FEDERAL RESERVE BANK OF KANSAS CITY

# Economic Review

*September/October 1991*

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# Contents

# How Will Reform of the Soviet Farm Economy Affect U.S. Agriculture?

By Alan Barkema

The economic upheaval in the USSR suggests a day of reckoning has come for the Soviet farm economy. Soviet agriculture—like the rest of the Soviet economy—simply does not work. Previous, half-hearted attempts to reform the farm industry have failed. In light of the ringing repudiation of the old-guard coup in August, further reform now seems certain.

U.S. agriculture has an enormous interest in the outcome of events in the USSR. During the past two decades, the USSR has imported millions of tons of U.S. grain to offset the shortcomings of its inept farm economy. The Soviets will continue to import grain as they reform their flawed agricultural system, regardless of the political organization the USSR eventually assumes. But successful reforms will someday reduce Soviet reliance on grain from the United States.

This article examines the vital trade linkages between U.S. farmers and Soviet consumers. The first section reviews the history of the grain trade between the USSR and the United States during the past two decades. The second section shows how inefficiencies in the Soviet agricultural economy have made the USSR dependent on imported grain. The third section considers the failed attempts to correct the flaws in the Soviet farm economy and the need for further reform. The fourth section concludes that a successful reform of the Soviet agricultural economy could sharply curtail the USSR's reliance on imported grain.

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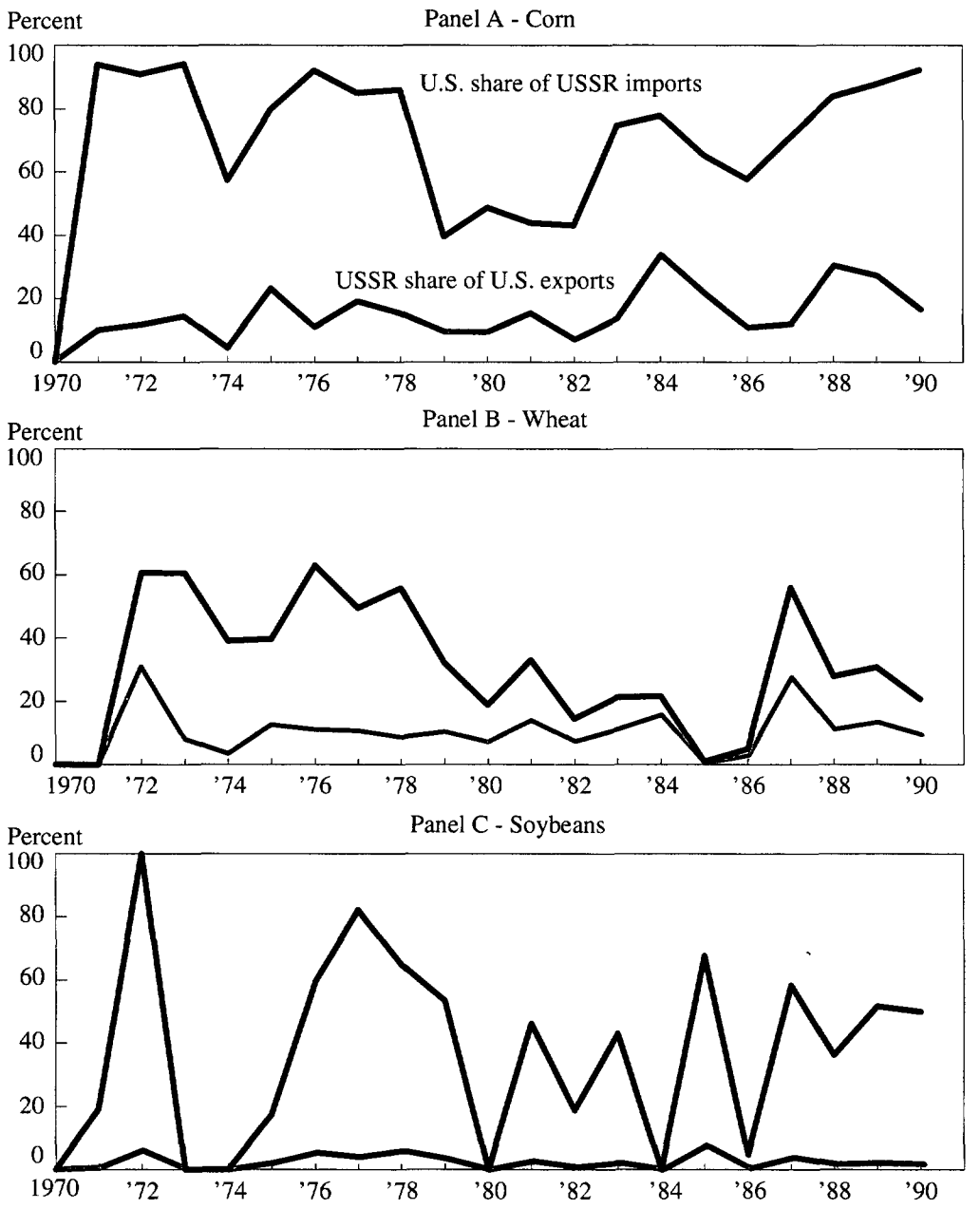
## *How Important Is Soviet Grain Trade to U.S. Farmers?*

The USSR has been one of U.S. agriculture's leading markets for the past two decades.[1] With the European Community and Japan, the USSR currently ranks among the top three buyers of U.S. feedgrains (mainly corn), wheat, soybeans, and soybean meal.[2]

*Chart 1*

***Grain Trade Between the USSR and the United States***




Source: U.S. Department of Agriculture, Economic Research Service.

Over the past two decades, the USSR has accounted for an average 12 percent of U.S. exports of corn and wheat, and as much as a third in some years (Chart 1).

The Soviets' sudden entry into world grain markets in the early 1970s caught the markets by surprise. Prior to 1970, grain markets in the United States and elsewhere generally heard very little from Soviet grain traders. The Soviets occasionally imported small quantities of wheat while exporting small quantities of coarse grains during the 1950s and 1960s.

The entry had its roots in a 1970 decision by the Soviet government to improve Soviet diets through increased meat and poultry production. An important objective of the five-year plan was to produce more grain to support bigger livestock herds. But the Soviets had a bad grain crop in 1972 that fell well short of the plan's goal. During previous crop shortfalls, Soviet consumers had simply tightened their belts. Under the new policy, the USSR simply turned to world grain markets to bolster the small domestic crop.

Since 1972, U.S. farmers have been the Soviets' chief grain supplier. The U.S. share of this immense market averaged about four-fifths for corn and about half for wheat and soybeans during the 1970s (Chart 1). A surge in grain production in other exporting countries and the 1980 embargo of U.S. grain sales to the USSR cut the U.S. share of the Soviet market in the 1980s.

The enormous Soviet market for U.S. grain has proven to be as unpredictable as it is large. The USSR has bought grain on world markets periodically to make up for shortfalls in Soviet crops. Much of the Soviet grain crop is produced in areas where the growing season is short and moisture is limited. Short delays in planting or harvesting in the harsh climate can cause big changes in the size of the Soviet crop, sending periodic shock waves through world grain markets (Chart 2).[3]

The most recent cutback in Soviet grain imports occurred in 1990. Exports of U.S. grain to the USSR fell more than half to only 10 million metric tons (mmt), pushing U.S. grain prices down sharply. The decline in Soviet purchases weighed heavily on grain prices despite a drought in the United States that otherwise would have raised prices (Kilman).[4]

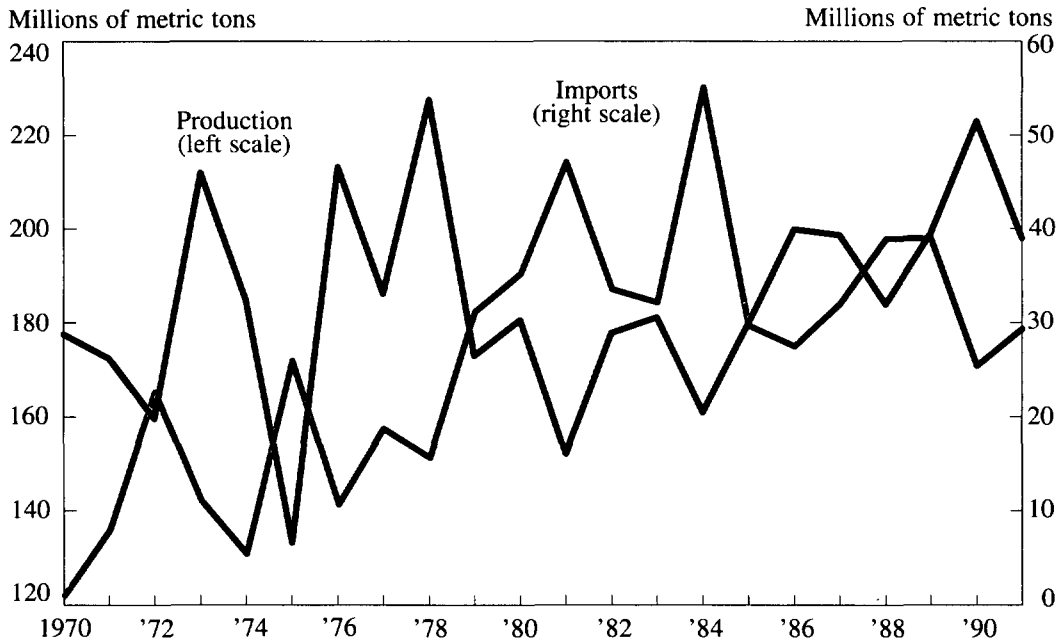
Two factors were responsible for the sharp decline in Soviet grain imports in 1990. First, a surge in Soviet grain production limited the nation's need for imported grain. Exceptionally favorable weather boosted the 1990 Soviet grain crop to more than 220 mmt, the second largest crop on record. Second, dwindling foreign exchange reserves constrained the Soviets' ability to pay for imported grain.[5] In 1990, the USSR's balance of payments deficit increased to more than $14 billion, up from less than $4 billion in 1989. The deficit drew down foreign exchange reserves from about $9 billion to only $5 billion, enough for only two months of imports.

The USSR's difficulty in paying for imported grain is likely to worsen in 1991. The 1991 Soviet grain crop is expected to fall to 195 mmt, suggesting that the Soviets may need to import 35 mmt of grain (International Wheat Council). At the same time, tightening world grain supplies have begun to raise grain prices, pushing up the cost of the larger Soviet imports. Thus, the USSR will rely even more heavily on credit or outright donations to fill its grain supply gap. The United States has already extended $2.5 billion in credit guarantees to the USSR to buy U.S. grain (see Box A).

The political and economic upheaval in the USSR, which reached a crescendo with the recently thwarted coup, adds even more uncertainty to the traditionally volatile grain trade between the USSR and the United States. How will the changes in the Soviet economy affect

*Chart 2*

***Soviet Production and Imports of Grain and Soybeans***




Source: U.S. Department of Agriculture, Economic Research Service.

U.S. farm exports to the USSR in the years ahead? A review of the factors underlying the USSR's need for U.S. grain is an important first step in answering that question.

## *What Is Wrong with Soviet Agriculture?*

Soviet grain production falls short of domestic needs because of three main problems in the Soviet agricultural economy. First, farmers produce inefficiently. Second, a dilapidated distribution and processing system wastes farm output. And third, retail food prices are too low. All three problems arise from a common cause: prices are set by the government rather than by a free market.

### *Inefficient production*

Soviet agriculture is a backward, labor-intensive industry. Soviet farms employ five times as many people but only half as many tractors as U.S. farms (Table 1, panel a). About 14 percent of the Soviet population work on farms, compared with less than 3 percent in the United States. Overall, nearly a third of the Soviet labor force works in the production, processing, and distribution of farm products, compared with about a sixth in the United States.[6]

Soviet farmers operate the largest cropland base in the world but are notoriously inefficient. Their 230 million hectares (a hectare is about 2.5 acres) of cropland are about a fourth larger

## *Box A*
## *U.S. Policy in the Soviet Grain Market*

The U.S. offer to the USSR of credit guarantees to buy U.S. grain is the latest in a long series of U.S. policy initiatives designed to manage the grain trade between the two nations. The primary goal of U.S. policy in the 1970s, when world grain supplies were lean, was to limit disruptions in U.S. grain markets caused by unannounced raids by shrewd Soviet buyers. But since the early 1980s, when world grain markets swung toward surplus, the goal of U.S. policy has been to boost sales of U.S. grain to the USSR.

### *Long-Term Bilateral Grain Agreements*

The U.S. policy initiatives began in 1975 with the signing of the first of three Long-Term Bilateral Grain Agreements (LBGA) between the United States and the USSR. The 1975 LBGA sought to smooth the flow of U.S. grain to the USSR by setting both a floor and a ceiling on Soviet purchases. Soviet purchases could exceed the ceiling only if U.S. authorities were consulted.

Subsequent LBGAs signed in 1983 and 1990 raised both the floor and ceiling on Soviet grain purchases in an effort to boost sagging U.S. grain sales. An embargo of U.S. grain shipments to the USSR from January 1980 to April 1981, which intended to punish the USSR for invading Afghanistan, had encouraged the USSR to seek other sources of grain. At the same time, grain production surged around the globe. As a result, the dominant U.S. share of the Soviet grain market slipped in the 1980s.

### *EEP subsidies*

The United States turned to another tool in its policy arsenal, the Export Enhancement Program (EEP), to meet the competition in the Soviet market in the mid-1980s. The EEP uses a government subsidy to lower the cost of grain (mainly wheat) to selected foreign buyers. The EEP subsidies for Soviet wheat purchases averaged about $30 per ton from 1986 through 1990, roughly 30 percent of the wheat's value.

### *Export credit guarantees*

The United States sweetened the terms of grain sales to the USSR even more during the past year when fierce competition from other exporters threatened the U.S. share of the Soviet market. The United States offered the USSR $2.5 billion in credit guarantees to buy U.S. grain. The guarantees were extended under the U.S. Department of Agriculture's Exports Credit Guarantee Program, or the GSM-102. Under the GSM-102 program, the U.S. Department of Agriculture guarantees repayment of loans from financial institutions that finance the export of U.S. crops to foreign buyers. The credit guarantees were extended in two increments, $1 billion authorized in December 1990 and another $1.5 billion authorized in June 1991.

The Soviets quickly used the first $1 billion of credit to purchase nearly 5 mmt of corn, more than 2 mmt of wheat, and smaller amounts of soybeans, soybean meal, and other products. The second credit allocation of $1.5 billion was to be provided in three increments, with $600 million released in June 1991, $500 million released in October 1991, and $400 million released in February 1992. But on August 26, 1991, the U.S. Department of Agriculture announced that $315 million of the October 1991 credit increment would be released immediately in response to a Soviet appeal for aid.

*Table 1*

***A comparison of Soviet and U.S. agriculture***

| *Panel a: Farm resources* | *USSR* | U.S. |
|---|---|---|
| Cropland (1,000 ha) | 232,426 | 189,915 |
| Agricultural labor force (percent) | 14.2 | 2.5 |
| Labor per 1,000 ha | 91 | 17 |
| Tractors per 1,000 ha | 12 | 25 |
| *Panel b: Crop data (1989)* | | |
| Crop production (mmt) | | |
| All grains | 201 | 284 |
| Wheat | 91 | 55 |
| Corn | 17 | 191 |
| Soybeans | 1 | 52 |
| Crop yields (kg/ha) | | |
| Wheat | 1,900 | 2,203 |
| Corn | 3,552 | 7,291 |
| Soybeans | 1,129 | 2,182 |
| *Panel c: Livestock data* | | |
| Meat production (mmt) | | |
| Total | 20.0 | 28.3 |
| Beef and veal | 8.8 | 10.6 |
| Pork | 6.8 | 7.2 |
| Poultry | 3.3 | 10.2 |
| Feed conversion (kg feed per kg liveweight gain) | | |
| Beef | 13.5 | 7.8 |
| Pork | 8.8 | 4.3 |
| Broilers | 4.0 | 2.0 |

Notes: Ha = hectares; mmt = million metric tons; kg = kilograms.

Sources: U.S. Department of Agriculture 1990, 1991; Economic Research Service Statistical Bulletin Number 815; Cook.

than U.S. cropland. Yet the Soviet farm system gets subpar yields from its plentiful soil resource. Soviet farmers achieve their best results with wheat, their main crop. They produce more wheat than farmers in any other nation, and in good years, attain yields that rival the U.S. average. Soviet corn and soybean yields, meanwhile, are roughly half the U.S. average (Table 1, panel b).[7]

The productivity of Soviet livestock herds also trails that of U.S. herds (Table 1, panel c). The leading cause of the lagging productivity of Soviet livestock is a severe protein deficiency in livestock feed. The USSR has relatively few sources of protein for its feed, unlike the United States, which crushes a huge

*Table 2*

***Investment in Soviet agriculture***

*(Billions of 1984 rubles, annual averages)*

| | 1976-80 | 1981-85 | 1986-89 |
|---|---|---|---|
| Agricultural production | 28.6 | 31.2 | 35.0 |
| Rural infrastructure | 6.1 | 9.7 | 12.5 |
| Large-scale irrigation | 8.0 | 8.7 | 8.9 |
| Agro-industry and storage | 5.3 | 5.2 | 6.8 |
| Total agriculture | 48.0 | 54.8 | 63.2 |
| Agricultural share of economywide investment | 33.4 | 32.5 | 30.6 |

Source: IMF and others.

soybean crop into high-protein meal. The USSR imports small quantities of soybeans but not enough to make up for its protein deficiency. Thus, Soviet farmers end up feeding their livestock larger quantities of low-quality rations.[8]

Soviet agriculture has continued to falter despite enormous efforts by the government to modernize it. During the 1980s, the government poured into agriculture nearly a third of its total annual investment in the entire Soviet economy (Table 2).[9] The huge farm investment has paid few if any dividends. That failure can be traced directly to two fundamental flaws in the pricing system in Soviet agriculture.

The first problem is that Soviet farm prices provide no information for channeling investments into the most productive uses. Large state and collective farms, which operate about 97 percent of all Soviet farmland, sell most of their output to meet government-set quotas at government-set *procurement prices*.[10] Because these prices are set by the government rather than by markets, they give farm managers no information on the most profitable or efficient ways to operate their farms. Thus, farm managers make operating and investment decisions based on government directives, rather than on the forces of supply and demand.

The second problem is that Soviet farm prices often reward the most inefficient producers and penalize the most efficient. Procurement prices include a base price plus a bonus determined by production costs.[11] Financially weak farms with high production costs receive large procurement bonuses to boost their financial positions. In contrast, farms with lower production costs receive smaller bonuses. These upside-down incentives simply discourage efficiency.[12]

### *Wasted output*

The dilapidated Soviet distribution and processing system wastes an enormous amount of farm output each year, an amount roughly equal to annual farm imports. Estimated losses

*Table 3*

***Per capita food consumption in the USSR and the United States***

*(Kilograms per year)*

| | USSR | | U.S. | |
|---|---|---|---|---|
| | 1970 | 1988 | 1970 | 1988 |
| Potatoes | 130.0 | 99.0 | 53.0 | 56.1 |
| Sugar | 42.2 | 50.0 | 50.3 | 30.2 |
| Vegetables | 79.1 | 97.2 | 89.5 | 103.0 |
| Fruit | 38.1 | 44.3 | 95.8 | 125.3 |
| Meat | 47.9 | 69.0 | 107.9 | 114.5 |
| Milk | 194.4 | 171.1 | 245.1 | 247.4 |
| Eggs | 8.8 | 15.4 | 18.0 | 13.9 |
| Fish and seafood | 24.4 | 28.0 | 14.6 | 18.0 |
| Calories per day | 3,341 | 3,378 | 3,384 | 3,660 |

Sources: USDA 1990; Food and Agricultural Organization.

after harvest range from 20 to 30 percent for grains and up to 40 to 50 percent for more perishable crops like potatoes and vegetables. Up to 1 mmt of meat is lost each year due to inadequate slaughter, processing, and cold storage facilities.

The huge Soviet grain crop in 1990 simply overwhelmed the crumbling distribution system. An estimated 30 to 36 mmt of grain spoiled due to a lack of functioning farm machinery, railroad equipment, and storage facilities (IMF and others; USDA 1991). Thousands of combines, tractors, and trucks lay idle during harvest due to shortages of fuel, batteries, and spare parts. Poor rural roads limited access to ripening fields, and an overworked railroad system struggled to deliver the crop to storage and processing sites. The huge crop swamped available storage space, some of which was already full of imported grain. Outdated processing technology, dilapidated processing equipment, and shortages of packaging materials contributed to further losses well after harvest.

The stunning losses in the Soviet distribution system are another direct result of government-set prices. Food processors buy raw farm products at subsidized prices. The prices are so low that managers of processing plants pay little attention to farm products wasted during processing. The problem is compounded when food processors sell food products at government-set prices too low to finance any improvements to the distribution and processing system. Instead, the government pays for all improvements. Yet the processing and distribution system receives a paltry 15 percent of the government's total investment in agriculture (Table 2). As a result, nearly two-thirds of the nation's processing equipment, much of which dates from the 1950s and 1960s, is obsolete or worn out (IMF and others).

### *Low retail food prices*

Government-set food prices in the USSR are too low. The government pricing scheme

relies on long queues of consumers and empty shelves—instead of market-determined prices—to ration food supplies. The long queues and empty shelves are an obvious sign that demand for food outstrips food supplies.

Contrary to popular belief, consumers in the USSR are not on the verge of starvation.[13] Soviet consumers eat much more meat today than 20 years ago, and they consume as many calories as U.S. consumers (Table 3). Still, the quality of the Soviet diet is low because Soviet consumers derive a larger proportion of their calories from nonprotein sources, such as bread and fat.

Low food prices, which have changed little since the 1960s, cause the long queues and empty shelves at Soviet food markets. Cheap food encourages wasteful consumption that quickly empties shelves. For example, bread has been priced so low that 4 to 5 mmt of bread is fed to livestock each year. Consumers spend countless hours waiting in queues for shelves to be restocked.

Soviet food prices stay low due to a huge government food subsidy. The subsidy makes up the difference between the price the government pays producers and the lower price the government charges consumers. In 1990, the food subsidy was about 18 percent of total government expenditures, exceeding government spending on health and education (Table 4). The subsidy is a leading contributor to the Soviet budget deficit (about 80 billion rubles in 1990), which the Soviets have financed by printing an endless flow of rubles. The flood of fresh currency has accumulated in the "monetary overhang," a cash horde that consumers cannot spend because food and other goods are unavailable.[14]

The monetary overhang aggravates the problems in the Soviet farm economy. The huge stash of unspendable rubles undermines the currency as a store of value and a medium of exchange. As a result, farmers and food processors avoid rubles and accumulate larger commodity inventories to use in a growing barter economy. Farmers and processors hoard farm products and then trade them rather than sell to the government for increasingly worthless rubles. The hoarding and widening use of barter worsen the problems of the agricultural distribution system, stretching delivery times, increasing waste, and aggravating shortages.

## *How Might Soviet Agriculture Be Reformed?*

President Mikhail Gorbachev's perestroika program has tried many times in recent years to solve Soviet agriculture's crushing problems. But all of the reforms have stopped short of letting free markets, rather than the government, determine prices. As a result, the reforms have all failed.

*Table 4*

### *Food subsidies in the USSR*

*(Billions of rubles)*

| | 1985 | 1990 | Share of total (%) 1990 |
|---|---|---|---|
| Meat | 26.6 | 48.0 | 50.1 |
| Milk | 18.9 | 31.0 | 32.3 |
| Fish | 2.1 | 3.1 | 3.2 |
| Grain | 4.4 | 7.3 | 7.6 |
| Potatoes | 3.0 | 4.4 | 4.6 |
| Sugar | 1.0 | 2.1 | 2.2 |
| Total | 56.0 | 95.9* | 100.0 |
| Share of total state expenditure | 14.5 | 18.0 | |

* 95.9 rubles were budgeted for 1990. Projected subsidies were 115 billion rubles after procurement price increases at midyear.

Source: IMF and others.

### *Why have agricultural reforms failed?*

The most fundamental reform the Soviets have tried to date is tinkering with farm and food prices. But the partial price reforms have left prices under government control. As a result, Soviet agriculture is mired in a partly dismantled system of unworkable government controls.[15]

*Higher farm prices.* In 1990, the Soviet government raised procurement prices and eliminated procurement bonuses. The Soviets hoped higher prices would encourage increased production by boosting farm profits. And they hoped eliminating procurement bonuses, which had rewarded farms with high production costs, would rid Soviet farms of a powerful incentive for inefficient production.

The procurement price changes were positive steps, but they have little prospect of spurring production on Soviet farms. The problem is that the new prices, and thus farm production and investment decisions, are still determined by the government rather than by markets. Farmers remain bound to old production patterns and practices by unworkable government plans.[16] In addition, production inputs—from herbicides to spare parts—that are required to boost production remain in short supply and of low quality. Finally, farmers hold a significant share of the nation's monetary overhang and already have more rubles than they can spend. Thus, they are unwilling to boost production in exchange for an increasingly worthless currency.

*Higher food prices.* In 1991, the Soviet government raised food prices sharply. Bread and meat prices have tripled and milk prices have doubled. The Soviets hoped the higher prices would cut the huge food subsidy while rationing food supplies. As a result, shelves in food stores might not empty as quickly, queues might shorten, and consumers might be less inclined to hoard food whenever it appears.[17]

Any beneficial effects of the food price hike will be short-lived, however. Because food prices are still set by the government, they remain below the cost of delivering food to the consumer. For example, the new meat and milk prices are still 30 to 40 percent lower than market prices would be. In addition, the government is considering a plan to compensate consumers for much of the increase in food prices, giving them more rubles to spend on low-cost food. The result would be a quick return to wasteful consumption, hoarding, empty shelves, and long queues.[18]

### *Why are sweeping agricultural reforms critical?*

Prospects for further reforms in Soviet agriculture are tied to political decisions that will determine the future course of the entire Soviet economy. Events in the USSR are swirling too rapidly to predict those decisions precisely. Still, the stunning rejection of the old-guard coup in August has given new impetus to the forces of change in the USSR.

Two factors make reform of Soviet agriculture critical to reforming the rest of the Soviet economy. First, agricultural reform would free millions of workers and billions of rubles of capital investment for more productive use elsewhere in the Soviet economy. In recent years, agriculture has accounted for about a third of all employment and investment in the USSR. Market reform would boost the productivity of both labor and capital in Soviet agriculture. Fewer workers would be needed on farms. To be sure, additional capital investments would be required to modernize Soviet agriculture. But eventually, a more efficient Soviet agriculture would require a much smaller share of the nation's investment, freeing capital to rebuild other industries.

Second, agricultural reform would

## *Box B*
## *Elements of Economic Reform*

Determining prices in markets rather than by government edict is the key element for a successful reform of the Soviet farm economy. By guiding food production and consumption decisions, market prices match food supplies to food demand. But moving to a market economy will not be easy.

Well-functioning markets have two basic requirements. First, producers must be free to respond to changing prices. Then they can boost production when rising prices signal that food supplies are tight, and vice versa. Second, producers must be held financially accountable for their actions. Then they are justly rewarded for responding to market signals or rightfully penalized for ignoring them. Both market requirements are met in a system of private enterprise, where prospective profits or losses encourage accurate business decisions by private business owners.

Efforts to privatize Soviet agriculture must overcome two obstacles. First, farm and business assets, which are now owned by the government, must be distributed to new private owners. At present, no one knows how much these assets—such as farmland—are worth because markets for private property do not exist. Second, the legal infrastructure that supports market transactions, including the ownership of property, must be established. While neither of these two obstacles is insurmountable, both will lengthen the USSR's transition to a market economy.

eliminate the nation's food subsidy, ease the nation's budget pressures, and help stabilize the ruble. The huge food subsidy (an estimated 115 billion rubles in 1990) is a large contributor to the Soviet budget deficit (about 80 billion rubles in 1990). Monetary policy in the USSR has financed budget deficits by printing rubles, causing a steady decline in the value of the ruble.[19] With its currency in free-fall, the USSR will be hard-pressed to purchase the Western technology it needs to modernize agriculture or other industries. Thus, agricultural reform would help right the nation's macroeconomic imbalances, shrink the monetary overhang, and stabilize the ruble. Then serious efforts to rebuild the Soviet economy can begin.

For any reform of Soviet agriculture to be successful, however, prices must be determined in markets rather than by government edict. Market prices ensure that food supplies are adequate by rewarding producers for supplying the food consumers want and by encouraging consumers to shop intelligently. In brief, market prices are the communication link between producers and consumers that for decades has been missing in the USSR. By freeing prices from government control and establishing free markets, Soviet agriculture could boost production, curb waste, and eliminate food shortages.

Adopting market pricing requires a sweeping overhaul of the Soviet agricultural economy. All segments of Soviet agriculture—including makers of farm machinery and fertilizers, farmers, and processing plant managers—must be able to respond to price signals if the industry is to supply the kinds and quantities of foods consumers want. Thus, the centralized government control of Soviet agriculture must yield to a new structure of independent, private entrepreneurs (see Box B).

### *What Are the Prospects for U.S. Grain Sales to the USSR?*

The preceding review of the Soviet farm economy points to some overall conclusions. The USSR will remain dependent on imported grain as it rebuilds its farm economy over the next few years. But agricultural reforms that now seem central to general economic reform will—if implemented—one day cut that dependence.

The USSR's dependence on imported grain will gradually decline as competitive markets and the profit motive encourage greater efficiency in all segments of Soviet agriculture. Improved labor incentives will boost the productivity of farm workers and managers. The quality and availability of seed, fertilizer, herbicides, farm machinery, and other production inputs will increase as the farm supply industry is revitalized. Better rural roads, storage facilities, and an improved distribution and processing system will minimize losses during and after harvest. Food retailers will strive to stock the products their customers demand. Rising efficiency in each of these segments of Soviet agriculture will gradually lessen the USSR's dependence on imported grain.

These sweeping market changes in Soviet agriculture will affect a broad cross-section of U.S. agriculture. Soviet purchases of U.S. wheat will decline. Soviet farmers are already proficient wheat growers, but market reform could boost wheat production by encouraging better management decisions. More timely planting and harvest, in particular, would reduce the impact of harsh climates on wheat yields and the variability in wheat production.[20] Harvest and storage losses would be cut sharply. The result would be smaller and less variable exports of U.S. wheat to the USSR.

Soviet gains in production of forages and other feeds could be even greater than in wheat production. While Soviet farmers are already adept at growing wheat, they have considerable potential for improving forage production.[21] Gains in forage production could cut demand for imports of U.S. feedgrains (mainly corn), which have been the mainstay of Soviet livestock production for the past 20 years.

Soviet demand for U.S. feedgrains could be trimmed further if Soviet farmers add more protein to livestock rations. Doing so would reduce the total amount of feed the animals consume. The current protein deficiency in Soviet livestock feeds is about 10 to 15 mmt of soybean meal per year (USDA 1991). Soviet farmers may fill part of the protein shortage with increased domestic production of sunflowers and other oilseeds. But part of the protein shortage may be filled with larger imports of U.S. soybeans and soybean meal. In recent years, the USSR has imported only 3.0 to 3.5 mmt of soybeans and meal per year. Thus, considerable expansion in U.S. soybean and meal exports could come at the expense of smaller U.S. feedgrain exports.

A growing market for value-added food products may also partly offset the likely decline in U.S. wheat and feedgrain sales to the USSR. Rising real incomes in a revitalized Soviet economy could boost consumer demand for a wider variety of high-quality, value-added food products. For example, U.S. poultry products are already in strong demand by Soviet consumers. The United States shipped about 138,000 tons of U.S. poultry to the USSR in 1990 and expects to make larger shipments this year. As Soviet consumers acquire a taste for high-quality products that the Soviet food system cannot deliver, Soviet demand for U.S. poultry and other value-added products will grow.

The development of Soviet agriculture may also create a huge new market for U.S. farm and food technology, ranging from improved

genetics for Soviet livestock herds to new food processing plants. Much of the USSR's farm and food technology is either far behind U.S. technology or inappropriate for a new market-based agriculture. Soviet farm machinery, for example, was developed for huge state and collective farms by the government-controlled monopoly (USDA 1991). The machinery is low quality by U.S. standards and too large to be used on smaller private farms.

Outright imports of U.S. technology or joint ventures with U.S. firms would speed the upgrading of Soviet agriculture. The political and economic infrastructure in the USSR must stabilize, however, before U.S. technology will be widely available to Soviet agriculture. Firms from the United States and elsewhere are unlikely to risk sales or investments in the USSR until they are certain that profits can be repatriated.

## *Summary*

Narrow reforms that retain the old centrally planned core of the Soviet agricultural economy have failed to correct the flaws in Soviet agriculture. As a result, the USSR is certain to rely on world grain markets to fill a widening gap between domestic production and consumer needs in coming years, just as it has during the past two decades. But the nation may not have the financial wherewithal to buy grain from the United States or anyone else much longer. The USSR's stock of hard currency is already low and its credit rating is sliding. Moreover, world grain supplies have begun to tighten after several years of surplus. The easy credit and cheap grain that bailed out Soviet agriculture in the past, therefore, may be running out. Thus, Soviet agriculture appears to be approaching its day of reckoning. A true, market-based reform of Soviet agriculture is becoming increasingly likely as that day of reckoning draws near and other options dwindle.

The rebuilding of Soviet agriculture is a daunting challenge that will take years to complete. Freeing markets from government control is simply the first critical step. Still, a successful market-based reform of Soviet agriculture would one day shrink the Soviet market for U.S. farm commodities. But a reformed Soviet economy would create new opportunities for marketing farm and food technology and value-added farm products in specific market niches. These new market niches may prove to be more lucrative for U.S. agriculture than earning slim margins on huge volumes of exported grain.

## *Endnotes*

[1] At this writing, the future existence of the Union of Soviet Socialist Republics (USSR) is becoming increasingly uncertain. Several of the 15 republics that comprise the USSR have already declared their independence. This article uses the expression "USSR" to refer to the geographic region of the 15 republics, regardless of what political or economic structure may emerge among them.

[2] Wheat, feedgrains, soybeans, and soybean meal account for 85 percent of the value of all Soviet imports of U.S. farm products since 1972.

[3] Johnson builds a strong case that the variability in Soviet crop production would be much less with improved management practices (Johnson and Brooks).

[4] In mid-summer 1991, U.S. wheat prices were a third lower than in January 1990, corn prices were a fifth lower than in June 1990, and soybean prices had languished at a relatively low level since late in 1989.

[5] A sharp decline in Soviet oil export revenues was the main cause of the USSR's shortage of foreign exchange. The USSR is the world's largest producer of oil and the world's second largest oil exporter. Continuing production and distribution problems in the Soviet oil industry, how-

ever, are believed to have reduced the volume of Soviet oil exports by about a fifth in 1990. The decline in oil revenues, in turn, limited the USSR's ability to pay for imported grain and other goods.

The growing shortage of foreign exchange also affected a wide range of other industries in the USSR. According to the extensive analysis by the IMF and others, "While in 1989 a shortage of foreign exchange had already begun to constrain some producers who relied on imported inputs, by the fall of 1990 this was being cited as one of the main causes of industry's problems. The automobile industry was short of cold-rolled steel sheets, the tire industry of critical additives, the furniture industry of imported dyes and lacquers, and the food processing industry of vital packaging materials" (Vol. 1, p. 43).

[6] Seventy percent of the Soviet farm work force and about half of the food processing work force does manual labor (USDA 1991).

[7] Johnson and Brooks found little room for improvement in Soviet wheat yields relative to those attained in parts of North America with similar climate. But yields of feedgrains and forages in the USSR were much less than those attained in North America. A more recent study of the efficiency of Soviet wheat and other small grains production confirms the Johnson and Brooks' analysis. Skold and Popov found Soviet farmers achieved 83 percent of the wheat production possible with the resources that were available. The farmers were much less efficient in producing corn, vegetables, and other minor crops. Thus, improved management practices could boost the efficiency of corn production and other minor crops, even without improving the current resource base.

[8] Johnson succinctly sums up the protein deficiency in Soviet livestock feed, "One important deficiency is the shortage of protein in livestock rations, a shortfall recognized by both outsiders and Soviet specialists. However, those who plan Soviet feed imports have apparently given little consideration to the possibility of reducing feed costs per unit of output by importing more oilmeals and less grain" (Johnson and Brooks, p. 59).

[9] Low interest rates of only 1 to 2 percent for short-term loans and only 0.75 percent for long-term loans have encouraged farm investment. In January 1991, however, interest rates were raised to 6 percent on short-term debt and 9 to 12 percent on long-term debt, rates which are still below the effective rate of inflation. How effective the new rates will be in guiding investment is not clear, however, given a history of lax lending standards and an underdeveloped capacity for credit analysis. The poor financial status of Soviet farms led to the forgiveness of 73 billion rubles of debt in the Soviet agro-industrial complex in mid-1990, and more debt forgiveness is expected. The IMF and others suggest, "Debt forgiveness has become so commonplace that the banks lending to agriculture have emerged as cash transfer agents for government funds rather than real banks."

[10] On state farms, land and assets are owned by the state, and all workers are employees of the state. The state absorbs profits and losses and provides most investment capital. On collective farms, assets are owned jointly by collective farm members, except for land, which is owned by the state. Labor is provided by farm members. Wages of collective farm members were about a third of those of state farm employees before wage reforms were passed in the mid-1960s. Since then, few differences remain between state and collective farms (IMF and others).

[11] Until recently, procurement prices have been somewhat below world market prices, imposing an economic penalty on Soviet farmers. Comparing Soviet procurement prices with world market prices is difficult, however, due to multiple exchange rates of the ruble. In addition, the penalty imposed on Soviet farmers by low procurement prices has been at least partly offset by low prices of farm inputs and low interest rates on farm debt.

[12] Johnson notes that farm wages also do not provide sufficient incentives for Soviet farm workers. "With the current system of payment for farm work, the farm worker sees little or no relationship between his or her work and the pay received. Consequently, there is little incentive to do any particular job well, to work hard, or to work long hours during busy seasons of the year" (Johnson and Brooks, p. 199).

[13] Shortages of some foods have worsened in recent months with the further deterioration of the nation's distribution system. The consumption of dietary staples, such as meat, milk, and bread, was probably the same in 1990 as in 1989, but consumption of fruits and vegetables probably declined modestly. Consumption may have fallen 8 percent for fruit and 4 percent for vegetables in 1990 (USDA 1991).

[14] Rapid growth in money incomes has also contributed to growth in the monetary overhang. A mid-1980s change in Soviet law, the Law on State Enterprises, reduced enterprise profit taxes, boosting enterprise profits and giving enterprises more control over profits. At the same time, government investment in enterprises remained high. The result was a surge in enterprise liquidity. The increased liquidity was quickly bid into wages, since inputs other than labor were scarce. As a result, money incomes of Soviet consumers have shot up, soaring about 40 percent from 1985 to 1990 (IMF and others; USDA 1991).

According to the IMF and others, the monetary overhang at the end of 1989 was 130 billion rubles held by consumers and 50 billion rubles held by enterprises. Other estimates of the overhang range up to 300 billion rubles (USDA 1991).

[15] The IMF and others study observes, "Attempts to enhance performance under the old system have proved to be counterproductive: central control was reduced but market signals and discipline were not established...The revolutionary opening up of public debate has cast doubts on earlier achievements while exposing the extent of the economic deterioration and creating uncertainty."

[16] Some private farming is allowed in the USSR, but private farming is still a tiny part of Soviet agriculture. The total amount of land in private farms is only 0.1 percent of all agricultural land, and private farms are generally found on marginal rather than highly productive land. New regulations allow for lifetime use of land including the right of inheritance. Still, the sale of land or its use as collateral is not allowed.

[17] The higher prices could cut the food subsidy to only 30 billion rubles in 1991, down more than two-thirds from a year ago. Thus, the food price hike is an important step toward slowing growth in the monetary overhang and stabilizing the ruble.

Other more direct measures to shrink the monetary overhang have been attempted. Last January the government repudiated all 50 and 100 ruble notes, allowing holders to exchange the large notes for smaller notes up to the value of their monthly salaries. The effort was expected to drain cash balances of about 15 billion rubles (IMF and others).

[18] Some carefully targeted financial assistance may be required to offset the financial pain inflicted by higher food prices on financially vulnerable segments of the population, such as the elderly living on fixed incomes (IMF and others).

[19] Marrese points out that Soviet agriculture faces a much larger adjustment to market prices than agriculture in the Eastern European countries. Agricultural subsidies in the USSR had risen to 12 percent of GDP by 1988. In contrast, agricultural subsidies as a percentage of GDP were 4.01 percent in Hungary, 5.8 percent in Poland, 6.27 percent in the Czech and Slovak Federated Republic. Still, the freeing of prices in Soviet agriculture should not set off an inflationary spiral, if monetary policy is disciplined (Marrese 1991).

[20] See endnote 3.

[21] See endnote 7.

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# Challenges to Stock Market Efficiency: Evidence from Mean Reversion Studies

By Charles Engel and Charles S. Morris

Analysts have traditionally regarded the stock market as an efficient market because they believe stock prices reflect the market value of future dividends. Dividends, in turn, depend on a company's profits. As a result, stock prices should change only in response to new information about future profits. For example, a company's stock price will rise if it patents a new way to harness solar power because future profits will rise. Conversely, its stock price will fall if its chief competitor discovers the new way first.

In recent years, however, many analysts have begun to question the efficiency of the stock market. What information, they ask, could have possibly caused the profitability of the companies in the Dow Jones Industrial Average to fall 23 percent on October 19, 1987? These analysts claim the stock market is inefficient because many traders pay attention to information unrelated to future profits. For example, some traders may jump on the bandwagon and buy stocks only because past returns were high. While prices will ultimately reflect true values, such behavior causes prices to overshoot true values in the short run. The tendency for prices to overshoot but eventually revert to true values is called *mean reversion.*

Is the stock market efficient? This article surveys the mean reversion evidence. The article finds that stock prices might be mean reverting, but the evidence is not strong enough to rule out market efficiency. The first section of the article discusses the features of an efficient stock market. The second section shows why prices may be mean reverting in an inefficient stock market. The third section shows that the evidence on mean reversion is mixed. Thus, more evidence is needed before declaring the stock market inefficient.

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## *Efficient Markets*

The efficient market theory describes how prices are determined in a securities market. In an efficient stock market, a stock's price reflects the current market value of its expected future income stream. If a stock's price is less than the value of its expected income stream, investors will quickly buy the stock. As they do, the price will rise until it equals the current value of the income. Conversely, if a stock's price is above the current value of expected income, selling pressure will quickly drive down the price to its current value.[1]

The income from a stock can be divided into two parts. One part is the dividends that are paid over the investment horizon. The second part is the price for which investors can sell the stock at the end of the investment horizon.

The market value of the expected income from a stock depends on the size of the income stream relative to the return on other investments that are equally risky. The return on equally risky investments can be represented by the inflation-adjusted, or real, interest rate on such investments. The real interest rate on a risky investment is the sum of the real interest rate on a riskless investment, such as Treasury bills, and a risk adjustment factor that rises with the riskiness of an investment. Thus, the current price of a stock, $P_0$, is

$$7P_0 = \frac{ED_1 + EP_1}{1 + r} \qquad (1)$$

where $ED_1$ is the dividends that investors expect to be paid at the end of the investment period, $EP_1$ is the expected end-of-period price, and $r$ is the real interest rate.[2] Thus, a stock will have a high price if it is expected to pay high dividends (high $ED_1$), if it is expected to appreciate rapidly (high $EP_1$), or if it is not very risky (low $r$).[3]

One feature of an efficient stock market is that highly profitable companies will have higher stock prices than unprofitable companies. In an efficient market, stock prices reflect the market value of future dividends, which ultimately depend on profits. Thus, stock prices reflect the market value of a company's future profits—that is, the company's *fundamental* value.

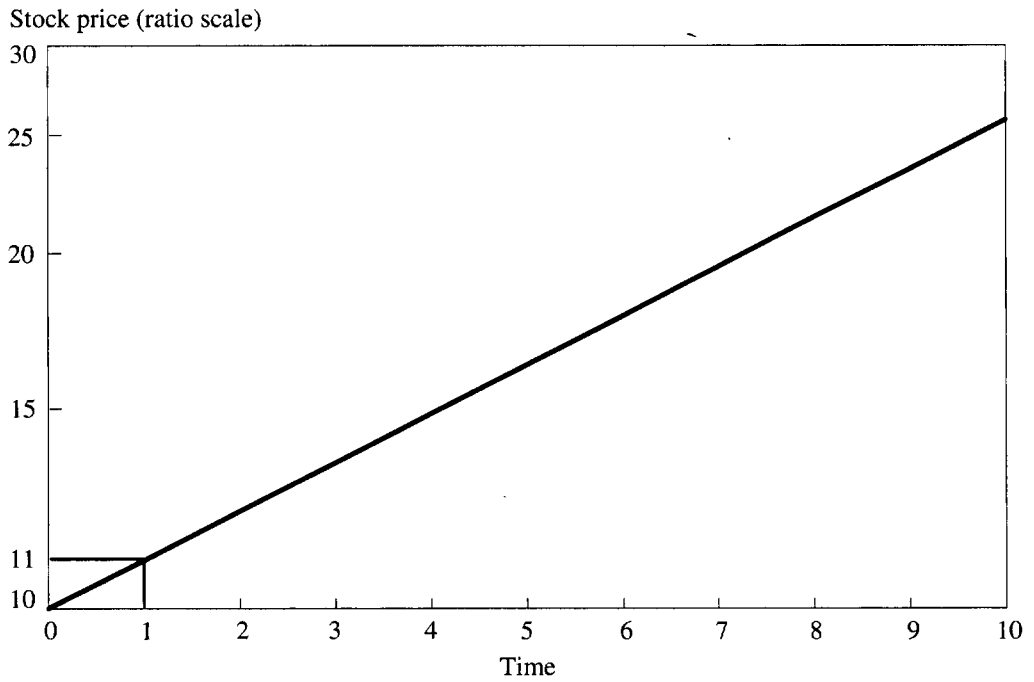
The economy benefits when stock prices reflect fundamental values because investment funds flow to their most valuable uses. Companies with profitable investment opportunities have high fundamental values, while companies without such opportunities have low fundamental values. As a result, companies with profitable investment opportunities can sell their stock for a higher price, and therefore get more investment funds, than companies without such opportunities.

A second feature of an efficient stock market is that expected real returns on stocks should be constant and equal to the real interest rate (Figure 1). Like most stock price indexes, such as the Dow Jones Industrial Average, the price in the figure includes the returns from dividends so that the percentage change in price is the total return.[4] If the real interest rate is constant over time, prices will grow along a straight line with a slope equal to the interest rate. The slope of the line is just the percentage change in price.[5] Thus, because the percentage change in price, is the total return, the expected return on the stock is constant and equal to the real interest rate.

A third feature is that only new information about future profits causes real stock returns to deviate from the real interest rate. Because stock prices already reflect everything that investors expect about future profits, prices should rise more or less than expected only if investors get new information about future profits. For example, suppose the interest rate is 10 percent and the stock price is $10 (Figure 2). At the end of period one, the stock price can be expected to rise to $11. But if the company

*Figure 1*

***Stock Prices in an Efficient Market***




announces it will pay higher dividends with the profits from a new discovery, the stock is a bargain at $11. As investors buy more of the stock, the price might rise to $13. Thus, while the expected return on the stock was only 10 percent, the unexpected news led to a 30 percent return.

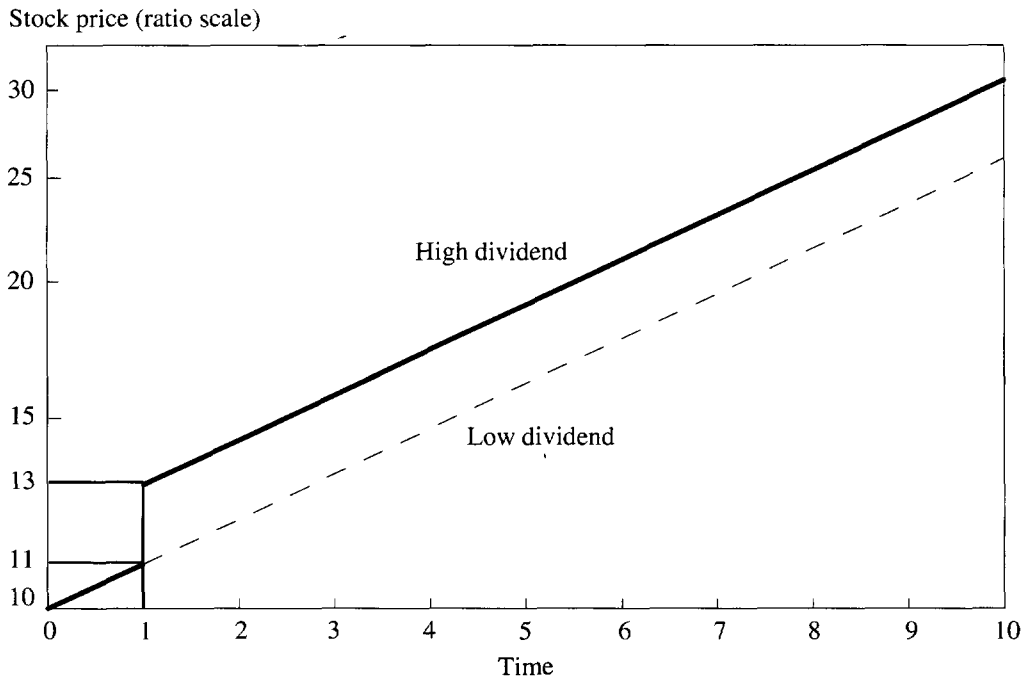
A final feature of efficient markets is that when actual returns differ from what was expected, investors should still expect future returns to be constant and equal to the real interest rate. In other words, if prices rise more than expected, investors should not expect prices to continue to grow faster just because they did so in the past. Furthermore, investors should not expect prices to grow slower to offset the unexpected increase. For example, in Figure 2, the stock price rose 20 percent more than expected over the first period. The unexpected increase reflected the *entire* value of the increase in future dividends. As a result, the stock price should resume growing at the old rate. This is shown in Figure 2 by the high-dividend path having the same slope as the low-dividend path.

## *Inefficient Markets*

Many analysts claim the stock market is inefficient because they believe prices often overreact to new information and overshoot fundamental values in the short run. If stock prices do not always reflect fundamental values, the stock market will not direct investment funds to

*Figure 2*

***Stock Prices in an Efficient Market: Change in Dividends***




where they are most valuable. Moreover, expected returns will vary over time because prices will be mean reverting. Finally, stock prices that overreact to new information are excessively volatile.

### *Why might the stock market be inefficient?*

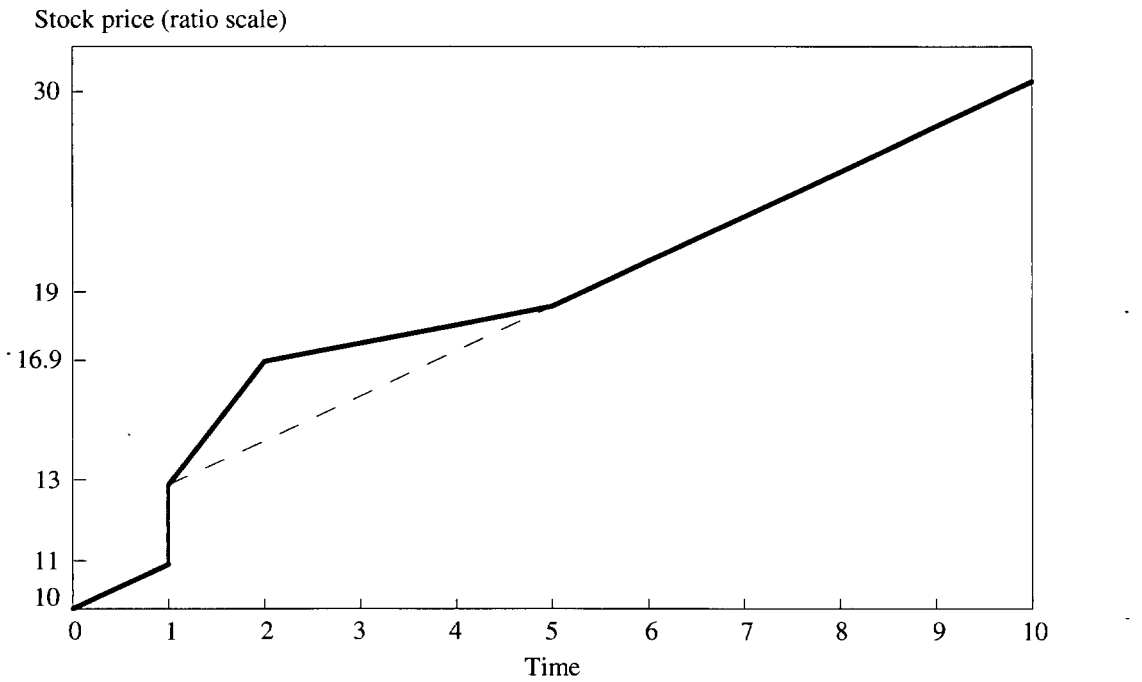
In an efficient market, stock prices reflect the current value of the future income that stocks generate because prices depend on *future* dividends, prices, and interest rates. If other factors, such as *past* prices and dividends, affect the value investors place on stocks, stock prices will deviate from fundamental values. When prices deviate from fundamental values, the market is inefficient.

One theory of why stock prices deviate from fundamental values is that many traders pay attention to recent trends in returns (Cutler, Poterba, and Summers). These "feedback traders" believe that if a stock's returns have been high in the recent past, they are likely to be high in the future. As feedback traders buy the stock to capture the excess returns, the price will rise above the stock's fundamental value. Likewise, if returns have been low in the recent past, feedback traders will sell the stock, driving the price below its fundamental value. Thus, in the short run, increases in stock prices are followed by further increases, and decreases are followed by decreases.

According to the theory, however, stock prices will ultimately return to fundamental

*Figure 3*

***Stock Prices in an Inefficient Market***




values. Arbitragers and traders who pay attention to fundamental values will discover which stocks are overvalued and which are undervalued. As they sell the overvalued stocks and buy the undervalued stocks, prices eventually reach their fundamental values.

An example may clarify how stock prices in an inefficient stock market differ from prices in an efficient stock market (Figure 3). Suppose a company's stock price jumps when it announces it will pay higher dividends with the profits from a new discovery. Because the return over the first period is 30 percent instead of 10 percent, feedback traders buy the stock. The upward pressure on the price drives the price above its fundamental value (shown by the dashed line segment). Traders who pay attention to fundamentals will then begin selling the overvalued stock, putting downward pressure on its price and causing the average return to fall over the next few periods. With lower past returns, fewer feedback traders buy the stock. Indeed, some may start selling the stock, producing even greater downward pressure on the price. Eventually, the price returns to its fundamental value. Prices that follow such a pattern of rising above their fundamental trend and then returning are said to be *mean reverting*.

### *Implications*

In contrast to an efficient stock market, an inefficient stock market does not direct investment funds to their best use because prices do

not necessarily reflect fundamental values. For example, feedback traders may irrationally drive the stock prices of companies with low fundamental values too high. Conversely, stock prices of companies with high fundamental values may be too low. As a result, companies with low fundamental values may be able to raise a lot of capital, while companies with high fundamental values may find it difficult to raise capital.

A second implication of an inefficient stock market is that mean reverting prices cause expected returns to vary. For example, although the average return in Figure 3 from the end of period one to the end of period five is 10 percent, the return is far from constant. As the price rises above the fundamental value, the return is 30 percent. But as the price reverts to the fundamental value, the average return is just 4 percent. Thus, greater than average returns are followed by less than average returns, while less than average returns are followed by greater than average returns.

A third implication is that prices are excessively volatile in the short run. Stock prices are volatile in an efficient market because new information causes unexpected changes in prices. However, prices are even more volatile in an inefficient market because prices will change by more than the value of the new information. In the long run, though, prices are not excessively volatile because they eventually revert to their fundamental trend. In other words, as shown in Figure 3, the long-run change in stock prices in an inefficient market is the same as in an efficient market.

## *Is the Stock Market Efficient?*

The evidence is mixed on whether the stock market is efficient. Some recent studies have found that stock prices are mean reverting, leading some analysts to conclude that the stock market is inefficient. Other studies cast doubt on this conclusion.

### *Evidence that stock prices are mean reverting*

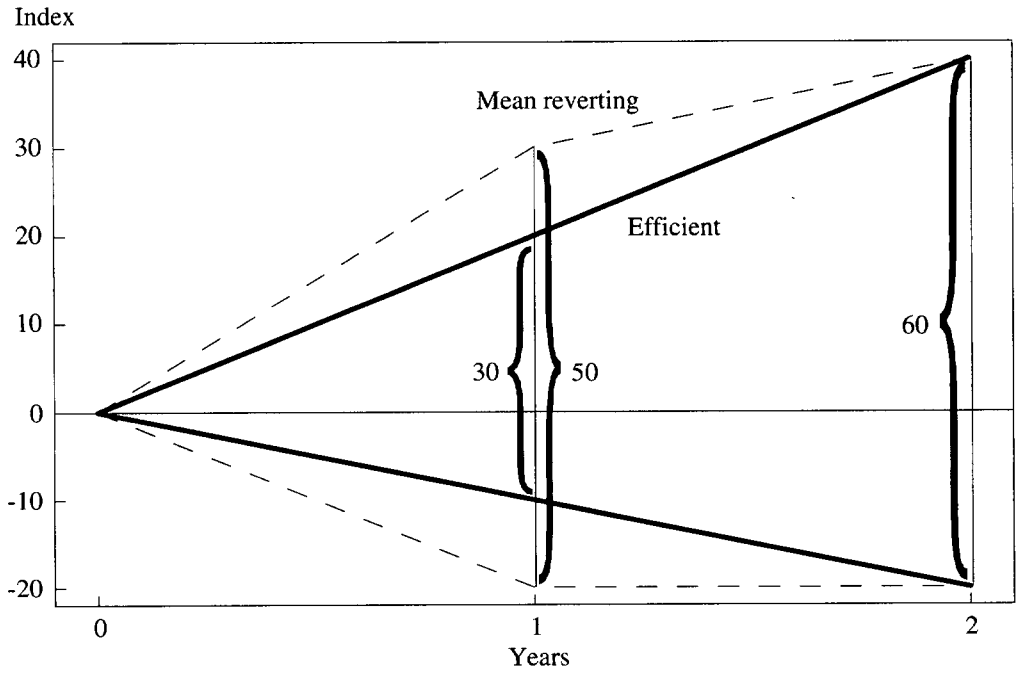
After years of testing the efficient market hypothesis, financial economists have generally agreed that the stock market is efficient. In recent years, however, new research strategies have shown that stock prices are mean reverting over long investment horizons. The strategies rely on new statistical techniques that are potentially better able to detect regularities in stock prices. In addition, some researchers have begun to pay more attention to the long-run behavior of stock prices.

*Variance-ratio tests.* In the long run, stock price volatilities are the same whether or not prices are mean reverting. Short-run volatilities, however, are greater if prices are mean reverting than if they are not. As a result, the ratio of long-run volatility to short-run volatility is smaller if prices are mean reverting. The new statistical techniques use ratios of long-run volatilities to short-run volatilities to determine whether stock prices are mean reverting.

An example may help clarify this point. Suppose a stock's price will either rise 20 percent a year or fall 10 percent a year (solid lines in Figure 4). One measure of the volatility of this stock is the difference between the best and worst possible returns over the investment horizon. For a one-year investment, the best return is a 20 percent gain and the worst a 10 percent loss, so the volatility is 30 percent (20 percent less a negative 10 percent). For a two-year investment, the best return is 40 percent—20 percent in each of the two years—and the worst is a negative 20 percent, so the volatility is 60 percent. Thus, the volatility of the two-year investment is twice that of the one-year investment. More generally, the volatility of a

*Figure 4*

***Investment Risk***




$k$-year investment will be $k$ times the volatility of a one-year investment if the market is efficient.[6]

The volatility of a $k$-year investment will be less than $k$ times the volatility of a one-year investment, however, if prices are mean reverting. Because prices overshoot fundamental values in the short run but not the long run, prices are excessively volatile only in the short run. For example, prices might either rise 30 percent or fall 20 percent so that the volatility is 50 percent in the first year (dashed lines in Figure 4). If the price returns to its fundamental value by the second period, the best two-year return is 40 percent and the worst is a negative 20 percent, so that the volatility is 60 percent—just as in the efficient market. Thus, the volatility of the two-year investment is much less than twice the volatility of the one-year investment.[7]

Poterba and Summers have argued that the efficient market theory can be tested by looking at whether volatility rises proportionally to the investment horizon. They measured volatility by the variance of stock returns. If the market is efficient, the variance of $k$-year returns ($r_k$) should equal $k$ times the variance of one-year returns ($r_1$).

$$Variance(r_k) = k \times Variance(r_1)$$

or

$$\frac{Variance(r_k)}{k \times Variance(r_1)} = 1 \qquad (2)$$

Thus, the ratio of the variances at all investment horizons should equal one if the market is efficient, but should be less than one if prices are

mean reverting.

Poterba and Summers concluded that the stock market is inefficient because prices are mean reverting. They calculated variance ratios for investment horizons of two to eight years. The data were excess returns on the New York Stock Exchange (NYSE) from 1926 to 1985, measured as monthly NYSE returns less U.S. Treasury bill returns. The variance ratios were less than one for all investment horizons greater than two years. For example, eight-year returns should be eight times more variable than one-year returns if the stock market is efficient. Poterba and Summers found, however, that eight-year returns are only three-and-a-half times more variable than one-year returns. In addition, the eight-year variance ratio is significantly less than one in a statistical sense. Finally, Poterba and Summers showed that mean reversion is stronger for stocks of small firms than of large firms.[8]

*Regression tests.* Another way to test the efficient market theory is to regress stock returns on past stock returns. If stock prices rise at a constant rate as suggested by the efficient market theory, returns should be constant over time and, therefore, unrelated to past returns. That is, in a regression of stock returns on a constant term and past returns, the constant term should be positive, but the slope coefficient on past returns should be zero. On the other hand, if prices grow faster than trend initially but slower as they return to trend, returns should be above and then below normal. Thus, if prices are mean reverting, the slope coefficient should be negative.

Many researchers have regressed stock returns on past returns to test the efficient market theory. Most of the studies used returns over very short investment horizons, such as daily or weekly returns. Although the slope coefficients were generally found to be statistically significant, they were not economically significant because they were so close to zero. Thus, in a review of many of the early studies, Fama concluded that the stock market is efficient.

More recent studies have extended the early research by using multiyear returns in the regressions. Fama and French (1988a) tested for mean reversion by regressing multiyear returns on past multiyear returns for investment horizons of one to ten years. They used monthly data adjusted for inflation from the NYSE and various industry groups over the period from 1926 to 1985. For example, for a four-year horizon, the return from March 1935 to March 1939 was regressed on the return from March 1931 to March 1935.

Fama and French concluded that stock prices are mean reverting. They found that the coefficients on past returns became negative for two-year returns, reached a minimum for three-to-five-year returns, and then approached zero as the investment horizon increased to eight years. For example, the coefficient on past NYSE returns for the four-year horizon was -0.36 and statistically significant. Thus, for example, if returns were 10 percent above average over the past four years, they are likely to be 3.6 percent below average over the next four years. Finally, like Poterba and Summers, Fama and French found that mean reversion is stronger for stocks of small firms than of large firms.[9]

Another way to use regressions to test for efficient markets is to regress stock returns on the difference between stock prices and a measure of fundamental values.[10] If stock prices are mean reverting, returns should be negatively related to past differences between prices and fundamental values. For example, if a stock price is above its fundamental value, future returns should be small as the price returns to the fundamental value.

Fama and French (1988b) found that stock prices are mean reverting when dividends are used to measure fundamental values. Dividends

are a measure of fundamental values because stock prices should be proportional to dividends in an efficient market (see equation 1). Thus, if prices are mean reverting, returns should be negatively related to the difference between prices and dividends. Using inflation-adjusted NYSE returns from 1926 to 1986, Fama and French found that two-year to four-year returns are negatively related to the difference between stock prices and dividends.[11]

Campbell and Shiller found that prices are mean reverting using dividends and earnings to measure fundamental values. Because dividends ultimately depend on earnings, earnings can also be used to measure fundamental values. Using excess returns and inflation-adjusted returns on the Standard and Poor's 500 stock index from 1871 to 1987, they found that prices are mean reverting over one-year, three-year, and ten-year horizons.

### *Why the stock market might still be efficient*

Despite the evidence that stock prices are mean reverting, the stock market might still be efficient for two reasons. First, some critics argue the evidence for mean reversion is weak, either because the data samples are too small or because the evidence depends entirely on the behavior of stock prices before World War II. Second, some critics argue that mean reverting stock prices are, in fact, simply a characteristic of more sophisticated versions of the efficient market theory.

*Small sample size.* Some researchers argue there are not enough data to conclude that stock prices are mean reverting. In general, the tests used to determine whether a statistic is significant assume that the statistic is calculated from an infinite number of observations. Because a finite number of observations are actually used in any test, the tests are only an approximation. The larger the number of observations, however, the better the approximation. The problem with mean reversion tests is that the data sets are very small. For example, from 1925 to 1985, there are only 12 independent observations of five-year returns (60 years divided by five).

Using statistical tests that account for the relatively small number of observations, several studies have found that previous work overstated the statistical significance of the mean reversion evidence (Mankiw, Romer, and Shapiro; Nelson and Kim; Kim, Nelson, and Startz; and McQueen). In general, these studies have found that the evidence on mean reversion is only marginally, if at all, statistically significant. Thus, while the evidence is suggestive, it is not strong enough to conclude that stock prices are mean reverting.

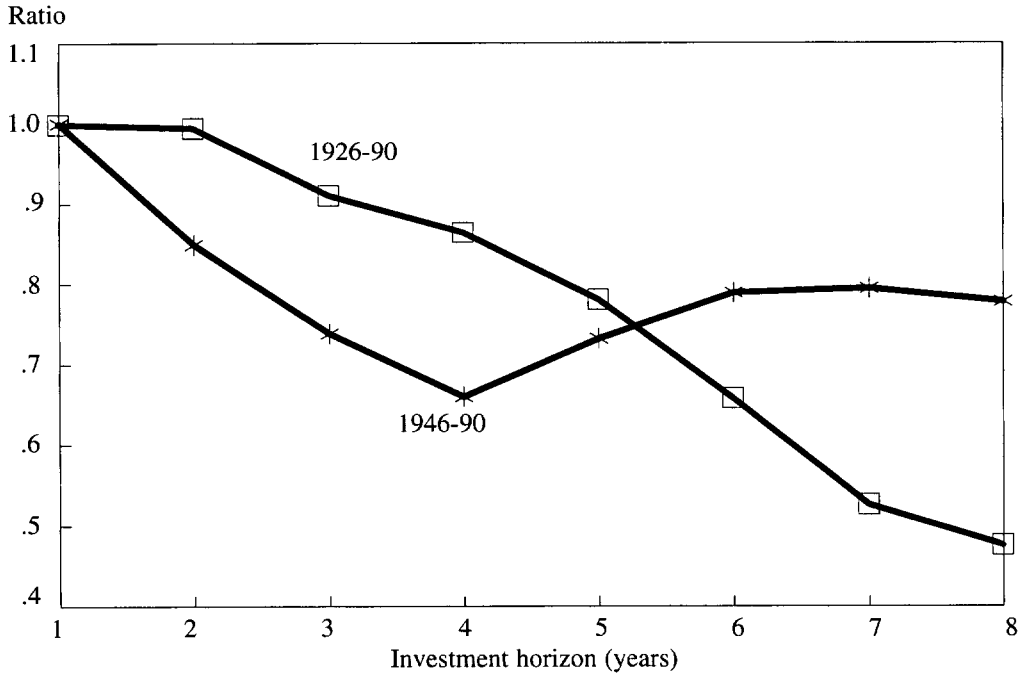
*Mean reversion is due to pre-World War II data.* Some researchers argue that stock prices may have been mean reverting in the past, but not anymore. According to these critics, stock prices were mean reverting only before World War II—stock returns were high in the late 1920s, low after the 1929 Crash and during the Great Depression, and then high during and right after the war. Since the war, however, they argue that such regularities in stock returns have largely disappeared.

Some recent studies show that mean reversion does disappear when the early years are excluded. Using NYSE returns from 1947 to 1986, Kim, Nelson, and Startz found that stock prices are not mean reverting. Indeed, for large-firm stocks, prices move away from the mean at long horizons.[12] Fama and French (1988a) found that mean reversion disappears for all of their groups when returns from 1941 to 1985 are used.[13]

Critics of the studies of postwar data might argue that the studies omit the second half of the 1980s—a period in which stock prices appear

*Chart 1*

***Variance Ratios***




Note: Returns are monthly returns on the equal-weighted New York Stock Exchange portfolio less monthly returns on U.S. Treasury bills from 1926 to 1990 and 1946 to 1990. The variance ratio for a k-year investment horizon is calculated as the variance of the k-year return divided by k times the variance of the one-year return. The variance ratios are adjusted for small-sample bias as discussed in Poterba and Summers.

Source: Center for Research in Security Prices.

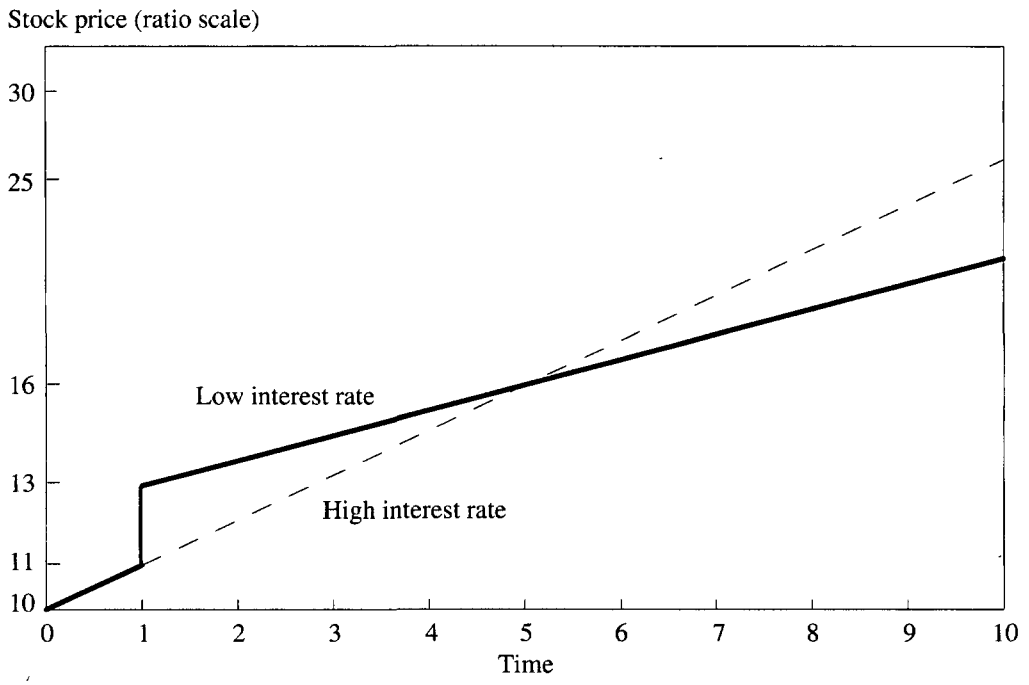
to have been mean reverting. For example, the return on the Dow Jones Industrial Average over the three years prior to the October 1987 collapse was 112 percent, while the return over the three years after the collapse was just 30 percent.[14]

Updating the postwar sample through 1990 does not significantly affect the results, however. The effect of updating the data is shown by calculating variance ratios over the 1946-90 period and comparing them with variance ratios calculated over the 1926-90 period (Chart 1). Mean reversion at long horizons has been weaker since 1946 than before 1946, although mean reversion at short horizons has been stronger over the postwar period. But because the sample is so small, these variance ratios are probably no more than marginally significant. Thus, overall, the postwar evidence casts doubt on the mean reversion evidence.

*Sophisticated efficient market theories.* Even if stock prices are mean reverting, the stock market might still be efficient. Mean reversion implies that the simple efficient market theory described earlier—where the real interest rate is assumed to be constant over

*Figure 5*

***Stock Prices in an Efficient Market: Change in Interest Rates***




time—is incorrect. In the simple theory, expected real returns are constant over time because the real interest rate is assumed to remain constant. But if real interest rates vary over time, returns should also vary over time in an efficient market. Indeed, if real interest rates are mean reverting, stock prices will also be mean reverting.

Real interest rates could vary for a variety of reasons. For a given riskless interest rate, changes in the riskiness of stocks or in investors' tolerance for risk would cause the risk adjustment factor, and therefore the interest rate, to change. Alternatively, for a given risk-adjustment factor, the riskless interest rate may change over time. Several researchers have developed sophisticated examples in which changes in risk tolerance and the riskiness of stocks cause interest rates, and therefore stock prices, to be mean reverting (Fama and French 1988b; Black; and Cecchetti, Lam, and Mark).

The basic idea underlying the sophisticated models is illustrated in Figure 5. Suppose that interest rates fall at the end of the first period. The decline could be due to a fall in the riskless interest rate, in the riskiness of stocks, or in the risk averseness of investors. According to equation 1, a decline in interest rates causes the current stock price to rise. At the same time, the lower interest rate implies that future prices will grow at a slower rate. As the figure shows, the stock price first jumps above the old trend and then slowly reverts to the old trend just as in the inefficient market theory.

Indeed, Figure 5 looks very similar to Figure 2. Thus, if interest rates are mean reverting, perhaps because they fall during recessions and rise during recoveries, stock prices may appear mean reverting even if the stock market is efficient.

Poterba and Summers argue, however, that changes in the riskiness of stocks or the risk tolerance of investors cannot explain the mean reversion found in the data for two reasons. First, the degree of mean reversion in stock price data implies changes in the riskiness of stocks or in risk tolerance that are implausibly large. Second, although the behavior of stock prices in the feedback trader model and sophisticated efficient market theories are similar, they are not exact. Specifically, prices should move away from trend in the short run if they are mean reverting. In other words, as shown in Figure 2, if prices grow faster than normal, feedback traders should cause them to continue to grow faster than normal in the short run. In the sophisticated models (Figure 5), however, prices should immediately begin to grow slower than normal after a fall in interest rates. Lo and MacKinlay, and Poterba and Summers find that prices move away from trend for investment horizons of two years or less, which supports the feedback trader model.

## *Conclusions*

Analysts have traditionally regarded the stock market as an efficient market. More recently, some analysts have argued that feedback traders cause the market to be inefficient. The major problem for the economy of an inefficient market is that investment funds are not directed to where they are most useful.

This article reviewed the mean reversion evidence on stock market efficiency. Some studies of stock prices suggest prices are mean reverting. However, it is too early to conclude that the stock market is inefficient for two reasons. First, other studies indicate that stock prices are not mean reverting. Some show that the statistical tests are relatively inaccurate due to a lack of long-horizon stock returns, while others show that the evidence in favor of mean reversion is much weaker if pre-World War II data are excluded. Second, even if stock prices are mean reverting, it may be that one of the more sophisticated efficient market theories is correct.

## *Endnotes*

[1] Investors cannot get higher than average returns by following simple investment strategies, however. In an efficient market, arbitragers work so quickly that investors cannot take advantage of any mispricing of securities.

[2] Because the real interest rate is used in equation 1, the price and dividend terms are also real values. Equation 1 would also hold if all values were expressed in nominal terms. Real terms are used to avoid changes in values induced by inflation. For expositional purposes, "real" will not be used as a modifier unless it is necessary for clarity.

[3] More formally, the efficient market theory says that the price of a stock should equal the present value of all future dividends.

$$P_0 = \sum_{i=1}^{\infty} \frac{ED_t}{(1+r)^t} = \frac{ED_1}{1+r} + \sum_{t=2}^{\infty} \frac{ED_t}{(1+r)^t}$$

The expected price of a stock one period in the future is just the present value of all dividends from that time on.

$$EP_1 = \sum_{t=2}^{\infty} \frac{ED_t}{(1+r)^{t-1}}$$

Dividing $EP_1$ by $1 + r$ gives

$$\frac{EP_1}{1+r} = \sum_{t=2}^{\infty} \frac{ED_t}{(1+r)^t},$$

which is just the summation term in the second line of the $P_0$ equation. Thus, substituting $EP_1/1+r$ into the $P_0$ equation gives equation 1 in the text.

[4] The dividend-inclusive price, $q_t$, is constructed so that the percentage change in price equals the total return from dividends and price appreciation. That is,

$$(q_t - q_{t-1})/q_{t-1} = (D_t + P_t - P_{t-1})/P_{t-1}.$$

One way to think of the dividend-inclusive price is that it is what the price of the stock would be if the stock did not pay dividends so that the total return comes from price appreciation.

[5] The slope of the line is the percentage change in price instead of just the change in price because the vertical scale of the figure is a ratio scale. The slope equals the risk-adjusted interest rate because the dividend-inclusive price is constructed such that the percentage change in price equals the total return including dividends (see endnote 4). That is,

$$slope = (q_t - q_{t-1})/q_{t-1} = (D_t + P_t - P_{t-1})/P_{t-1} = r,$$

and $r$ is assumed to be constant over time in the simple efficient market theory described in the text. More sophisticated efficient market theories allow $r$ to vary over time. In those theories, expected returns will vary over time with $r$. These theories will be discussed later in the article.

[6] If risk is measured by the variance of returns, the variance of the return on a $k$-year investment is just $k$ times the variance of the return on a one-year investment. For example, if $p_t$ is the log of the dividend-inclusive price, the two-year return is

$$(p_t - p_{t-1}) + (p_{t-1} - p_{t-2}) = p_t - p_{t-2}.$$

The variance of the two-year return is

$$var(p_t - p_{t-2}) = var(p_t - p_{t-1}) + var(p_{t-1} - p_{t-2}) + 2cov(p_t - p_{t-1}, p_{t-1} - p_{t-2}).$$

If the market is efficient, the covariance between the current one-year return and the lagged one-year return is zero. Assuming the variance of one-year returns is constant over time, the two-year variance becomes $2var(p_t - p_{t-1})$.

[7] If risk is measured by the variance of returns, the variance of the return on a k-year investment is less than k times the variance of the return on a one-year investment. For example, if $p_t$ is the log of the dividend-inclusive price, the two-year return is

$$(p_t - p_{t-1}) + (p_{t-1} - p_{t-2}) = p_t - p_{t-2}.$$

The variance of the two-year return is

$$var(p_t - p_{t-2}) = var(p_t - p_{t-1}) + var(p_{t-1} - p_{t-2}) + 2cov(p_t - p_{t-1}, p_{t-1} - p_{t-2}).$$

If prices are mean reverting, the covariance between the current one-year return and the lagged one-year return is negative. Thus, assuming the variance of one-year returns is constant over time, the two-year variance is less than $2var(p_t - p_{t-1})$.

[8] Poterba and Summers report results for both value-weighted and equal-weighted NYSE returns. Value-weighted returns are calculated from a weighted-average price index for all stocks on the NYSE, where the weight on a stock's price is the market value of the firm's outstanding shares divided by the market value of all shares on the NYSE. Equal-weighted returns are calculated from a price index in which all stock prices have the same weight. The primary difference between the two measures of returns is that value-weighted returns are dominated by large-firm stocks.

The variance ratios for both types of returns are less than one for all horizons over two years. However, the equal-weighted statistics generally are smaller than the value-weighted statistics. For example, eight-year equal-

weighted returns are three-and-a-half times more variable than one-year returns, while eight-year value-weighted returns are five-and-a-half times more variable than one-year returns. Because smaller firms carry a larger weight in equal-weighted returns than in value-weighted returns, these results suggest mean reversion is more prominent for stocks of small firms than of large firms.

Poterba and Summers report Monte Carlo estimates of the standard errors of the variance ratios for all horizons, but they report the statistical significance only for the eight-year horizon. The eight-year variance ratio is statistically different from one at the 8 percent level for the value-weighted returns and at the 0.5 percent level for the equal-weighted returns. It should be noted, however, that none of the variance ratios are more than two standard deviations from one.

The data used by Poterba and Summers end before the October 1987 stock market collapse. Extending the data through 1990, however, does not change the results.

[9] Fama and French report results for value-weighted and equal-weighted NYSE returns, equal-weighted returns for groups of NYSE firms of similar size, and equal-weighted returns for various industries. In general, the coefficients for the three-to-five-year horizons are the most negative for all groups. Moreover, for most of the groups, the coefficients are more than two standard errors from zero only for the three-to-five-year horizons. The exceptions are the large-firm portfolios and the value-weighted returns, which are not more than two standard errors from zero at any horizon. Thus, like the Poterba and Summers results, mean reversion is more prominent for stocks of small firms than of large firms.

[10] If the stock market is efficient, any difference between prices and a measure of fundamental value must be due to errors in measuring fundamental values. Because the measurement errors should cancel each other out over time, however, returns should not be systematically related to such measurement errors.

[11] Fama and French actually regress returns on the log of dividends minus the log of prices and find that the slope coefficients are positive. This implies that the coefficient on prices minus dividends should be negative as discussed in the text. They report results for value-weighted and equal-weighted real returns. In general, the slope coefficients are larger in the equal-weighted regressions than in value-weighted regressions. Thus, they also find that mean reversion is more prominent for stocks of small firms than of large firms.

[12] Kim, Nelson, and Startz use the term "mean aversion" to describe the tendency of prices to move away from the mean. Like mean reversion, mean aversion is not consistent with the efficient market theory. However, no one has come up with a story that explains why prices should be mean averting over long horizons.

[13] Poterba and Summers find that mean reversion does not disappear when returns from 1936 to 1985 are used. These results are apparently due to the fact that the sample still includes returns from the Great Depression.

[14] The return over the three years prior to the 1987 collapse was calculated from monthly averages of the Dow Jones Industrial Average from September 1984 to September 1987. The return over the three years after the 1987 collapse was calculated from monthly averages of the Dow Jones Industrial Average from November 1987 to November 1990.

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# New Evidence Firms Are Financially Constrained

*By Donald P. Morgan*

Financing investment may not be a problem for large, well-known firms. If GM or IBM cannot finance a promising project with internal funds, they can turn to banks or outside investors for funds. But many analysts believe that smaller, less well-known firms sometimes find it difficult to finance worthy projects. Banks and outside investors may be reluctant to fund unfamiliar firms, forcing these firms to finance their investment internally. As such, these firms can be defined as *financially constrained.*

The implications for the economy are serious if firms are financially constrained. By forcing firms to finance their own investment, financial constraints can make the economy less stable. Indeed, some analysts blame the current sputtering economy on financial constraints. And over the longer run, reduced investment spending on plants and machinery can slow economic growth.

A growing body of evidence suggests many firms in the economy are financially constrained. This article adds to the evidence, finding that firms without a bank loan commitment, such as a line of credit, appear to be more financially constrained than firms with a bank loan commitment. Bank loan commitments loosen financial constraints in two ways. First, a loan commitment provides liquidity to a firm when its internal funds are low. Second, a loan commitment from a bank provides information to outside investors about the firm's creditworthiness. This information may then enable the firm to tap nonbank sources of funds.

The first section of the article discusses how financial constraints affect the economy and how such constraints arise. The second section reviews past evidence of financial constraints. The third section presents new evidence based on bank loan commitments.

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## *Financial Constraints and the Economy*

Financial constraints affect both the stability and growth of the economy. By making investment spending more volatile, financial constraints make the economy more volatile. And by slowing investment spending on plant and machinery, financial constraints slow the economy's long-term growth.

### *Why financial constraints matter*

By making firms dependent on the availability of internal funds, financial constraints make business investment spending more volatile. Aggregate investment spending in the economy fluctuates much more than any other major component of national spending. Some of these ups and downs just reflect changes in firms' investment prospects, which wax and wane on their own. But if firms are financially constrained, some of these ups and downs may also reflect fluctuations in firms' internal funds. That is, firms may be forced to reduce investment when their cash flow declines, even if their investment prospects have not changed.

More volatile investment spending aggravates the business cycle. When business is booming, firms are flush with cash and banks and investors are eager to provide funds. This liquidity boosts investment spending and further speeds the economy. On the downside, when business is slowing, outside funds may be scarce and firms' internal funds dwindle. This illiquidity reduces investment spending and further weakens the economy. Thus, a firm's financial condition influences investment spending over the course of the business cycle. In fact, business analysts have long observed a systematic relationship between economic activity and financial variables such as bank lending and liquidity over the postwar business cycle (Eckstein and Sinai).

The effects of financial constraints, however, were most apparent in the prewar business cycle. Bernanke, for example, investigated the effect of financial constraints in the Great Depression. The banking crisis during that episode sharply curtailed bank lending, while the stock market crash effectively ruled out issuing shares to raise funds. Thus, external sources of funds dried up as the ongoing depression squeezed firms' internal funds. Such tight financial constraints prolonged and deepened the depression.

Aside from aggravating the business cycle, financial constraints also slow long-run growth in the economy. Firms forced to finance their own investments will invest more slowly than if external funds are available. Slower investment spending means a slower increase in firms' capital stock of plant and machinery which, in turn, slows economic growth.

### *What causes financial constraints?*

Financial constraints arise when banks and investors have incomplete information about a firm's investment project. What information do banks and investors need? First, they need information about the competency of the firm's management. They also need to know about the project itself. How risky is it, how much will it cost, how long will it take, among other things. Lacking complete answers to such questions, banks and investors may refuse to fund the project. Or they may charge so much for funds that the firm abandons the project unless it can be financed internally. Either way, the firm is financially constrained because internal funds are its cheapest or only source of funds.

Some firms may be more tightly constrained than others. Small and medium-sized firms may be unable to raise funds directly from investors in public debt and equity markets. These firms may instead rely on lending by financial intermediaries, such as banks, who are

expert in determining the creditworthiness of companies through screening and monitoring. But banks may charge such a high premium that the firm still forgoes investment projects it cannot finance internally.

Other firms might be unable to borrow from banks at all. Very small firms, for example, may have inadequate collateral to secure a bank loan. Or very new firms may not have the track record needed to convince bankers they are a good credit risk. Consequently, banks may refuse to grant a loan to such firms, forcing them to finance their own investment.

Even large firms that issue publicly traded stock and debt might be financially constrained to some extent. To be sure, the very fact that these firms can tap the capital market suggests they are less constrained than firms which cannot. Publicly traded firms have the option to pick and choose among alternative sources of funds until they find the cheapest. Still, investors may have lingering uncertainty about the prospects for even publicly traded firms. This uncertainty will make external funds to the firms expensive, leading the firm to rely solely or in part on internal funds.

### *Past Evidence Firms Are Financially Constrained*

Evidence of financial constraints dates back to some of the earliest research on investment spending. Over 30 years ago, Meyers and Kuh found aggregate investment spending increased when cash flow increased and decreased when cash flow decreased. The positive correlation between investment and cash flow could reflect that firms relied on internal cash flow to finance their investment. For example, firms were forced to reduce investment spending when cash flow decreased even if their investment prospects were still good. Conversely, when cash flow increased, firms could afford to invest in good investment projects that went begging when cash flow was low. Under this interpretation, the correlation between cash flow and investment suggested that many firms in the economy were financially constrained.

Meyers and Kuh's findings were open to a second interpretation, however. Investment spending might have declined when cash flow declined, not because firms relied on cash flow, but because the decline in cash flow signaled that firms' investment prospects were not as good. If investment prospects had diminished, firms would have reduced investment even if they were not financially constrained. Likewise, investment spending might have increased when cash flow increased because the increase in cash flow signaled that firms' investment prospects had improved. Viewed this way, the correlation between investment and cash flow had nothing to do with financial constraints. Instead, investment was correlated with cash flow because cash flow was correlated with investment prospects.

One way to rule out this alternative interpretation is to control for investment opportunities with a variable other than cash flow. In a recent study, Fazzari, Hubbard, and Petersen controlled for investment prospects with a variable termed $q$. Loosely speaking, $q$ is the ratio of benefits and costs of investing—thus, when $q$ is high the firm should increase investment. More precisely, $q$ is the market value of a firm's capital stock divided by its current replacement value. If the ratio ($q$) is larger than one, the firm should invest because the increase in the firm's value from investing exceeds the cost of doing so.

Using this approach, Fazzari, Hubbard, and Petersen found strong evidence that firms were financially constrained. In a sample of several thousand manufacturing firms, cash flow and investment were strongly correlated even when

the authors controlled for investment prospects with $q$.

To the extent that $q$ fully measures firms' investment prospects, the correlation between cash flow and investment must reflect that firms were financially constrained. But $q$ may not perfectly measure firms' investment prospects.[1] If not, their findings may be subject to the same alternative interpretation as Meyers and Kuh: investment and cash flow may be correlated because cash flow contains information about investment prospects not contained in $q$.

To provide evidence against this interpretation, Fazzari, Hubbard, and Petersen divided their sample according to the firms' history of retaining earnings. Firms that retain the most earnings, they reasoned, may be those that find external finance most expensive. In particular, firms that are financially constrained in equity markets may find it cheaper to finance investment with retained earnings than to issue new shares. Consistent with this view, the authors found investment by firms with a history of high retained earnings depended more on cash flow than did investment by firms with historically low retained earnings. This finding is evidence against the view that cash flow and investment were correlated only because cash flow captured information about investment prospects not measured by $q$. While $q$ may not fully measure prospects, it is hard to imagine why the mismeasurement would be worse (and thus cash flow more important) for firms with high retained earnings.

Fazzari, Hubbard, and Petersen's research launched a number of related studies.[2] Others followed the strategy of identifying the firms thought to be most constrained and testing whether those firms behaved accordingly. For example, Whited tested whether firms without a corporate bond rating were more financially constrained than firms with a bond rating. She reasoned that a bond rating would provide liquidity to firms by giving firms access to corporate debt markets. In addition, a bond rating provides information to investors in other capital markets about the firm's creditworthiness. This information might give the firm easier access to other sources of finance, such as the stock market. Consistent with this reasoning, Whited found unrated firms appeared to postpone profitable investment to a greater extent than rated firms. That is, unrated firms were more financially constrained.[3]

## *New Evidence Using Bank Loan Commitments*

In recent years, a growing number of businesses have sought loan commitments from banks. Loan commitments, such as a line of credit, might be expected to loosen financial constraints in two ways. First, they may provide liquidity to a firm whose internal funds are low. Second, a commitment from a bank may inform outside investors about the firm's creditworthiness, thus enabling the firm to tap nonbank sources of funds. Consistent with this reasoning, this section finds that firms appear more financially constrained when they do not have a bank loan commitment.

### *Loan commitments and financial constraints*

All bank loan commitments promise the holder a loan up to some limit for some length of time. The most common type of commitment is revolving credit agreements. These are formal, long-term contracts committing the bank to lend to the holder for several years. Confirmed lines of credit are another, less common commitment. These are informal, short-term agreements, usually running a year or less.

Bank loan commitments of either type relax financial constraints by providing a source of liquidity to a firm. If a firm is low on cash, it

can draw on its line of credit and avoid reducing investment. In contrast, firms without a line of credit may need to reduce their investment when they are illiquid. The liquidity provided by a loan commitment is especially important during a credit crunch, when banks may refuse to lend to borrowers without a commitment (Morgan). In a 1988 Federal Reserve Board survey, senior loan officers ranked "protection from a credit crunch" as one of the most important reasons why firms obtain loan commitments (Duca).

A bank loan commitment may also relax financial constraints by providing information. Like a corporate debt rating, a loan commitment provides information to outside investors about a firm's creditworthiness. Indeed, a bank's willingness to lend to a firm could be even more informative than a corporate debt rating because banks are considered experts at determining the creditworthiness of firms. Thus, by granting a loan commitment, a bank sends a strong signal to capital markets about the firm's creditworthiness. For example, firms cannot borrow in the commercial paper market without obtaining a bank loan commitment (Calomiris). And in the equity market, a firm's share price rises when it receives a bank loan commitment and falls when it loses or retires the commitment, suggesting the commitment provides information to stock market investors (James).

If commitments relax financial constraints, why do some firms not have a commitment? Based on the 1988 survey of senior loan officers, Duca concluded bankers are reluctant to commit to smaller firms. And drawing on experience as a corporate treasurer, Kastantin observed that a bank's willingness to grant a commitment depends on its experience with a borrower and number of years the borrower had been in business. Thus, small start-up companies often have difficulty persuading a bank to approve a commitment.

Whatever the reason, many firms in the economy do not have a commitment. In a 1990 Federal Reserve survey, 73 percent of small firms did not have a loan commitment. Among medium-sized firms, 40 percent of those surveyed did not have a commitment (Ellihausen and Wolken).[4]

### *New evidence*

To the extent commitments provide liquidity and easier access to outside funds, firms in the economy without a bank loan commitment will be forced to finance more of their investment internally. In other words, these firms will be more financially constrained than firms with commitments. To test this possibility, commitment data were collected on a sample of 130 small manufacturing firms.[5] A sample period from 1980 to 1984 was chosen because it included a credit crunch in 1980 and recessions in 1980 and 1981-82.[6] Thus, the sample covered a period in which financial constraints might be especially tight.[7]

Some firms had a bank loan commitment in some years but not in others, which presented an issue of how to divide the sample. One possibility was to separate firms that never had a commitment from those with a commitment at least once over the sample period. However, a commitment arguably provides liquidity and information only in the year a firm actually had a commitment. That is, the benefits may not carry over into other years. Accordingly, firms were sorted according to whether they had a commitment in a given year. Under this sorting scheme, the observations were not firms but *firm-years*: a given firm in a given year. Of the total of 650 (130x5) observations, there were 579 firm-years with commitments and 71 firm-years without commitments.[8]

Differences in the two groups' average behavior across the sample period suggest firms

*Table 1*

***Investment, Liquidity, and Prospects: Averages Over 1980-84***

| | All firm-years | Firm-years with commitments | Firm-years without commitments |
|---|---|---|---|
| Cash flow/K | .131 | .12 | .227 |
| Cash stock/K | .207 | .177 | .451 |
| Investment/K | .114 | .115 | .103 |
| q | 1.36 | 1.2 | 2.64 |
| Capital (K) in 1980 | 88.86 | 91.53 | 68.21 |
| Number of observations | 650 | 579 | 71 |

Variable definitions:
K = replacement value of capital stock of property, plant, and machinery in 1982 dollars.
Cash flow = income after all expenses, special items, and income taxes, but before dividends.
Cash stock = all liquid assets such as cash, checking deposits, and Treasury securities.
q = market value of firms' capital stock divided by replacement value of capital stock (K).
Investment = expenditures on property, plant, and machinery.

were more constrained when they did not have a loan commitment. As shown in Table 1, firms on average invested slightly less when they did not have a commitment even though their investment prospects ($q$) were much better.[9] Low investment in the face of good investment prospects is a telltale sign of financial constraints.

If firms are more financially constrained without a commitment, their investment should depend more on internal funds than firms with commitments. To determine if this was the case, the following investment equation was estimated for the whole sample and separately for each of the two groups:

$$Investment = \alpha + \beta_1(q) + \beta_2(cash\ flow) + \beta_3(cash\ stock)$$

By controlling for investment prospects with $q$, this equation isolates the liquidity effect of internal funds (cash flow and cash stock) on investment.

The results of estimating the equation are shown in Table 2.[10] The first column of regression results indicates that all firms in the sample were financially constrained to some extent. Investment was positively and significantly related to changes in cash flow even when controlling for firms' investment prospects with $q$. Thus, firms appeared to rely in part on internal cash flow to finance their investment, suggesting they were financially constrained. Investment was not significantly correlated with changes in their stock of cash, however.

Comparing the second and third columns of regression results suggests that firms were more constrained when they did not have a commitment.[11] Specifically, firms' investment depended more on both liquidity measures when they did not have a commitment. Investment was about twice as responsive to changes in cash flow for the group without commitments. For this group, a dollar decrease in cash flow corresponded to a 38-cent decrease in investment. For firms with a commitment, a dollar decrease in cash flow corresponded to a

*Table 2*

***Investment, Liquidity, and Prospects: Regression Results***

| | All firm-years | Firm-years with commitments | Firm-years without commitments |
|---|---|---|---|
| q | .008 | .01 | -.006 |
| | (.003) | (.003) | (.004) |
| Cash flow | .2 | .193 | .383 |
| | (.03) | (.029) | (.109) |
| Cash stock | .001 | -.012 | .066 |
| | (.018) | (.018) | (.028) |
| R-squared | .18 | .16 | .29 |
| Number of observations | 650 | 579 | 71 |

Notes: The dependent variable is investment. Coefficients are shown for each explanatory variable q, cash flow, and cash stock, with standard errors in parentheses. Regression estimates are for 1980-84. To eliminate differences across time, year dummies were included (not reported). To eliminate fixed differences across firms, all variables were expressed as deviations from firm-year averages. All variables are scaled by beginning-of-period capital stock.

19-cent decrease in investment. Likewise, investment was responsive to changes in the stock of cash only when firms did not have a loan commitment. A dollar decrease in these firms' stock of cash was associated with about a 7-cent decrease in their investment spending.

Taken together, the results in Table 1 and Table 2 provide evidence firms were more financially constrained when they did not have a bank loan commitment. On average over the sample period, firms invested slightly less when they did not have a commitment, even though they appeared to have much better investment prospects. And the regression results reveal that liquidity and investment were more correlated when firms did not have a loan commitment, suggesting such firms relied more on internal funds to finance their investment.[12]

## *Summary*

If outside investors and banks have incomplete information about a firm, they may be reluctant to finance the firm's investments. By slowing investment and making it more volatile, such financial constraints slow economic growth and make it more volatile. A growing body of evidence suggests many firms in the economy face financial constraints. This article adds to the evidence by examining the link between bank credit commitments and investment for a sample of firms from 1980 to 1984. The results suggest that firms appear more financially constrained when they do not have a bank loan commitment.

## Endnotes

[1] In the case of imperfect competition or increasing returns to scale, q may not perfectly measure firms' investment prospects.

[2] Other research on financial constraints is collected in *Asymmetric Information, Corporate Finance, and Investment,* edited by R. Glenn Hubbard.

[3] Whited uses an alternative method to test for constraints that does not require using q.

[4] Small firms were defined as those with 49 or fewer employees. Medium-sized firms were those with 49 to 500 employees. Larger firms were not included in the survey.

[5] The data are from the financial notes to firms' annual reports (form 10-K) to the Securities and Exchange Commission. The author thanks Herb Baer of the Federal Reserve Bank of Chicago for pointing out this data source.

[6] The Federal Reserve imposed credit controls briefly in 1980.

[7] In an extension of Fazzari and others, Gertler and Hubbard found firms' investment was more sensitive to cash flow during recessions than during expansions, suggesting firms are more constrained during recessions.

[8] Loan commitments are either short-term lines of credit or long-term revolving lines of credit. Of the 71 firm-years without commitments, 40 observations were on eight firms that never had a commitment over the entire five-year sample period. The remaining 31 observations were on 17 firms that had a commitment in some years and not in others.

[9] Data on cash stocks, cash flows, and investment are from Standard and Poor's Compustat Database. The variable $q = (V + B - N)/K$, where $V$ = market value of firm's shares (common and preferred) at the beginning of the year, $B$ = book value of short-term and long-term debt, $N$ = market value of inventories, and $K$ = replacement value of firm's capital stock at the beginning of the period. The author thanks Fazzari, Hubbard, and Petersen for providing the $q$ and $K$ series; see their appendix for details on the construction of these series.

[10] The equations were estimated by ordinary least squares using RATS.

[11] In another experiment, firms were sorted into those that never had a commitment over the sample period and those that had a commitment one or more years. The regression results were roughly the same except the differences across these groups were significant at only about the 10 percent level. There were no significant differences when firms were sorted by the size of their commitment loan limit.

[12] These findings are consistent with Hoshi, Kashyap, and Scharfstein. They investigated whether Japanese firms were more financially constrained when they did not have a close relationship with a bank. As they explained, the Japanese industrial giants, such as Mitsubishi and Fuji, are organized as huge industrial conglomerates called Keiretsu. At the center of each Keiretsu is a bank that maintains a very close working relationship with the member firms. For example, banks hold both debt and equity of the member firms. The authors found Keiretsu firms were not financially constrained, while non-Keiretsu firms lacking such a close relationship appeared financially constrained.

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# The Rising Cost of Medical Care and Its Effect on Inflation

*By Paula Hildebrandt and Eric A. Thomas*

Prices in a few sectors of the economy continue to climb at near double-digit rates despite some progress lately in reducing the overall inflation rate. Of concern is that the persistence of relatively high inflation in these sectors could dampen further progress toward price stability. One sector receiving particular attention recently has been the medical-care industry. Medical-care prices have risen faster than the overall price level since the early 1980s. Last year, for example, medical-care prices rose nearly twice as fast as the overall consumer price index (CPI).

Does the relatively fast pace of inflation in medical care pose a problem for policymakers? This article argues that high inflation in medical care makes achieving price stability more difficult, but that its effect on overall inflation is not large enough to inhibit policymakers from pursuing price stability as a goal. The first section of the article describes recent trends in the medical-care component of the CPI and shows that medical-care prices have a relatively small weight in the overall CPI. The second section argues that medical-care prices ultimately contribute more to overall CPI inflation than would be indicated by their small weight but, nevertheless, are not so large as to impede the attainment of price stability.

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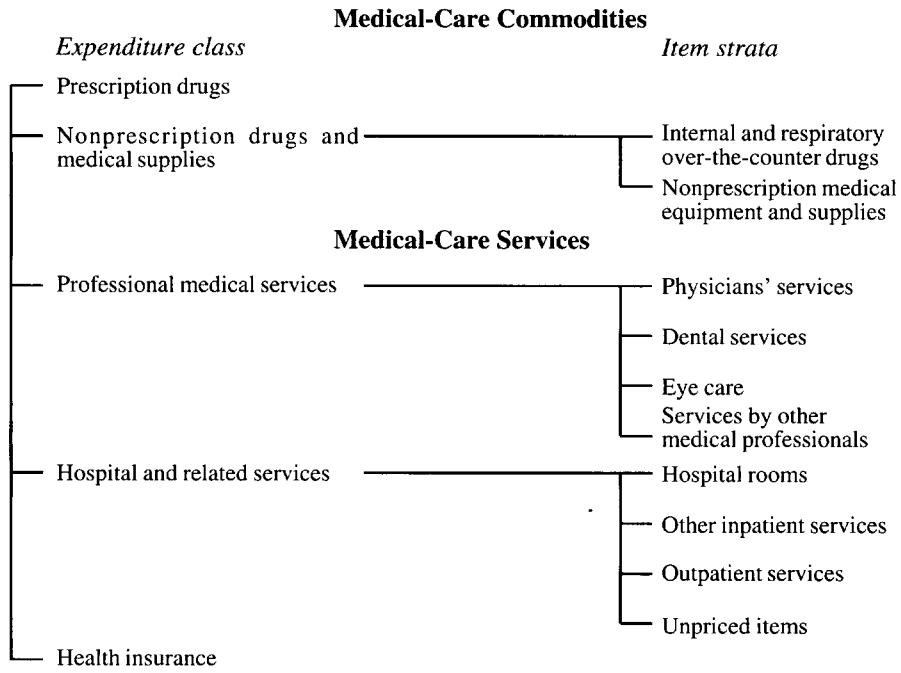
## *The Medical-Care Component of the CPI*

Higher inflation in the medical-care component of the CPI than in the total CPI potentially poses a problem for monetary policymakers. If medical-price inflation has a big effect on overall inflation, policymakers may find reducing overall inflation difficult. This section examines the importance of medical-care prices in the overall CPI. After describing how the CPI is calculated, the section

*Figure 1*

***Medical-Care Component of the CPI***




Source: Bureau of Labor Statistics.

documents the rapid increase in medical-care prices relative to total CPI inflation. The section then shows that, despite the relatively fast rate of increase of medical-care prices, the medical-care component of the CPI remains relatively small.

### *Overview of the CPI*

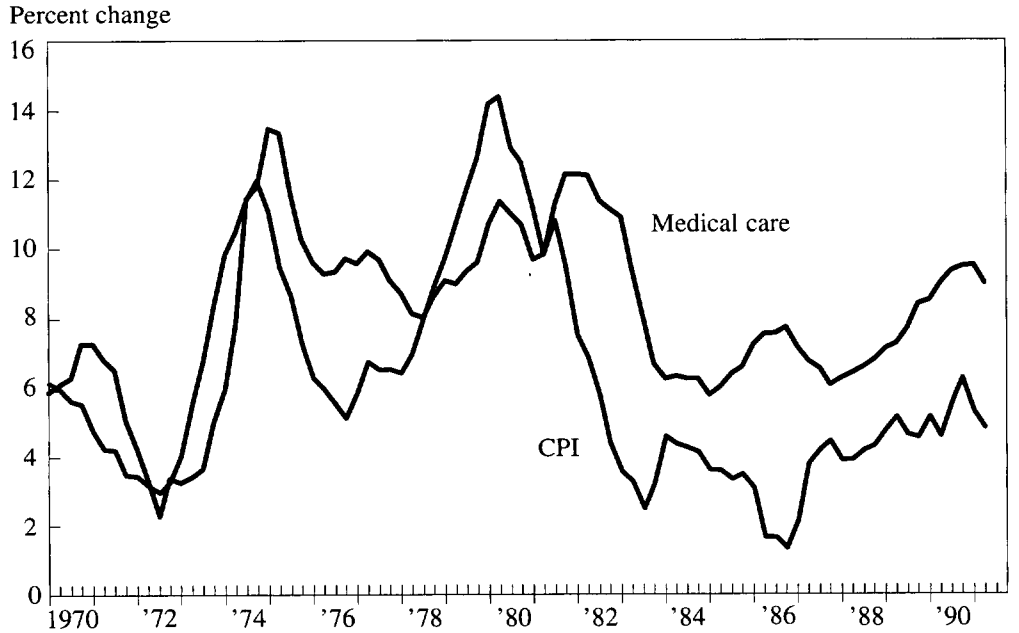
The CPI is compiled by the Bureau of Labor Statistics (BLS) and measures the price of a fixed market basket of goods and services at a point in time. Items in the basket include goods and services that consumers buy in day-to-day living, including everything from video games and breakfast cereals to prescription drugs and automobiles.

The BLS calculates two separate CPI indexes—the CPI-U and the CPI-W. The CPI-U represents the buying habits of all urban consumers, who account for 80 percent of the population. The CPI-W represents the buying habits of urban wage and clerical workers, who account for 32 percent of the population.[1] This article focuses on the CPI-U because the all-urban index represents a greater portion of the entire population.

The goods and services that make up the CPI's market basket are selected based on the Consumer Expenditure Survey. This survey is compiled yearly by the Bureau of the Census and yields detailed spending information on a sample of 10,200 families and individuals.[2] The survey includes only "out-of-pocket" expenses, omitting expenses not paid directly by consumers, such as employer-financed or government-

*Chart 1*

***Consumer and Medical-Care Price Indexes***




Note: Variables are expressed as 12-month rates of change.

Source: Bureau of Labor Statistics.

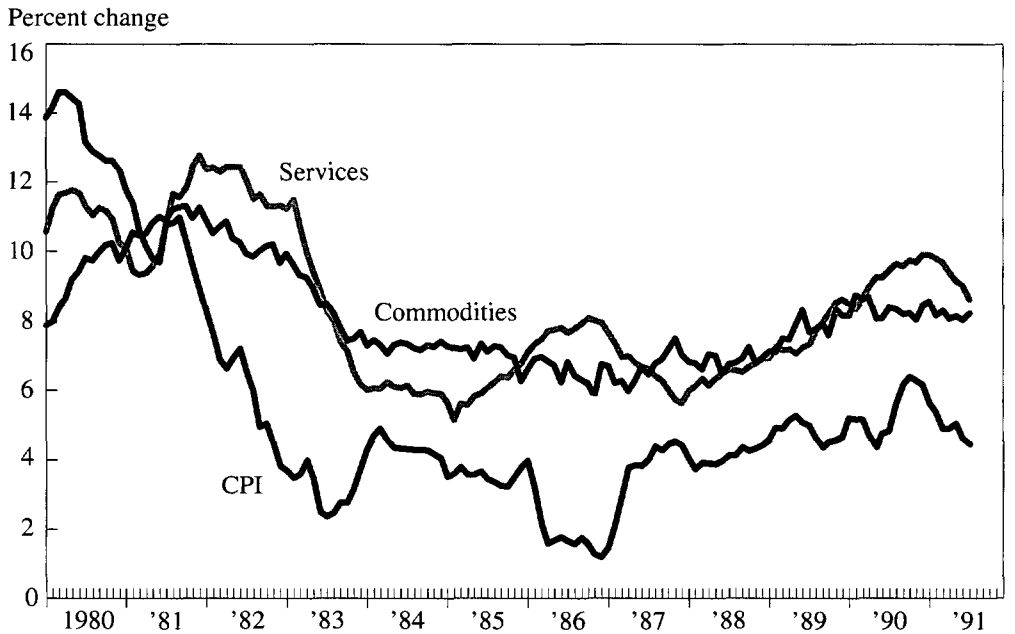
financed health insurance. Roughly every ten years, the BLS uses information from the survey to revise the market basket and recalculate the weight of each good or service in the overall CPI. The *weight* of an item in the CPI—which remains fixed between revisions—is the expenditure share of the item in the market basket.

The CPI's market basket consists of seven major components—food and beverages, housing, apparel and upkeep, transportation, medical care, entertainment, and other goods and services.[3] Each component is divided into two or more *expenditure classes*, consisting of closely related items. For example, the medical-care component has five expenditure classes—prescription drugs, nonprescription drugs and medical supplies, professional medical services, hospital and related services, and health insurance (Figure 1). Expenditure classes are further divided into groups of like items, called *item strata*. In the professional medical-service expenditure class, for example, item strata include physicians' services, dental services, eye care, and services by other medical professionals.

To determine the prices of the specific goods and services in the market basket, BLS field representatives gather information each month from selected retail outlets in urban areas across the United States. The field reps record the prices of goods and services, which have specific, well-defined characteristics. If the characteristics of a good or service change, the BLS attempts to determine how the new characteristics affect the value of the product so it

*Chart 2*

***Price Indexes of Medical-Care Commodities and Services***




Note: Variables are expressed as 12-month rates of change.

Source: Bureau of Labor Statistics.

can adjust the price accordingly.[4] New characteristics that measurably improve the quality of a good, for example, lead the BLS to adjust the price downward. Once the field reps have completed recording prices and noting changes in characteristics, the BLS compiles the data and calculates the CPI.

### *Recent price trends in medical care*

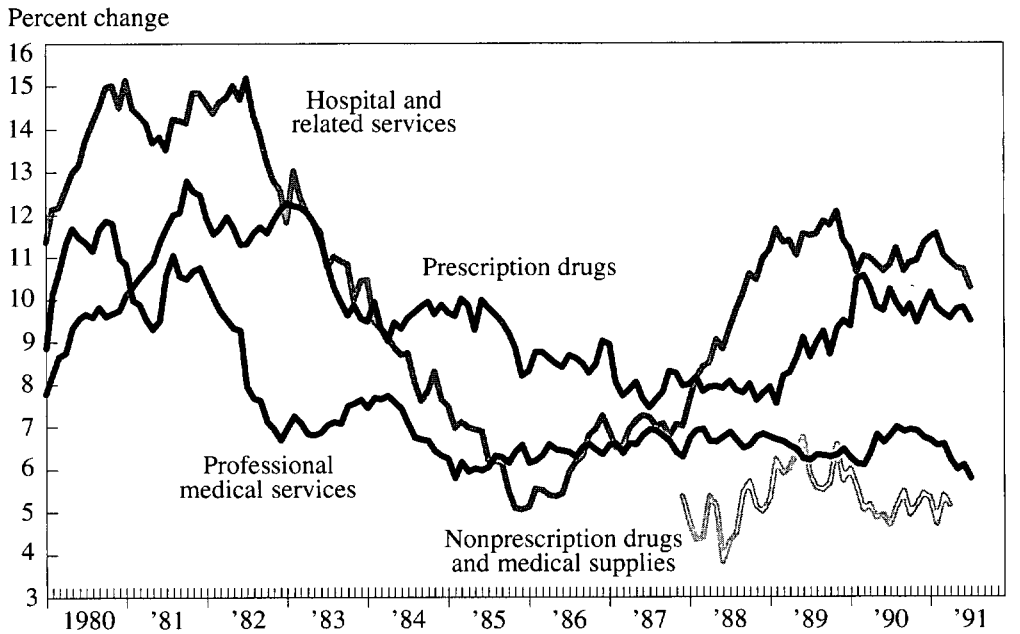
In contrast to the experience of the 1970s, medical-care prices since 1981 have consistently risen faster than the overall CPI (Chart 1). Since 1981, prices in the medical-care component have climbed an average 8.1 percent per year, while the overall CPI has climbed just 4.7 percent per year. Medical-care commodities and medical-care services have shared equally in this price rise (Chart 2).

Somewhat more divergent behavior is apparent among the expenditure classes of the medical-care component (Chart 3). Prices for prescription drugs and hospital services have generally risen faster than prices for nonprescription drugs and professional medical services. Thus, the main force behind inflation in medical-care services has been price increases for hospital services.[5] The main force behind inflation in medical-care commodities has been price increases for prescription drugs.

Analysts cite several factors to explain surging prices in medical care. Two of the main factors are the rapid introduction of expensive new technologies and the aging of the population. Another factor contributing to the problem is the fear of malpractice suits (Aaron). While

*Chart 3*

***Price Indexes of Medical-Care Classes***




Note: Variables are expressed as 12-month rates of change. Data on the health insurance expenditure class are not published. Also, data on the nonprescription drugs and medical supplies expenditures class were not published before December 1986.

Source: Bureau of Labor Statistics.

such explanations for high medical-care inflation have been hotly debated, this debate is beyond the scope of this article.

### *Relative importance in the CPI*

Medical-care prices have clearly risen sharply in recent years. However, for medical-care inflation to boost overall inflation significantly, not only must medical-care inflation be relatively high, but medical-care goods and services must also represent an important share of the CPI's market basket. As the data show, however, the share of medical care in the market basket has been relatively small.

*The concept of relative importance.* In constructing the CPI, the BLS calculates the *relative importance* of each item in the market basket. The relative importance of an item is its fixed *weight* in the market basket—based on expenditure survey information—times its price index divided by the total consumer price index. For example, suppose medical care's weight in the CPI was 5 percent. In addition, suppose that the price index for the medical-care component was 150, while the total consumer price index was 100. Then, the relative importance of medical care would be 7.5 percent (5 percent times 150/100 equals 7.5 percent). Despite the relatively high level of medical-care prices, the relative importance of medical care would be low because of the small weight of medical care in the CPI.

As relative prices change, an item's relative importance changes even though its expenditure weight remains fixed. The relative

*Table 1*

## *Relative importance of the components of the CPI*

| | (CPI-U) December 1986 | (CPI-U) December 1990 |
|---|---|---|
| Medical care | 5.420 | 6.387 |
| *Medical-care commodities* | *1.083* | *1.203* |
| Prescription drugs | .699 | .812 |
| Nonprescription drugs and medical supplies | .384 | .391 |
| Internal and respiratory over-the-counter drugs | .248 | .256 |
| Nonprescription medical equipment and supplies | .136 | .135 |
| *Medical-care services* | *4.337* | *5.184* |
| Professional medical services | 2.815 | 3.119 |
| Physicians' services | 1.469 | 1.688 |
| Dental services | .854 | .928 |
| Eye care | .334 | .337 |
| Services by other medical professionals | .158 | .166 |
| Hospital and related services | 1.334 | 1.842 |
| Hospital rooms | .531 | .725 |
| Other inpatient services | .492 | .708 |
| Outpatient services | .307 | .404 |
| Unpriced items | .004 | .005 |
| Health insurance | .188 | .223 |
| Food and beverages | 17.824 | 17.706 |
| Housing | 42.947 | 41.356 |
| Apparel and upkeep | 6.335 | 6.073 |
| Transportation | 17.217 | 17.796 |
| Entertainment | 4.403 | 4.316 |
| Other goods and services | 5.855 | 6.367 |
| All items | 100.0 | 100.0 |

Note: All numbers are percentages. The relative importance of each item is based on the expenditure weights from the 1982-84 Consumer Expenditure Survey.

Source: Bureau of Labor Statistics.

importance of an item increases if its price rises faster than the total CPI. The relative importance of an item decreases if its price rises slower than the total CPI. For example, if medical-care prices doubled while the total CPI remained unchanged, the relative importance of medical care in the CPI would also double.[6]

*Recent developments in medical care's relative importance.* The relative importance of the medical-care component has steadily increased in recent years because medical-care prices have risen faster than the overall CPI. However, the relative importance of medical care remains relatively small. In 1990, the relative importance of medical care in the CPI was only 6.4 percent (Table 1).[7] Most of medical care's relative importance was concentrated in the service sector. In December 1990, medical-care services had a relative importance of 5.2 percent, while medical-care commodities had a relative importance of 1.2 percent.

Because of its small weight in the CPI, the medical-care component has a smaller relative importance than most of the other six major components of the CPI. Only *apparel and upkeep* and *entertainment* are less important than medical care, while *other goods and services* have roughly the same relative importance as medical care. In contrast, the relative importance of *housing* in the CPI is more than six times the relative importance of the medical-care component. Thus, a price increase in the medical-care component would increase the CPI much less than a price increase in most of the other major components of the CPI.

## *Implications for Achieving Price Stability*

Does the low relative importance of medical care imply that medical-care inflation will not be an obstacle to further progress against overall inflation? This section examines the relationship between medical-care inflation and overall CPI inflation. The section first examines direct effects. That is, does medical-care inflation make the goal of price stability more difficult to achieve when medical-care prices are assumed not to affect prices of nonmedical goods and services? The section then examines indirect effects. That is, does medical-care inflation cause prices of nonmedical goods and services to rise, thereby making price stability harder to achieve?

### *Direct effect*

The direct effect of medical-care inflation on overall inflation is the amount that price changes in the medical-care component contribute to the CPI, ignoring the influence of medical-care prices on prices of other goods and services.[8] A simple simulation illustrates the direct effect in terms of the goal of achieving price stability.

For simplicity, the simulation makes several assumptions. First, it assumes the Federal Reserve conducts monetary policy so as to reduce CPI inflation by one percentage point a year, starting with an inflation rate of 5 percent in the first year and achieving price stability in the fifth year.[9] Second, price stability is assumed to correspond to 1-percent inflation in the CPI to account for measurement biases that cause CPI inflation to be overstated.[10] Third, based on a review of the literature, the medical-care component of the CPI is assumed to be no more or less subject to these biases than the CPI as a whole (see appendix).

Finally, the simulation assumes that inflation of medical-care prices remains three percentage points above the overall CPI inflation rate throughout the simulation horizon. This assumption is consistent with the visual evidence from Chart 1. For a large part of the 1980s, medical-care inflation rose and fell with

*Table 2*

***Simulated disinflation with high medical-care inflation***

| | Assumptions | | |
|---|---|---|---|
| | CPI inflation | Medical-care inflation | Implication for CPI inflation less medical care |
| First year | 5 | 8 | 4.8 |
| Second year | 4 | 7 | 3.8 |
| Third year | 3 | 6 | 2.8 |
| Fourth year | 2 | 5 | 1.8 |
| Fifth year | 1 | 4 | .8 |

Note: Implied CPI inflation less medical care is computed from the assumptions using two identities (see footnote 12). All numbers are percentage increases from the previous year.

Source: Authors' calculations, based on the stated assumptions, and Bureau of Labor Statistics.

overall CPI inflation but remained roughly three percentage points above overall inflation. Thus, the simulation assumes that medical-care inflation falls in response to a disinflationary monetary policy but remains relatively high.[11]

Given these assumptions, two implications of rising medical-care prices for achieving price stability are clear. First, with medical-care inflation higher than overall inflation, nonmedical inflation must be lower than overall inflation. Second, once overall price stability has been achieved, persistent inflation in the medical-care component will require steady deflation (relative to the 1-percent "price stability" inflation rate) in the nonmedical component.

How much will prices in the nonmedical component have to "fall" to achieve overall price stability? The simulation shows only a modest direct effect of relatively high medical-care inflation on policymakers' efforts to achieve price stability. The first two columns of Table 2 show the assumed downward paths of overall CPI and medical-care inflation. Given these assumed paths, the direct effect of the medical-care component can be seen. The final column shows that nonmedical inflation will have to fall roughly a quarter point below 1 percent to achieve price stability in the fifth year.[12] Thus, achieving overall price stability in the presence of persistent inflation in the medical-care sector does not imply a sharp deflation in the prices of nonmedical goods and services. But this is only the direct effect.

### *Indirect effect*

The simple simulation ignores the *indirect* effect of rising medical-care prices on the CPI by assuming that medical-care prices do not influence the prices of other goods and services. Yet, the indirect impact of surging medical-care prices on the prices of nonmedical goods and services may be an important obstacle to lowering overall inflation. This obstacle arises primarily from the medical costs employers pay and pass on to consumers in the form of higher

prices.[13] Measuring these indirect effects is necessary to determine the "true" effect of rising medical-care prices on overall consumer inflation. Achieving price stability in the face of soaring medical-care prices may prove more difficult than implied by the simple simulation.

The potential importance of the indirect effect is evident in rising premiums for health insurance. In recent years rising health insurance premiums have significantly raised the costs to businesses that pay part or all of their employees' health insurance. These businesses are likely to pass on at least part of these rising costs to consumers in the form of higher prices for their products. These rising prices will push the CPI higher but will not be reflected solely as price increases in the medical-care component. Thus, by ignoring the indirect effect of rising health insurance premiums on consumer inflation, analysts claim that medical care's contribution to consumer inflation is understated.[14]

Recent data on employee medical-care compensation, however, suggest that the indirect effect of medical-care inflation on overall inflation is modest. From March 1987 to March 1991, for example, average total compensation for workers as measured by the Employment Cost Index (ECI) was $14.37 per hour. Of this amount, $1.29 represented employer-paid medical-care costs, including payments for medical insurance premiums, workmen's compensation, and Medicare.[15] Thus, medical-care costs were just under 9 percent of total compensation.

Despite medical care's small share of total compensation, the rapid increase in medical-care costs relative to other types of employee compensation has measurably raised the overall cost of business. For example, from March 1988 to March 1991, employee medical costs rose an average 9 percent annually, while total compensation costs—wages and salaries plus medical and nonmedical benefits—rose 3.5 percent. If medical costs had grown at the same rate as other employer costs over the same period, total compensation would have grown only 3 percent. Thus, rising medical-care prices added 0.5 percentage point to the inflation rate of employee compensation. If only part of this indirect effect is passed on to consumers in the form of higher prices, the indirect effect will have clearly made achieving price stability more difficult. The amount does not seem large enough, however, to deter policymakers from pursuing price stability as a goal.

## *Conclusion*

Soaring medical-care prices are a concern to policymakers because they could impede further progress against inflation. In recent years medical-care prices have increased nearly twice as fast as the total CPI. But because the medical-care component is such a small share of the total CPI, higher medical-care prices have had only a modest direct effect on total CPI inflation.

Medical-care prices also have an indirect effect on inflation through their effect on business costs. Although this indirect effect is potentially more important than the direct effect, it too seems to be relatively small. Thus, although soaring medical-care prices will clearly make achieving disinflation more difficult, they should not inhibit policymakers from pursuing price stability as a goal.

## *Appendix*

## *Measurement Biases in the CPI*

The CPI potentially measures inflation inaccurately because of problems associated with quality changes and the fixed market basket. Some critics argue that medical-care prices are particularly susceptible to these measurement problems. However, recent studies have found no clear evidence that the medical-care component is any more biased than the total CPI. As long as both indexes are equally biased, the simulation in the text correctly shows the effect of medical-care inflation on the goal of achieving price stability.

### *The quality bias*

Because the BLS attempts to isolate the "pure" price change of a particular good or service, price increases that result from quality improvements should be excluded. To accurately measure price changes, the BLS must measure the same good, with a specific set of characteristics, each month. Quality improvements may often lead to higher prices. But these price increases should not be included in the CPI, because quality improvements essentially create a "new" good. To compare the "same" good over time, price increases caused by improved quality must be factored out.

Sometimes, however, adjusting for quality improvements within the medical-care component has proven difficult. It is hard to measure accurately the quantitative value added to a product by quality improvements. Suppose, for example, that a particular medical treatment has been made less painful to patients but that the improved treatment now costs more. How can the value of less pain be determined? It is difficult to measure changes in the quality of human life caused by better medical treatment. Consequently, some measured price increases in the CPI may actually reflect quality increases, causing the CPI to overstate medical-care inflation (Koretz).[16]

### *The substitution bias*

The CPI may also be overstated because it ignores the *substitution* effects of price changes. When determining inflation, the BLS measures price changes but assumes the quantities of the goods and services in the market basket remain fixed. Yet, assuming that consumers purchase the same amounts of each good or service, regardless of the change in its price, is unrealistic. When a particular good's price increases, consumers often switch to a comparable item that costs less. By neglecting the substitution between items, the CPI overstates the welfare-reducing effects of a particular price increase. For example, a sharp increase in the price of a name brand aspirin may lead consumers to a cheaper generic brand of aspirin. The reduction in quantity of the higher-priced aspirin offsets some of the impact of its higher price. Over the long run, the substitution effect is likely to increase. Consequently, the BLS periodically revises the market basket to reflect changing consumer spending patterns. However, between revisions some observers charge that the CPI is increasingly inaccurate because of these substitution effects (Madigan).[17]

### *Estimates of the total bias*

Despite all that has been written on the difficulties of accurately measuring medical-care inflation, the medical-care component is not likely to be any more upward biased than the total CPI. Some analysts argue that quality improvements in medical care are just as likely to be picked up by BLS field representatives as quality improvements in other goods and services (Rappoport). Moreover, Triplett argues that "existing research ... is insufficient to indicate whether the medical-care components are upward biased." In addition, studies show that the substitution bias within the medical-care component as well as in the overall CPI is negligible (Braithwait).[18]

## *Endnotes*

[1] Neither index includes the spending habits of consumers in the Armed Forces.

[2] The Consumer Expenditure Survey consists of two surveys: the diary survey for routine purchases and the interview survey for major purchases (BLS 1987).

[3] The other goods and services component includes such items as tobacco, cosmetics, college tuition, and legal service fees.

[4] The BLS uses four methods—directly comparable, direct quality adjustment, linking with overlap price, and linking without an overlap price (BLS 1988).

[5] In fact, the hospital rooms' item strata increased faster than any other item strata in the total CPI from 1979 to 1989 (Jackman).

[6] More realistically, if medical-care prices doubled while nonmedical prices remained unchanged, the total CPI would rise and the relative importance of medical care would increase less. Nevertheless, the relative importance would still rise.

[7] In 1987, the market basket was recalculated. As a result, the medical-care component's relative importance was revised down more than 20 percent. Most of the downward revision can be explained by the growth of employer-provided health insurance, which is excluded from the CPI. From the 1972-73 period to 1982, the percentage of full-time employees covered by fully employer-paid health plans rose from 71 percent to 73 percent (Ford and Sturm). This led to a sharp reduction in the relative importance of the health-insurance expenditure class and, consequently, the medical-care component.

[8] The direct effect is related to the relative importance of medical care. Specifically, medical care's relative importance reflects the contribution to total CPI inflation of each percentage increase in medical-care prices. One measure of the direct effect is the difference between CPI inflation including and excluding medical care. For example, the "CPI less medical care" increased 5.17 percent in 1990, while the total CPI increased 5.41 percent. Thus, in 1990 the direct effect of rising medical-care prices was 0.24 percentage point. Another equivalent measure of the direct effect is the difference between medical-care and nonmedical inflation weighted by the previous year's relative importance of medical care. For example, the relative importance of medical care in 1989 was 6.2 percent, while the difference between medical-care and nonmedical inflation in 1990 was 3.9 percentage points. Thus, the direct effect was again 0.24 percentage point (3.9 percentage points times 6.2 percent).

[9] The Federal Reserve has not officially set a target date or path for achieving price stability. The path for overall inflation was arbitrarily chosen to simplify the analysis.

[10] Lebow, Roberts, and Stockton estimated that "zero" inflation corresponds to a 0.5 to 1.5 percent CPI inflation rate.

[11] In contrast, Families USA Foundation projects medical-care inflation to increase at an 8.6 percent annual rate through the year 2000. This projection, however, does not make the explicit assumption made in the simulation that the Fed achieves price stability in five years.

[12] Data in the final column are computed from the assumptions, using two identities relating medical-care inflation to total CPI inflation. First,

$$P_T = r_{-1}P_m + (1 - r_{-1})P_{nm},$$

where $P_T$ represents total CPI inflation, $r_{-1}$ represents the last year's relative importance of medical care, $P_m$ represents inflation in medical care, and $P_{nm}$ represents inflation in the CPI less medical care. And second,

$$r = r_{-1}(P_m + 1)/(P_T + 1).$$

Thus, the first identity gives $P_{nm}$ for period $t$, and the second identity updates the relative importance used in calculating $P_{nm}$ for period $t+1$. The relative importance of medical care in the first year is assumed to be its actual

level in December 1990. For more information on calculating the relative importance, see McKenzie.

[13] Another indirect effect of medical-care inflation on overall inflation arises through government spending on medical care. The U.S. government is a major purchaser of medical care. The government provides health insurance for its employees, as well as providing health insurance for the elderly and disabled. As medical-care prices increase, the government must ultimately increase taxes to help finance its medical-care outlays. To the extent these taxes take the form of excise or sales taxes, they push up the prices paid by consumers for goods and services. These effects are likely to be small, however, compared with the direct effect of higher medical-care inflation and the indirect effect of medical-care inflation on employee compensation costs.

[14] Some critics charge the low weight of hospital services within the medical-care component is largely responsible for understating medical care's contribution to the CPI (Newhouse). Because expenditures for hospital services are mainly paid for by employer- or government-financed insurance, most hospital expenditures are not reflected in the CPI. But prices for hospital services are rising fastest among the five expenditure classes of the medical-care component (Chart 3). Thus, the indirect effect of hospital services inflation on the total CPI is likely to be large.

[15] This is based on BLS estimates that Medicare represents approximately 19 percent of the social security component in the employment cost index.

[16] Although quality is difficult to measure, the BLS is able to factor out some quality changes. For example, the BLS separates quality from price changes in the medical-care component when a price increase results from an already-priced service or good being added to the original service or good. Suppose, for example, a standard visit to a throat specialist cost $50 one month and $65 the next. If a $15 throat culture was added to the standard visit the second month, the $15 "price increase" of the standard visit actually represents a quality change. Consequently, this $15 price increase will not be incorporated in the medical-care component. The BLS is also able to factor out some quality changes when measuring health insurance by using an indirect pricing method (Ford and Sturm).

[17] Because of the problems associated with using a fixed market basket in the CPI, some analysts suggest using the PCE deflator as a measure of medical-care inflation. The PCE deflator does adjust for changes in consumer buying habits. However, the PCE deflator covers only medical-care services, excluding medical-care commodities.

[18] In fact, Braithwait found that the substitution bias in the medical-care component may be negative. This implies that neglecting the substitution effect *understates* medical-care inflation.

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