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The economy's sluggish response to monetary policy ease is nonetheless understandable from the standpoint of the credit view of monetary policy. According to this view, the force of monetary policy depends partly on the willingness of banks to lend. If banks are cautious about lending, as they have been recently, then faster money growth and lower market interest rates may pack a weaker economic punch than in the past.

Morgan examines both the credit view of monetary policy and the money view. He concludes that while credit channels usually magnify the effects of monetary policy, the current weakness in the banking sector may have partly blocked these channels. As a result, the credit view helps explain why the economy has remained sluggish despite a considerable easing of monetary policy.

Tenth District Construction: Smoother Sailing Ahead? 43

By Tim R. Smith

Activity in the Tenth District's construction sector underwent wide swings in the 1980s. During the national recessions of the early 1980s, construction slowed from its torrid pace of the late 1970s. Then, just as building activity began to recover in the mid-1980s, two events shook the district's construction industry. Federal tax reform removed strong incentives for investment in commercial construction. And the collapse of the energy industry ended much of the demand for office space and housing in the district's major cities. As the decade drew to a close, building activity in most parts of the district stood still.

Will the district's construction sector enjoy smoother sailing in the 1990s? Smith examines the growth of construction in the district and concludes that growth in the 1990s will be slower than in the 1980s but less erratic.

The Changing Economy of the Tenth District 57

By Glenn H. Miller, Jr.

The Commerce Department recently released new gross state product (GSP) estimates through 1989 and revised GSP estimates dating back to 1977. Comprehensive and consistent across states, the GSP data by industry offer a broad, in-depth view of economic performance. The data are especially useful for studying long-run growth trends and long-run changes in industrial structure.

Miller uses the new GSP figures to describe the Tenth District economy at the end of the 1980s and to show how its industrial makeup has changed since 1979. While the district economy has retained its distinctive character, it has become more like the national economy in important ways. The performance of the district economy in the years to come may reflect these changes.

Agriculture's Portfolio for an Uncertain Future: Preparing for Global Warming

By Mark Drabenstott

To help prepare U.S. delegates to the upcoming United Nations Conference on Environment and Development, the U.S. Department of Agriculture in 1991 commissioned the Council for Agricultural Science and Technology (CAST) to determine how U.S. agriculture can prepare for global warming. CAST assembled a panel of 11 national experts, including eight biological and physical scientists and three economists. Their report, *Preparing U.S. Agriculture for Global Climate Change*, is being published by CAST. Copies are available from CAST, 137 Lynn Avenue, Ames, IA 50010-7197, telephone (515) 292-2125. This article summarizes the report's major findings and recommendations.

On June 3, world leaders will convene in Rio de Janeiro for the United Nations Conference on Environment and Development—or what people around the world are calling "Earth Summit." Earth Summit will draw legions of official delegates and perhaps up to 50,000 observers, all anxious to see whether nations can agree on a strategy for maintaining economic progress while coping with mounting concerns about the environment. Recognizing that lofty aim, some are calling this conference the ecological equivalent of Bretton Woods, the 1944 New Hampshire summit that set the global financial framework for a generation of postwar economic growth.[1]

The conference will take up many issues, but the central topic will be global warming. The burning of fossil fuels and a host of other human activities are putting more greenhouse gases like carbon dioxide in the atmosphere, threatening a warmer climate in the future. Like other industries, agriculture emits greenhouse gases, but it

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is unique in that it also absorbs them through photosynthesis. Delegates at the conference will consider ways to cut emissions of greenhouse gases, store the gases that are emitted, and help the global economy adapt to a different climate.

Global warming poses a bigger threat to agriculture than to any other industry. Agriculture is conducted mostly outdoors, and changes in climate affect where, when, and how food and timber are produced. But climate is always changing, and for centuries farmers and foresters have been discovering ways to adapt to climate change. In the twentieth century, dramatic advances in technology have made agriculture even more adaptable. Thus, while global warming may pose a very real threat, U.S. agriculture will have many tools with which to respond and adapt.

Many attempts have been made to predict how global warming would affect U.S. agriculture, but these predictions remain inconclusive because tomorrow's climate is so uncertain. To decide how public policy should prepare for the threat of global warming, the following questions must be answered.

First, does U.S. agriculture play a big role in emitting greenhouse gases, and can it emit less and store more? The first section of this article describes the greenhouse effect and shows that U.S. agriculture contributes only fractionally to global greenhouse gases. Still, agriculture could store substantial amounts of the gases in forests and soil, if necessary.

And second, what can U.S. agriculture do to adapt successfully to future climate change? The second section concludes that the nation should manage a diverse portfolio of agricultural assets to adapt to an uncertain future climate. The nation has a strong base portfolio of ten assets—each of which can help agriculture adapt. A crucial asset will be the world market that facilitates trade flows among countries. But if agriculture is to adapt successfully, steps must be taken now both to strengthen those assets—including world trade channels—and to increase the flexibility in using them.

U.S. AGRICULTURE AND THE GREENHOUSE EFFECT

The greenhouse effect, although widely discussed, is still widely misunderstood. Part of the confusion is that the greenhouse effect is both natural and induced. *The natural greenhouse effect* results from gases like carbon dioxide and water vapor forming an atmospheric thermal blanket around the earth, trapping the warmth of sunlight and making the earth habitable. It has been estimated that without that natural blanket of greenhouse gases, sunlight would simply be reflected back into space and the earth's temperature would be colder by 33 degrees Celsius (C), or 59 degrees Fahrenheit (F). *The induced greenhouse effect*, or what scientists call climate forcing, is the result of additional greenhouse gases put into the atmosphere through human activities, such as the release of carbon dioxide when fossil fuels are burned. The induced greenhouse effect is well understood, and the rise in greenhouse gases from human activity is well documented. What remains unclear is how and when the increase will affect the earth's climate.

Agriculture has three vital links to the greenhouse effect. First, agriculture is made possible only through the natural greenhouse effect, and any changes to the current climate will change agriculture itself. Second, agriculture contributes to the induced greenhouse effect; burning fossil fuel to power tractors, for example, releases carbon dioxide. Finally, agriculture can reduce the amount of greenhouse gases in the atmosphere because trees and plants absorb carbon dioxide from the atmosphere and store carbon in wood or soil. This section examines these three links.

The greenhouse effect and global warming

The root issue in the global debate over climate change is whether an observed increase in greenhouse gases will change the climate in the future, and if so, how. Unfortunately, scientists

have not made a conclusive link between rising atmospheric concentrations of the major greenhouse gases and future changes in climate. Notwithstanding the scientific loose ends, the consensus view today is that more greenhouse gases will mean a significant change in climate tomorrow.[2]

Without doubt, the atmosphere contains more of the major greenhouse gases than it did a century or two ago. Table 1 lists the four main greenhouse gases: carbon dioxide, methane, nitrous oxide, and chlorofluorocarbons (CFCs). The table describes the sources of emission for the gases and then compares the concentrations of the gases before the industrial revolution and today, along with their current rate of increase. Carbon dioxide is the biggest culprit in climate forcing, or the induced greenhouse effect. From 1980 to 1990, carbon dioxide accounted for an estimated 55 percent of climate forcing. To stabilize the concentration of carbon dioxide at current levels, emissions from human activities—largely the burning of fossil fuels—would have to drop more than 60 percent, a highly unlikely prospect.[3]

The more important issue is how these rising concentrations of greenhouse gases will change tomorrow's climate. To answer that question, climatologists and physicists have constructed ambitious computer models called General Circulation Models (GCMs).[4] GCMs quantify the complex processes of the global climate system and are so massive that they can be solved only by running the biggest supercomputers for weeks or months on end. Once constructed, model parameters can be changed to examine the effects of rising concentrations of greenhouse gases. Nearly all projections are based on carbon dioxide concentrations doubling from pre-industrial revolution levels, an outcome that might happen by 2050 if the current rate of greenhouse gas emissions continues.

The United Nation's Intergovernmental Panel on Climate Change (IPCC) is widely regarded as issuing the benchmark prediction of future change (IPCC 1990). Drawing on GCM projections, the panel's 1990 report predicted that a doubling of carbon dioxide would ultimately raise the earth's mean temperature 1.5° to 4.5°C (2.7° to 8.1°F), with 2.5°C (4.5°F) the best guess. They also estimated that the earth will warm 1°C (1.8°F) by 2030. Along with a rise in temperature, global precipitation would increase 3 to 15 percent.

The IPCC estimated that changes in temperature and precipitation would not be distributed uniformly around the globe, but they placed less confidence in their regional projections than their global ones. For central North America (including the United States), the IPCC estimated that by 2030 temperatures would increase 1° to 3°C (1.8 to 5.4°F) in winter and 1 to 2°C (1.8° to 3.6°F) in summer. Precipitation would increase 0 to 15 percent in winter but decline 5 to 10 percent in summer. Overall, the climate would be more adverse for agriculture, particularly due to a drop in soil moisture and more days of extreme heat in the summer.

All of the IPCC projections must be tempered, however, by the many shortcomings of the GCMs that lie behind the projections (Rosenberg; National Academy of Sciences 1991a; Solow). The models divide the world into segments roughly the size of Colorado—a scale too big to capture important regional effects. And for agriculture, the regional effects are far more important than global averages. The models do not capture the dynamic interaction between temperature, evaporation, and cloud cover. That is, the models cannot predict whether global warming means more or fewer clouds, a key point in deciding how much sunlight is reflected and how much is trapped. Most important of all, the models do not effectively couple the atmosphere and the oceans, a crucial link in the earth's climate system.

The future climate cannot be predicted with a lot of certainty, but if the IPCC scenario proved true, the change in climate would have a major impact on U.S. agriculture. Higher temperatures might cut crop yields, especially if temperatures were significantly higher during critical periods such as corn pollination. Shifting temperature and

Table 1

The Principal Greenhouse Gases

	Carbon dioxide	Methane	Nitrous Oxide	CFC11	CFC12
Source of emission	Fossil fuels, deforestation	Rice cultivation, ruminants, biomass burning, coal mining	Fossil fuels, biomass burning, agricultural practices	Refrigerants, propellants solvents	Refrigerants propellants solvents
Atmospheric concentration	parts per million	parts per million	parts per billion	parts per trillion	parts per trillion
Pre-industrial (1750-1800)	280	.8	288	0	0
Present day (1990)	353	1.72	310	280	484
Current rate of change per year	1.8	.015	.8	9.5	17
	.5%	.9%	.25%	4%	4%
Reduction in human-made emissions required to stabilize concentration at present-day levels	more than 60%	15-20%	70-80%	70-75%	75-85%
Contribution to global climate forcing from 1980 to 1990	55%	15%	6%	17%	

Source: Compiled from a number of tables and figures in the Policymakers Summary and Part I of IPCC (1990), Lemon et al. (1992), and Solow (1991).

precipitation patterns might force regional shifts in production—a northward drift of the corn belt, for example. Increased rates of evaporation would make irrigation more costly and perhaps impractical in many parts of the country, including the Great Plains. But these negative impacts would be counterbalanced by the positive impact of more carbon dioxide available for photosynthesis and new technologies and production practices enabling plants and animals to adapt to the new climate.

In sum, no one can be sure that climate forcing will warm the future climate at all, but scientists generally agree that it will. A benchmark report recently issued by the National Academy of Sciences offers some helpful insights (National Academy of Sciences 1991a). The Academy's panel of experts concluded the following: At least a decade or more may be needed before atmospheric scientists refine their predictions. In the meantime, there is a "reasonable chance" (they do not put a numerical probability on reasonable chance) that greenhouse gas concentrations may double by the middle of the next century. There is also a reasonable chance that global temperatures will rise from 1° to 5°C

(1.8° and 9°F), although increases of less than 1° or more than 5°C cannot be strictly eliminated. Such a rise will have several troublesome effects on agriculture and other industries. Offering no claim that any of their projections are imminent, the Academy panel of experts also concluded that "none are precluded" (p. 26).

The CAST panel began its work with the premise that the steady enrichment of the atmosphere by greenhouse gases makes warming likely. Whether the global climate will change inconsequentially, change differently among regions, or warm even more in the future, only time will tell. But the responsible course today is to examine how agriculture might adapt to a degree or two of warming.

U.S. agriculture's contribution to the greenhouse effect

The emission of greenhouse gases is a by-product of agricultural production: carbon dioxide is released when fossil fuel is burned to power tractors. Methane is released by rice paddies and by cattle and other ruminants—animals that have more than one stomach enabling them to digest grass. And nitrous oxide is released when fertilizer decomposes in the soil. Contrary to perception, agriculture's emissions of greenhouse gases are small. The CAST panel found that emissions of carbon dioxide, methane, and nitrous oxide from U.S. agriculture comprise only 0.8 percent of global climate forcing by these three greenhouse gases (Chart 1).[5] While cattle and other ruminants are often viewed as major contributors to global warming, in fact, emissions from U.S. ruminants are a very small portion of total climate forcing from methane. Thus, it is clear that strategies aimed at reducing emissions from U.S. agriculture will have very minor impact on total global warming.

Agriculture's potential contribution in reducing greenhouse gases

Although ways could be found to cut the industry's emissions of greenhouses gases, the greater opportunity for U.S. agriculture to help mitigate climate change lies in "stashing" carbon in soil and trees and displacing fossil fuel. Stashing is a term for any process that stores or sequesters carbon out of the atmosphere and keeps it out. Agriculture is a unique industry in that it not only emits greenhouse gases, it also stashes carbon. Through photosynthesis, plants and trees use carbon dioxide and in the process store carbon in crops and trees. The consumption or decay of crops and trees returns some carbon to the air as carbon dioxide, but much is stored in timber or as organic matter in the soil. (A molecule of carbon stored in a tree that becomes a piece of furniture can be kept out of the atmosphere for a very long time.)

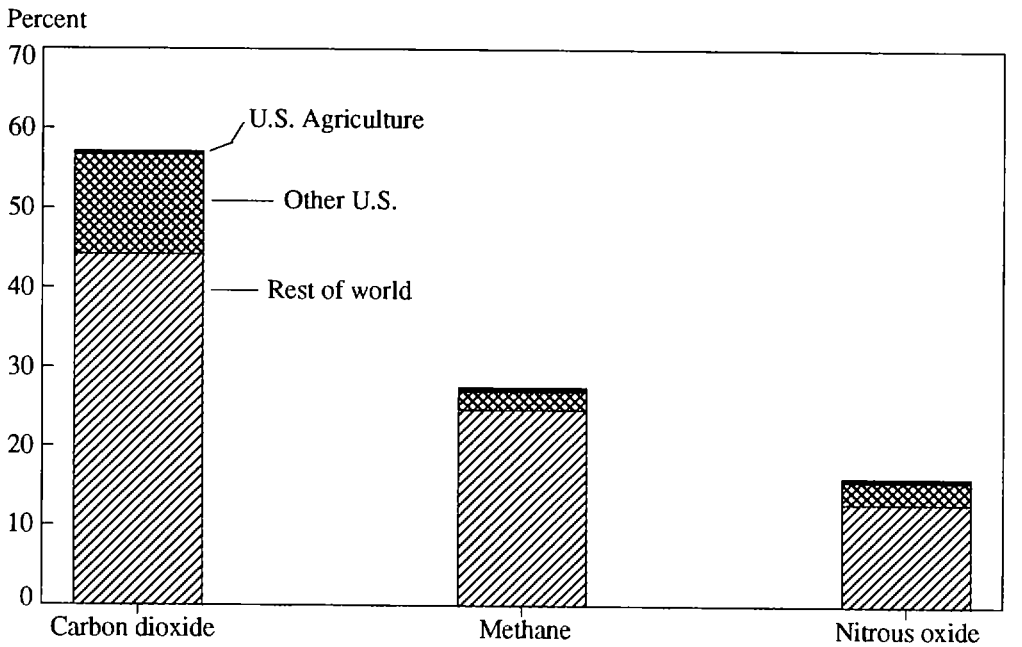
Agriculture can also produce biofuels, fossil fuel substitutes made from renewable crops, such as trees or corn. Ethanol, for example, can be produced from either wood or corn. The advantage of biofuels is that the carbon in them comes from the atmosphere. That is, photosynthesis uses carbon dioxide to produce the corn or trees that yields the biofuel. The carbon in fossil fuels, on the other hand, has been stored in the earth for millennia. When biofuels are burned, therefore, they simply recycle the carbon already in the atmosphere, unlike fossil fuels which release new amounts of carbon into the atmosphere.

Many strategies are available, but biofuels appear to offer agriculture's biggest potential to store more carbon.[6] Scientists and economists estimate that renewable crops could supply 8 percent of current U.S. energy needs. Displacing fossil fuels, the renewable crops would reduce U.S. total emissions of greenhouse gases fully 10 percent. Moreover, the biofuels would turn U.S. agriculture into a net absorber of greenhouse gases rather than a net source of their emission.

The biofuels approach to reducing atmospheric carbon dioxide, however, is not economical today. Under some circumstances, biofuels are economically competitive, but displacing more fossil fuels will require more incentives than cur-

Chart 1

Sources of Global Climate Forcing Based on 1990 Emissions



rent markets provide. To become more feasible, either the price of fossil fuels must rise or the public must be willing to tax their use.

ENCOURAGING SUCCESSFUL ADAPTATION: A PORTFOLIO APPROACH

Scientific predictions notwithstanding, agriculture faces an uncertain future climate. And in a world where population and incomes will continue to rise, agriculture's ability to adapt to climate change is crucial. Thus, the CAST panel devoted most of its attention to the question, "How well might agriculture adapt to global warming in a world with more people and more trade?"

U.S. agriculture has great inherent ability to adapt—what agricultural scientists term autonomous adaptation. The adaptations are called autonomous because they take place without policy encouragement.[7] Global temperatures have risen about 0.5°C (0.9°F) this century, but that change in climate has had virtually no impact on U.S. agriculture. The change in climate coincided with rising concentrations of carbon dioxide that are good for plants. Any impact of the slight warming was swamped by the shift from horses to tractors, from open-pollinated to hybrid corn, and the arrival of soybeans and agricultural chemicals (National Academy of Sciences 1991b).

Looking ahead, the CAST panel believes that autonomous adaptations plus improved photosynthesis from more carbon dioxide will ease much of the harmful impact of climate change on U.S. agriculture.[8] The industry will be able to draw on many resources as it adapts, including a vast land base and an extensive array of technology. Water may be the most constraining resource in adaptation, since less of this vital resource will be available to agriculture as more is reallocated to other uses whether the climate changes or not.

Yet while the nation's resilient farmers can adapt in many ways, successful adaptation will depend on the social costs that accompany autonomous adaptation. Some adaptations will cost farmers and the rest of society more than others. Social costs include adverse impacts on humans, the economy, and the environment. If the climate changes severely, farmers in some regions could be forced from business, food prices could rise, and some cropland could be lost. And those costs could mount even with a number of autonomous adaptations.

To reduce the social costs of climate change to acceptable levels, further adaptation will need to be encouraged through a series of policy steps, both now and in the future. Therein lies the goal for policymakers: pursuing policies that encourage adaptation to a range of possible future climates at minimum social cost.[9] But how can policymakers prepare now for a future climate that is so uncertain?

A portfolio strategy for encouraging adaptation

Portfolio theory suits the climate problem well because it is "concerned with decisions involving outcomes that cannot be predicted with complete certainty" (Sharpe). Moreover, U.S. agriculture has many "assets," each a unique and valuable resource for responding to climate change. The nation's extensive land base is one such asset, its agricultural research capacity yet another.

With so much uncertainty ahead, policymakers should assemble a portfolio of agricultural assets that is both diverse and flexible. Diversity is key because no one knows today which agricultural resources will provide the best opportunity for successful adaptation in the future. As in the investment world, "a good portfolio is more than a long list of [assets]. It is a balanced whole, providing the [policymaker] with protections and opportunities with respect to a wide range of contingencies" (Markowitz). To illustrate: climate change may make some U.S. farm land unproductive (effectively reducing the amount of our land asset), while greater investment in research (a net addition to our research capacity asset) could enhance productivity on the remaining land base. Alternatively, some land may become less productive, while other parts of the U.S. land base could become more productive.

Assets are valuable, but they do not help adaptation if they are frozen. Thus, flexibility is a second critical attribute of the effective portfolio. Flexibility brings the assets into play, gradually if climate change is gradual, or rapidly if an extreme drought heralds sudden change. A quick change in regional weather patterns, for instance, may mean idling land in one region while expanding plantings in another. Or it may mean using less land and more water. Flexibility will be necessary, therefore, both within an asset category, such as land, and *across* assets.

Adopting a portfolio strategy not only enables U.S. agriculture to adapt to future climates, it also measures the industry's current preparedness to adapt. Two weak spots appear immediately. First, many agricultural resources are not currently viewed as "climate change assets." Climate change assets are the unique resources that will be the basic elements in agriculture's adaptation to climate change. Responding to climate change, for example, may require agriculture to draw on the fullest reaches of its genetic diversity, placing new value on an overlooked national asset. Second, agriculture's current mix of assets is bound by several institutional barriers that prevent full use

of some assets or make it difficult to switch from one asset to another. To cite but one example, numerous farm trade barriers around the world stifle the very trade flows that would mitigate climate-caused shifts in farm production.

A portfolio of flexible climate change assets

U.S. agriculture has ten assets for adapting to climate change (Table 2). Other assets might be added to the portfolio, but these ten form what will be the backbone for successful adaptation. The table describes their value as a climate change asset and summarizes the policy steps needed to make the asset stronger and more flexible in adaptation. The list of assets is not intended to initiate a quantitative assessment of all options available, but "to uncover the elements necessary for intelligent policy choices" (Nordhaus 1990). These ten assets provide options for adaptation, acknowledging that each may not be appropriate to a given situation. Collectively, however, they provide a diversity of response and thus a maximum probability that U.S. agriculture can adapt at acceptable social cost.

The United States holds a strong portfolio of climate change assets, especially compared with many other nations. The United States can lay claim to all ten assets, and it has a rich endowment of many of them. Given such strength, U.S. agriculture can play a lead role in developing the global strategy for adapting to changes in climate. Notwithstanding the portfolio's overall strength, however, the nation will have to make new efforts to both strengthen some assets and allow greater flexibility in using them. The ten assets and the CAST panel's recommended policy steps are discussed below.

Land. Land is agriculture's cornerstone asset. Compared with other sectors of the economy, agriculture uses wide expanses of land. This is no surprise because agriculture is in the business of capturing sunlight and converting it into food, fiber, and timber. Fortunately, the nation has a large base of cropland for agricultural purposes, currently about 188 million hectares (465 million acres). The nation has another 239 million hectares of pasture and range (591 million acres) and 262 million hectares of forest land (647 million acres). The wide expanse of U.S. agricultural land ranges across a diversity of climates, offering some built-in insurance against whatever climate changes might occur.

The United States could thus pursue several land options in responding to climate change. It could convert additional land to cropland. It could shift crop and animal production from one region to others. And it could devote more land to the production of biomass for fuels or to forests for stashing carbon dioxide.

Reform agricultural policy to encourage flexible land use. While the nation has an extensive land asset, policy changes are needed to fully utilize that asset as the climate changes. Current farm programs discourage farmers from shifting to alternative crops and they also discourage production shifts from one region to another. With the future climate uncertain, farm policy should encourage farmers to switch land uses freely in response to changing market signals.

Water. The nation can draw on a substantial water asset in responding to changing climate. Ground water reserves and surface water supplies are considerable in many parts of the country. Nevertheless, the competition between agriculture and other uses is already cutting the irrigated acreage in most regions. That growing competition would be heightened by any change to a drier climate.

Several water options are available for responding to climate change. Farmers can more fully adopt proven technologies that improve water use efficiency, or the quantity of farm output per unit of water input. Scientists can search for crops, production methods, and irrigation systems that increase water use efficiency. Water markets could be improved and expanded to facilitate transfers to the most valuable uses. Better weather information systems could be combined with

Table 2

Portfolio of Assets to Prepare for Climate Change

Asset	Value for adapting to climate change	Policy steps to increase flexibility
1. *Land*	Extensive cropland across diverse climates provides diversity for adaptation.	• Reform agricultural policy to encourage flexible land use.
2. *Water*	Water, which already limits farming in some regions, is crucial for adaptation if climate becomes more dry.	• Reform water markets to encourage more prudent use of water. • Raise the value of crop per volume of water used.
3. *Energy*	Reliable energy supply is essential for many adaptations to new climate.	• Improve the efficiency of energy in food production. • Explore new biological fuels and ways to stash more carbon in trees and soil.
4. *Physical infrastructure*	Facilitates trade and input flows when market signals change.	• Maintain and improve input supply and export delivery infrastructure.
5. *Genetic diversity*	Provides source of genes to adapt crops and animals to new climates.	• Assemble, preserve, and characterize plant and animal genes. • Conduct research on alternative crops and animals.
6. *Research capacity*	Provides source of knowledge and technology for adapting to climate change.	• Broaden research agenda to encompass adaptation to climate change. • Encourage private research on adaptation. • Find farming systems that can be sustained in new climates. • Develop alternative food systems.
7. *Informtion systems*	Provide information needed to track climate change and adapt to it.	• Enhance the nation's systems that exchange information. • Encourage the exchange of agricultural research information.
8. *Human resources*	Provide pool of skills enabling farmers and researchers to adapt to climate change.	• Make flexible skills the hallmark of agriculture's human resources. • Strengthen rural education systems, particularly continuing education.
9. *Political institutions*	Determine the policies and rules that facilitate or hinder adaptation to new climates.	• Harmonize agricultural institutions and policies.
10. *World market*	Enables trade to mediate shifts in farm production and sends price signals that eventually adjust production to new climates.	• Promote freer trade and avoid protectionism.

regional operation of water facilities to better manage scarce water supplies.

Reform water markets to encourage more prudent use of water. With a climate that seems likely to make water more scarce in the United States, water policies will need to be overhauled so that water prices reflect true social costs. That step will encourage better market allocation of water supplies, both within agriculture and between agriculture and other parts of the economy. Policies and institutions that govern water transfers also need careful review and investment. Efficient water markets are now found in some places, but more such markets are needed. Agriculture needs both the incentive and the mechanism to move water from low-value use to high-value use.

Raise the value of crop per volume of water used. Another high priority is to develop and introduce technologies and management systems that enhance water use efficiency. Some technologies or practices will decrease the amount of water consumed per area of cropland. Others will raise the yield of crop per area and even substitute more valuable species of crop for less valuable ones. Still others will discover and use crops for drier land and even saline water.

Energy. Although agriculture consumes less than 3 percent of the nation's total energy demand, a reliable supply of energy will be an important asset as agriculture adapts to climate change. Agriculture uses energy as tractor fuel and in the guise of fertilizers. Low energy prices in the future will help agriculture adapt, but may also encourage more emissions as agriculture consumes fossil fuels. Higher energy prices, of course, would discourage emissions but could make adaptation more difficult. Whether prices rise or fall, finding ways to increase efficiency will strengthen farmers capacity to adapt.

Improve the efficiency of energy in food production. So long as agriculture uses fossil fuels, getting more food from each unit of energy will lessen emission of a greenhouse gas. Moreover, if energy prices rise—due to reduced supplies or taxes to limit emissions—energy would be a more limiting factor in food production, forcing farmers to use it more efficiently.

Explore new biofuels and ways to stash more carbon in trees and soil. Agriculture has a second connection to energy. In addition to its traditional production of food and fiber, agriculture and forestry can produce renewable energy from solar energy by photosynthesis and the yield of biomass. The same processes can also stash away carbon from the atmosphere in trees or soil.

Physical infrastructure. One climate change asset that should not be overlooked is the nation's physical infrastructure, which supports agricultural production and trade. The Soviet Union lacked efficient systems for distributing inputs, storing and handling output, and processing food, and thus could not move its deficient supplies to consumers. By contrast, these systems mark a real strength of U.S. agriculture.

Infrastructure will play a critical supporting role in adaptation. The nation's efficient grain transportation system will facilitate new flows of trade. Irrigation systems may become even more important if the climate becomes hotter and drier. But, to be used effectively for adaptation, the nation's infrastructure cannot be taken for granted. Some grain-handling infrastructure, for example, may need to be relocated if the Corn Belt moves north.

Maintain and improve input supply and export delivery infrastructure. Due to a global consolidation of the grain industry, some segments of the U.S. grain handling and transportation system are being eliminated—elevators and rail lines, for example. Although difficult to predict now, some of the pieces now being lost could prove useful to the nation under a different climate. This suggests a thorough review of transportation infrastructure as a climate change asset. Meanwhile, enhancing water storage and distribution systems will allow easier transfer of water across uses and regions in response to changing economic conditions. In addition, adding more water storage capacity would make it easier to adapt successfully under some climate scenarios.

Genetic diversity. A diverse portfolio of genes is clearly an asset for adapting to change. One action is needed to strengthen the asset and another to bring it into play.

Assemble, preserve, and characterize plant and animal genes. A major constraint in developing a cost-effective strategy for collecting, preserving, and using genetic resources is an adequate characterization of the nation's genetic materials. A thorough description and cataloging of plant and animal genetic resources is essential if the United States is to make effective use of the plant and animal breeding techniques—including genetic engineering—that are available now and that will become available in the future. Moreover, maintaining the genetic richness of our forests and less managed ecosystems will be key to their adaptation.

Conduct research on alternative crops and animals. On a local or regional basis, developing and incorporating minor crops and animal species into mainstream production could contribute significantly to adaptation. Nevertheless, it is unlikely that alternative crops or animals will soon emerge to substantially replace existing crops or animal species now in production.

Research capacity. The nation's research capacity offers the most versatile, and perhaps most enduring, asset in the nation's portfolio of climate change assets. In many respects, research is the gilt-edge investment that will be asked to do much of the work of adaptation. With an uncertain climate ahead, the traditional focus of agricultural research on production in stable circumstances must be changed to a new mission: preparing for an uncertain climate ahead while expanding production to meet the demands of growing population and trade.[10] From this new mission flow four recommended actions.

Broaden the nation's agricultural research agenda to encompass climate change. Global warming will impose new demands on the nation's agricultural research system. In short, that system must carry out today's research agenda while at the same time preparing agriculture for an uncertain future climate. To meet that challenge, multidisciplinary research will be critical to finding technologies that will enable the nation's farmers and foresters to adapt to climate change.

Broadening the research agenda will require more funding. Part of the funding will come from the private sector, and part can be achieved through improved efficiency in public research efforts. But much of agriculture's research agenda that relates to global warming will be conducted only by publicly funded researchers.

With the extent and speed of future climate change largely unknown now, the nation's agricultural research system will need to become more flexible. If climate change is rapid, social costs of the change could mount quickly before agricultural researchers can provide technological adaptations. Thus, ways need to be found to shorten the time between the discovery of agricultural technology and its applications.

Encourage private research on adaptation. Changes in the regulations that govern agricultural production and practices often hobble the research plans of the private sector. Private sector agricultural research is quite sensitive to uncertainty about changes in regulatory regimes and how regulations are administered. Regulations that restrict the use of technology discourage new investments in research and limit the returns of previous research. Consumers, for example, may press for regulation for aesthetic reasons. If public funding for agricultural research remains limited, regulations that hobble private research will be even more debilitating in preventing successful adaptation.

Find farming systems that can be sustained in new climates. Climate change may lead to sharp impacts on the quality of the U.S. environment, intensifying the attention paid to agriculture's effect on the environment. Many technical and institutional innovations are possible to make agriculture more environmentally friendly. Among the technical possibilities are the design of new "third" of "fourth" generation chemical and biologi-

cal pest management technologies and practices that enhance agriculture's ability to stash carbon.

Develop alternative food systems. If the climate change is severe, the United States may need to consider entirely new food systems. A food-system perspective should become the organizing principle for improving existing systems and for designing new systems. Many of these alternatives will include the use of plants other than current grain crops. Some of the alternatives may involve radical changes in food sources. Rogoff and Rawlins, for instance, have suggested one such system based on cellulose—both for animal production and human consumption.[11]

Information systems. Agriculture, like nearly all other industries, has been swept along as technology carries the economy into an "information age." The information asset is vital to managing modern production agriculture. It is also the lifeblood of the world market, which sends the many price signals that bring forth the supply of food that consumers are demanding. Information becomes even more important in a world where climate may change considerably. Information will be needed about climate and weather as well as about progress in adaptation.

Enhance the nation's systems that exchange information. One of the major reasons that scientists have difficulty predicting climate change is a paucity of meteorological data. Weather data for developing countries are especially weak, and because weather patterns know no borders, the threat of climate change is a strong motivation for improving weather monitoring systems globally. Using additional weather data to forecast weather for a whole season will be especially valuable to farmers who must choose their crop before a season begins and who must ration water over a whole season of irrigation. Although private weather services will continue to innovate, providing weather data will remain largely the responsibility of government.

In a changing climate, animal and plant pests and diseases will move to new regions. "Smart" systems will be required to support extension agents, consultants, and producers in identifying new problems and selecting optimum and environmentally sound control strategies. New information technology and less expensive electronic hardware provide opportunities for upgrading existing information systems.

Encourage the exchange of agricultural research information. Historically, the public sector has conducted much of the nation's agricultural research and thus maintained much of agriculture's research data. Today, private sector institutions are developing more and more new technologies for their own needs, especially in fields such as biotechnology and plant breeding. Increasingly, proprietary claims are attached to new technologies, whether the research institution is public or private. These proprietary claims (generically known as "intellectual property rights," and including such things as patents, plant variety protection, and trade secrets) are actually new ways of stimulating the development and exchange of new biological information and materials.

All mechanisms for developing and exchanging research information and materials become increasingly important as researchers—both public and private—attempt to respond quickly to climate change. It therefore behooves public and private research institutions to work together. The two groups must learn how to build on the growth in intellectual property rights and develop additional beneficial mechanisms for developing and exchanging information and materials in biological research.

Human resources. People manage the farms and invent the technology that will adapt to climate change. Agriculture's people clearly need to be well-trained. But the uncertainty surrounding the future climate calls for additional care in training this important asset.

Make flexible skills the hallmark of agriculture's human resources. Farmers and researchers have proved they can adapt to changing climatic circumstances. History is replete with examples. But

the uncertain climate ahead suggests even greater need for improving general and technical skills. While it is difficult to gauge the overall skill levels of agriculture's human resources, climate change will place new and different demands on them. With so many different climates possible in the future, those that manage the farms and do the research must be able to switch production practices or research strategies with elan.

Strengthen rural education systems, particularly continuing education. Continuing education will be particularly important in helping rural communities cope with climate change. If the Corn Belt migrates north, for example, many rural communities in the southern Corn Belt face a difficult transition.

Political institutions. The institutions we create become the conduits of change. When well conceived, institutions allow agriculture to adapt to changing circumstances. When poorly conceived, institutions can hobble the inventiveness and resourcefulness that might otherwise mitigate a change in climate.

Institutions take many forms. A major institution affecting U.S. agriculture is the array of programs that constitute the nation's agricultural, natural resource, and trade policies. The rules that govern world trade in agriculture shape the trade flows that try to offset variations in agricultural production around the world.

Climate change will demand that our institutions become more flexible. For example, the water policy that settled the West in the late nineteenth century must obviously change if it is to cope with the potential climate of the twenty-first century. A number of the institutional changes needed have been mentioned for each asset, but to these we add one overriding recommendation.

Harmonize agricultural institutions and policies. The disharmony that now exists in some agricultural policies and institutions will hobble successful adaptation in the future. To cite but one example, U.S. commodity programs encourage producers to maintain production in one particular crop. The result is a rigid planting pattern across the nation, where crops become tied to one region and where alternative crops are discouraged.

The disharmonies must be identified and then corrected. There is a great need to better understand the design of institutions that encourage compatible behavior across individuals, organizations, and society at large. Policy changes will be needed in many areas, but more flexible commodity programs and improved water allocation are likely to be priorities.

World market. Perhaps the most overlooked asset in the U.S. portfolio is the world market. Today, the world market allows U.S. agriculture to sell its abundant production abroad, earning foreign exchange for the nation. The market also puts U.S. consumers in touch with foreign foods that are lower priced or more available than from domestic sources. But as the climate changes, the world market will provide even bigger benefits. It will signal U.S. producers where climate change is creating new markets for them. Its prices will encourage U.S. producers to shift production into alternative crops for society's benefit. The flow of trade will relieve food shortages, whether in the United States or elsewhere. As the grand invisible hand that coordinates adaptation, therefore, the world market is a particularly valuable climate change asset.

Promote freer trade and avoid protectionism. The world market will be a key asset to encourage successful adaptation in the future. Today, the world market is beset by a battery of trade barriers and subsidies that distort world prices. If producers respond to the wrong price signals, consumers may suffer. That is, as the climate changes farmers may produce a surplus of products that consumers do not need and a scarcity of products they want. In short, trade barriers and distortive subsidies lead to wayward adaptations that are wide of the target society intended to hit. The only way to prevent these wayward adaptations is to reduce protectionism and promote free trade through such efforts as the Uruguay Round of GATT negotiations.

CONCLUSIONS

Farmers and foresters will adapt as the climate changes, but the attendant social costs call for policy steps now to encourage even more adaptation. The challenge to policymakers can be viewed as building a balanced portfolio of climate change assets and then managing it effectively. The nation already has a rich allocation of agricultural resources, but these resources must be improved if they will be effective adapting agents in the future. With climate change highly uncertain, the portfolio must be diverse, providing several options for future adaptation. The portfolio must also be flexible, allowing ready substitution both across assets and within an asset category.

Assembling such a portfolio will not be free. As in the financial world, building the portfolio will require investment. One of the most difficult decisions facing policymakers is deciding how much to invest, and in which assets to invest. Ideally, today's investment would be weighed against the social costs imposed by climate change tomorrow. The problem, of course, is that those costs cannot be calculated.

Does this policy dilemma have a solution? There are partial solutions. First, many of the actions outlined above represent only small public investments. It is obviously in society's interest to make investments or policy changes that cost little today while substantially enhancing adaptation tomorrow. Second, most of the actions outlined above will pay economic and social dividends even if the climate does not change at all. For example, consumers will reap steady benefits from a freer world market, the grand invisible hand that coordinates adaptation. Building the physical structures and adopting policies to move water from use to use as market forces change will help the nation with its current climate and needs and certainly will speed adaptation to new climate and needs. Thus, society gains from the investment while it also prepares itself for an uncertain climate ahead.

Put simply, investing in a diverse portfolio of agricultural assets must be viewed as prudent policy. The climate seems likely to change; how much and how soon, we do not know. If the climate changes, there will be social costs to the nation, and the costs could be large. A prudent way to hedge the risk of those costs is to hold a diverse portfolio of assets and assure the flexibility to use them. Such a portfolio offers the best chance for agriculture to adapt successfully to whatever climate unfolds. And even if the climate stays the same, investing in such a flexible portfolio will surely pay dividends in the stream of other changes bound to come.

ENDNOTES

[1] "Bush Caught in Earth Summit Crossfire," *Wall Street Journal,* April 7, 1992.

[2] This section is based largely on Rosenberg, with supplemental information from Solow and Schneider and others.

[3] Human activity accounts for only a part of the earth's total emissions of carbon dioxide. Therefore, to stabilize the amount of the gas in the atmosphere, emissions from human activity would have to be curtailed sharply.

[4] A good explanation of GCMs is found in Lawrence Livermore National Laboratory (LLNL): "GCMs divide the global atmosphere into tens of thousands of discrete boxes and use the dynamical equations of motion, energy, and mass to predict the changes in winds, pressure, and water vapor mixing ratio (humidity). The vertical domain of GCMs typically extends from the Earth's surface to about 35 kilometers; this distance is divided from 2 to 20 computational levels. The horizontal domain covers the globe with grid cells, each of which is several hundreds of kilometers on a side."

[5] Chart 1 is a simplification. It includes only carbon dioxide, methane, and nitrous oxide because those are the three greenhouse gases agriculture emits. As a result, the share of climate forcing attributed to the three gases is somewhat different than listed in Table 1. If other greenhouse gases are included, agriculture would have an even smaller share of total emissions.

[6] Other strategies for sequestering carbon include conservation tillage practices in row crop production, preserving

natural wetlands, minimizing dryland fallowing, and reforestation. For a discussion of these and other approaches, see chapter 6 of the CAST report.

[7] The process of autonomous adaptation can be illustrated as follows. When weather changes—the onset of a drought, for example—market prices change, setting in train a sequence of responses that ultimately serves to offset the initial impacts of the drought. In the case of drought, farmers unaffected by the drought plant more, lured by the higher prices. The rise in prices also encourages consumers to use less or buy more from foreign growers. The rise in prices, if sustained, also induces scientists to develop drought-resistant crops. Over time, all of these actions serve to dampen the initial rise in prices and, if the drought is mild or the production capacity elsewhere is great, mitigate it altogether.

[8] A warmer climate may adversely affect U.S. agriculture, but an increase in carbon dioxide increases photosynthesis and thus makes plants more productive. A doubling of carbon dioxide from pre-industrial revolution levels, for example, is estimated to increase corn yields 10 percent and soybeans yields 30 percent (Acock and others; Jones and others; and Kimball).

[9] This article focuses on the policy issues confronting agriculture. For a discussion of broader issues for economic policymakers, see Nordhaus 1991 and Schelling.

[10] More than 15 years ago, Goeller and Weinberg demonstrated the right response to an uncertain future. Technical change must be directed toward widening the possibilities of substitution among natural resources and between natural resources and technology (Goeller and Weinberg).

[11] Their unconventional approach suggests that some foods now produced by cereal grains and oilseeds could be produced from plants, such as trees, that contain cellulose. By means of fermentation processes, they contend, food could be engineered out of wood pulp. The advantage of the approach would be that trees are much more efficient plants than most cereals and oilseeds.

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Monetary vs. Fiscal Policy: New Evidence on an Old Debate

By Peter E. Kretzmer

The economy's apparently sluggish response to lower interest rates during 1991 has led some analysts to speculate that monetary policy may be less effective than in the past. These analysts argue that fiscal stimulus is necessary to combat the recent slow growth of the economy. In response, the President and Congress are debating the shape of a fiscal stimulus package.

Questions about the relative effectiveness of monetary and fiscal policy are not new. The issue was at the heart of the Monetarist-Keynesian debate of the 1960s and early 1970s. The monetarists held that monetary policy was much more important to the economy than fiscal policy, while the Keynesians argued that fiscal policy was dominant.

Evidence from this debate, however, is of limited help to today's policymakers. First, the debate was never fully resolved. Moreover, numerous changes in the U.S. economy have occurred in the last two decades.

This article revisits the monetary-fiscal policy debate. The first section reviews the dispute between the monetarists and the Keynesians. The second section discusses how the effects of monetary and fiscal policy on the economy may have changed in recent years. The final section presents evidence indicating that while monetary policy has become less effective over the years, it is still relatively more effective than fiscal policy.

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THE MONETARY-FISCAL POLICY DEBATE

The debate over the relative importance of monetary and fiscal policy was originally waged by two philosophically opposed groups of economists. The monetarists believed the money supply played a central role in determining economic performance. They used evidence from their empirical studies to show that changes in the money supply had a larger effect on the economy than changes in fiscal variables. The Keynesians believed that to stabilize the economy, fiscal policy was essential. They claimed that methodological problems invalidated the conclusions of the monetarist studies.

The first empirical study that attempted to determine which of the two positions was correct was conducted by Milton Friedman and David Meiselman in 1963. They examined simple correlations between consumption and money and

between consumption and fiscal variables. Friedman-Meiselman found that consumption was correlated to a much larger extent with money than with the fiscal variables. They interpreted this piece of evidence as consistent with the monetarist belief that monetary policy is more important than fiscal policy.

In 1965, Keynesians Albert Ando and Franco Modigliani argued that Friedman and Meiselman's evidence failed to show that monetary policy was more important than fiscal policy. First, Ando-Modigliani attacked Friedman-Meiselman's choice of sample periods on the grounds that the results may be sensitive to the inclusion of the World War II years. Second, Ando-Modigliani criticized Friedman-Meiselman's focus on contemporaneous relationships, reasoning that any complete study of the effectiveness of policy must account for lags in the effect of policy changes.

Ando-Modigliani's most serious criticism, however, was that Friedman-Meiselman failed to allow for feedback from the economy to the measures of monetary and fiscal policy. One example of this problem arose in the way in which Friedman-Meiselman measured their fiscal variable (called autonomous expenditures). Ando-Modigliani pointed out that the monetarists' measure of autonomous expenditures included the fiscal deficit, which moves inversely with economic activity. To see why this is a problem, suppose the government increases autonomous expenditures to increase economic activity. The increase in economic activity will reduce the deficit by generating tax revenue, thereby offsetting part of the initial rise in autonomous spending. As a result, the correlation between economic activity and autonomous spending would appear weak even if the initial increase in spending had a strong effect on output.

A 1968 study by Leonall Andersen and Jerry Jordan responded to some of the Ando-Modigliani critique.[1] Andersen-Jordan regressed U.S. nominal GNP on current and lagged measures of money and two fiscal variables.[2] They made a key improvement over the Friedman-Meiselman study by including lagged effects of the monetary and fiscal variables. They also used fiscal policy measures that corrected for the problem of feedback from the economy. Andersen-Jordan found that the coefficients on the monetary variable were statistically significant, while the coefficients on both fiscal variables were not. Thus, despite changes in methodology, the Andersen-Jordan results continued to support the Friedman-Meiselman conclusion that monetary variables dominate fiscal variables in explaining the U.S. macroeconomy.

But the Andersen-Jordan study, and similar studies that followed, still had problems. A remaining central flaw, noted in 1974 by Alan Blinder and Robert Solow, was a failure to control for the feedback from the real economy to the conduct of monetary policy. Blinder-Solow argued that such feedback could lead to incorrect conclusions about the relative importance of monetary and fiscal policy.

This feedback problem arises from the way in which the Federal Reserve has conducted monetary policy during much of the post-World War II era. With some exceptions, the Fed has carried out a policy of stabilizing interest rates over the short term. Suppose an increase in investment demand pushes interest rates and output upward. If the Fed is stabilizing interest rates, it will increase the money supply to limit the increase in interest rates. In other words, the increase in output causes the increase in the money supply, not the reverse. Failure to allow for the effect of output on money could have led to positive coefficients on money in the Andersen-Jordan study even if changes in money do not cause changes in output. Thus, not accounting for the potential feedback from output to money may render the monetarist conclusion unwarranted.[3]

By the mid-1970s, the debate between the monetarists and the Keynesians subsided without either side being able to convert the other.

Monetarists continued to believe monetary policy was dominant, while Keynesians continued to believe the flaws in the studies were serious enough to invalidate the monetarists' conclusions.

RECENT CHANGES IN THE EFFECTS OF MONETARY AND FISCAL POLICY

The uncertainty surrounding the results of the early studies makes it difficult for policymakers to draw firm conclusions on the effects of monetary and fiscal policy. But even if the debate had been resolved, would the results be of value today? Probably not, because the economic impact of monetary and fiscal policy is likely to have changed since the mid-1970s.

Monetary policy

Monetary policy in the United States is conducted primarily through Federal Reserve open-market operations. Open-market operations, which are purchases or sales of Treasury securities by the Fed, change the quantity of reserves held by the banking system. Open-market operations also affect the federal funds rate, the interest rate at which banks lend reserves to one another for short periods of time. Changes in the federal funds rate in turn can affect real output. For example, a decrease in the federal funds rate can lead to a decrease in other interest rates, thereby raising both consumption and investment demand.[4]

Recently, however, structural changes in the U.S. economy may have changed the impact of monetary policy on real output. These changes include the removal of interest rate ceilings on bank deposits, the development of more nonbank sources of financing for firms, and the growth of the foreign sector.[5]

Prior to their removal in the 1980s, interest rate ceilings on bank deposits tended to reinforce the effect of higher interest rates on economic activity. When market rates rose above the ceilings, disintermediation—the flight of funds from the banking system—took place. With a smaller pool of funds available to banks, bank credit for purchases such as homes and consumer durables became less available, reinforcing the effects of higher interest rates. The removal of interest rate ceilings on bank deposits, therefore, has probably reduced the real effects of monetary policy.

The growth of more nonbank sources of financing for firms has also probably weakened the effect of monetary policy. Investment by firms that depend largely on bank loans is sensitive to their availability. But now that more firms can turn to the commercial paper market, the convertible bond market, or the swap market to help finance their investment, interest rate increases may have less effect on business investment.

The growth in the foreign sector has also impacted the effect of monetary policy. As world capital markets have become more integrated and the U.S. share of the world economy has shrunk, monetary policy has become less effective because it is more difficult for the Federal Reserve to alter U.S. interest rates relative to other countries' interest rates. For example, assume the Federal Reserve sells Treasury securities in an effort to increase U.S. interest rates. The higher interest rates will now immediately attract foreign investors. As the foreign investors purchase the securities, U.S. interest rates are pushed back down. Thus, it has become more difficult for the Federal Reserve to alter U.S. interest rates.

On the other hand, with a larger foreign sector, the exchange rate has become more important for output determination because it affects the levels of both exports and imports. If expansionary monetary policy causes the value of the dollar to fall, exports should increase and imports should decrease, thereby expanding real output. Now that the foreign sector is larger, the output effect will be larger. Thus, the exchange rate channel for monetary policy has become more important, potentially making the economy more sensitive to monetary policy.

Fiscal policy

Fiscal policy refers to expenditures by federal, state, and local governments and to the taxes levied to finance these expenditures. The U.S. economy has recently changed in several ways that may have altered the impact of fiscal policy on real output. First, transfer payments have grown and defense spending has shrunk as shares of the federal budget. Second, federal individual income tax rates dropped sharply in the 1980s. And third, budget deficits have been large in recent years.

Defense and transfer payments. The balance between defense spending and transfer payments as shares of the economy has changed rather dramatically over the past few decades. Defense spending proposed by President Bush's latest budget (FY 1993) continues a long-term decline, falling from over 10 percent of GNP in the early 1950s to about 5 percent today.[6] At the same time, transfer payments—payments from the government to a group of people defined by a characteristic such as age or income—have increased from about 3 percent of the economy in the 1950s to over 10 percent today.

This change in the makeup of the budget may have reduced the potency of fiscal policy. In the 1950s, a 1 percent change in government spending across the board would have included larger changes in defense spending than in transfer payments, because defense spending was a larger share of the budget.[7] Today, however, a 1 percent change in spending would include larger changes in transfer payments. Because defense spending is stimulative while many types of transfer payments are not, the effect of proportional changes in government spending on output may have weakened over the years.

Increases in defense spending are likely to stimulate aggregate demand. To understand why, first consider another form of government spending that affects the economy differently than defense spending. For example, when the government buys food products to serve meals to its employees, the purchases presumably substitute for about an equal amount of private meal purchases (by the same employees) that would otherwise have been made. Thus, there is little or no net increase in aggregate demand. However, when the government buys military equipment, the purchase is not a good substitute for private spending on goods and services. Thus, an increase in defense spending is likely to generate a net increase in aggregate demand.[8]

Transfer payments affect aggregate demand only if the spending patterns of the group receiving the transfer payments differ from the spending patterns of taxpayers in general. To illustrate, consider government aid to students. This program takes money from taxpayers and redistributes it to students. As long as the spending patterns of students are similar to the spending patterns of the general population, expanding aid to students should have no effect on aggregate demand.

Tax rates. Tax rates fell substantially in the 1980s, potentially increasing the effectiveness of fiscal policy. When the government buys goods and services, it creates income for the producers of the goods and services. The income is consumed in an amount that depends, among other things, on how much of the income remains after taxes. With lower tax rates, more after-tax income is earned, more consumption takes place, more after-tax income is generated, and so on. The size of this "multiplier" for government expenditure thus depends on tax rates. Lower tax rates in the 1980s may have increased the output effect of government expenditures, making fiscal policy more potent.

Budget deficits. The large budget deficits of recent years may have forced policymakers to rely less on fiscal policy to influence the economy. A great deal of public attention has focused on the size of the deficits and their possibly harmful effects. In this environment, it has become more difficult to propose new expenditure programs or engage in other aggressive fiscal policy, making

fiscal policy a less important factor in the 1980s. Furthermore, fiscal policy could lose even more importance in the 1990s, since the 1991 budget agreement forces Congress to offset expenditure increases or tax reductions so that the budget deficit does not grow.[9]

NEW EVIDENCE ON THE MONETARY-FISCAL POLICY DEBATE

This section presents evidence on the monetary-fiscal policy debate that attempts to account for the methodological problems of previous studies and for the changes in the U.S. economy. The results suggest that while monetary policy has become less effective over the years, it is still more effective than fiscal policy.

Empirical model

One of the remaining problems with the earlier studies is that they did not completely account for the feedback from the economy to the policy variables. To account for the feedback, a vector autoregression (VAR) is used to analyze the data. In a VAR, each variable is regressed on its own lags and the lags of each of the other variables in the data set. In this way, the procedure allows each variable to be affected by its own history and the history of each of the other variables. For example, output is regressed on lags of policy variables in one equation, while the policy variables are regressed on lags of output in other equations.

The variables in the VAR are quarterly measures of real output, inflation, two monetary policy variables, and two fiscal policy variables.[10] Output is measured by the growth rate of industrial production.[11] Inflation is measured by the growth rate of the CPI. The monetary policy variables are the growth rate of the monetary base and the 90-day Treasury bill rate.[12] The fiscal policy variables are the change in total government expenditures (net of interest payments) as a fraction of GNP and the government budget deficit as a fraction of GNP.[13]

VARs are run for two 30-year subsamples. The results are then compared in order to identify changes over time in the potency of monetary and fiscal policy.[14] The first subsample extends from the second quarter of 1950 through the fourth quarter of 1979. The second subsample extends from the second quarter of 1962 through the fourth quarter of 1991.

Results

Using the results of a VAR, there are several ways to evaluate the effects of monetary and fiscal policy on output. The three used here are causality tests, variance decompositions, and impulse response functions. Causality tests focus on the statistical significance of monetary and fiscal policy variables in affecting real output. Variance decompositions compare the relative contributions of the monetary and fiscal variables in explaining output. Impulse response functions show the estimated responses of output to hypothetical changes in policy.

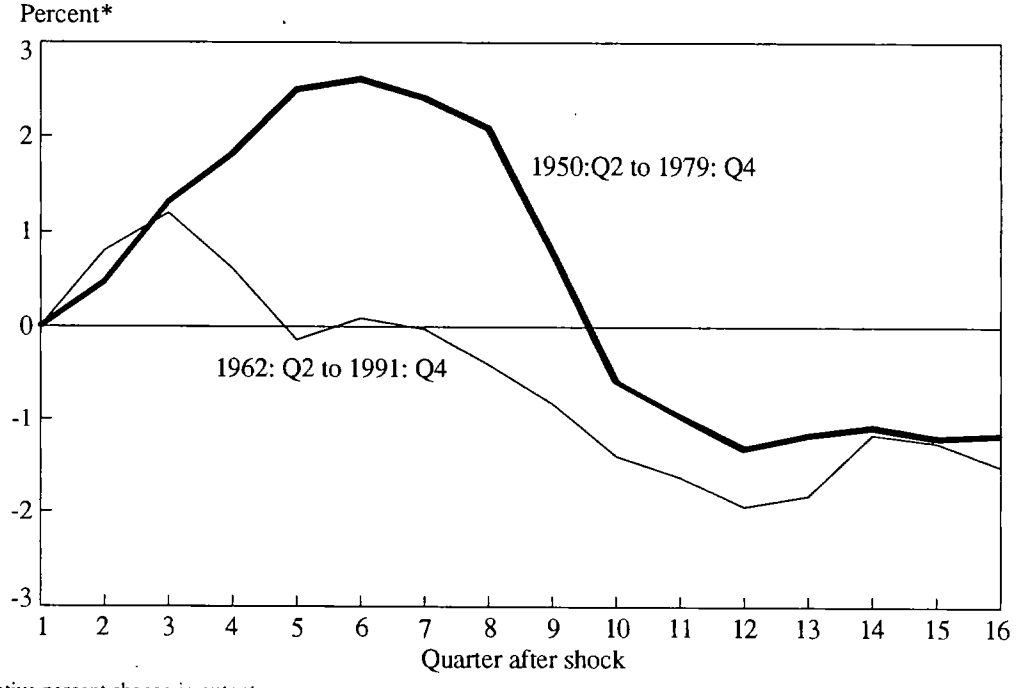
Causality tests. Causality tests are used to determine whether the effects of the policy variables on output are statistically significant. For example, if the coefficients on the monetary policy variables are significant but the coefficients on the fiscal policy variables are not, the test would suggest that monetary policy is more effective than fiscal policy.

The effects of monetary policy on output, while not that strong, probably exceed the effects of fiscal policy (Table 1). The coefficients on the monetary policy variables are statistically significant, at the 10 percent significance level in the first subperiod and at the 5 percent significance level in the second subperiod. In contrast, the fiscal policy variables do not have a statistically significant effect on output in either subperiod.

Variance decompositions. While the causality tests indicate whether policy variables have a

Chart 1

Effect of Monetary Base Shock on Output



* Cumulative percent change in output.

statistically significant effect on output, they do not show the relative size of these effects. The variance decomposition of output, however, can be used to compare the size of the monetary policy effect with the size of the fiscal policy effect, and to see how the size of the effects has changed over time. Specifically, the variance decomposition shows the percentages of the variability of output that are explained by the monetary and fiscal policy variables.[15]

Table 1

Causality Tests

Sample period	Monetary	P-value	Fiscal	P-value
1950:Q2–1979:Q4	1.64	.07	1.05	.42
1962:Q2–1991:Q4	1.76	.05	1.46	.13

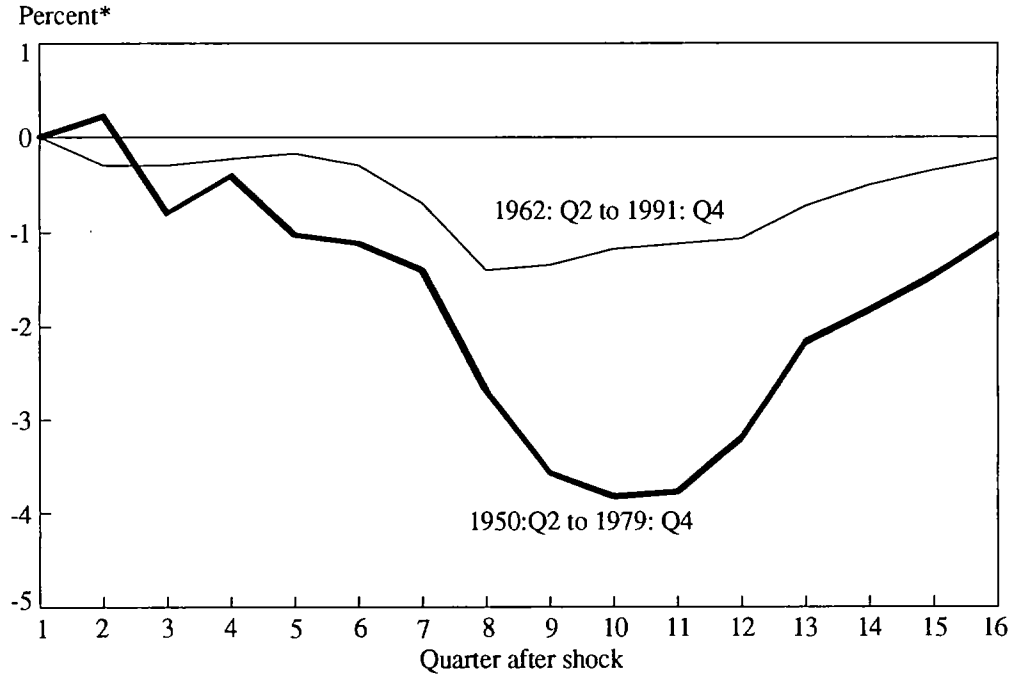
Note: Column 2 reports F-statistics for the hypothesis that monetary variables do not affect output. Column 4 reports F-statistics for the hypothesis that fiscal variables do not affect output. Columns 3 and 5 report the associated significance levels for the hypotheses tests.

The variance decomposition results appear in Table 2. The first column, the estimated effect of monetary policy, shows the percentage of the variance of output explained by monetary base changes and Treasury bill rate changes. The second column, the estimate of the effect of fiscal policy, shows the percentage of the variance of output explained by government expenditure changes and budget deficit changes.[16]

Table 2 indicates that the effect of monetary policy is greater than the effect of fiscal policy in

Chart 2

Effect of Interest Rate Shock on Output



* Cumulative percent change in output.

both subperiods. For example, in the first subperiod, the variation in output due to monetary policy is estimated to be about twice that due to fiscal policy. Table 2 also shows that the importance of monetary policy fell somewhat from the first to the second subperiod, while the importance of fiscal policy remained about the same.

Impulse response functions. The impulse response function shows the estimated response of output to a permanent change in monetary or fiscal policy.[17] It is particularly useful for determining the economic significance of the output response to a policy change of a particular size. Charts 1 and 2 show the output responses to changes in the monetary policy variables, while Chart 3 shows the output responses to changes in the fiscal policy variables.

Chart 1 compares the response of output to a 1 percent increase in the monetary base in the two subperiods. The increase in output is larger in the first subperiod than in the second subperiod. For

Table 2

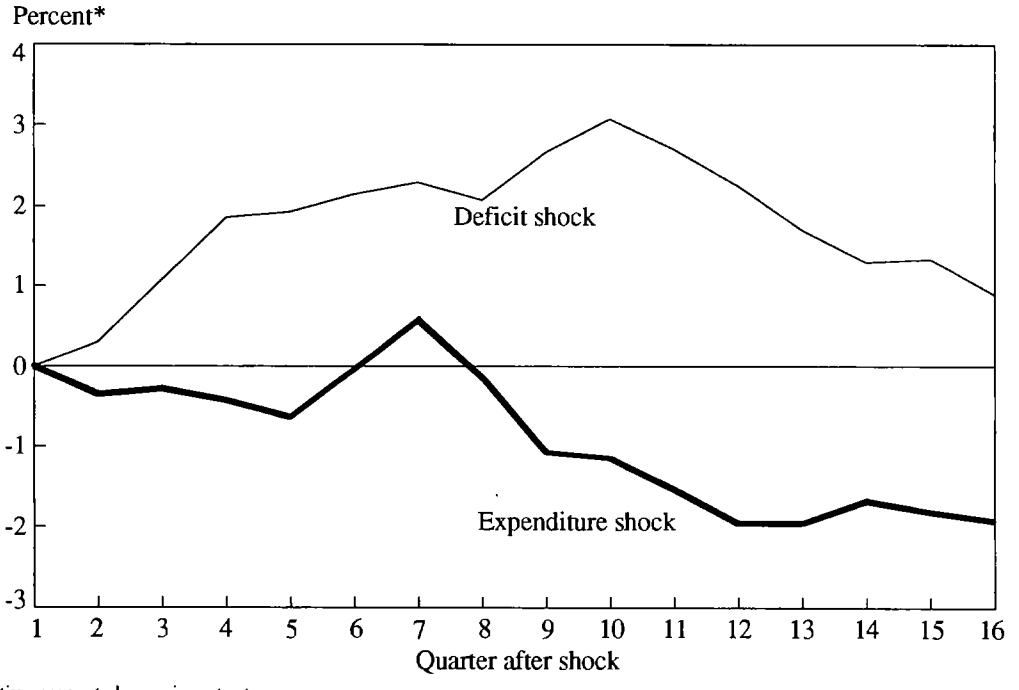
Variance Decompositions of Output

Sample period	Monetary	Fiscal
1950:Q2–1979:Q4	28	15
1962:Q2–1991:Q4	23	17

Note: Column 2 reports the estimate for the percentage of output variance explained by monetary policy variables. Column 3 reports the estimate for the percentage of output variance explained by fiscal policy variables.

Chart 3

Effect of Expenditure and Deficit Shocks on Output



* Cumulative percent change in output.
Note: Sample period is 1962: Q2 to 1991: Q4.

the first subperiod, the peak response of output to a 1 percent base increase is between 2 and 3 percent.[18] For the second subperiod, the peak response of output is just over 1 percent.

Chart 2 compares the response of output to a one-percentage-point increase in the Treasury bill rate in the two subperiods. The decline in output following an increase in the Treasury bill rate is larger for the first subperiod than for the second subperiod. For the first subperiod, output falls almost 4 percent after a one-percentage-point increase in the Treasury bill rate. For the later subperiod, the response is much smaller—output falls between 1 and 2 percent.[19]

Chart 3 shows how output responds when government expenditures and the budget deficit increase by 1 percent of GNP. Only the second subperiod is shown for these fiscal policy changes because the causality tests clearly showed that fiscal policy was statistically insignificant in the first subperiod. The response of output to the increase in government expenditures is slightly positive after about two years but appears to be negative in the longer run. Output responds more strongly to the increase in the budget deficit, rising by about 3 percent.

CONCLUSIONS

Monetarists and Keynesians debated the relative importance of monetary and fiscal policy throughout the 1960s and 1970s. Yet the evidence from this period is of limited help to today's policymakers, since these studies had methodological flaws and many changes in the U.S. economy have occurred in the last two decades.

This article corrects the flaws of the early studies and finds that monetary policy has become less effective over time, but is still more effective than fiscal policy. The effects of both money and interest rates on output appear to have fallen over the years. As a result, more monetary stimulus may now be necessary to achieve a particular change in output than in the past.

The study also suggests that the fiscal stimulus packages being debated by Congress may be of limited help. While the effect of fiscal policy on output is not statistically significant over the sample period, there is some evidence that increases in the budget deficit may increase output. The fiscal packages under consideration, however, leave the deficit unchanged, as required by the 1991 budget agreement.

ENDNOTES

[1] The Andersen-Jordan study was the first, and perhaps the most important, of the St. Louis studies, so-called because the studies were prepared by the research department of the Federal Reserve Bank of St. Louis.

[2] The monetary variable was M1 or the monetary base, and the fiscal variables were full-employment expenditures and full-employment tax receipts. The sample period extended from the first quarter of 1952 through the second quarter of 1968.

[3] More precisely, the bias in the estimated coefficient on money arises if output shocks are contemporaneously correlated with money through the feedback mechanism or if output shocks cause future changes in money and there is autocorrelation in the output shocks.

[4] Newly created reserves, through increasing the money supply, may make households and corporations feel wealthier. This perceived increase in wealth may also stimulate consumption and investment demand.

[5] Kahn discusses a similar set of factors as reasons for the changing interest sensitivity of the U.S. economy.

[6] The decline in defense spending was only partially offset by the Reagan defense buildup during the first half of the 1980s.

[7] This example assumes that the 1 percent change affects all categories of expenditure proportionately, leaving each category's share of the government budget unaffected. It is not difficult to imagine an expenditure proposal that violates this assumption. The measure of expenditures used in the empirical section of this article does not differentiate among different types of government spending.

[8] The effect defense spending has on the aggregate supply of goods and services depends on the degree to which the spending affects the productivity of the private economy. There is substantial debate over the effect of defense spending on productivity. One argument is that defense spending spurs innovation and scientific progress that add to the productivity of the nondefense sector. Others argue the defense industry is a drag on productivity, since it diverts scientific talent from nondefense to defense jobs. There is currently no clear consensus on the effects of defense spending on productivity and aggregate supply.

[9] Congress must compensate for any tax reduction by cutting expenditures or raising other taxes; any expenditure increase must be offset by an expenditure cut elsewhere or a tax increase.

[10] Similar data sets have been analyzed by authors such as Sims and Litterman and Weiss, but usually without the fiscal variables.

[11] The empirical work was repeated using the growth rate of real GNP as an alternative output measure.

[12] The monetary base was chosen over M1, since its movements are more likely to indicate Fed monetary policy. Movements in M1 are also influenced by bank behavior as well as the liquidity preferences of the public.

The federal funds rate is considered by many to be the optimal interest rate for the analysis of monetary policy because it has often been the Fed's main policy instrument. The short-term Treasury bill rate is substituted in its place because a longer series is readily available for the Treasury bill rate than for the funds rate. Both interest rates yield similar results.

Using both the interest rate and money variables tends to exaggerate the importance of monetary policy, since interest rate innovations can also reflect other nonmonetary shocks to the economy. Sims, and Litterman and Weiss assume that only money stock innovations reflect the effects of monetary policy, an assumption that almost surely underestimates the true importance of monetary policy. This research treats the combined effect of monetary and interest rate innovations as reflecting an upper bound on the possible influence of monetary policy. By ordering the interest rate last in computing the variance decompositions and impulse response func-

tions, the degree of exaggeration in this measure of the effect of monetary policy is minimized. See Kretzmer (forthcoming) for further details.

[13] The budget deficit is measured as the difference between government expenditures, net of interest payments, and total government receipts, including inflation tax revenue. The deficit is used as the second fiscal variable, rather than receipts, in order to impose on the VAR the cointegration of government expenditures and government receipts. See Bohn and Kretzmer (forthcoming) for more details on this issue.

[14] The subsample length of 30 years is judgmental, based on the tradeoff between statistical power and the ability to infer when changes in the effects of policy actually occurred. There are six variables and ten quarters of lags included in the VAR. Thus, each equation has 61 regressors. At least 120 observations, twice the number of regressors, are needed to obtain a reasonable degree of precision.

[15] The estimated variance decompositions and impulse response functions (the third technique) are unique only if the innovations in the variables are mutually uncorrelated. In the absence of this condition, it is necessary to model the relation among the contemporaneous innovations. Typically, an ordering is determined, where first in the ordering means "most exogenous" and last in the ordering means "most endogenous." In this setup, innovations in X, for example, are maintained to be related only to the innovations in the variables that precede X in the ordering.

[16] Innovations in the two fiscal policy variables are strongly positively correlated. As a result, it is difficult to separate out the individual influences on output of expenditure innovations and deficit innovations with any degree of confidence. Equivalently, the ordering of the two variables substantially affects the individual results. However, the sum of the influences is quite unaffected by the ordering.

[17] In order to compute the impulse response function, it is necessary to invert the VAR, expressing each variable as a function of lagged innovations in itself and the other variables. Then, the coefficients on the lagged innovations measure the response over time of the dependent variable to a unit shock in that independent variable. Thus, the change is permanent in the sense that it is not actively reversed by policymakers.

[18] Recall that the results reported here use industrial production as the output measure. Industrial production is more responsive to money than is real GNP. This result is consistent with Kretzmer (1989) who finds that output of service industries is less responsive to money than output of durable manufacturing industries. The results using real GNP are qualitatively similar to the results reported for industrial production.

[19] The reduced sensitivity of output to interest rate innovations is consistent with the results presented in Kahn.

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Are Bank Loans a Force in Monetary Policy?

By Donald P. Morgan

Federal Reserve monetary policy has eased considerably over the last two years. As policymakers have increased the supply of reserves to banks, short-term market interest rates have dropped to a 20-year low. According to the traditional *money view* of monetary policy, these actions should have led to a marked pickup in economic activity. Thus far, however, the economic recovery remains notably sluggish.

The economy's sluggish response to monetary policy ease is nonetheless understandable from the standpoint of the *credit view* of monetary policy. According to this view, the force of monetary policy depends partly on the willingness of banks to lend. If banks are cautious about lending, as they have been recently, then lower market interest rates may pack a weaker economic punch than in the past.

This article examines both the credit view of monetary policy and the money view. The first section explores why bank credit, not just money, may carry the force of monetary policy. The second section evaluates some new evidence on the credit view. The third section discusses the relevance of the credit view for the current economic recovery. The article concludes that while credit channels usually magnify the effects of monetary policy, the current weakness in the banking sector may have partly blocked these channels. As a result, the credit view helps explain why the economy has remained sluggish despite a considerable easing of monetary policy.

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WHY CREDIT MATTERS

Sharp drops in bank lending have periodically staggered the economy over the last century. These episodes cast doubt on the traditional money view that only a change in the supply of money transmits monetary policy. According to the alternative credit view, changes in the supply of bank loans may also carry the force of monetary policy.

Credit crunches

Drastic declines in the supply of bank loans, or credit crunches, have punctuated economic history in America. In the past, credit crunches resulted from bank runs and from the combination of tight monetary policy and ceilings on bank deposit rates. More recently, a shortage of bank capital may have caused a credit crunch (Bernanke and Lown; Johnson).[1]

Before deposit insurance was introduced, credit crunches were often triggered by "runs" on the banking system. Depositors, hearing rumors that their bank might fail, raced to withdraw their

bank savings. But, with much of its money invested in long-term loans, the bank could not pay all of its depositors at once, often forcing the bank to fail. And because one bank invariably owed another bank money, bank failures "dominoed" across the country. The rampant bank failures halted bank lending and, with it, economic activity.

Deposit insurance eliminated bank runs after 1933, but credit crunches continued periodically. In the 1960s and 1970s, for example, tight monetary policy caused lending to drop whenever the Federal Reserve pushed interest rates above the level banks were allowed to pay depositors. Lured to higher market interest rates elsewhere, depositors withdrew their money from banks, forcing banks to cut back their lending. Crunches such as these ceased in the early 1980s when banks were permitted to pay market interest rates to depositors.

As recent events suggest, however, not even the deregulation of deposit rates has ended credit crunches. In the past several years, banks have suffered huge losses on loans to developing countries, agriculture, energy, and most recently, real estate. These losses have eroded banks' capital, while regulators have raised the minimum permissible ratio of capital to assets. The only way for many banks to increase their capital-asset ratio has been to shrink their balance sheets—that is, to sell assets, reduce deposits, and halt lending. The aftermath has resembled earlier credit crunches, only this time a capital shortage may be to blame.

These episodes provide support for the credit view, reminding analysts and policymakers that bank lending appears to matter very much indeed. Whatever the cause of these crunches, most have occurred a few months before or after the onset of recession. These crunches alone, however, are not proof that credit helps transmit monetary policy. In each episode, the growth of money also fell dramatically. So the recession attending each crunch could have resulted entirely from the decline in money.

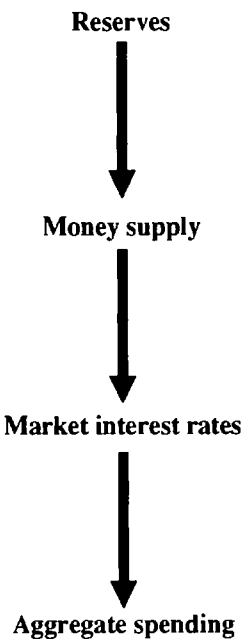
Money versus credit

Understanding the credit view requires examining the roles of both money and credit in the transmission of monetary policy. Both the credit view and the money view acknowledge a common money channel of policy. But, according to the money view, only money matters. Reduced availability of bank loans does not matter because firms can supposedly maintain their spending by borrowing elsewhere. According to the credit view, however, bank loans do matter. Many firms rely on banks for credit—thus, bank loans are *special.* If true, monetary policy may be amplified through credit channels.

In describing the two views, this article uses simple, abstract models. While these models help explain the role of money and credit in the economy, they ignore much of the complexity inherent in the actual conduct of monetary policy.[2] In addition, for ease of exposition, this article discusses the two views by focusing on the effects of a *tightening* of monetary policy. This focus is shared by most other studies of the credit view.

The money view. In the money view of the monetary transmission mechanism, the effects of tightening monetary policy take place in two stages (Figure 1). In the first stage, the Federal Reserve pushes up market interest rates by reducing the supply of money. This stage begins when the Fed sells government securities to the public in exchange for checks drawn on private banks in the economy. As the Fed debits the reserve accounts of these banks, reserves in the banking system fall relative to deposits. If reserves fall below the Fed's legal reserve requirements, the banking system as a whole must reduce its holdings of deposits. As a result, the supply of money in the form of bank deposits falls. But because the demand for money has not changed, market interest rates rise to allocate the smaller supply of money. Interest rates continue to rise until people are satisfied holding fewer deposits and more government securities.

Figure 1
The Money View of the Monetary Transmission Mechanism



In the second stage of the transmission mechanism, higher market interest rates reduce spending in the economy. Business investment on plant and equipment declines in the face of higher borrowing costs. Consumer spending also falls, particularly spending on housing and durable goods (such as furniture and cars) that people often buy on credit.

According to the money view, the transmission mechanism ends here.[3] Spending declines only because market interest rates rise, and market interest rates rise only because the Federal Reserve reduces the supply of deposits when it tightens policy. Whether banks reduce lending after their deposits decline is irrelevant in the money view. If banks do cut back on loans, firms who borrowed from banks before policy was tightened will instead borrow at similar terms in the bond market or commercial paper market. In other words, the money view assumes that firms can maintain their desired level of spending simply by switching from bank loans to other sources of credit.

The credit view. The credit view holds that bank loans are special because some firms may not be able to find other sources of credit. While large, reputable firms can borrow in the commercial paper and bond markets, smaller, less-established firms may rely solely on banks for loans.

The credit view describes a pecking order in credit markets, with firms ranked according to their size and reputation. Size is important because the credit markets require collateral to secure a loan—collateral that a smaller firm may not have. And reputation is important because, unless a lender can monitor a firm's operations, the lender must rely on the firm's history of business

decisions—a reputation that younger firms lack.

At the top of the pecking order are the largest, most established firms in the economy—companies able to pick and choose where they borrow. For example, a recent study found that manufacturing firms with plant and equipment worth more than $1 billion obtained less than 15 percent of their long-term credit from banks (Gertler and Hubbard).[4] These "blue-chip" firms can easily offset a decline in bank lending, even a crunch, by switching to the bond market or to the commercial paper market.

Beneath these blue-chip companies are companies that rely primarily on banks for credit. For example, medium-sized firms with plant and equipment worth between $100 million and $1 billion were found to obtain about 45 percent of their long-term credit from banks. Still smaller companies with less than $100 million in plant and equipment relied on banks for roughly 70 percent of their long-term credit (Gertler and Hubbard).

Among firms that rely on banks for credit, a second pecking order emerges, based on whether firms obtain a loan commitment. Loan commitments, such as a line of credit, assure firms they can borrow up to some limit for a certain period of time. Bankers indicate that an important reason firms obtain commitments is to protect themselves from a credit crunch. Yet banks appear reluctant to grant commitments to smaller, fledgling firms.[5] For example, a recent survey revealed that 60 percent of medium-sized firms with 50 or more employees had a loan commitment, while only 27 percent of smaller firms had a commitment (Ellihausen and Wolken). During a credit crunch, then, small firms without commitments may get served last or not at all. For such companies, bank loans are special.

The credit channels of monetary policy

When bank loans are special, tight monetary policy can be amplified through at least two credit channels. The *direct channel* works through the reduced willingness of banks to lend at the going market interest rate. The *indirect channel* works through the effect of higher market interest rates on banks' willingness to lend.

The direct channel. Monetary policy is transmitted through a direct credit channel if changes in bank reserves directly affect the supply of bank loans (Figure 2). As in the money view, tighter monetary policy begins when the Federal Reserve drains reserves from the banking system, which in turn forces banks to reduce their deposits. As banks reduce deposits, they must also reduce their holdings of loans and securities. To the extent banks trim their loans, borrowers who rely on banks for credit must reduce their spending.[6]

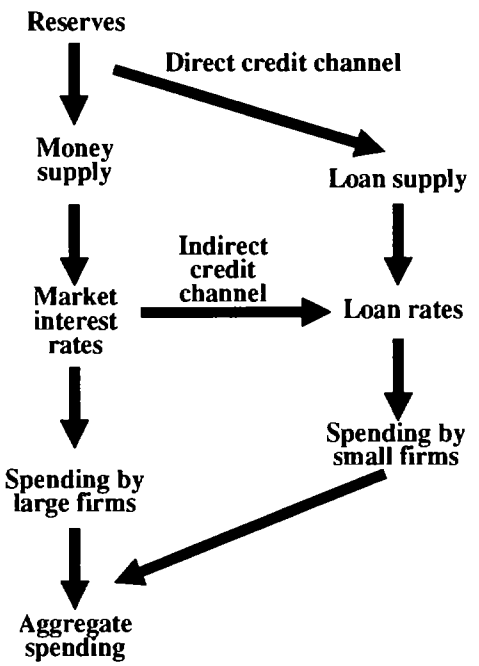
Monetary policy is amplified through this direct credit channel because spending declines more than in the money view, where borrowers are supposed to offset the decline in bank lending by borrowing elsewhere. The channel is direct because it does not depend on how much, or whether, market interest rates rise. Even if market interest rates did not rise for some reason, the reduced supply of bank loans would still reduce spending.[7] Indeed, this credit channel can operate independently of monetary policy. If banks decide to cut back their supply of loans irrespective of monetary policy, economic activity will decline.

The indirect channel. Monetary policy may also be amplified through an indirect channel. The indirect channel operates when a rise in market interest rates following a tightening in policy causes a further increase in loan rates (Figure 2).

As in the money view, when the Fed drains reserves from the banking system, market interest rates rise.[8] Thus, even if lower reserves do not directly force banks to raise loan rates, the rise in market interest rates will. In the money view, banks raise their loan rates only enough to cover the increase in their cost of funds resulting from higher market interest rates. If banks tried to raise their rates any higher, firms would simply switch to other credit markets.

In the credit view, however, loan rates rise

Figure 2
The Credit View of the Monetary Transmission Mechanism



more than market interest rates because higher rates make borrowers more prone to default. Default risk increases because higher loan rates increase a borrower's total debt burden, which, all else equal, increases the likelihood that the borrower's profits will not cover its debt payments. To compensate for the higher default risk, banks must raise loan rates more than is required simply to cover the higher cost of funds. Banks may also tighten other terms of lending, such as collateral requirements and the size and maturity of loans.

It is true, of course, that market interest rates may also increase due in part to default risk. But in the credit view, banks will raise loan rates and tighten other lending terms more than lenders in capital markets (Gertler and Gilchrist). They will do so because the default cost of bank borrowers, relative to the amount borrowed, is higher than the default cost of capital market borrowers. Default costs will be relatively higher for banks, which specialize in lending to small firms, because the administrative costs of bankruptcy are to some extent fixed.[9] In other words, for a small firm, the cost to administer bankruptcy proceedings is larger, relative to the amount borrowed, than for a large firm. Thus, an increase in market interest rates will lead banks to tighten their lending terms more than capital market lenders.[10]

The indirect credit channel of tighter lending terms at banks amplifies monetary policy because spending declines more than it would if bank borrowers could borrow under relatively easier terms in other credit markets. The channel is indirect because it operates only to magnify the effect of higher market interest rates. If for some reason

market interest rates did not rise after policy was tightened, banks would not tighten their terms of lending, all else equal.

DOES CREDIT MATTER?

In investigating whether credit matters in transmitting policy, researchers focus on three questions. Does the behavior of money and loans after a change in policy support the money view or the credit view? Do small firms respond more than large firms to monetary policy? And, does the supply of loans still depend directly on reserves?

Why money before loans?

Two recent studies have uncovered a key fact: after policy is tightened, money growth slows immediately, while loans and output slow several months later. The authors of the studies interpret this fact differently. Bernanke and Blinder (1989) take the credit view, arguing that because loans and output decline together, slower output may result in part from slower lending. In other words, policy does not reduce output until the supply of bank loans declines. Romer and Romer take the money view, arguing that because money declines before output, slower money causes output to fall. Reduced output then reduces the demand for loans.

Choosing the correct interpretation requires understanding why money declines before loans when policy is tightened. Bernanke and Blinder speculate that loans may decline with a lag because firms continue to borrow under loan commitments arranged before policy was tightened. Banks can refuse loans only to smaller firms without commitments and to firms whose commitments have expired.

One test of this possibility is to see whether the proportion of business loans made under commitments rises when monetary policy is tightened. In fact, increases in the federal funds rate, which Bernanke and Blinder associate with tightened monetary policy, are accompanied by increases in the share of business loans made under commitment (Chart 1).[11] This fact supports the possibility that credit commitments explain the lag between monetary policy and loans.

Romer and Romer, however, find evidence against this possibility. They reason that during periods of tight monetary policy, banks may refuse to grant new commitments. Thus, if loan commitments explain the lag, the amount of borrowed commitments should depend on the amount of unused commitments arranged before policy was tightened. Romer and Romer find no such relationship, however, either in general or following a monetary contraction.[12] They conclude that the lag between tight policy and slower lending does not merely reflect continued borrowing under loan commitments.

In view of these conflicting results, explaining the lag between a tightening in monetary policy and the subsequent decline in loans will require further research. Until then, it seems unclear whether the relative timing of money and loans supports the credit view.[13]

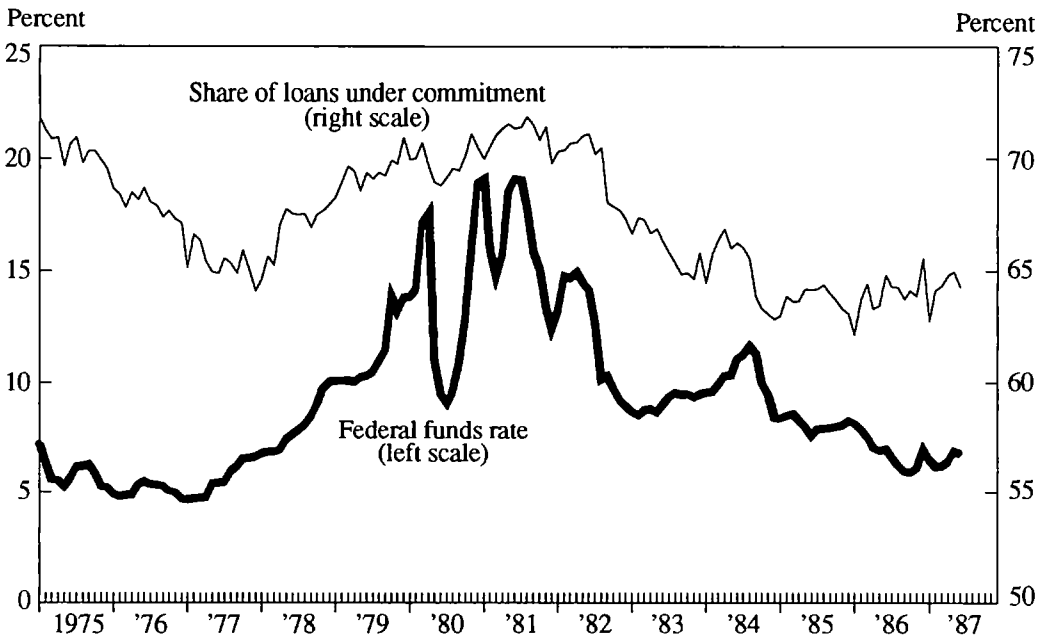
Do small firms respond more to monetary policy?

Clearer evidence for the credit view comes from recent cross-sectional studies. One study compares the sales of small firms to the sales of large firms after a change in policy. Another study compares the spending behavior of firms with loan commitments to smaller firms without commitments. These studies support the credit view and avoid the risk of interpreting (or misinterpreting) the relative timing of money and loans after a tightening in policy.

Gertler and Gilchrist reason that since small firms bear the brunt of the credit channels, they should respond more than large firms to monetary policy. To test this reasoning, they compare the impact of tight monetary policy on small manufacturing firms—firms with assets less than $25 million—and larger manufacturing firms during the period from 1959 to 1990. They find that in the two and one-half years following a change to tighter monetary

Chart 1

The Federal Funds Rate and Commitment Lending



Source: Data on the Federal funds rate and loans made under commitment are monthly and come from the Board of Governors of the Federal Reserve System. Data on total business loans, also monthly, are from the Federal Reserve Bank of St. Louis.

policy, annual sales growth of small firms was more than four percentage points lower than sales growth of large firms.

Gertler and Gilchrist then examine the source of this different impact of monetary policy on small and large firms. They find that while bank loans to small firms declined after policy was tightened, lending to large firms actually increased. This finding suggests that the supply of bank loans to small firms dried up, perhaps because they did not have loan commitments.[14]

Another recent study suggests that the availability of bank loan commitments does affect firms' behavior, providing further evidence for the credit view (Morgan). The study compares the investment behavior of firms with bank loan commitments to smaller firms without commitments over the 1980-84 period, a turbulent period covering a tightening of monetary policy in October 1979 and a credit crunch in 1980. Firms with loan commitments maintained their investment spending when their cash flow declined. This finding suggests these firms were able to borrow from the bank, or in other credit markets, to offset reduced cash flow. When firms did not have a bank loan commitment, however, their investment declined whenever their cash flow declined.[15] The dependence of their investment spending on cash flow suggests they were unable to borrow from banks to finance their spending.

Does loan supply depend on reserves?

While cross-sectional evidence supports the credit view, it does not identify the relative importance of direct versus indirect credit channels. In fact, the ability of banks to fund loans with certificates of deposit (CDs) may block the direct credit channel (Romer and Romer). Because banks can now fund loans by issuing CDs, which no longer require reserves, a change in reserves may no longer directly affect the supply of loans.[16] That is, when reserves decline banks can substitute CDs for demand deposits without reducing their lending.

Not all researchers agree on this point. Smaller, undercapitalized banks may not be able to issue all the CDs they need at the market interest rate (Gertler and Gilchrist). Such banks face a risk premium in the CD market, just as small, little-known firms face a risk premium at banks. For such banks, a loss in reserves may directly reduce their willingness to supply loans.[17] Whoever is right, it is important to note that Romer and Romer argue only that CDs block the direct credit channel. They do not dispute the indirect channel described by the credit view.[18]

The evidence marshaled above generally supports the credit view. Although evidence on the relative timing of money and loans is ambiguous, cross-sectional evidence on small and large firms suggests that credit does matter. The ability of banks to fund loans with CDs, however, may mean that credit matters primarily through the indirect channel.

A CREDIT VIEW OF THE CURRENT RECOVERY

The credit view helps explain why the economy has responded sluggishly to easier policy in the current recovery. Although credit channels should act to amplify easier monetary policy, in the current recovery these channels may be partly blocked. In particular, the combined effect of high loan losses and new capital requirements may leave banks reluctant to increase their lending.

Loan losses

A recent study examines how high loan losses at banks in a given state affect the state's income growth (Samolyk). Samolyk reasons that if banks in a state are burdened with bad loans, firms there may be short of credit, thereby slowing growth in the state.[19] She finds that from 1983 to 1990, higher loan losses in a state were generally associated with lower income growth in that state, even allowing for states' recent economic performance.

To sharpen her conclusion, Samolyk divides the sample into states with weak banks and states with strong banks, according to whether banks in a state had loan loss rates higher or lower than the national average. She finds that the rate of bank loan losses explains substantially more of the income growth in states with weak banks. She concludes that banks matter most when weak banks clog the credit channels.

Although Samolyk's sample period does not extend to the present, her results still seem to bear on the current recovery. Banks in some regions of the country, New England for example, are still staggering under high loan losses. Despite easier monetary policy, these banks may be reluctant to increase their lending, thereby dampening the recovery.

New capital requirements

While banks are currently struggling with high loan losses, they are also adjusting to stricter capital requirements. The stricter requirements reflect changes in both international and domestic banking standards. A committee of banking officials from 12 industrial countries recently endorsed risk-based capital requirements, which require banks to hold more capital against loans than against securities. U.S. bank regulators adopted this stand-

ard and independently imposed a minimum overall capital-asset ratio. Full compliance with both standards is required by the end of this year.[20]

The new capital requirements may block the direct credit channel of monetary policy. The higher overall ratio of capital to assets required under the new regulations may lead some banks to reduce their assets, both loans and securities. In that case, increasing bank reserves will not directly boost bank lending, so the impact of monetary policy will be weaker.

Basing capital requirements on risk further weakens monetary policy by blocking the indirect credit channel. In the credit view, easier policy should lower market interest rates and, in turn, ease the terms of lending at banks. Yet the risk-based capital requirements decrease banks' tolerance for risk, all else equal. Specifically, banks will have a stronger preference for securities than for loans. Therefore, easier monetary policy will ease the terms of lending by less than it did before capital requirements were changed, which diminishes the impact of monetary policy.

SUMMARY

According to the credit view, the force of monetary policy depends partly on banks' willingness to lend. A tightening of policy, for example, causes bank lending to slow, augmenting policy's traditional money channels. Although researchers disagree about whether the timing of money and loans after a change in policy supports the credit view, they generally agree that cross-sectional evidence suggests at least an indirect credit channel of monetary policy.

The credit view helps explain why the economy has responded only sluggishly to easier monetary policy. If banks are still struggling with high loan losses and stricter capital requirements, they will be reluctant to increase lending. This reluctance obstructs the credit channels, which weakens the impact of monetary policy. Of course the usual money channels are still open, so policy remains effective. The credit view merely explains why policy will be weaker and the recovery slower, if banks are reluctant to lend.

ENDNOTES

[1] Bernanke and Lown found a significant correlation between the decline in bank lending and the decline in bank capital, suggesting the sharp decline in lending near the beginning of 1990 did not merely reflect reduced demand for loans.

[2] The discussion of the money view is based on the traditional IS/LM model in which there is only one monetary aggregate. According to the model, easier monetary policy should lead to faster growth in "money" and lower market interest rates. In practice, defining an appropriate monetary aggregate is difficult. For example, the behavior of the three aggregates that have been monitored or targeted by the Federal Reserve—M1, M2, and M3—has sometimes diverged. While growth of the narrow monetary aggregate, M1, has accelerated in the last two years in response to easier monetary policy, growth of the broader monetary aggregates, M2 and M3, has remained subdued.

The discussion of the credit view is based largely on an extension of the IS/LM model in which bank loans are an imperfect substitute for other sources of credit. See Blinder and Bernanke for a formal discussion of this model.

[3] This article ignores possible wealth effects and exchange rate effects resulting from the change in market rates and the stock of money.

[4] Gertler and Hubbard obtain their data from the U.S. Department of Commerce, Bureau of the Census, *Quarterly Financial Report of Manufacturing, Mining, and Trade Corporations*, various issues. Net plant and equipment were valued in 1982 dollars.

[5] Duca draws this conclusion based on a Federal Reserve Board survey of loan officers. Kastantin came to the same conclusion after several years as a corporate treasurer. See Morgan (1989) for a discussion of the protection offered by commitments from a crunch.

[6] Unlike the money view, the credit view assumes banks will reduce their lending—not just their securities—when their deposits fall (Bernanke and Blinder 1986).

[7] Market rates would not rise, for example, if people could find perfect substitutes for bank deposits; in that case, *only* loans, not money, affect spending. Bernanke and Blinder (1988) note that market rates might even decline after policy is tightened because of the decline in spending resulting from the reduced supply of bank loans. In other words, the IS curve shifts more than the LM curve.

[8] In their version of the credit view, Romer and Romer argue that market rates rise more following a monetary contraction when bank loans are special. Banks drive market rates higher as they compete for reserves to maintain their lending, as well as their deposits. This possibility, which they ultimately reject, suggests a direct credit channel from reserves, to loan rates, then to market rates.

[9] The little evidence available on the magnitude of default costs suggests the costs are proportionately higher for small firms. For example, Warner found that in a small sample of failed railroad companies, the administration fees for bankruptcy were a larger share of the asset value of the smaller companies than of the larger companies. In a larger study of 1675 bankruptcy cases, Stanley and Girth reported that bankruptcy expenses take a very large part of the firm's assets in the smallest cases, but take a smaller fraction in the largest cases.

[10] The difference is magnified if the risk of default by bank borrowers increases more than for capital market borrowers when interest rates rise. Bank borrowers' default risk would increase more rapidly if higher interest rates lead them to engage in riskier activities to a greater extent than borrowers in capital markets. According to the credit view, such incentive problems are precisely why smaller, lesser-known firms must borrow from banks instead of in capital markets.

[11] In a separate study using a quarterly data series from 1977 to 1988, Berger and Udell also find the share of new business loans made under commitment rises when the T-bill rate increases. They questioned, however, whether the increase in the proportion was economically significant.

[12] Specifically, they found that growth in unborrowed commitments did not help predict growth in borrowed commitments one to six months later, when controlling for lagged growth in borrowed commitments.

[13] The debate in interpreting the time-series behavior of money and loans has raged for some time. King (1986) found that growth in bank loans did not help predict output, controlling for money growth. He interpreted this as evidence against the credit view. However, Bernanke (1986) challenges that conclusion on the grounds that King was merely picking up the fact that money leads output, which does not prove it causes output. More recently, Kaship, Stein, and Wilcox (1991) find time series evidence for the credit view when they discovered that the ratio of bank loans to commercial paper decreases following a monetary contraction, and that this ratio helps predict output. Using a longer time series, however, Miron (1991) found that this ratio does not always increase after an episode of tight monetary policy.

[14] They also found that sales of small firms responded more to changes in aggregate spending than sales of large firms, which they interpret as evidence of an additional, indirect credit channel of monetary policy. An initial decline in aggregate spending ultimately causes a larger decline by reducing investment of firms that rely on cash flow to finance their spending. This accelerator results from information problems emphasized in the credit view (Fazzari, Hubbard, and Petersen). The accelerator flattens the IS curve, implying a given shift in the LM curve has a larger effect on spending.

[15] Reduced cash flow reduced firms' investment spending, even controlling for sales and Tobin's Q. These results could reflect that firms without commitments could not borrow from banks (or elsewhere), or that firms with loan commitments had better access to other credit markets, or both.

[16] Banks have been allowed to issue CDs with relatively low reserve requirements since 1974. The reserve requirement was reduced to zero in 1990. The decline in reserves affects loan supply only indirectly, as banks pass on the higher cost of CDs to borrowers.

[17] Researchers also dispute this point because it assumes that banks do not care where they obtain the funds they lend. However, banks may prefer to fund their loans with transaction deposits rather than CDs, because banks can monitor a borrower's spending by observing its transactions (Fama). If a bank sees a borrower squandering a loan, it can call the loan and cut its losses.

[18] Indeed, they suggested the distinction. In particular, they suggested a scenario in which higher market rates resulting from reduced reserves is amplified through the indirect channel, culminating in a bank credit crunch.

[19] Healthy banks in other states will be reluctant to lend to out-of-state firms not well known by the banks.

[20] See Keeton for a discussion of the new capital requirements and the effects on banks.

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Tenth District Construction: Smoother Sailing Ahead?

By Tim R. Smith

Activity in the Tenth District's construction sector underwent wide swings in the 1980s. During the national recessions of the early 1980s, construction in the district slowed from its torrid pace of the late 1970s. Then, just as building activity began to recover in the mid-1980s, two events shook the district's construction industry. Federal tax reform removed strong incentives for investment in commercial construction. And the collapse of the energy industry ended much of the demand for office space and housing in the district's major cities. As the decade drew to a close, building activity in most parts of the district stood still.

Will the district's construction sector enjoy smoother sailing in the 1990s? This article examines the growth of construction in the 1980s and explores the outlook for district construction in the decade to come. The first section of the article documents the nation's construction cycle in the 1980s and highlights the factors responsible for the cycle. The second section explains how the district's construction cycle varied from that of the nation and how construction activity varied across the district's major real estate markets. The third section concludes that growth in the district's construction sector in the 1990s will be slower than in the 1980s but less erratic.

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THE NATION'S CONSTRUCTION CYCLE IN THE 1980s

Understanding the wide turns in the district's construction sector requires a closer look at the nation's construction cycle. In the 1980s, both cycles were driven by a wave of commercial property development—that is, by multifamily residential construction and nonresidential construction, such as office, industrial, and retail structures. The wave in commercial property development was caused by three forces: new tax laws regarding real estate investments, changes in the lending behavior of financial institutions, and the boom and bust of the energy industry.

Other types of construction were less sensitive to these forces. Single-family residential construction responded primarily to other factors such as demographic trends and real mortgage interest rates (Miller; Peach; and Garner).[1] And nonbuilding construction such as roads, bridges, and dams responded to state and local budget outlays for public infrastructure. As a result, these types of construction took a back seat to multifamily residential and nonresidential construction in shaping the construction cycles in the nation and the district during the 1980s. Therefore, this article focuses on construction of commercial property.[2]

After the nation's construction activity dropped sharply in the early part of the decade, commercial property development fueled a rapid and dramatic recovery in building activity. More favorable tax laws, readily available financing, and the energy boom boosted commercial property development. Construction jobs, a good measure of overall construction activity, fell during the 1980 and 1981-82 recessions, turned around in 1983, and climbed sharply in the middle years of the decade (Chart 1).[3] The nation continued to add construction jobs moderately until 1990, when the number of construction workers peaked at over 5 billion. In 1991, building activity faltered and construction jobs fell again sharply, a key element in the economy's recent sluggishness.

Not all of the forces that shaped the nation's construction cycle in the 1980s had the same impact everywhere. Changes in the tax treatment of real estate investments sharply altered the incentives faced by real estate developers nationwide. And financial institutions stepped up their lending to real estate developers across the country. But the energy boom and bust jolted real estate markets only in the energy-producing regions of the country.

Tax treatment of real estate investments

The U.S. Tax Code was revised numerous times during the 1980s, but two revisions stand out as milestones for the construction industry. First, to shore up an ailing national economy, Congress passed the Economic Recovery Tax Act of 1981 (ERTA). ERTA increased real estate investment mainly by allowing more rapid depreciation for commercial property and lowering effective tax rates on capital gains.[4] The increase, particularly in investment in office buildings, condominiums, and apartment complexes, prompted a surge in construction employment after 1982.[5]

The second important change in national tax law came in 1986 when Congress attempted to improve the efficiency and effectiveness of the tax system. The 1986 Tax Reform Act eliminated the favorable treatment real estate had enjoyed during the mid-1980s. In addition to taking away the tax advantages from property investors, tax reform also raised effective tax rates on passive income, which includes rents.[6] Some analysts believe the 1986 tax legislation reduced the present value of the future flow of earnings from a property investment up to 20 percent (*The Economist* 1991). The reduced earnings made many prospective building projects infeasible and many existing building projects insolvent. Although stronger regional economies such as New England continued to register gains in construction activity, tax reform slowed the pace nationwide.

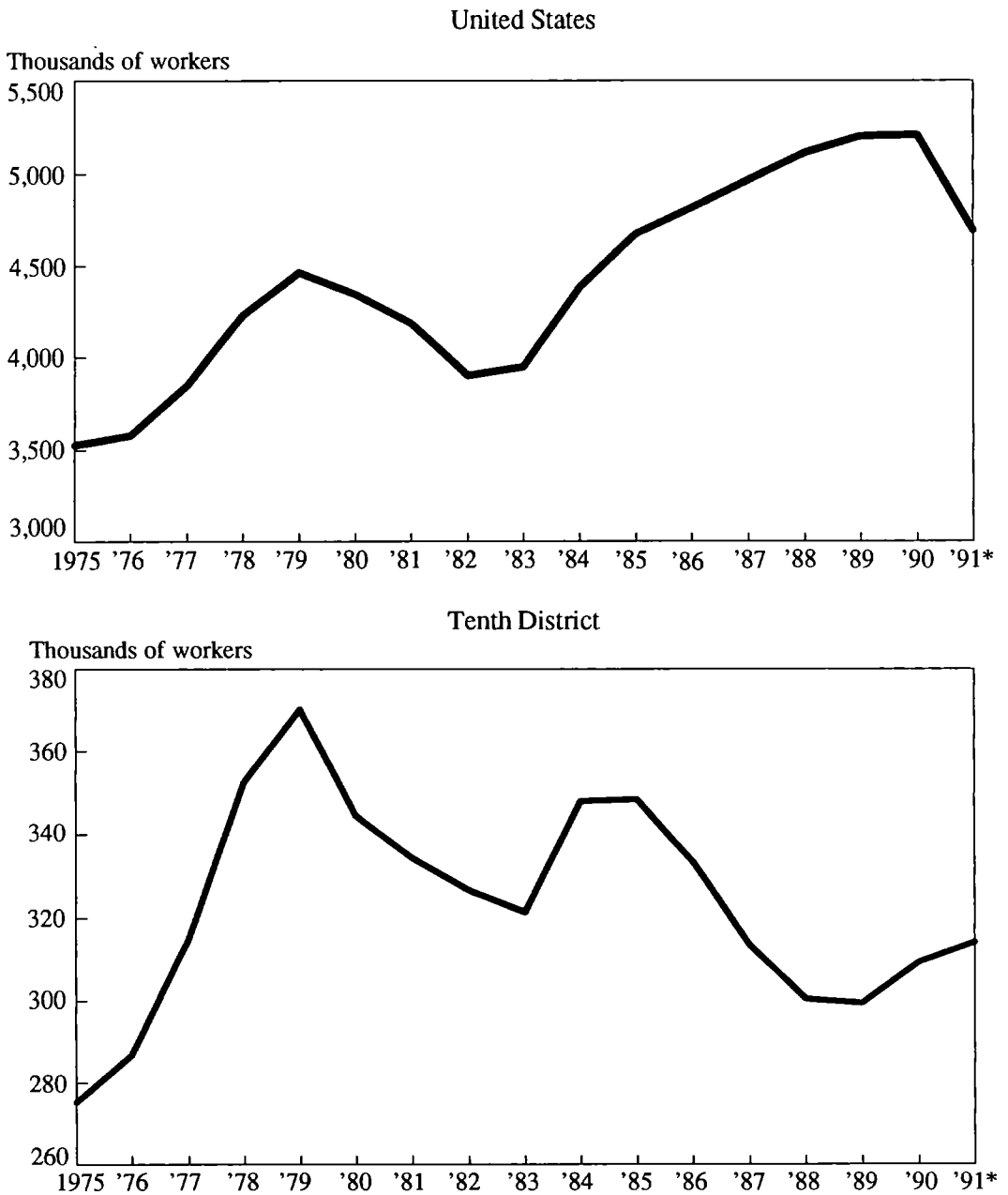
A new wave of real estate lending

As the nation's tax environment became more favorable to real estate in the early 1980s, lenders began to direct more funds to commercial property development. With deposit rate ceilings removed and lending restrictions relaxed, thrifts were free to expand investment in commercial real estate markets.[7] Meanwhile, commercial banks increased their real estate lending to offset revenue losses in other parts of their loan portfolios. The result was a new wave of lending for office buildings, hotels, shopping centers, and multifamily residential structures.

Thrifts increased their real estate lending for two main reasons. First, deregulation of deposit rates allowed thrifts to channel more funds into nonresidential real estate loans (Opsata). As thrifts offered higher paying savings instruments, they invested in more nonresidential real estate loans, which carried higher yields and higher risks than traditional residential mortgages.[8] Second, the Garn-St Germain Depository Institutions Act of 1982 enabled thrifts to double the amount of their nonresidential real estate loans, from 20 to 40 percent of assets.

Commercial banks also stepped up their real estate lending during the 1980s in response to

Chart 1
Construction Employment



*1991 data are for the third quarter of the year.
Source: U.S. Department of Labor.

deposit rate deregulation and to offset their loss of revenue from other sources. Commercial and industrial borrowers were turning increasingly away from banks to the commercial paper and junk bond markets for credit. Demand from other traditional sources, such as agriculture and foreign governments, also diminished in the first half of the 1980s. To balance these losses, and to generate substantial fee income, banks channeled more funds into real estate (LaWare).

The energy boom and bust

The boom and bust of the energy industry also helped power the nation's real estate cycle in the 1980s. Skyrocketing oil prices during the 1970s and early 1980s launched a boom in energy exploration and related activities in the energy-producing regions of the nation. In energy states, such as Texas, Oklahoma, Colorado, and Louisiana, employment grew rapidly. The new oil-field jobs spurred job growth in supporting industries, such as financial and legal services. In Dallas, Houston, Denver, Oklahoma City, and other energy cities, demand for office space exploded. New nonresidential construction projects mushroomed and worker migration created new demands for housing and retail space.

In 1986, oil prices nosedived, compounding the downward pressure from tax reform on construction. Energy companies downsized their operations in the energy cities, causing office vacancy rates to soar. The weakness of the economies in energy regions slowed the growth of construction activity nationwide in the late 1980s. Still, the booming economies in other regions continued to push construction employment upward (Chart 1).

THE DISTRICT'S CONSTRUCTION CYCLE IN THE 1980s

The forces that shaped the nation's construction cycle in the 1980s also shaped the district's cycle, but the performance of the energy industry was much more important in the district. As a result, the district's construction cycle diverged significantly from the nation's. For example, while the nation's construction cycle continued upward in the late 1980s, the district's cycle turned down with the collapse of the energy industry. Moreover, the energy industry was the main reason why the construction cycle varied across the major real estate markets within the district.

Wide swings in district construction

The 1980s were tumultuous years for district construction (Chart 1). The decade began just after the energy boom in the Rocky Mountains and the Southwest pushed regional construction to its peak in 1979. Then, the national recessions of the early 1980s buffeted the construction sector. Effectively stalled for about two years, construction activity finally picked up again as the district kept pace with the nation, adding 27,000 construction jobs from 1983 to 1984.

In 1986, construction activity in the district plummeted, while in the nation it continued to climb. Not only did falling oil prices deal a severe blow to many parts of the district economy, but tax reform also took away special incentives to commercial real estate development. The district lost nearly 50,000 construction jobs from 1985 to 1989, in sharp contrast to the continued expansion of the construction sector in the nation. Strong economic growth on the east and west coasts and an overhang of projects started before tax reform continued to propel national building activity through the end of the decade.

Thus, the boom and bust of the energy industry was the key difference between the district's construction cycle and the nation's. The oil boom helped jump-start construction in both the region and the nation. But while the collapse of oil prices only slowed construction in the nation, it crippled construction in the district.

Construction cycles in Tenth District cities

Just as the region's building cycle diverged from the nation's, individual markets within the district diverged from the overall district pattern. The key to this divergence again is the energy industry. The major cities in the district can be divided into two groups: *diversified cities* and *energy cities*. Kansas City, Albuquerque, Omaha, and Wichita have diversified economies, where construction generally mirrors the national pattern (Chart 2). Denver, Oklahoma City, and Tulsa depend more on energy, and thus construction in these cities follows the district pattern (Chart 3).

Diversified cities. Kansas City's broad-based economy led to a building cycle in the 1980s that resembled the nation's. Construction in Kansas City fell during the recessions in the early 1980s, then rebounded in step with the national recovery (Chart 2). In 1987, tax reform and a sluggish local economy led to another decline in construction activity, pushing the downtown office vacancy rate above 25 percent. Still, Kansas City's office vacancies compared favorably with the energy cities. As the decade drew to a close, moderate growth in the service sector was beginning to fill the empty office space.

The construction pattern in *Omaha* paralleled that of Kansas City until the late 1980s (Chart 2). As in Kansas City, construction in Omaha recovered soundly from the 1981-82 recession, then began to backslide in 1986. For three years, construction activity was sluggish, until the fast-growing service sector boosted construction in 1989 and again in 1990. Key elements in the strength of the construction sector at the end of the decade were new office facilities for telecommunications and food-processing firms and a healthy residential market.

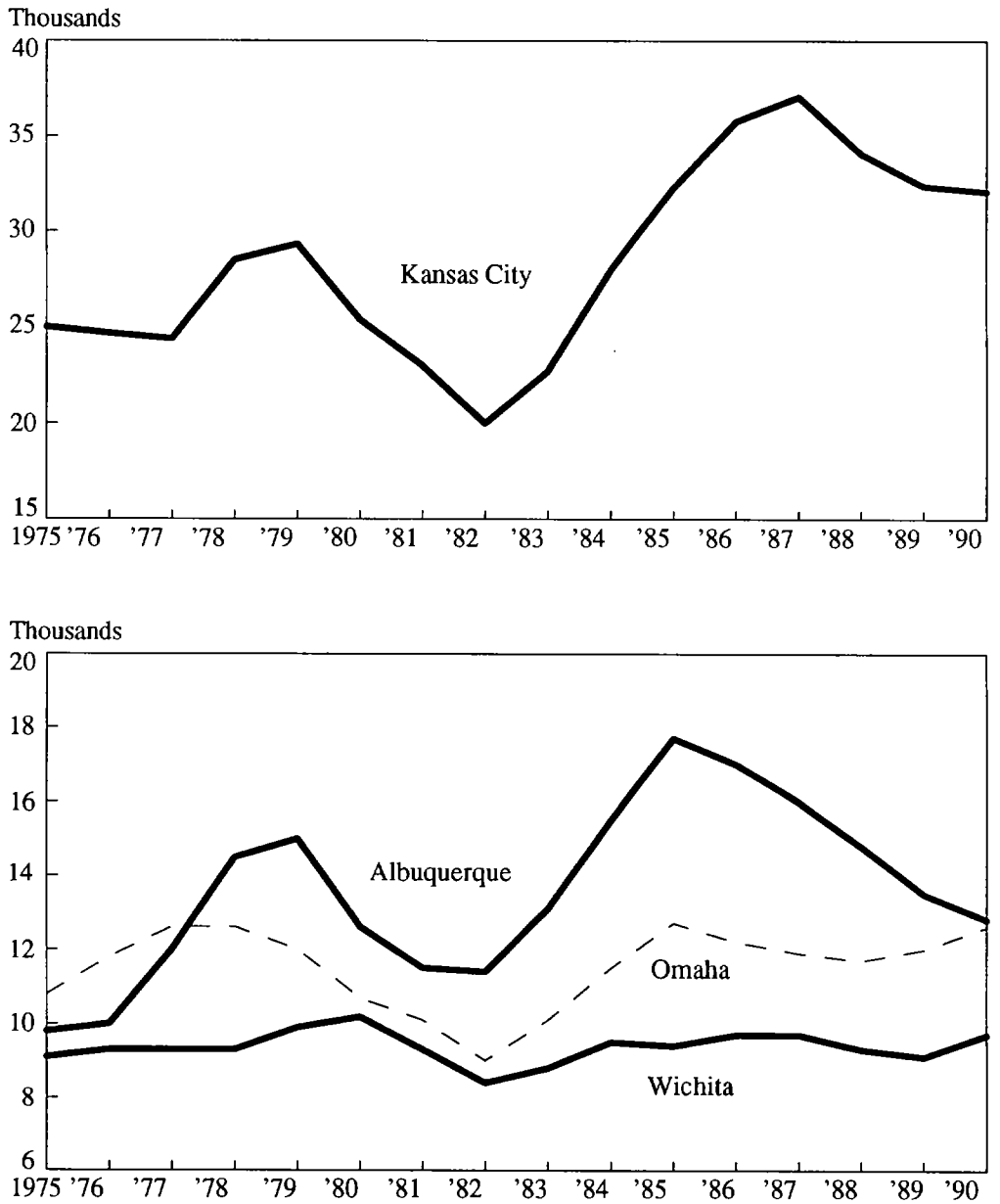
Although *Wichita's* economy depends somewhat on the energy industry, its reliance on other industries led to a 1980s building cycle similar to Kansas City and Omaha. After dipping during the recessions of the early 1980s, construction recovered only modestly until late in the decade (Chart 2). The local economy was hampered in the mid-1980s by a struggling general aviation manufacturing industry and a weakening energy sector. As the decade drew to a close, the aircraft industry began to revive, spurring some expansion by manufacturers and their suppliers. Strong service growth in the late 1980s, particularly in health care, also bolstered construction in Wichita.

The building cycle in *Albuquerque* through the mid-1980s resembled other diversified cities (Chart 2). Then, a shakeout in high-technology manufacturing and some adverse effects of the energy bust began to curb the city's growth. Construction began to fall in 1986 and continued to fall through the end of the decade. After 1986, office vacancies increased slightly as the sluggish local economy could not absorb the new office space being built. By the end of the decade, office vacancies jumped significantly and building completions slowed. A slowing in the housing sector in the second half of the decade also helped weaken construction activity. After rising steadily during the first half of the decade, home values in Albuquerque leveled off, signaling a weaker housing market.

Energy cities. Energy was the driving force in *Denver's* construction cycle in the 1980s. In the late 1970s and early 1980s, rapidly expanding energy companies developed large appetites for office space and housing, fueling the construction boom (Chart 3). Legal and financial services grew alongside the energy sector, further swelling the demand for office space, housing, and retail space.

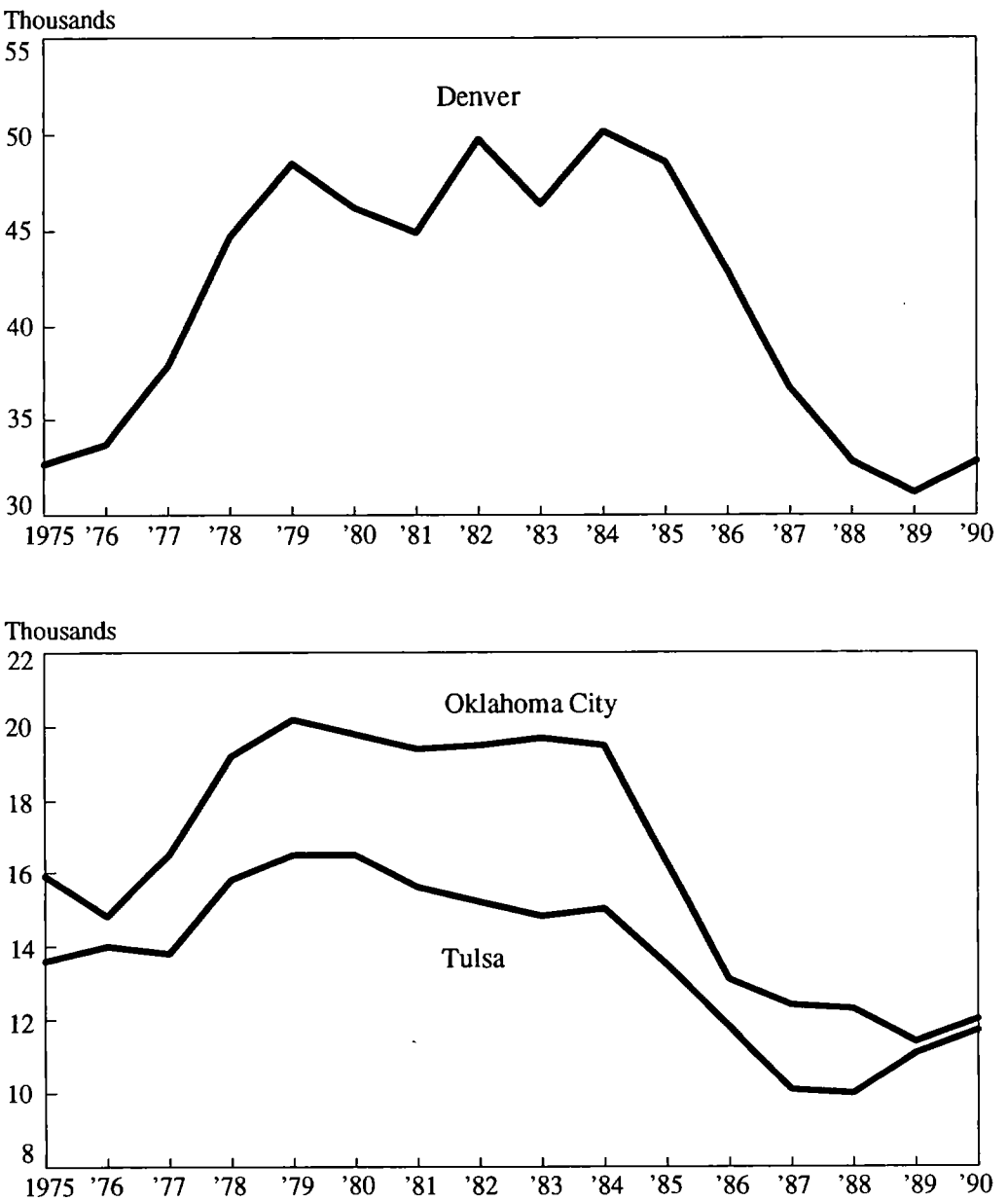
But when oil prices collapsed in 1986, Denver's construction boom ended. Most large energy companies consolidated their operations, closing or downsizing their regional offices. Office vacancies soared and office construction halted. Public works projects, such as a new convention center, took up some of the slack toward the end of the decade, helping to stem the freefall in construction activity. In 1990, construction was bolstered by the new Denver International Airport and some new homebuilding.

Chart 2
Construction Employment, Diversified Cities



Source: U.S. Department of Labor.

Chart 3
Construction Employment, Energy Cities



Source: U.S. Department of Labor.

Oklahoma City's construction cycle resembled the cycle in Denver. The expanding energy sector sustained construction at peak levels from the late 1970s through the middle of the 1980s (Chart 3). By early 1981, strong growth in office employment had virtually eliminated vacant office space. The strong demand for office space pushed up rents and induced a wave of nonresidential building. The building wave hiked the downtown office vacancy rate to 25 percent even before oil prices collapsed in 1986. After 1986, office vacancies in downtown Oklahoma City surged past 30 percent and were among the highest in the nation. Continued high office vacancies depressed nonresidential construction through the end of the decade.

In *Tulsa*, the dominant force in shaping the building cycle was again the energy industry. After peaking in 1980, construction activity declined slowly until 1984 (Chart 3). Then the decline steepened until 1987 when construction activity finally leveled off. In the last two years of the decade, construction activity in Tulsa turned around and posted modest gains.

SMOOTHER SAILING FOR DISTRICT CONSTRUCTION IN THE 1990s

The forces responsible for wide swings in the district's building cycle in the 1980s will have much less influence in the 1990s. Changes in federal taxes during the next ten years are impossible to predict, but sharp tax code reversals such as those passed in 1981 and 1986 are unlikely.[9] The flood of lending by commercial banks and thrifts for real estate investment is long past. And the downsized energy sector will be a much smaller influence on construction in the district, regardless of the future stability of oil markets. Commercial property development will experience fewer ups and downs, and single-family residential construction will probably play a larger role in the region's construction activity. Therefore, the district's construction sector will probably not undergo another boom and bust cycle in the 1990s.

While construction activity in the decade will be smoother, it is likely to achieve only moderate growth at best.[10] Lower mortgage rates will probably stimulate residential construction across the district in the near term. Proposals to lower capital gains taxes or provide tax credits to first-time home buyers, if enacted, might provide some short-term stimulus to the construction industry. And the recently enacted transportation bill will boost highway and bridge construction through 1996. Over the course of the decade, however, a slow-growing regional economy and a tighter lending environment will probably lead to only slow growth in overall building activity.

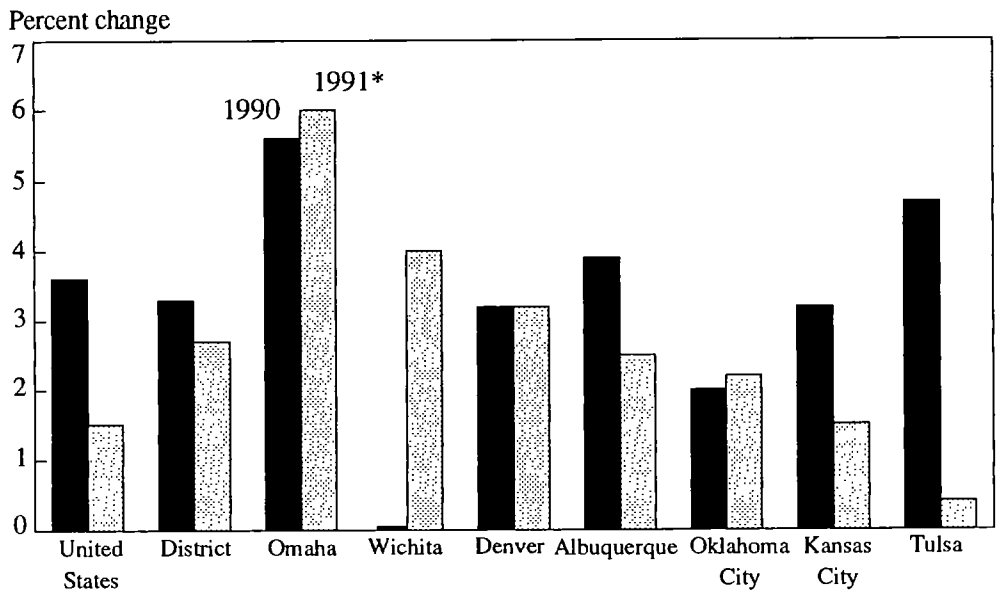
With the downsizing of the district energy sector in the late 1980s, energy has become less important in shaping the district's construction potential in the 1990s. Therefore, instead of grouping the district's cities according to their reliance on energy, this section groups them according to their overall potential for growth in construction. *Moderate growth cities* have relatively tight real estate markets and solid prospects for economic growth. Construction in these cities will bounce back sooner and achieve moderate growth throughout the decade. *Slow growth cities* have slack local real estate markets and dimmer economic prospects. Construction in these cities could remain sluggish well into the decade before achieving growth that is slow at best.

Moderate growth cities

Omaha's real estate market is currently the strongest in the district.[11] The robust building activity of the late 1980s has continued in the early 1990s. In the first ten months of 1991, construction employment increased over 11 percent. Growth in telecommunications, telemarketing, and food-processing businesses continues to support office construction and homebuilding in Omaha. Office vacancies declined in 1990, and although considerable new space was added, office vacancies

Chart 4

Office Employment, Service and F.I.R.E. Workers



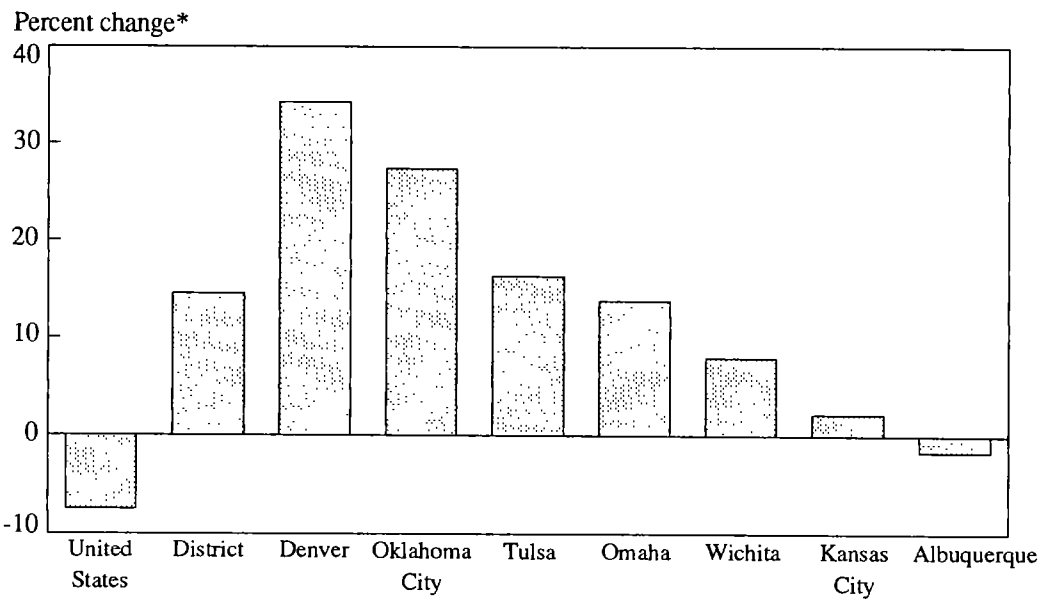
*Percent change from first ten months of 1990 through first ten months of 1991.
Source: U.S. Department of Labor.

increased only slightly in 1991 due to strong growth in office employment (Chart 4).[12] Housing prices have been rising moderately and single-family building permits jumped sharply in 1991 (Chart 5).

The outlook for construction in Omaha is quite good. Continued strong growth in office employment and stable vacancy rates bode well for office construction. The recent increases in home prices suggest that homebuilding is not outpacing housing demand. Thus, the growing economy should continue to support homebuilding at a moderate pace. While the Omaha economy may not sustain growth at the rapid pace of the past few years, it is likely to continue to outperform other district cities.

Denver's real estate market is improving. The stronger real estate market and a surge in public works construction have already stimulated building activity in the city. After five straight years of decline, construction employment grew 5.1 percent in 1990 and 7.9 percent in the first ten months of 1991. The improvement in building activity reflects the near absence of office construction since 1987, a rebound in economic growth, and healthy recent growth in office employment (Chart 4). By late in 1991, the downtown office vacancy rate had fallen from a peak of 31 percent at the beginning of 1987 to near 20 percent, still above the national rate of 18 percent. Denver's housing market began to pick up in 1988 after collapsing in 1986 and 1987. Inventories of single-family homes fell and their prices increased in 1989 and 1990. Building permits for both single-family and multifamily housing units surged in 1991 (Chart 5).

Chart 5
Growth in Single-Family Building Permits, 1991



*Percent change from first ten months of 1990 through first ten months of 1991.
Source: U.S. Department of Labor.

The outlook for construction in Denver is good. Moderate economic growth is expected to continue and is likely to absorb more office and residential space. Some modest increase in office construction is expected by mid-decade. Until then, homebuilding and construction of the Denver airport should maintain Denver's upward trend in construction employment.

Kansas City's real estate market has been one of the healthiest in the district. Construction employment rebounded modestly in 1991 after falling for three consecutive years. The slowing in construction activity in Kansas City in the late 1980s helped keep office vacancies below the national average. Recently, however, the downtown office vacancy rate in Kansas City jumped above the national rate, and office employment growth slowed considerably (Chart 4). Nonetheless, the office market remains relatively healthy. Rising home prices and a mild uptick in building permits reflected the recent improvements in the residential market (Chart 5).

Kansas City's construction activity is likely to improve modestly. Steady absorption of office space is expected to support some increase in office building. But office construction will probably trail its mid-1980s pace until late in the decade. The uptick in building permits in 1991 signals a return to modest homebuilding activity. As in most other markets, single-family building will probably be much stronger than multifamily building.

Slow growth cities

Wichita's real estate market opened the decade as the strongest among the slow growth cities.[13]

Construction employment growth was solid in 1990 and 1991. Absorption of office space was boosted by a surge in office employment in 1991 (Chart 4). As a result, office vacancies edged down, leaving vacancies in downtown and other parts of the city below the national average. Housing prices and single-family permits increased in 1991 (Chart 5).

While the solid growth of the early 1990s may not continue, expansions in manufacturing and services could help stabilize building activity and may lead to some improvement. Nothing in sight suggests an erosion of the traditional stability of Wichita's housing market. A slight upward trend in home prices and homebuilding likely will continue.

Albuquerque's real estate market is currently weak. Construction employment fell in 1991 for the sixth year in a row. A downtown office vacancy rate of 27.5 percent in the third quarter of 1991 was nearly ten percentage points above the national average. Office employment growth has been growing moderately (Chart 4), but the high vacancy rate and softening lease rates have slowed office construction to a near standstill. Home prices have leveled off in Albuquerque, signaling a similarly weak residential market. And for the fifth consecutive year, single-family building permits fell in 1991 (Chart 5).

The outlook for construction in Albuquerque is cautiously optimistic. If office employment continues to expand at a healthy pace, office construction is likely to resume within a few years, gaining strength through the end of the decade. Sluggish growth in the Albuquerque economy will probably not soon reverse the downward trend in homebuilding. Lower mortgage rates may help stem the decline, but a strong rebound appears unlikely.

Oklahoma City's real estate market has been improving, but considerable slack remains. Construction employment increased 5.3 percent in 1990 after falling for six straight years, but fell again in the first ten months of 1991. And the downtown office vacancy rate has persistently exceeded 30 percent since the end of 1986, despite a lack of new construction. The weak absorption of office space reflects a generally weak local economy and only moderate growth in office employment (Chart 4). Only recently has a slight upturn in employment growth helped the office vacancy rate edge down from 35.5 percent at the beginning of 1989 to 33.9 percent in the third quarter of 1991. The housing market has also turned around after collapsing from 1986 to 1990. House prices began to increase and single-family building permits increased nearly 30 percent in 1991 (Chart 5).

The outlook for construction in Oklahoma City is lackluster. Due to the big overhang of existing office space, office construction is not expected to pick up until the mid-1990s.[14] And only slow growth is likely until the end of the decade. Recent housing activity and lower mortgage rates suggest that home prices may level off or continue to increase slightly, supporting modest increases in home building.

Tulsa's real estate market is also weak.[15] Construction activity, however, has recently been somewhat stronger. After four years of sharp decline, construction employment in Tulsa began to increase in 1989 and continued to increase through the first ten months of 1991. Downtown office vacancies in Tulsa have been shrinking but remain near 25 percent, halting new office construction. In addition, office employment growth nearly halted in 1991 (Chart 4). On the up side, the residential market has recently shown some signs of strength. After several years of steady decline, home prices began to firm up in 1990 and 1991. In 1991, single-family building permits increased 17 percent (Chart 5).

As in Oklahoma City, Tulsa's construction activity is likely to be sluggish. Tulsa's economy is likely to absorb the large stock of office space very slowly, delaying the rebound in office building until the middle of the decade—and the rebound itself will probably be very slow.[16] The

recovery in residential construction will probably continue, but it is unlikely that home prices will reach early 1980s levels any time soon.

CONCLUSIONS

The 1980s brought wrenching changes to the construction sector in the Tenth District. Tax reform and increased real estate lending by financial institutions influenced the construction cycle in both the region and the nation. But the energy boom and bust led to a construction cycle in the district out of sync with the nation's cycle. While national construction activity continued to grow throughout most of the decade, construction activity in the district peaked in the late 1970s and turned down sharply in the late 1980s.

The ups and downs of the construction sector were not felt evenly in the district's major real estate markets. The energy boom and bust caused construction in the district's energy cities to behave differently from construction in other more diversified district cities. Energy cities generally followed the district pattern, while the other cities followed the national pattern.

In the decade ahead, construction in the district will probably return to a moderate pace after a few weak years. And construction will be less volatile because the factors that produced the wide swings in construction during the 1980s will play a much smaller role in the 1990s. The outlook, however, differs from market to market across the district. Construction will rebound sooner in cities with relatively tight real estate markets and prospects for solid economic growth. In other cities with slack real estate markets and prospects for modest growth, construction will remain sluggish until the mid-1990s or possibly even later.

ENDNOTES

[1] While multifamily residential construction responded to specific provisions in the tax law, such as depreciation rules, single-family residential construction responded to broad changes in marginal income tax rates during the 1980s. Reductions in marginal income tax rates in 1981 and 1986 dampened housing demand by increasing the after-tax cost of home ownership (Peach).

[2] There is no single measure of building activity to assess the importance of different types of construction. However, combining construction contract data with building permit data helps to show the importance of commercial property in U.S. construction. The value of construction contracts from F.W. Dodge show that residential construction accounted for 43.6 percent of the value of construction contracts in 1990, nonresidential construction accounts for 36.2 percent, and nonbuilding accounts for 20.2 percent. Data on building permits show that about 72 percent of building permits authorized in 1990 were for single-family housing units and 28 percent were for multifamily units. However, the importance of multifamily construction was much greater in the mid-1980s when its share of building permits reached near 46 percent. These data also show a similar relationship between types of construction in the district.

[3] Growth in construction employment closely mirrors growth in the real value of the construction component of Gross State Product which measures the output of the construction sector.

[4] The Economic Recovery Tax Act of 1981 increased the after-tax return to real estate investment by shortening depreciation schedules for nonresidential properties to 15 years (Garner). Previously, the depreciation period varied from 22 to 40 years depending on the particular method used to calculate the depreciation (Downs). ERTA also extended the favorable 15-year depreciation allowance to newly purchased used property (Kopcke and Aldrich). In addition to stretching depreciation schedules, ERTA reduced the maximum tax rate on net capital gains from 28 percent to 20 percent. Sixty percent of net capital gains remained deductible from gross income, but the top tax rate on gross income was reduced from 70 to 50 percent.

[5] The turnaround in building activity is difficult to attribute to any single factor. As the nation emerged from recession in 1982, building activity increased as part of the cyclical recovery. However, there is little doubt that tax and financial factors bolstered the performance of the construction sector after 1982.

[6] The Tax Reform Act of 1986 (TRA) extended the depreciation schedule for commercial property to 31.5 years and residential property to 27.5 years (McMahan). In addition to stretching depreciation schedules, TRA eliminated favorable capital gains rates for real estate and other investments. The act also disallowed the deduction of operating losses from real estate investments against ordinary income such as wages and salaries. Instead, passive losses could only be deducted against passive income other than interests and dividends, but

could be carried forward and deducted upon sale of the property. By taxing capital gains at the same rates as ordinary income, TRA also eliminated favorable capital gains rates for individuals for real estate and other investments.

[7] In this article the term "thrifts" is used to describe federally chartered savings and loans and mutual savings banks. Both of these types of financial institutions were affected by deposit rate deregulation and relaxation of lending limits on commercial real estate during the 1980s.

[8] In some cases, thrifts increased their commercial real estate lending to offset higher costs of funds. In other cases, thrifts wanted to invest in commercial real estate and bid up deposit rates to attract funds for this purpose. The claim that deregulation of deposit rates led thrifts (or banks) to make riskier loans, such as commercial real estate loans, has been widely debated. However, Keeton gives two compelling reasons to support the risk-taking argument. First, deposit deregulation worsened the moral hazard problem banks and thrifts faced under a fixed-rate deposit insurance system. Second, unregulated deposit rates made it easier for risky banks and thrifts to grow by outbidding safe banks for deposits.

[9] The Bush administration has proposed a number of tax reforms that may boost construction activity: lowering capital gains taxes, a tax credit for first-time home buyers, and allowing passive losses to be deducted from ordinary income. It is uncertain, however, how Congress will respond to these proposals.

[10] Several indicators are used in this section to appraise the current condition and the outlook for major district cities. These office and housing market indicators—downtown office vacancy rates, median home prices, single-family building permits, and office employment growth—are generally available for all markets discussed in this article. Retail and industrial market indicators are not available for all markets and, where available, are not strictly comparable. The outlooks for office construction in Denver, Kansas City, Oklahoma City, and Albuquerque were partly based on forecasts by CB Commercial/Toro Wheaton Research. Where noted, local sources in other cities were used to supplement these forecasts.

[11] This article's assessment of the Omaha real estate market is based on information contained in Building Owners and Managers Association of Omaha.

[12] Office employment is defined in this article to include employment in services and employment in finance, insurance, and real estate. Information about growth in office employment, used in combination with vacancy rates, helps to assess growth in demand for office space and the tightness of the market for office space.

[13] This article's assessment of the Wichita real estate market is based on J.P. Weigand and Sons, Inc.

[14] A large percentage of office vacancies in Oklahoma City and Tulsa are in older, obsolete properties that may never be occupied. As a result, vacancy rates in these cities may not be reliable indicators of the tightness of office markets. Construction could resume in the mid-1990s without a big decline in office vacancy rates.

[15] This article's assessment of the Tulsa real estate market is partly based on information in National Association of Industrial and Office Parks, Tulsa Chapter.

[16] See footnote 12.

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The Changing Economy of the Tenth District

By Glenn H. Miller, Jr.

The Commerce Department recently released new gross state product (GSP) estimates through 1989 and revised GSP estimates dating back to 1977. Comprehensive and consistent across states, the GSP data by industry offer a broad, in-depth view of economic performance. The data are especially useful for studying long-run growth trends and long-run changes in industrial structure.[1]

This article uses the new GSP figures to describe the Tenth District economy at the end of the 1980s and to show how its industrial makeup has changed since 1979. While the district economy has retained its distinctive character, it has become more like the national economy in important ways. The performance of the district economy in the years to come may reflect these changes.

THE CHANGING INDUSTRIAL CHARACTER OF THE DISTRICT ECONOMY, 1979-89

The economy of the Tenth District is in some ways similar to and in other ways different from the nation's economy. In 1979 and 1989, both economies relied on the same three industries as their top contributors to total output: (1) manufacturing, (2) services, and (3) finance, insurance, and real estate (FIRE). But the district and the nation differed significantly in both 1979 and 1989 in how much they relied on resource-based industries. Agriculture and mining have contributed much more to district total output than to U. S. total output (Chart 1).

Using GSP data to analyze economic change in the district from 1979 to 1989 yields two conclusions. First, the district economy grew slowly during the 1980s, as total output growth reflected the ebbs and flows of its individual industries. District GSP climbed just 1.4 percent per year from 1979 to 1989 (Chart 2). Slow growth in the government and financial sectors, coupled with declines in mining and construction activity, hampered overall district growth.

Real output in the district grew just half as fast as total U. S. growth of 2.8 percent per year, lowering the district's share of total U.S. output moderately (Table 1). The slower total output growth in the district reflected slower growth in nearly all district industries. Only manufacturing and transportation grew faster in the district than in the nation from 1979 to 1989 (Chart 2). Output also grew more slowly in every district state than in the nation as a whole (Chart 3).

The GSP data also show that from 1979 to

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Table 1

Tenth District Real GSP as a Share of U.S. Real GSP, By Industry, 1979 and 1989
(percent)

Industry	1979	1989
Total	7.6	6.7
Agriculture	13.2	11.9
Mining	17.4	13.6
Construction	8.3	5.5
Manufacturing	5.5	5.7
Transportation	8.3	8.4
Wholesale trade	7.3	6.1
Retail trade	7.6	6.7
FIRE	7.2	5.6
Services	6.6	5.9
Government	7.5	7.2
Addendum: Total output valued in billions of 1982 dollars		
United States	3,143	4,130
Tenth District	238	275

Source: U.S. Department of Commerce, Bureau of Economic Analysis.

1989 the district's industrial structure changed due to differences in industry growth rates. Manufacturing picked up substantially, while mining dropped off sharply, making the district's industrial structure look more like that of the nation in 1989. Manufacturing's share of total output grew in every district state from 1979 to 1989, while mining's share shrank. The major difference between the district and national economies remained the district's heavier reliance on resource-based industries. Despite the diminished importance of mining and little change in the importance of agriculture, the district continued to rely more heavily than the nation on both mining and agriculture.

Agriculture

The relative importance of agriculture to the district economy changed little from 1979 to 1989. Farm output grew at about the same pace as total output in both the district and the nation. Consequently, agriculture's share of total output stayed about the same in both regions. Thus, the 1980s closed with agriculture still making nearly twice as large a contribution to output in the district as in the nation (Chart 1).

State by state changes in agriculture's contribution to district GSP were mixed. Farming's share increased in Nebraska, the district's most agricultural state. Among district states in 1989, agriculture's share of total output ranged from 12.9 percent in Nebraska to 2.4 percent in Wyoming (see appendix for GSP data for individual states).

Mining

The mining industry suffered in the 1980s in both the district and the nation, but the percentage decline in output was considerably larger in the district (Chart 2). Continuing the decline of the past quarter-century, mining's share of total output in the district fell nearly 40 percent during the decade. Still, mining in 1989 remained twice as important in the district as in the nation (Chart 1).

The drop-off in district mining during the 1980s can be blamed almost completely on the slumping oil and gas sector. Oil and gas extraction in the district plummeted over the 1980s, but still remained the largest segment of the mining industry at decade's end. For the district as a whole, oil and gas extraction's share of total output shrank from 9 to 5 percent. In the region's three largest producing states—Oklahoma, New Mexico, and Wyoming—the oil and gas share of GSP ranged from 13 to 16 percent in 1989, down from 20 to 30 percent ten years earlier.

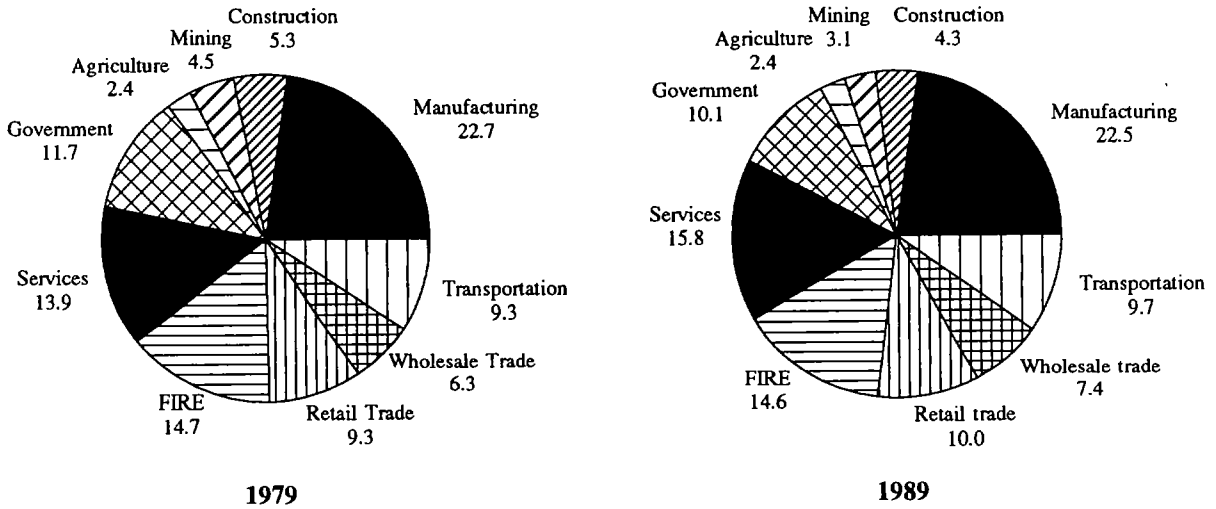
Coal mining bucked the tide of poor performance by the district's mining sector during the 1980s. Coal output grew slightly more than 10

Chart 1

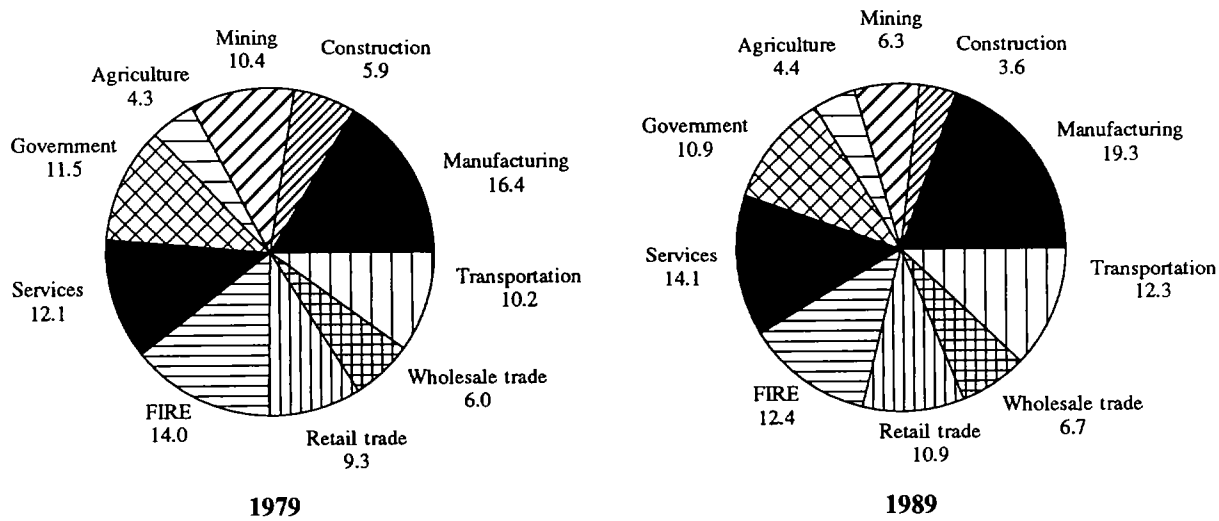
Real GSP by Industry as Share of Total GSP

(Percent)

United States



Tenth District

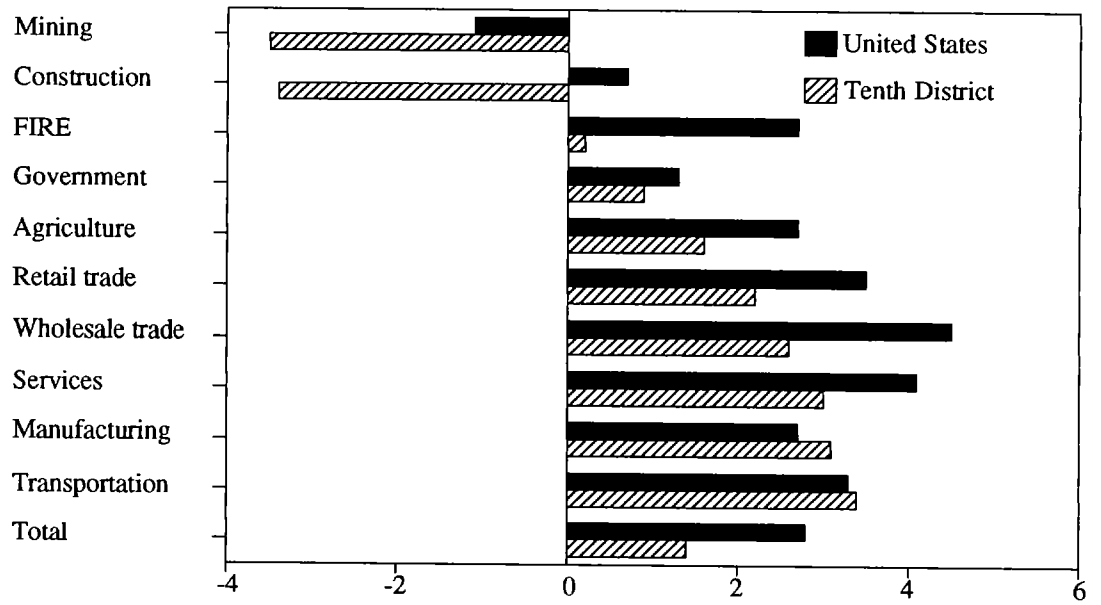


Source: U.S. Department of Commerce, Bureau of Economic Analysis.

Chart 2

Real GSP Growth by Industry in the U.S. and Tenth District, 1979-89

(Average annual percent change)



Source: U.S. Department of Commerce, Bureau of Economic Analysis.

percent per year over the decade, reflecting the desirable features of district coal, such as its low sulfur content and ease of mining. Production soared in Wyoming and New Mexico. By 1989, nearly 16 percent of Wyoming's GSP came from coal mining.

Non-energy mining has contributed much less than energy to the district economy. But metal mining and the production of nonmetallic minerals other than fuels—especially important in Wyoming—also slackened in the 1980s, further weakening the region's mining sector.

Manufacturing

In both 1979 and 1989, manufacturing contributed more to total output than any other industry in both the district and the nation (Chart 1). Over the decade, manufacturing output grew faster in the district than in the nation—3.1 percent per year compared with 2.7 percent, respectively (Chart 2). Yet only three district states recorded faster manufacturing growth than the nation—Colorado, Missouri, and New Mexico.

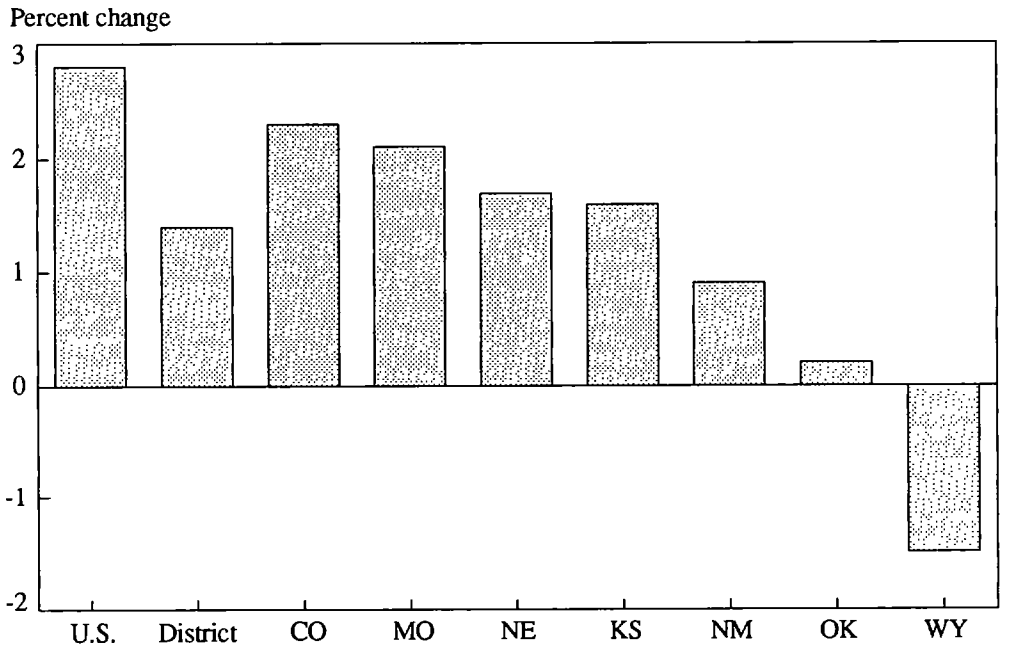
Output of both durable and nondurable goods grew faster in the district than in the nation. In the district, durables production outpaced nondurables production, despite only a small rise in the output of motor vehicles. Nondurables growth suffered from relatively slow growth by the district's important food processing and printing and publishing industries.

In the district, manufacturing's share of total output grew substantially over the course of the

Chart 3

Real GSP Growth in the U.S. and Tenth District, 1979-89

(Average annual percent change)



Source: U.S. Department of Commerce, Bureau of Economic Analysis.

decade, as growth in factory output considerably outpaced growth in total GSP. In the nation, meanwhile, manufacturing's share of total output stayed much the same, as the nation's manufacturing growth just matched the pace of its total output growth. Consequently, the gap between manufacturing's importance in the nation and in the district narrowed by nearly one-half. Nonetheless, Missouri was the only state in the district where manufacturing produced a larger share of total output than in the nation.

IMPLICATIONS FOR THE 1990s

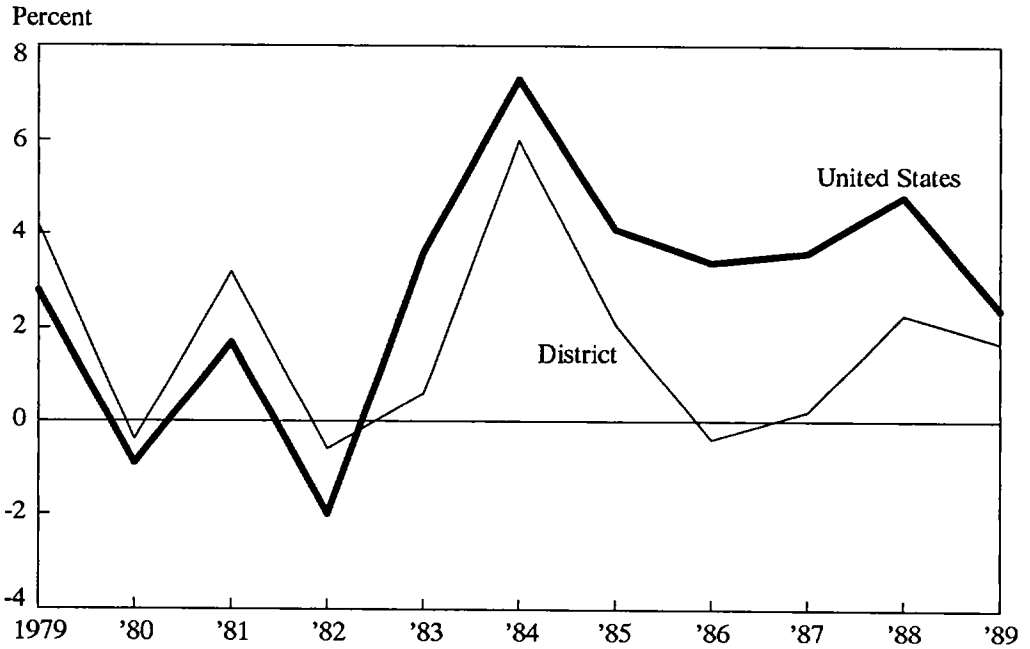
In the past, the economies of the nation and the district have behaved differently, partly due to the differences between their industrial structures. Sometimes the differences benefited the district. For example, since World War II, recessions have been milder on average in the district than in the nation. But sometimes the differences have caused the district economy to suffer. For example, because energy and agriculture are so important to the district, downturns in those sectors sometimes hurt the district economy disproportionately.

Instances of both of these examples were clearly evident in the 1980s. From 1980 through 1985 the district followed much the same path as the nation in recession and recovery (Chart 4). District GSP declined less than national output in the recession years of 1980 and 1982, but the nation rebounded more strongly from the 1982 recession. This performance matched the post-World War II record, in which recessions have been milder on average

Chart 4

Real GSP Growth in the U.S. and Tenth District, 1979-89

(Average annual percent change)



Source: U.S. Department of Commerce, Bureau of Economic Analysis.

in the district than in the nation, but growth in early recovery periods has been slower in the district.

After 1985, when the nation's economic growth left the district behind, a key factor was the district's greater reliance on energy. The sharp fall in oil prices and collapse of the energy industry brought a drop in real output in the district in 1986 and virtually no growth in 1987. In the final years of the decade, district growth improved but still trailed the national rate, due in part to the impact of the energy industry collapse on real estate and other parts of the regional economy.

What are the implications of the changes in the district economy for the region's future? Changes in industrial structure might change how the district performs relative to the nation, especially with regard to the district's short-run ups and downs in economic activity.

Now that the district's industrial structure has become somewhat more like the nation's, the district may see both advantages and disadvantages. On the negative side, the district's business cycles might behave more like the nation's, due primarily to the district's increased reliance on manufacturing. For example, recessions might not be milder on average for the district than for the nation, as they have been in the past. On the positive side, with less reliance on energy, the district may be less affected by cycles in the energy sector. For example, large swings in world oil prices may have less impact on regional economic activity than they had in the 1970s and 1980s. Thus, the district economy may find itself more susceptible to the effects of national recessions but less susceptible to the effects of large swings in the performance of a single sector.

APPENDIX

Real GSP Growth by Industry, 1979–89

Industry	US	Tenth District	CO	KS	MO	NE	NM	OK	WY
Agriculture	2.7	1.6	5.8	.3	-1.7	4.0	2.1	1.6	-1.7
Mining	-1.1	-3.5	-2.3	-5.9	-1.1	-2.5	-2.7	-4.3	-2.8
Construction	.7	-3.4	-4.3	-3.3	-1.4	-2.5	-1.7	-5.7	-6.7
Manufacturing	2.7	3.1	4.7	2.5	3.0	2.5	5.3	2.7	-.8
Transportation	3.3	3.4	4.4	3.9	2.9	2.8	3.1	2.8	4.0
Wholesale trade	4.5	2.6	3.6	2.5	2.8	2.2	3.3	1.5	-1.4
Retail trade	3.5	2.2	2.4	2.4	2.6	1.1	3.0	1.7	-2.0
FIRE	2.7	.2	.3	.9	.9	.1	-.5	-1.0	-1.0
Services	4.1	3.0	4.0	2.5	3.3	2.3	3.6	2.1	-1.1
Government	1.3	.9	1.1	1.3	.8	.6	1.1	.6	1.3
Total	2.8	1.4	2.3	1.6	2.1	1.7	.9	.2	-1.5

Source: See Table 1.

Industry Output as a Share of Total GSP, 1979

(Percent)

Industry	US	Tenth District	CO	KS	MO	NE	NM	OK	WY
Agriculture	2.4	4.3	2.3	6.4	3.8	10.3	2.4	3.7	2.5
Mining	4.5	10.4	5.3	6.0	.5	.5	27.3	21.4	41.5
Construction	5.3	5.9	7.4	5.2	5.0	4.7	6.3	5.3	10.0
Manufacturing	22.7	16.4	13.6	20.1	24.4	15.1	5.1	13.8	3.7
Transportation	9.3	10.2	9.8	11.3	11.3	11.1	8.7	8.9	8.3
Wholesale trade	6.3	6.0	6.1	6.3	7.3	7.3	3.4	5.3	2.8
Retail trade	9.3	9.3	10.9	8.9	10.1	9.8	7.8	8.4	6.3
FIRE	14.7	14.0	16.2	13.7	14.1	16.2	13.9	11.6	11.1
Services	13.9	12.1	14.7	11.3	13.5	12.2	11.0	10.2	6.5
Government	11.7	11.5	13.9	10.8	10.0	12.8	14.2	11.3	7.2

Source: See Table 1.

Industry Output as a Share of Total GSP, 1989

(Percent)

Industry	US	Tenth District	CO	KS	MO	NE	NM	OK	WY
Agriculture	2.4	4.4	3.3	5.6	2.6	12.9	2.7	4.2	2.4
Mining	3.1	6.3	3.4	2.8	.4	.3	18.9	13.6	36.4
Construction	4.3	3.6	3.8	3.2	3.5	3.1	4.9	2.9	5.8
Manufacturing	22.5	19.3	17.0	22.0	26.5	16.3	7.9	17.7	4.0
Transportation	9.7	12.3	11.9	14.2	12.3	12.3	10.8	11.5	14.4
Wholesale trade	7.4	6.7	6.9	6.9	7.8	7.6	4.3	6.1	2.9
Retail trade	10.0	10.0	11.0	9.6	10.5	9.3	9.6	9.8	6.0
FIRE	14.6	12.4	13.2	12.8	12.6	13.8	12.1	10.3	11.7
Services	15.8	14.1	17.3	12.4	15.1	12.8	14.3	12.3	6.8
Government	10.1	10.9	12.3	10.5	8.7	11.5	14.5	11.7	9.6

Source: See Table 1.

ENDNOTES

[1] For a description of the construction of GSP estimates and their uses, see Glenn H. Miller, Jr., "Changes in Tenth District Industrial Structure, 1963-86: Evidence from New State Data," Federal Reserve Bank of Kansas City, *Economic Review*, November 1989, pp. 35-51.

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