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# World Agricultural Trade:

## The Potential for Growth *By Marvin R. Duncan and C. Edward Harshbarger*

Efforts to expand world agricultural trade are an important part of the Multilateral Trade Negotiations (MTN) now taking place under the auspices of the General Agreement on Tariffs and Trade (GATT). Expanding world agricultural trade is viewed to be important because of a greater awareness by governments of the need to increase the world food supply. Furthermore, U.S. trade negotiators have insisted that agricultural issues be an integral part of the MTN. Sensing a need for further discussion of the issues involved, the Federal Reserve Bank of Kansas City hosted a symposium on world agricultural trade in May 1978. This article represents the ideas discussed at that symposium.

World food production has been in an increasingly close race with world population over the past few decades. Additional demand pressures have resulted from increasing population, consumer incomes, and expectations. These factors among others have led to increased export demand for U.S. farm products.

In response to the rising world demand for food, much of the increase in U.S. agricultural output since 1970 has been marketed abroad. Presently, U.S. farmers sell in export markets the production from about one-third of their harvested acres. The result has been a growing interdependence between U.S. farmers and the U.S. agribusiness community on one hand and

foreign customers—both private and **government—on** the other.

Thomas F. Eagleton, U.S. Senator from Missouri, summarized the farmers' new reality in these words:

By 1977, the American farmer truly had arrived in the arena of world commerce. . . . Two-thirds of our rice, more than one-half of our wheat and soybeans, one-third of our cotton, and one-fourth of our seed grains were sold overseas. We supplied 64 per cent of the world's feed grain, one-half of the **oilseed**, **40** per cent of the wheat, and one quarter of the world's rice. The sale of agricultural goods grossed our country **\$23.7** billion in 1977. The world depended on us for a reliable source of food, and we depended on the world for a reliable market for our agricultural production.

But all Americans have become more dependent on expanding agricultural export markets in recent years. Agricultural exports have generated many new jobs across the U.S. economy. Howard **Hjort**, director of Economics, Policy Analysis, and Budget at the U.S. Department of Agriculture (**USDA**) said: "It is estimated that for each dollar of

agricultural exports about two dollars of domestic economic activity is generated." Agricultural exports also are currently large enough to offset a large part of the U.S. trade deficit. For fiscal 1978, more than \$26 billion of agricultural exports and an agricultural trade surplus of nearly \$13 billion indicate the importance to the U.S. economy of agricultural export markets. In a very real sense, the United States relies on farm product sales to partly offset its purchases of imported oil.

As population and incomes continue to grow around the world, it is reasonable to expect food demand to increase as well. A high proportion of increasing income in developing countries will likely be spent on food. But answers to the questions of how to increase world agricultural trade and to what extent U.S. farmers might share in that increase are complex. Even more difficult is an accounting of the gains and losses from such trade expansion.

Thus, it is useful to examine the agricultural trade issue in a comprehensive fashion. The symposium addressed this issue from different, but related, perspectives: (1) an international perspective on supply and demand; (2) agricultural trade: the potential and the problems; and (3) linking world food supply and demand.

Clifford **Hardin**, vice chairman of the board, the Ralston Purina Company, opened the symposium with a keynote address, in which he asserted:

It is my belief that the high efficiency of our agriculture, our great productivity, and our body of technology have tremendous potential for improving the lot of mankind, and, properly positioned and intelligently used, for promoting peaceful relations among nations. All this is in addition to

making a strong contribution to the U.S. Balance of Payments, providing a dependable supply of wholesome food for the American consumer, and hopefully, in a manner that will provide improved incomes for those who produce the food. Food can make the difference!

## AN INTERNATIONAL PERSPECTIVE ON SUPPLY AND DEMAND

A serious examination of export potential for U.S. farmers can only be made against the backdrop of world potential to produce food—and of the potential demand that might call forth such increased production. Such an examination tends to support an optimistic conclusion about the capacity of world agriculture to support a growing food demand. That optimism must be tempered, however. A number of bamers stand in the way of full realization of production capacity.

### Food Production Potential

A major way to improve world food output would be to apply "state of the art" technology and more intensive production techniques in developing countries. For example, in the 1934-38 period, grain yields averaged 1.15 tons per hectare in the developed countries and a nearly identical 1.14 tons per hectare in the developing countries. But by the **1973-75** period, yields in developed countries—3.0 tons per hectare—had far outstripped the 1.4 tons per hectare in developing countries. Most of the production increase in developed countries in the last 40 years has occurred with the application of new technology to agriculture—plant breeding, fertilization, chemical herbicides, and pesticides. Agricultural production also has become more intensive, utilizing multiple cropping, intercropping, and im-

proved water management. Increased spending for agricultural research and education has been closely associated with improved productivity in the developed countries. There is little reason developing countries cannot dramatically increase their production as well. Indeed, the geography and climate in some developing countries may be more favorable than in the developed countries.

Substantial opportunity also exists to bring potentially arable land into production and to increase irrigation. It is estimated that only 22 per cent of the arable land in Africa, 11 per cent in South America, and about 45 per cent worldwide is now under cultivation. The 1,406 million hectares now under cultivation could possibly be increased to 3,419 million hectares. Even in the United States, from 150 to 265 million additional acres could perhaps be brought under crop cultivation. The United Nations Food and Agriculture Organization (FAO) has estimated that, over a 10-year span, more than 50 million hectares of new land could be brought into production and an additional 46 million hectares could be renovated and improved at a cost of about \$8 billion per year. It must be conceded that some costs—in terms of environmental deterioration—may be associated with such proposed increases in acreage under cultivation.

Other means for increasing food production include reduction of post-harvest waste and the diversion of grain crops from livestock to direct human use. Ample opportunity exists to reduce waste in almost all developing countries. Of these two, diversion of grain from livestock presents a much more complex alternative; it is not clear that such a move would either accomplish its intended purpose or could be instituted in the near future.

The potential for a sizable increase in world food production by developing countries over the next 30 to 40 years is substantial. Between 1960 and 1975, cereal production in developing

countries increased about 3 per cent per year, comfortably ahead of the 2.5 per cent annual population growth rate. Furthermore, during the 1960-66 period, over 50 per cent of the increased food production came from expanded land area, while in the 1967-75 period about 70 per cent came from yield increases. Moreover, Earl O. Heady, professor at Iowa State University, has asserted that given the heightened level of technology and the larger pool of trained manpower available now compared to 1960, food production performances in the developing countries can be as good or better in the future.

Despite optimism about food production capacity, actual production will likely fall short of the desired levels. The constraints on increased production are mainly policy and capital. Policy is likely the more serious constraint. Substantial investment will be required in agricultural research and education in order to bring "state of the art" technology to farmers. Much of this burden will likely rest on the governments in developing countries. However, farmers will not be quick to adopt these techniques without food price policies that permit them to benefit from increased production. In many countries, this suggests the need for changes in land tenure and food pricing policies. Whether governments in developing countries will—on their own volition—implement policies favoring food development is yet to be seen.

Developed countries, through trade and economic aid policies, can inhibit or hasten agricultural production in developing countries. If developed countries use food aid as a device just to dispose of surplus production, then market incentives to developing country producers will be decreased. If, on the other hand, food and other aid are given in a way that is supportive of increased indigenous production, such aid can be helpful. Developing countries will need substantial

capital investment from both private and public sources, often on generous terms, to overcome problems in increasing agricultural production. Policies that encourage freer international trade flows also would be conducive to increased food production.

### **Growth of Demand for Food**

Population growth rates must be contained if world food supplies are to be adequate. Earl O. Heady, in a paper outlining world food production alternatives and constraints, commented:

The world is not necessarily faced with calamity in the short run, but this is only true if the politicians and administrators of selected developing countries enact agricultural, development, and trade policies which hurry and guarantee adequate food supplies. Over the longer run, however, praise or blame for these same politicians and administrators will rest on their actions in initiating and implementing appropriate population policies. Whether the citizens of their countries live in misery at food subsistence levels in a half century will depend on the actions they take in **the** next two decades. Leaders of developed countries can provide encouragement through technical and financial assistances, but success or failure depends mainly on the leaders and citizenry of developing countries.

World population growth—including growth in the developing countries—is fairly predictable, especially over a decade or so. Thus, the

probable food demand related to population is also predictable for given dietary levels.

The growth in demand that is related to income growth, however, is dependent on development policy. John Mellor, director of the International Food Policy Research Institute, noted in a paper:

Accelerated economic growth in Third World countries holds potential for immense growth in their agricultural imports. Perhaps surprisingly, policies which stimulate development of the domestic agricultural sectors of these countries are likely to provide the most rapid growth in their agricultural imports. This results from the close interrelation of employment growth, demand for food, and the supply of agricultural commodities. How quickly and to what extent their import potential develops will be substantially influenced by international policies with respect to **trade**, general development assistance, food aid, and food security.

Demand and supply for agricultural products typically grow at roughly the same pace during the early stages of a country's development. This situation has characterized most Third World countries since World War **II**. In more mature stages of **development**—after most dietary and food quality needs have been met—the supply of agricultural products typically grows at a rate substantially greater than demand. But, in the middle phases of development—before most dietary and food quality levels have been met—increases in income translate into large increases in demand for food. Such demand usually exceeds the

domestic food supply and spills over into rapidly growing import demand.

As a country approaches the middle income phases of development, three factors cause food demand to outrun the domestic supply. Rapid increases in per capita income, along with a high—although declining—income elasticity of demand for food, cause a **runup** in domestic food prices and substantial import demand. Population growth rates accelerate or remain high because better nutrition and medical care reduce infant mortality and lower death rates without affecting birth rates in the short run. Finally—and most important—the demand for food is increasingly determined by events outside of agriculture. Increased manufacturing frequently provides greater foreign exchange earnings that can support even more imported food purchases.

Many developing countries—representing a large share of world population—are about to enter this high food-import phase of development. Taiwan, South Korea, and some of the newly wealthy oil-producing states are examples. Thus, the world appears to be on the verge of a lengthy—but finite—period of high food-import demand.

An increase in import demand will be first evidenced in greatly increased purchases of food grains. Later, as major nutritional deficits are met, developing world consumers will begin to climb the food ladder. Their domestic livestock production will increase and import demand will shift to feed grains and oil seed crops. Still later, import demand will increase for meat products and high-quality fruit and vegetable crops.

The timing of this burst of import demand for food is dependent upon the economic growth strategy pursued by developing countries. Economic growth that restricts income gains to relatively high-income families will result in slow growth in food demand. Similarly, growth that emphasizes heavy

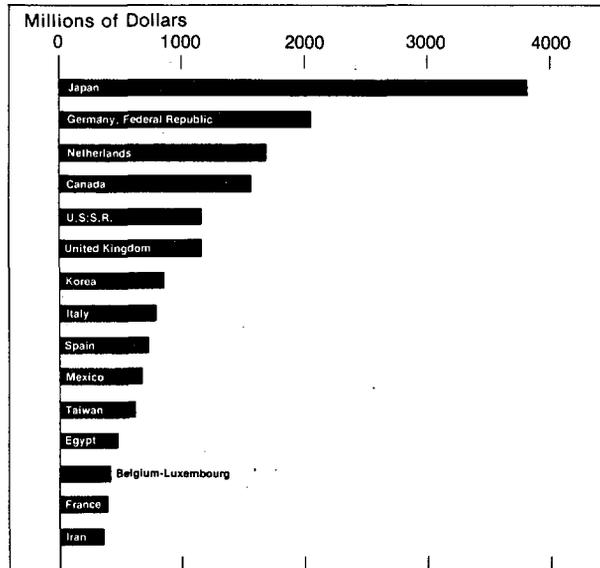
industry over agriculture is very capital-intensive, suppresses foreign trade growth, and will also delay the arrival of rapidly growing food import demand. Russia is an example of such a growth strategy. Nonetheless, at some delayed point, the import demand will become apparent. Conversely, a high-employment growth strategy that emphasizes rapid development of the rural sector, agriculture, and foreign trade will likely hasten the arrival of high food import demand.

It is apparent, then, that the greater the degree of high-employment development, the earlier the developing countries will demand—and can afford—food imports. Increased investment in agriculture and the rural economy is the cornerstone of such high-employment development. Unfortunately, such investment may not pay off immediately. Consequently, governments with only short-term planning horizons may abandon this approach. Many of the risks associated with this approach can be limited, however, by a well-organized world food-security system and the ready availability of food aid to back up a high-employment development program until indigenous agricultural development begins to pay off. Thus, the U.S. Government may be acting in the best long-term interests of its farmers when it engages in food aid and holds a food reserve for emergency aid.

## **AGRICULTURAL TRADE: THE POTENTIAL AND THE PROBLEMS**

U.S. agricultural exports have grown rapidly over the past two decades—by about **600** per cent in nominal terms, with almost half that increase occurring since **1966-70**. Over the same two decades, the U.S. share of world agricultural exports has increased from just over **12** per cent to about **16.5** per cent. While U.S. domestic consumption of agricultural products increased at an annual rate of about

**Chart 1**  
**FIFTEEN TOP MARKETS FOR U.S. AGRICULTURAL EXPORTS, 1977**



4.5 per cent, export demand grew at a 9 per cent rate.

### Market Potential

The developed countries are major U.S. markets (Chart 1). Japan—with \$4 billion worth of U.S. farm exports last year—is by far the single most important customer. Sales to Japan have increased at about a 15 per cent annual rate for the past 15 years. West Germany is the second most important market, with annual imports about half as large as Japan's. However, when sales to all European Economic Community (EEC) countries are combined, the EEC is by far the largest U.S. market, with purchases of \$7.1 billion.

The centrally planned countries of the world are becoming important markets as well. In 1977, these countries purchased 7 per cent of all U.S. agricultural exports, but 17 per cent of

the wheat exports and 12 per cent of the feed grain exports. In recent years, they have also accounted for much of the variability in U.S. exports. Long-range efforts to increase the quality of diets in these countries suggest they will become even more important customers for U.S. farm products.

Developing countries are growing markets and—with the exception of Egypt—are nearly all cash markets. South Korea and Taiwan—the fastest growing Asian markets—developed from concessional Public Law 480 (P.L. 480) markets to cash markets within the last two decades. In recent years, oil exporting countries have become rapidly expanding markets for U.S. farmers as well. From \$440 million in 1972, agricultural exports to OPEC countries grew to \$1.7 billion in 1977. In 1977, the developing countries bought 31 per cent of our agricultural exports. But they accounted for 58 per cent of our wheat sales and 74 per cent of our rice sales.

While it is impossible to predict the future, some market trends are apparent. The impact of population and income growth will be substantial, as noted previously. Indeed, as that growth occurs in some of the developing countries, the demand for food imports will likely be explosive. Furthermore, it seems evident that political decisions to increase dietary quality, especially in the centrally planned countries, can result in marked increases in U.S. agricultural exports.

Different farm products will face different market demand. Developed countries and most of the centrally planned countries will likely increase their imports of feed grains, oil seed crops, fruits, vegetables, and high-quality meat products as they attempt to upgrade dietary quality for their citizens. China and the other developing countries may be more concerned about meeting adequate dietary standards, at least in the near future. Thus, for a **time**—perhaps a decade or more—demand for food gains will likely increase substantially. But eventually these countries will also begin to upgrade diet quality. Growth in import demand then will shift toward feed grains and oil seed crops. Greatly increased demand for food grains is, therefore, a transitory phenomenon that will be replaced in the future by increased demand for agricultural imports associated with higher dietary quality.

While the important U.S. export markets of the future are in centrally planned countries and the developing countries, serious competition for these export markets can be expected. Howard **Hjort**, remarking on market development, reminded the symposium audience that:

The Foreign Market Promotion Program is aimed at (1) maintaining and/or expanding demand for U.S. products in established markets, (2) developing demand for products—

particularly U.S. commodities—in emerging markets, and (3) introducing new U.S. products into both established and emerging markets. Promotional activities are designed to supplement other factors such as price, quality, supply availability, and financing to give the U.S. product a competitive edge.

Future promotion programs will have to blend demand stimulants, credit incentives, quality controls, and technology transfers into a well coordinated export strategy if the U.S. international competitive advantage is to be exploited to the fullest.

## Constraints on Trade Growth

Despite well-founded optimism about potential demand, several things could happen to temper the realization of that potential. Slower economic growth among U.S. trading partners would slow the growth of export demand. Political decisions related to development strategy can postpone or diminish expected levels of demand. As discussed earlier, it is in the self interest of the United States to implement—preferably in cooperation with other developed countries—the kinds of programs that will encourage developing countries to choose high employment development strategies.

U.S. foreign and economic policy must be conducive to increasing trade as well. Withholding "most-favored nation status"<sup>1</sup> from most of the centrally planned countries may

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<sup>1</sup> In practice, extending MFN status amounts to nondiscriminatory treatment in trade.

discourage trade growth with those countries. Also limiting trade growth is legislation such as the Jackson-Vanik Amendment to the Trade Act of 1974—which denies export credit to centrally planned countries having discriminatory immigration policies—and requirements that certain proportions of some exports must move **in** U.S. ships. Quite apart from the legitimate questions that can be raised about whether these pieces of legislation accomplish their intended purpose, it seems unfair to burden U.S. farmers with their trade constraining impact.

U.S. policymakers also must assure trading partners that this country is a stable and reliable source of supply. Export embargoes of certain products or to certain countries are clearly not consistent with this assurance. Part of the price to U.S. producers for this assurance may be the need to maintain some minimum level of food reserves in farmer or government ownership.

The United States and many of its trading partners are nearing completion of the **MTN—expected** by many observers to be the last large, multicountry negotiations under GATT auspices during this century. Not surprisingly, agricultural trade barriers have proved to be a real sticking point in the negotiations. Food issues are enormously difficult to resolve since the issues are fundamental to the economic health, social progress, and security of each nation. The principal protagonists are the United States, Japan, and the EEC. Each country is attempting to protect domestic producers—especially with nontariff barriers such as health and labeling requirements, quotas, export subsidies, and variable levies—while pressing for reduction of such barriers in other countries.

Ambassador Alan Wm. Wolff, U.S. Deputy Special Representative for Trade Negotiations, presented the basic concepts underlying the

U.S. negotiating effort at Geneva for agricultural trade.

The U.S. view in this round has been that, despite their intractability, the problems of agricultural trade must be addressed and the efforts of solutions made an essential part of the broader trading system. This belief is built on several basic concepts.

We believe that international cooperation in agricultural trade can enhance the ability of individual countries to improve the welfare of their farmers and consumers;

We further believe that international cooperation can lead to a continued expansion of international trade in agriculture;

Finally, we believe that international cooperation can lead to national policies and programs that promote improved patterns of agricultural production and a more equitable sharing of the burden of adjustment during periods of oversupply or scarcity.

I am optimistic that the MTN can produce a comprehensive set of new agreements which, in the process of reducing trade barriers and strengthening the GATT framework, will encourage fuller integration of world agriculture into the trading system.

Wolff further urged formation of a continuing forum for discussion within the GATT framework after the conclusion of the MTN. Such a

forum could assist trading partners in identifying and resolving the remaining trade barriers as well as future areas of misunderstanding. This could be particularly useful since a number of the major agricultural trading nations have trade barriers that they are not presently prepared to modify. Examples of these are the EEC variable levies and the U.S. protection of its dairy industry.

The ECC position in the MTN was given in a paper prepared by Vice President Finn Gundelach of the EEC and presented by Herman **deLange**, first secretary of the Delegation of the Commission of the European Communities to the United States:

We see that the United States wants to increase its total exports to offset **its oil** deficit and we see that this will apply to agriculture. We are sympathetic. At the same time, you must recognize our position.

- We are making a major contribution to bringing world markets into balance by controlling our own production. This will steady prices and increase everyone's export earnings.

- We are resisting calls from our farmers for greater protection on a variety of products.

- We are developing our internal markets but we too want to see export markets opened up. We have special interest in the dairy sector.

- We want erratic price fluctuations ironed out because they damage our open farm **economy**—adversely affecting farmers and disturbing our internal policy.

World trade can be developed but this must be done in a way that spreads the benefits. That way, trade unites nations. In any other way it is divisive, it has a potential for good or for ill. We can turn trade into an economic battleground. Or we can cooperate and respect each other's interests. We in the European Community choose the latter.

It is not difficult to find common ground in the positions of the United States and the Common Market. It is equally easy to note areas of sharp disagreement. Two areas are particularly evident. The United States would like to see reductions in export subsidies and no extension of variable levy barriers to oil seed crops. The Europeans, on the other hand, view the levy system as a cornerstone to their common agricultural policy and that levy system generates funding for export subsidies.

Europeans are alarmed at the one-sided nature of **U.S.-EEC** agricultural trade and do not want their farm deficit with the United States to grow. Their farmers would like to have the U.S. market opened up to EEC dairy and processed meat products. This is a very sensitive issue with U.S. farmers. U.S. policymakers contend the Common Market countries have exported agricultural price instability—and hence, problems of adjustment to other countries' farmers—as a result of a highly protected EEC farm economy. Europeans respond that such protection is essential to smooth the transition of European agriculture from a subsistence structure to a modern commercial structure while, at the same time, removing trade restrictions among the nine member countries. Furthermore, they assert that their pricing policies are moving in the direction of correcting market imbalances such as dairy product surpluses. Nonetheless,

Tim Josling, professor in the **Food** Research Institute at Stanford University, remarked:

U.S. agriculture is in large part oriented towards world markets, whilst European agriculture has enjoyed a high degree of isolation from these same market forces. . . . Whilst U.S. farmers are made aware of the swings and roundabouts of the international grain trade, EC farmers know that there is an open-ended option of selling grain into **intervention**, at prices which would seem very attractive to producers in the United States, to be disposed of on world markets by means of equally open-ended export subsidies.

It seems apparent that agricultural trade is on the verge of significant and continued growth. Furthermore, the extent to which U.S. farmers cash in on this growing market will depend, in large measure, on the mix of foreign and domestic policies the United States adopts. A number of important policy questions remain unanswered, however. They are parts of a larger question: What are the gains and losses that fall to the United States as a result of increased trade? In addressing this issue, Jimmie **Hillman**, professor at the University of Arizona, posed a number of knotty questions to the symposium:

Is a continued growth of trade good for all farmers, all sections of the economy, and the U.S. society in general? What might be the economic limits of U.S. **exports—**

and imports? Or should there be limits? Must agriculture "bear the cross" continually for U.S. trade imbalances? Is there an optimum level and mix of farm exports which are superior to all other levels and mixes for national security, for income and employment, and for the general welfare?

As answers are found to these questions, the probable dimensions of future U.S. agricultural exports will become more apparent.

### **LINKING WORLD FOOD SUPPLY AND DEMAND**

The world food situation poses a curious paradox. The statistics on **world** production levels show quite clearly that aggregate food stocks are large enough to prevent widespread hunger and malnutrition. Yet, a majority of the world's population suffers from these maladies. Although humanitarians would argue that food should be transferred from surplus producing regions to areas where supplies are inadequate, the solution to the world food problem is not that simple. A shortage of food is basically a manifestation of poverty. Therefore, income levels in many parts of the world must be increased before the world food problem can be solved.

While some progress in raising income levels is being made, the unfortunate fact remains that the task of developing resources and improving incomes in Third World countries is painstakingly slow. Therefore, alternative means for linking world food supplies with potential demand should be given careful consideration. Two approaches to establishing this link are frequently advocated: expanded food-aid programs and special financing arrangements.

## Charitable Programs: Are They Effective?

The United States has a well-established record of food-aid programs. Since 1954, when P.L. 480 was enacted, the Food-for-Peace Program has moved \$25 billion worth of farm products to hungry people in foreign lands. Not all of this food was given away; most of it was sold on a concessional basis in which the recipient countries were extended liberal credit terms. On the basis of this history, it should be possible to draw some conclusions about the effectiveness of food-aid programs in promoting economic development.

Several objectives can guide a food-aid program. When P.L. 480 was first drafted, U.S. motives were quite specific—to dispose of farm products that were a burden to the domestic economy and to increase exports. Subsequent amendments broadened the objectives to include foreign policy issues and the improvement of nutritional levels of people in low-income countries. In the final analysis, though, self interest has usually served as the foundation for U.S. food-assistance programs, while humanitarian considerations were clearly secondary.

Another way of looking at charitable programs is from the viewpoint of the recipient country. According to D. Gale Johnson, professor at the University of Chicago, humanitarian efforts will make a positive contribution to the economic improvement of the world's poorest people only if:

1. It meets directly . . . a quite specific human or social need, such as the food needs of children and mothers, or . . . a clean water supply . . .
2. It increases the degree of security of food supply in a way that does

not have significant disincentive effects upon local producers.

3. It results in an increase in the productive capacities and incomes of poor people . . .

Although most assistance programs can easily be rationalized in terms of the **first** objective, it is not at all clear how the last two objectives can be satisfied with a greatly expanded food-aid program. Unless it can be shown that recipient countries will realize a substantial benefit, humanitarian efforts can have only a limited role in improving the nutrition of the world's poorer people and in increasing U.S. agricultural exports. Johnson, in describing the difficulty of being a good and effective donor, suggests that humanitarian efforts can still serve useful purposes, but

. . . that giving must be modest, well defined in its objectives, and primarily for the benefit of the recipient rather than a seemingly simple solution for one or more of the donor's problems.

In discussing Johnson's paper, Don Paarlberg, professor emeritus at Purdue University, made the following observations:

There are such limits on giving and receiving as to rule out humanitarianism as a way of solving the world's food problem. . . . The relationship between the volume of giving and the benefit that ensues is in the form of a curve, not a straight line. At too low a level, the opportunity to help is foregone. At too high a level, dependency is created and disincentives occur. At some mid-level net good results.

While there are limits to charitable efforts, food aid can make a substantial contribution to food security by minimizing the adverse effects of occasional production shortfalls in developing countries. In fact, Johnson argues that it is now possible to prevent nearly all deaths and most of the hardships associated with production shortfalls by instituting a grain insurance program.

Johnson's grain insurance program calls for the United States, either alone or in cooperation with other exporting countries, to guarantee to each developing country that any shortfall in their annual grain production that dips more than a given percentage below **trend—6** per cent, for example--would be supplied by the donor countries. Moreover, if the developing countries were willing to adopt modest storage **programs** of their own, year-to-year variability in grain supplies could be held to within 3 or 4 per cent of trend production. Thus, assuming stable growth in demand, a substantial degree of price stability could be achieved at a relatively low cost for both the donor nations and the **developing** countries alike. Although the plan has considerable merit, several potential problems also exist. For example, to work successfully, the insurance agency must have access to accurate production data. In addition, the governments of developing countries would have to cooperate with the donor nations by providing early warnings about possible crop failures.

Johnson's proposal, while novel, is not designed to expand per capita production and consumption levels in the developing countries. Neither his proposal nor any other form of food aid can accomplish that objective. But the insurance plan does offer some hope for eliminating or at least greatly reducing the specter of hunger and starvation in many parts of the world. In a final comment, however, Johnson noted that, as intriguing as the

insurance plan is as a means of achieving world food security, it is quite inferior to a liberalization of trade in agricultural products. Freer trade would tend to increase per capita incomes, which is the most reliable way of reducing food insufficiency among poor people.

### Promoting Trade with Credit

Just as credit propels the American economy by making it possible for consumers and investors to buy goods and build new facilities, the expansion of international trade depends increasingly on the availability of loanable funds. Since 1973, total world trade has increased about 50 per cent and now amounts to about \$2 trillion **annually—exports** and imports combined. Because both the importing and the exporting of a product are frequently financed, much of the growth in world trade would not have occurred without credit.

Since credit plays such an important role in promoting international trade, future developments on this front will likely depend on the willingness and the ability of financial institutions to continue providing funds. The prospects are good that adequate credit will be available to finance future trade transactions. Tilford Gaines, senior vice president and economist at Manufacturers Hanover Trust Company, observed that there is no real shortage of credit now, nor should there be in the future, provided that the commodity or project being financed has solid economic merit and the recipient country is creditworthy.

In recent years, the terms of credit have been liberalized to permit longer repayment periods, among other things. This practice not only enhances the competitive position of an exporting country, but it also eases the balance-of-payments problem in a recipient country. In terms of acceptable credit procedures, however, Benjamin Jaffray, vice president and treasurer of **Cargill, Inc.**,

questioned the wisdom of providing commercial credit to finance a commodity much beyond the time when the commodity is **consumed**—especially in a developing country where credit-worthiness is often deficient.

Given the obvious difficulties for some of the developing countries in satisfying various tests for credit, Jaffray contends that the financing of agricultural exports will likely involve an increase in special governmental programs. Both the United States and its chief competitors have instituted credit programs to facilitate trade, ranging from short-term loans at market rates of interest to concessional credit or outright grants. Presently, the United States uses two programs to provide export credit—the **GMS-5** program under the Commodity Credit Corporation, which makes loans to recipient countries for up to three years, and the more familiar program associated with Title I of P.L. 480.

Over the years, various changes have been made in these programs to provide more flexibility with respect to interest rates and repayment procedures. Moreover, there is every reason to believe that additional changes will be made in the future to help ease balance-of-payments problems in the recipient countries, as well as to finance development projects that will enhance nutritional levels. As Jaffray indicated, one of the principal arguments for government-supported trade credit is not so much to compete with other exporting countries but to encourage growth in the overall demand base, from which all participants will benefit.

Clarence D. **Palmby**, vice president of Continental Grain Co., suggested that political considerations will have an important bearing on future trade levels. For example, in many developing countries, the politics of food is so important that almost anything will be done to avoid the possibility of widespread hunger. Similarly, a decision by a centrally planned

economy—such as Russia—to upgrade diets can result in sharply higher import requirements. Thus, political-economic decisions do and will continue to influence international trade, as well as the manner in which that trade is financed. In this connection, any government credit program that allows a recipient country to more easily finance food imports is likely to be well received.

However, credit programs should be properly designed so that their intended purposes are served. Harold **Bjarnason**, senior economist at the Canadian Wheat Board, noted that financing international trade can be predicated on several motives. If the financing makes it possible for a food-deficit nation to import food, the program is serving a useful purpose. However, if the financing simply represents an attempt to gain a competitive advantage on other exporters, who really benefits? **Bjarnason** contends that a credit program which provides financing solely for the purpose of acquiring a competitive advantage results in nothing more than a transfer of income from farmers in the exporting nations to governments or buyers in the importing countries. In other words, the extra credit is tantamount to a subsidy for the foreign buyer. Thus, careful thought should be given to tailoring government credit programs so that they meet the real financial needs of the individual food-deficit nations. However, an international credit program, if properly structured, can provide a vital link between the productive capacity of U.S. agriculture and the demand for food in foreign lands.

## CONCLUSION

Expanding international trade offers great promise for reducing hunger and malnutrition in many parts of the world. Although people have been grappling with hunger since the beginning of time, the problem is not

attributable to a lack of resources or technology. Adequate food supplies can be produced to meet the nutritional needs of the world's population with today's resources and know-how. The world food problem is best described in terms of inadequate public policies to encourage increased food production and of inadequate incomes that limit effective demand. Solving these problems requires policies that will both promote economic development in the Third World and increase per capita income levels. Policies based on an expansion of international trade will likely enhance the development process, thereby benefiting not only the developing countries but the exporting nations as well.

While an expansion of trade is readily justified on theoretical grounds, progress in the real world is likely to proceed slowly. Given the realities of world politics, government involvement will increasingly emerge as a market factor in the future. Some of this involvement may produce positive results if credit programs and other assistance efforts are designed to meet the specific needs of recipient countries. However, world trade is presently hampered by various barriers, and these restrictions will likely continue to impede the full realization of U.S. trade potential, notwithstanding the current round of negotiations.

Clayton **Yeutter**, president of the Chicago Mercantile Exchange, pointed out that worldwide supply and demand will be in equilibrium on relatively few occasions in the years to come. Either supplies will be outrunning demand, or, more likely, demand will exceed available supplies. **Yeutter** offered a number of policy suggestions on how a better balance between supply and demand might be achieved in both the short run and the long run. While his proposals were quite specific (grain reserves, aid programs, income protection, production incentives, etc.), **it** was clear that **Yeutter** viewed international trade as the primary vehicle for linking available supplies and effective demand around the world.

On balance, ample potential exists to increase U.S. agricultural exports. However, building new markets and expanding old ones require long-term commitments by the U.S. Government, marketing firms, and producers. Export markets will not readily expand or contract to accommodate occasional changes in government policy or U.S. production levels. Instead, export markets will respond to income growth in the purchasing country, consistent market development efforts, and to reliable supplies of quality products that are reasonably priced.

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# Interest Rate Variability, The Level of Interest Rates, and Monetary Policy

By V. Vance Roley

Interest rates have fluctuated substantially in recent years. Some financial market observers have expressed concern that the variability of interest rates may have some detrimental effects. In particular, increased variability may cause investors to be more uncertain about their assessments of future yields and prices of securities. The increased uncertainty may result in higher risk premiums in the levels of long-term interest rates. Thus, interest rate variability may cause higher average levels of interest rates than would otherwise be the case. Furthermore, to the extent that interest rates affect the performance of the economy, the higher interest rates may reduce economic growth.

The question of whether the variability of interest rates affects their average levels has implications for the conduct of monetary policy. Alternative approaches used to conduct monetary policy may have different impacts on interest rate variability. Using a reserve aggregate approach to monetary control—as has been suggested by a number of observers—may lead to greater interest rate variability than the approach now being employed, which uses short-term interest rates to influence money stock growth. Thus, the Federal Reserve's choice of the monetary policy instrument may influence the variability of interest rates.

The first section of this article examines the relationship between the variability and average levels of interest rates. The historical variability of interest rates is reviewed, and empirical tests are performed to determine whether the average levels of rates are affected by their variability. The second section explores the possible links between the conduct of monetary policy and the variability of interest rates. Further empirical tests are reported to determine the degree of Federal Reserve influence on interest rate variability. The final section summarizes the main conclusions.

## THE RELATIONSHIP BETWEEN THE VARIABILITY AND AVERAGE LEVELS OF INTEREST RATES

### The Concept of Variability

The distinction between the level and the variability of an interest rate or yield may be important to investors. Specifically, investors may be concerned with both the average level and the variability of a security's **yield**—defined in this article to include the capital gain or loss on a security in addition to the security's coupon, dividend, or discount yield. A yield defined in this manner is referred to as a holding-period yield. It may be computed over any interval or holding period that investors

may use when evaluating the rate of return on their investments.

A holding-period yield, therefore, reflects the rate of return on a security during a holding period of a specific length. In this article, the holding period is assumed to be one calendar quarter. The variability of a security's holding-period yield refers to the fluctuation of the yield around its average level. A common statistic that represents this characteristic is the variance, which is computed by averaging the squared differences of a security's holding-period yield from its average holding-period yield over a particular period.<sup>1</sup>

### The Variability of Security Yields Since 1950

The variability of selected security yields during the period beginning in the first quarter of 1950 and ending in the fourth quarter of 1977 is illustrated in Chart 1. The measure chosen to represent the variability of a security's yield is the variance of the security's quarterly holding-period yield<sup>2</sup> evaluated over the current and past seven quarters. For the fourth quarter of 1977, for example, the variance of the Treasury bond yield is computed using values of the security's quarterly holding-period yield from the first quarter of 1976 to the fourth quarter of 1977. During this period the **quarterly** holding-period

<sup>1</sup> For example, the eight-period variance of a variable X in period t is defined as:

$$\text{variance}(t) = \sum_{i=0}^7 (1/7) (X(t-i) - \bar{X}(t))^2,$$

where  $X(t)$  is the value of variable X in period t, and  $\bar{X}(t)$  is the mean of the variable X over the current and past seven periods—that is,

$$\bar{X}(t) = \sum_{i=0}^7 (1/8) X(t-i).$$

For a further discussion of these statistics, see any elementary mathematical statistics textbook.

yield on Treasury bonds averaged 8.26 per cent; however, it fluctuated considerably, varying from a high of 24.86 per cent to a low of -19.24 per cent. The computed variance was 199.04 for the fourth quarter of 1977.

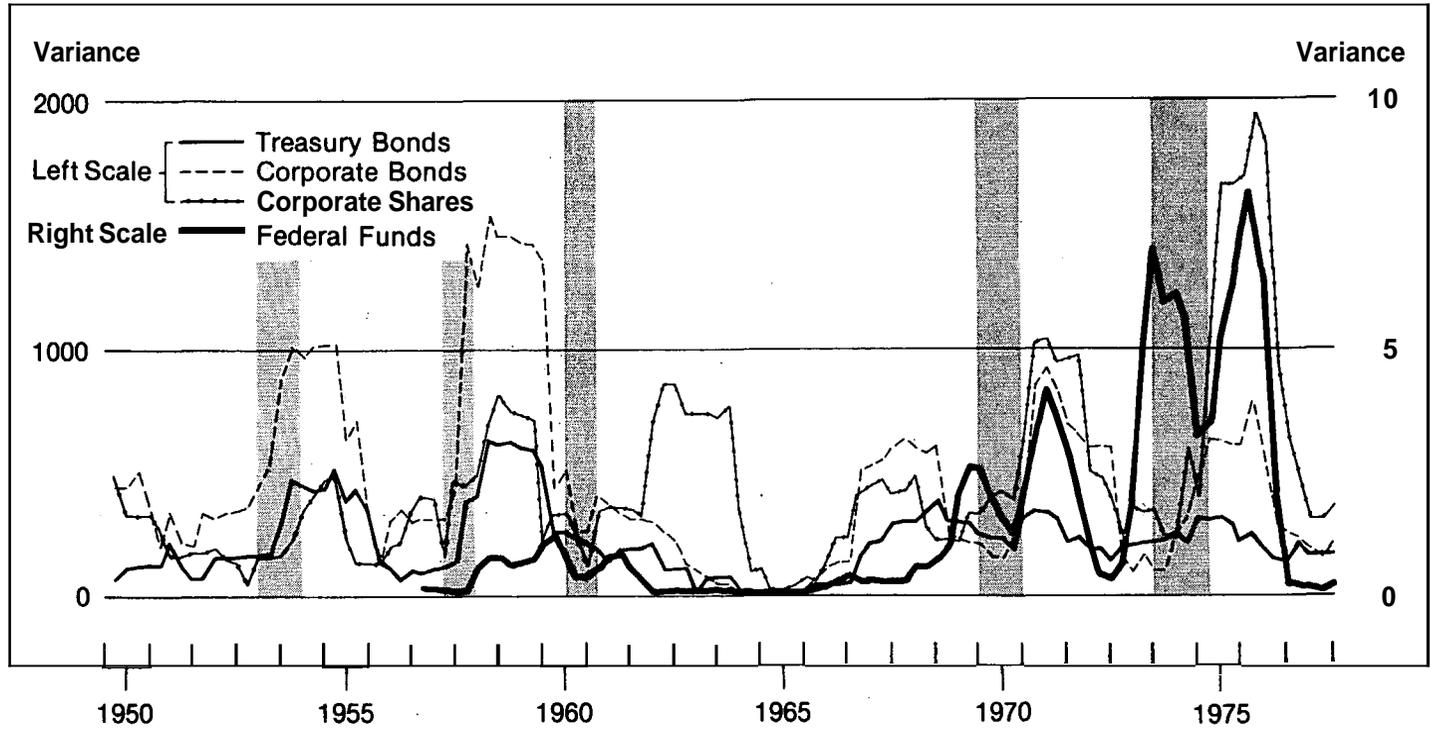
The left-hand scale of Chart 1 measures the variability of quarterly holding-period yields on three long-term securities—Treasury bonds, corporate bonds, and corporate shares.<sup>3</sup> Long-term yields are emphasized in this article because most economists would agree that long-term yields have a more direct impact on the economy—through the cost of capital for private nonfinancial investment—than do short-term yields. The variability of these three long-term yields reflects factors which determine the variability of the demand for and/or supply of securities. Accordingly, in the initial phases of four of the five economic recoveries from recessions during the period examined in Chart 1,<sup>4</sup> the variability of security yields increased, reflecting cyclical variability in security demand and supply conditions. The recent substantial variability in corporate share yields may be due to such

<sup>2</sup> Again, the quarterly holding-period yield of a security is defined as the asset's coupon, dividend, or discount yield plus any capital gain or loss on the asset, where the capital gain or loss is defined as the annualized percentage change of the price of a security during the given quarter. For debt securities, an approximation was used to compute the capital gain or loss component of the holding-period yield. The approximation is based on the assumption that long-term securities may be treated as consols—securities with infinite maturities and fixed coupons—so that the price of the security in period t ( $P_t$ ) equals the reciprocal of its yield to maturity ( $r_t$ ). It follows that a security's capital gain or loss may be represented as  $(P_t - P_{t-1})/P_{t-1} = (r_{t-1} - r_t)/r_t$ .

<sup>3</sup> The holding-period yield on corporate shares is defined as the annualized percentage change of Standard and Poor's composite common stock price index. This measure is exhibited in Chart 1 since it is used in the empirical models reported below in the text.

<sup>4</sup> The four economic recession periods correspond to the National Bureau of Economic Research reference troughs of 1954:Q2, 1958:Q2, 1970:Q4, and 1975:Q1.

Chart 1  
THE VARIABILITY OF SECURITY YIELDS SINCE 1950



factors as the changing outlook for the economy and varying prospects for a national energy policy, the **U.S.** balance of payments, and potential tax reforms. Other factors, such as variable rates of inflation and Federal Reserve monetary policy, may have also contributed to the variability of all long-term yields.

### **The Relationship Between the Variability and Average Levels of Interest Rates: Theoretical Considerations**

Interest rate variability may influence average interest rate levels because investors may feel that increased variability increases uncertainty about future holding-period yields. The impact of uncertainty on the portfolio selection behavior of investors has been formalized in the economics literature beginning in the **1950's**.<sup>5</sup> In the literature, it is usually assumed that investors not only assess the future holding-period yields on securities, but also consider the degree to which actual future holding-period yields may vary from their expected levels. As defined previously, this variation is measured by the variances of the future holding-period yields on securities.

Many versions of portfolio selection theory also suggest that investors demand less of a particular security if its future holding-period yield becomes more uncertain (variance increases), and demand more if its future holding-period yield becomes less uncertain (variance decreases). Furthermore, an increase in the variance of the future holding-period yield on corporate bonds, for **example**, may increase the demand for Treasury bonds if the

variance of the future holding-period yield on Treasury bonds remains unchanged. This follows because there would be more uncertainty about the future holding-period yield on corporate bonds relative to the future holding-period yield on Treasury bonds. Thus, the investor would desire a larger share of his investment portfolio to consist of Treasury bonds, assuming that all yields remain unchanged.

### **The Relationship Between the Variability and Average Levels of Interest Rates: Empirical Evidence**

To examine the relationship between the variability and average levels of interest rates, two separate models of Treasury bond yield determination were employed. Two models were used to demonstrate that the results are not unique to a particular model. Because Treasury bonds are long-term securities, the models examine the impact of interest rate variability on long-term security yields. In doing so, the models examine a number of the possible determinants of the Treasury bond yield in order to ascertain whether interest rate variability is one of the determinants. After a brief discussion of the methodologies employed in forming the models, estimates of the impact of the variances of long-term security yields on the level of the Treasury bond yield are presented.

**Two Models of Treasury Bond Yield Determination.** The two models of interest rate determination that are estimated are based on the portfolio selection theory reviewed earlier. This theory suggests that an investor's demand for a particular type of security varies positively with its expected rate of return, negatively with the rates of return on other securities, negatively with the variance of its future rate of return, and positively with the variance of the

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<sup>5</sup> See Harry Markowitz, "Portfolio Selection," *Journal of Finance*, Vol. 7 (March 1952), pp. 77-91; and James Tobin, "Liquidity Preference as Behavior Toward Risk," *Review of Economic Studies*, Vol. 25 (February 1958), pp. 65-86.

future rates of return on other securities<sup>6</sup> Additional factors, such as investors' wealth and the level and/or variance of inflation,' may also affect the demand for a security.

While the two models used in the empirical tests are based on the same theory, they differ in important ways. In particular, one model is a disaggregated structural model, and the other is a reduced-form model.<sup>8</sup> The disaggregated structural model separately represents the demands for securities by individual categories of investors. These investors include: commercial banks, households, life insurance companies, mutual savings banks, nonfinancial corporate businesses, other insurance com-

panies, private pension funds, savings and loan associations, state and local government general funds, and state and local government retirement funds. A typical estimated equation within the structural model represents the demand for a type of security by including terms for expected holding-period yields, variances of future yields, and other factors—such as wealth and portfolio adjustment parameters—that may differ across categories of investors. The aggregate demand for a type of security is the total of the individual demands for the security. By equating aggregate demand with aggregate supply, the holding-period yield of the security is determined.

In contrast to the disaggregated structural model, the reduced-form model does not distinguish among different categories of investors. The derivation of the reduced-form model begins by considering the aggregate demand for a particular type of security. Before estimating the model, aggregate demand is equated with aggregate supply to form an equation for the expected holding-period yield on the security.<sup>9</sup> Thus, instead of equations

<sup>6</sup> To empirically represent investors' assessments of the levels and variability of future security rates of return, it is additionally assumed that investors have relatively short portfolio holding periods so that capital uncertainty is predominant. With a quarterly holding period, for example, the holding-period yield on a 3-month Treasury bill is riskless in nominal terms, and the holding-period yields on securities with longer maturities are risky because of the uncertain future values of the capital gain or loss components. The theory of portfolio selection under uncertainty also suggests that the covariances of future rates of return on securities' are determinants of an investor's portfolio selection behavior. Covariances are not, however, treated explicitly in this article.

<sup>7</sup> The level of inflation may represent an investor's return on real (as opposed to financial) assets, or represent a component of an investor's expectation formation process concerning nominal security yields. See, for example, Martin Feldstein and Otto Eckstein, "The Fundamental Determinants of the Interest Rate," *Review of Economics and Statistics*, Vol. 52 (November 1970), pp. 363-75; Martin Feldstein and Gary Chamberlain, "Multimarket Expectations and the Rate of Interest," *Journal of Money, Credit and Banking*, Vol. 5 (November 1973), pp. 873-902; Franco Modigliani and Robert J. Shiller, "Inflation, Rational Expectations, and the Term Structure of Interest Rates," *Economica*, Vol. 40 (February 1973), pp. 12-43; and Benjamin M. Friedman, "Price Inflation, Portfolio Choice and Nominal Interest Rates," Working Paper No. 235, National Bureau of Economic Research. 1978.

<sup>8</sup> For a more detailed comparison of structural and reduced-form models, see Benjamin M. Friedman and V. Vance Roley, "Structural Versus Reduced-Form Models of Long-Term Interest Rate Determination," Working Paper No. 78-04, Federal Reserve Bank of Kansas City, 1978.

<sup>9</sup> For example, the equation may be represented as

$$E(r_g^h) = a_0 + a_1V_g + a_2V_c + a_3V_s + a_4E(p) + \dots,$$

where  $E(r_g^h)$  is the expected holding-period yield on Treasury bonds,  $E(p)$  is the expected rate of price inflation, the "V" terms are the variances of future long-term security holding-period yields as defined previously, and the "a" terms are coefficients to be estimated. Other terms, such as the levels of security supplies, may also appear in the equation. Since the expected holding-period yield may be approximated as

$$E(r_g^h) = r_g + E(c_g),$$

where  $r_g$  is the current market yield on Treasury bonds and  $E(c_g)$  is the expected capital gain or loss on Treasury bonds, the expression for the current market yield may be written as

$$r_g = -E(c_g) + a_0 + a_1V_g + a_2V_c + a_3V_s + a_4E(p) + \dots$$

that estimate the demands for a security, the reduced-form approach estimates an equation for the yield **directly**.<sup>10</sup>

**The Impact of Variances of Long-Term Security Yields on the Level of the Treasury Bond Yield.** The estimation results for both the structural and reduced-form models indicate that security yield variability does affect the level of the Treasury bond **yield**.<sup>11</sup> For the structural model, the estimation results indicate that variances of holding-period yields are determinants of the Treasury bond yield through their impact on individual investor category demands for Treasury bonds. The reported t-statistics, shown in Table 1, indicate that the variance terms appearing in four of the estimated equations are statistically significant—that is, t-statistics greater than 2.0 indicate highly statistically significant **effects**.<sup>12</sup> Thus, if the variance of the holding-period yield on Treasury bonds increases, for example,

<sup>10</sup> Although the reduced-form approach allows a fairly simple representation of a security's yield, it has several disadvantages. First, the yield expression is not constrained by the determinants of the portfolio selection behavior of individual categories of investors. Second, spurious correlation between economic time-series data may be more prevalent. Finally, reduced-form models may be unable to accommodate all of the economic variables that are relevant because of limitations on the sample size—that is, an equation cannot be estimated unless there are more data observations than economic variables.

<sup>11</sup> As before, security yield variability is represented by lagged eight-quarter moving-average variances. The use of eight quarters was judged best based on experimentation with the models.

<sup>12</sup> Values of coefficients are not shown since yield and variance terms in the structural model are multiplied by either flows or stocks of the net acquisition of financial assets. Only the t-statistics on the flow terms, which have unambiguous prior sign restrictions, are reported in the table if both appear in an estimated equation. Further estimation and simulation results involving the structural model are examined in detail elsewhere, and are available on request. See V. Vance Roley, *A Structural Model of the U.S. Government Securities Market*, Ph. D. dissertation, Harvard University, 1977.

**Table 1**  
**SELECTED STATISTICS FOR THE**  
**STRUCTURAL MODEL**  
**(Sample Period: 1960:Q1 to 1975:Q4)**

Net Purchases of Treasury Bonds By:	t-Statistics	
	Variance of Treasury Bond Yield	Variance of Corporate Bond Yield
Commercial Banks	-1.7	
Households		4.3
Life Insurance Companies	-3.7	3.0
State and Local Retirement Funds	-2.6	4.0
Root-Mean-Square Error of the Treasury Bond Yield (in per cent) = 0.20		

commercial banks, life insurance companies, and state and local government retirement funds were found to reduce their demand for Treasury bonds. The variance terms are statistically insignificant in the estimated equations for the other investor categories, but the four investor categories with significant variance terms hold a majority of the outstanding Treasury bonds (63 per cent of private domestic holdings as of yearend 1975). Also, the overall results indicate that the structural model has a high degree of explanatory power. In particular, the Treasury bond yield has a root-mean-square error—a measure of within-sample predictive **accuracy**—of only 20 basis points for the sample period beginning in 1960:Q1 and ending in 1975:Q4.<sup>13</sup>

The estimation results for the reduced-form model are comparable to those of the structural

<sup>13</sup> The simulation used to obtain the root-mean-square error is fully dynamic in the sense that all lagged endogenous variables (i.e., Treasury bond demands and the Treasury bond yield) take values solved from the model in previous periods.

**Table 2**  
**ESTIMATION RESULTS FOR THE REDUCED-FORM MODEL**  
**(Sample Period: 1960:Q1 to 1975:Q4)**

<u>Dependent Variable</u>		
Treasury Bond Yield (in per cent)		
<u>Independent Variables</u>	<u>Coefficient</u>	<u>t-Statistic</u>
Constant	3.55	52.1
Variances:		
Treasury Bond Yield	0.00265	3.9
Corporate Bond Yield	-0.00118	-4.2
Common Stock Capital Gain or Loss	-0.000211	-1.9
Capital Gain or Loss on Treasury Bonds:		
Current Period	-0.100	-4.4
Sum of Eight Previous Periods	-0.00853	-1.3
Percentage Change in Consumer Price Index:		
Current Period	0.125	4.4
Sum of Eight Previous Periods	0.335	10.8
Multiple Correlation Coefficient Corrected for Degrees of Freedom ( $\bar{R}^2$ ) = 0.96		
Standard Error of Estimate (in per cent) = 0.24		
Durbin-Watson Statistic = 1.15		

model." The results again indicate that variances of holding-period yields are statistically significant determinants of the Treasury bond yield. (See Table 2.) The estimated coefficients suggest that an increase in either the variance of the holding-period yield on corporate bonds or corporate shares reduces the yield on Treasury bonds. In this case, the yield on Treasury bonds falls because

alternative securities have become relatively riskier, causing an increased demand for Treasury bonds which lowers their yield. Similarly, an increase in the variance of the holding-period yield on Treasury bonds increases the Treasury bond yield. For example, a 10 per cent increase in the variance of the Treasury bond yield over the sample period implies that the Treasury bond yield would have been an average of 5 basis points higher. The yield increases in this case because Treasury bonds have become riskier in comparison to alternative securities, thereby reducing the demand for Treasury bonds which increases their yield. The overall explanatory power of the model is also comparable to that of the structural model, with a standard error of estimate equaling 24 basis points.

Although the estimation results indicate that the variability of long-term security yields does affect the average level of the Treasury bond yield, further experimentation with the models

<sup>14</sup> For purposes of estimation, the expected capital gain and price inflation terms are represented by autoregressive processes—that is, it is assumed that investors form future expectations from past values of capital gains and inflation. For an empirical comparison of alternative models of expectations formation, see Benjamin M. Friedman and V. Vance Roley, "Investors' Portfolio Behavior Under Alternative Models of Long-Term Interest Rate Expectations: Unitary, Rational, or Autoregressive," *Econometrica* (forthcoming). The autoregressive expectations terms in Table 2 were estimated using third-degree polynomials with the right-hand tails constrained to zero, and the lead coefficients estimated outside of the lag structure.

## MONETARY POLICY AND THE VARIABILITY OF INTEREST RATES

indicates that a **simultaneous** increase in the variability of **all** long-term security yields would have virtually no effect on the average level of the Treasury bond yield. In particular, a 10 per cent increase in all variances suggests that the Treasury bond yield would have been an average of three-tenths of 1 basis point lower according to the structural model, and four-tenths of 1 basis point higher according to the reduced-form model. These results may indicate that the effect of an increase in all long-term security variances in inducing investors to shift out of long-term securities is not of sufficient magnitude to detect empirically, given data limitations and other complications.<sup>15</sup> These findings may further imply that investors have somewhat longer holding periods than supposed, since investors apparently would not try to reduce their holdings of long-term **securities** if long-term security yield variability increases.

To summarize, the theory of portfolio selection suggests that the variability of interest rates is a determinant of the average levels of interest rates. Using two estimated models of the Treasury bond yield, variances of long-term security yields appear as statistically significant determinants of the average level of the Treasury bond yield. Thus, an increase in the variability of any one type of **security**—Treasury bonds, corporate bonds, or corporate **shares**—**does** affect the Treasury bond yield. However, a simultaneous increase in all long-term security variances has very little effect on the average level of the Treasury bond yield according to the models.

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<sup>15</sup> To further explore the impact of increasing all long-term security variances, a general equilibrium model that simultaneously determines a variety of long- and short-term yields would be desirable. The construction of such a model is, however, beyond the scope of this study.

This section investigates the possibility that Federal Reserve **monetary** policy has contributed to the variability of long-term yields. Turning to this possibility, the right-hand scale of Chart 1 measures the variability of the Federal funds rate—the interest rate that the Federal Reserve influences in the daily implementation of monetary **policy**.<sup>16</sup> The plot of the Federal funds rate's variability begins in 1957, which roughly corresponds to the emergence of a national Federal funds market that became fully developed in the late 1950's and early 1960's. It is evident that the Federal funds rate has always had some variability, but there has been a dramatic increase in its variability during the 1970's—the period corresponding to the Federal Reserve's stronger emphasis on stable growth of monetary and credit aggregates." The impact of the variability of the Federal funds rate on the variability of long-term security yields is examined below, and the possible further effect on the level of long-term interest rates is also explored.

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<sup>16</sup> For a discussion concerning the implementation of monetary policy, see William Poole, "The Making of Monetary Policy: Description and Analysis," *Economic Inquiry*. Vol. 13 (June 1975), pp. 253-65. For a detailed description of the Federal funds market, see Charles M. Lucas, Marcos T. Jones, and Thom B. Thurston, "Federal Funds and Repurchase Agreements," *Federal Reserve Bank of New York Quarterly Review*. Vol. 2 (Summer 1977), pp. 33-48.

<sup>17</sup> See Alan R. Holmes, Paul Meek, and Rudolph Thunberg, "Open Market Operations in the Early 1970's: Excerpts from Reports Prepared in 1971, 1972, and 1973," in *Federal Reserve Bank of New York. Monetary Aggregates and Monetary Policy* (New York: Federal Reserve Bank of New York, 1974), pp. 114-34.

## Monetary Policy and Long-Term Interest Rate Variability: Theoretical Considerations

One possible determinant of long-term interest rate variability over a given period is the variability of the Federal funds rate over the same period.<sup>18</sup> The variability of the Federal funds rate may influence the variability of long-term interest rates through at least two interdependent links. First, through the arbitrage process, changes in the Federal funds rate may cause changes in other short- and long-term interest rates. Second, a change in the Federal funds rate may change expectations about the future course of monetary policy, and, therefore, the future levels of interest rates.<sup>19</sup> That is, current interest rate levels may change not only because of changes in the current Federal funds rate, but also because of further anticipated changes. For example, if the Federal funds rate is expected to increase in the future because of a recent increase, then other interest rates may also be expected to increase through the arbitrage process. Specifically, since investors holding long-term securities would suffer a capital loss if

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<sup>18</sup> For a full description of the structural determinants of the corporate bond yield, see Benjamin M. Friedman, "Financial Flow Variables -and the Short-Run Determination of Long-Term Interest Rates," *Journal of Political Economy*. Vol. 85 (August 1977), pp. 661-89.

<sup>19</sup> This link may not hold if a reserve aggregate approach is followed in the implementation of monetary policy. In particular, a reserve aggregate approach would allow the Federal funds rate to fluctuate while the level of some measure of reserves is controlled. Thus, the level of and changes in the Federal funds rate would not necessarily be a good indicator of even current Federal monetary policy. If the reserve aggregate approach were adopted, however, the Federal funds market may stabilize after a brief transitory period. See Richard G. Davis, "Short-Run Targets for Open Market Operations," in *Monetary Aggregates and Monetary Policy* (New York: Federal Reserve Bank of New York, 1974), pp. 40-59.

long-term yields increase, they may attempt to sell long-term securities thereby depressing long-term security prices.

## Monetary Policy and Interest Rate Variability: Empirical Evidence

**The Impact of the Variance of the Federal Funds Rate on the Variance of Long-Term Security Yields.** The empirical relationship between the variability of the Federal funds rate and the variability of long-term security yields is examined using ordinary-least-squares estimation. From the estimated relationships, the variance of the Federal funds rate appears as a statistically significant positive determinant of the variances of the holding-period yields on Treasury bonds, corporate bonds, and corporate shares. (See Table 3.) That is, the relationships show that increased variability of the Federal funds rate increases the variability of long-term security yields.<sup>20</sup> In each case, however, the estimated relationship does not provide much explanatory power for the variance of the respective long-term security yield. The greatest explanatory power, as measured by the multiple correlation coefficient ( $\bar{R}^2$ ), is in the corporate share variance equation. In general, the low multiple correlation coefficients and the highly serially correlated residuals, as reflected by the low Durbin-Watson statistics, indicate that other determinants of long-term security variances may be more important than the variance of the Federal funds rate.

### **The Impact of the Variance of the Federal Funds Rate on the Level of the Treasury Bond**

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<sup>20</sup> As is usual in empirical work, simultaneous relationships may, to some extent, exist between the variances of long-term security yields and the variance of the Federal funds rate. The causal effect of the variance of the Federal funds rate on the variances of long-term security yields most likely predominates, however.

**Table 3**  
**SIMPLE RELATIONSHIPS BETWEEN THE VARIANCE OF THE FEDERAL FUNDS RATE**  
**AND VARIANCES OF LONG-TERM SECURITY YIELDS**  
**(Sample Period: 1960:Q1 to 1975:Q4)**

	Independent Variables		$\bar{R}^2$	Standard Error	Ourbin-Watson Statistic
	Constant	Variance of Federal Funds Rate			
Variance of Treasury Bond Yield	150 (9.7)	13.1 (4.0)	0.19	93.4	0.27
Variance of Corporate Bond Yield	259 (6.7)	23.8 (2.9)	0.10	235	0.40
Variance of Common Stock Capital Gain or Loss	139 (2.1)	73.7 (5.4)	0.31	392	0.84

Yield. The estimated relationships in Tables 1, 2, and 3 may be used to determine the impact of the variance of the Federal funds rate on the average level of the Treasury bond yield. In an experiment using the structural and reduced-form models, the average variance of the Federal funds rate was increased by 10 per cent over the sample period beginning in 1960:Q1 and ending in 1975:Q4. The results from the experiment indicate that the average Treasury bond yield declines very slightly. In particular, a 10 per cent increase in the variance of the Federal funds rate results in a 0.00035 per cent decrease in the Treasury bond yield according to the structural model, and a 0.0028 per cent decrease according to the reduced-form model. The decline in the Treasury bond yield results from the disproportionate effect of the variance of the Federal funds rate on the variance of the corporate share yield. (See Table 3.) Thus, an increase in the variance of the Federal funds rate increases the variance of the corporate share yield relative to the variance of the Treasury bond yield, causing investors on average to increase their demand for Treasury bonds thereby reducing the Treasury bond yield. Again, it should be noted that the

Treasury bond yield decreases by less than 1 basis point for a 10 per cent increase in the variance of the Federal funds rate.

The results from the experiment indicate that the Federal Reserve may make reasonable discretionary changes in the Federal funds rate without having much influence on the average Treasury bond yield. This is not to say that the average level of the Federal funds rate is unimportant in the determination of the Treasury bond yield, only that the variability of the Federal funds rate does not have much effect. Furthermore, the results do not necessarily imply that large increases in the variance of the Federal funds rate would cause the average Treasury bond yield to decline significantly. Large changes in the variance of the Federal funds rate may induce structural shifts that would invalidate the estimated models.

### CONCLUSIONS

Because financial market investors are uncertain about the future yields of the assets in which they are trading, both the levels and

variability of interest rates may be important in forming investment decisions. Variability of interest rates may be important if investors translate variability into uncertainty about future security yields. The empirical results in this article do, in fact, indicate that the variability of past security yields is a determinant of the yield on **U.S.** Treasury bonds. The empirical results also indicate that relative changes in the variability of long-term security yields are more important than simultaneous changes in terms of the impact on the level of the Treasury bond yield.

It was also found that monetary policy may influence the variability of long-term security

yields by influencing the variability of the Federal funds rate. However, the results indicate that increased variability of the Federal funds rate would have only a very small effect on the average level of the Treasury bond yield. The results imply, therefore, that increased variability of the Federal funds rate caused by either frequent monetary policy changes or the use of an alternative monetary policy instrument would not significantly affect the average level of the Treasury bond yield. Because other long-term yields may depend on similar factors, the results may generalize to include a broad range of long-term security yields.

