storage facilities for liquid helium and nitrogen, detectors, and computers. Teams of high-energy physicists working on alternate design proposals for the SSC have come up with remarkably similar price tags, around $3 billion.

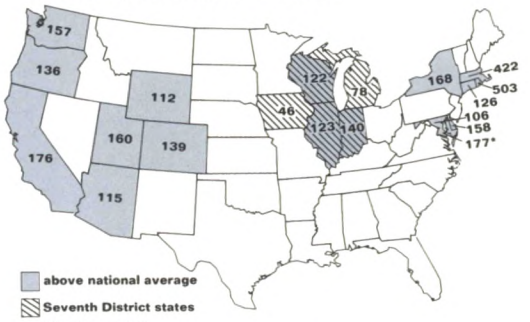
Whether the SSC will actually be built is by no means clear. The American physics community, fearful of losing out to the Europeans in high-energy particle physics, is clearly in favor. But a long and chancy schedule must be met. The Department of Energy (DOE), which is funding the preliminary design work, must get a commitment from the Congress for the funds to build the machine. This will not be easy in a time of high deficits and spending cutbacks. Assuming Congressional approval, plans call for a final site selection by April 1986, a construction start later that year, and a fully operational SSC by 1994.

Despite the uncertainties, many states are beginning to plan and lobby for selection as the home of the SSC. Among them are New York state, Utah, Arizona, New Mexico, Washington, and Texas. In the Seventh Federal Reserve District, Illinois, already home of Fermilab, one of the two largest high-energy physics centers in the world, is gearing up for a run at the SSC.

Illinois' plan would base the SSC at Fermilab in Batavia. The existing infrastructure, officials say, would reduce the preliminary price tag of the SSC by $500 million, and provide a seasoned technical staff as well. In addition, because of Chicago's ongoing Deep Tunnel project, Illinois has an edge over other areas in tunneling technology.

The Illinois state government has already allocated funds for geological, natural history and environmental impact surveys of the area. The Congressional delegation is preparing for its role in landing the project. State officials are also lining up private business support. But the final decision will be made in Washington and it will be based on national goals and the state of the economy, available scientific resources and local economic inducements, and, not least, political clout.

Figure 9. **National Science Foundation obligations for R&D to universities and colleges: 1982**
(per capita, percent of national average)




NOTE: Alaska (445%) and Hawaii (134%) not drawn on map.

Services. Indiana, Illinois, and Wisconsin are above the national average in the receipt of R&D funds from the National Science Foundation on a per capita basis. None of the District states are major recipients of R&D funds from NASA.

### Outlook for the Seventh District

Current trends in federal spending for R&D by the major agencies indicate that states in the Seventh District will not benefit from the increase in federal obligations for R&D. Consequently, federal R&D support cannot be relied upon to improve the competitive position of industry in the area or serve as a stimulus to the development of new goods and services.

The increased emphasis on defense-related R&D, in particular, will not benefit the District. Instead, it may be expected to improve the competitive position of a limited number of states where it is already important. Only if District industry begins to aggressively seek out defense R&D contracts, will states in the District obtain these funds, and the subsequent defense procurement contracts.

Increased federal funding for basic research, especially at universities, may be expected to aid the District states. Basic research, however, represents only 15 percent of the total federal R&D budget and the impact, therefore, may be limited. In addition, funding by the agencies where basic research will increase in real terms, namely, DOD, NASA, NSF, and DOE, is generally below the per capita national average in District states. It will require a concerted effort by both the private and public sectors to obtain funds from these departments and agencies for R&D in those fields where the District has, or expects to have, the resources and skills to conduct successful research.

## ECONOMIC PERSPECTIVES—Index for 1984

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