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The 1980s: A Turning Point for U.S. Agricultural Exports?

By Mark Drabenstott

The 1970s were a decade of remarkable growth for U.S. agricultural exports. A near-fivefold increase in farm exports during the decade reshaped U.S. agriculture by boosting farm income, raising farmland prices, and encouraging investments that increased agricultural productive capacity. A growing agricultural trade surplus also became a significant factor in limiting the size of America's rising balance of trade deficit. As a result, agricultural interests generally expected continued rapid growth in the current decade.

Thus far, however, the 1980s have seen growing weakness in agricultural exports. The value of U.S. agricultural exports grew slowly in 1981 and then declined in 1982. The recent weakness has been largely a result of weak economies abroad, large world grain supplies, and a strong U.S. dollar. Weak export markets, in turn, have been a major cause of farm financial stress in the past three years. Therefore, given the importance of these exports to U.S. agriculture and the balance of trade, whether U.S. farm exports return to the rapid growth of the 1970s is of considerable significance.

This article examines the probable course of U.S agricultural exports during the rest of the 1980s. The first section discusses the changing trends in U.S. agricultural exports. The second section examines how a number of market factors have reduced agricultural exports during the past three years. The third section analyzes new market developments and trade policies that might stimulate future exports. The final section draws some conclusions about the future of U.S. agricultural exports and summarizes the findings of the article.

RECENT DECLINE IN AGRICULTURAL EXPORTS

The decline in U.S. agricultural exports in the early 1980s followed a period of rapid export growth in the 1970s. The 1970s produced rapid growth in export value and volume, with most of the growth occurring in grains. The value of farm exports, which totaled $7.3 billion in 1970, nearly doubled in 1973, the year of the first big Soviet wheat sale (Chart 1). By 1980, the value of U.S. agricultural exports had increased to $41.2 billion.[1] Export volume had

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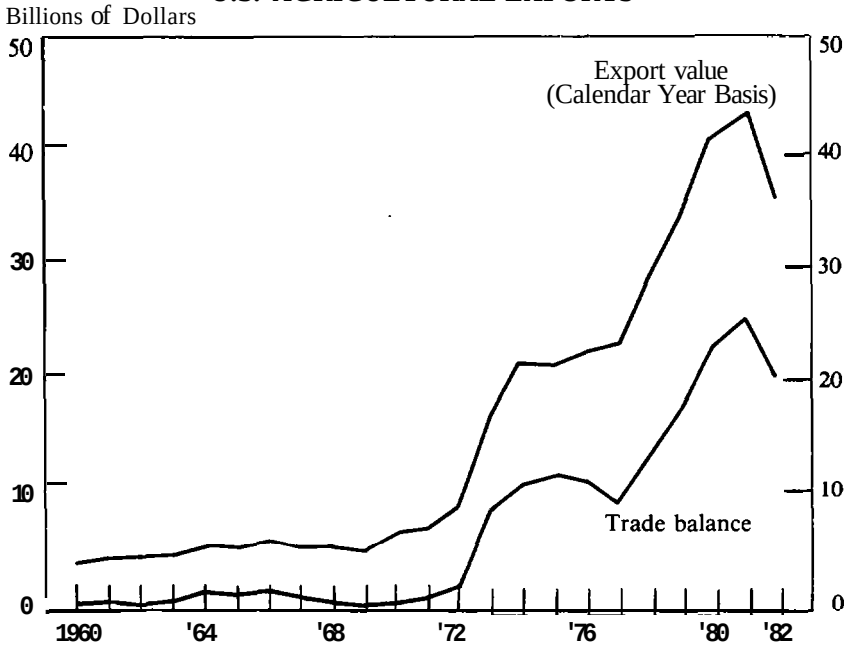
[1] *Foreign Agricultural* Trade *of the* United Stares, Economic Research Service, U.S. Department of Agriculture, 1981.

Chart 1
U.S. AGRICULTURAL EXPORTS



Source: Foreign Agricultural Service, U.S. Department of Agriculture.

reached 162 million metric tons (mmt) by 1980 compared with only 64 mmt in 1970. The rapid expansion in U.S. agricultural trade was fueled mostly by strong economic growth abroad, readily available world credit, opening of trade with centrally planned economies, and a relatively weak U.S. dollar.

The markets for U.S. agricultural exports changed significantly during the 1970s. Although Japan and Western Europe remained the two most important markets—accounting for nearly half of U.S. exports—new markets emerged. The fastest growing markets were the Soviet Union, China, Latin America, and Eastern Europe (Table 1). Where the Soviet Union accounted for less than 0.5 percent of U.S. agricultural exports in 1970, it made up 3.6 percent in 1980. Where the United States and China had no agricultural trade in 1970, China had become the biggest single customer for U.S. wheat by 1980. As real incomes rose in Latin American countries, especially in Mexico and Brazil, these countries developed strong demand for U.S. farm products. Eastern Europe increasingly turned to the United States and others to bolster domestic feed grains supplies.

Impact of the 1970s rise in exports

Rapidly expanding exports had an historic impact on America's farms. As grain exports became increasingly important to American farmers—accounting for 43 percent of the grain produced in 1980, compared with only 16 percent in 1970—farm income rose from the levels of the 1960s. Net farm income averaged $23.1 billion in the 1970s compared to $12.4 billion in the 1960s.[2] In real terms (1967 dollars) net farm

2 *Economic Indicators of the Farm Sector,* U.S. Department of Agriculture, 1981.

income averaged $14.9 billion in the 1970s, compared with $12.8 billion in the 1960s (Chart 2). Along with higher farm income, expanded exports brought greater volatility to farm prices and incomes. Farmland values rose at unprecedented rates, registering the sharpest rise in real value for any decade of this century. Encouraged by higher incomes, low real interest rates, and expectations of continued export growth, farmers made large investments to increase their productive capacity.

While escalating oil prices contributed to a mounting U.S. trade deficit during the 1970s, agricultural trade became increasingly important as a source of trade surplus. From less than $2 billion in 1970, the agricultural trade surplus grew to $24 billion in 1980 (Chart 1). With a trade deficit of more than $25 billion in overall merchandise in 1980, agriculture's contribution to the U.S. trade balance was significant.

Official U.S. policy in the 1970s encouraged agricultural exports. Stimulating exports was considered appropriate because of the benefits to both farmers and the country's balance of payments. Farm policy generally encouraged fencerow-to-fencerow production, while trade policy promoted free world markets and increased exports to centrally planned countries.

Table 1
U.S. AGRICULTURAL EXPORTS VALUE BY REGION FISCAL YEARS 1970 AND 1980

	1970		1980	
Region	Billion Dollars	Percent of U.S. Exports	Billion Dollars	Percent of U.S. Exports
Western Europe	2.369	35.2	12.569	31.0
Eastern Europe	0.133	2.0	2.449	6.0
U.S.S.R.	0.017	0.3	1.457	3.6
Asia	2.452	36.5	14.298	35.2
Japan	1.089	16.2	5.775	14.3
China	0.0	0.0	1.957	4.8
Other	1.363	20.3	5.506	16.1
Canada	0.767	11.4	1.830	4.5
Africa	0.229	3.4	2.277	5.6
Latin America	0.649	9.7	5.482	13.5
Oceania	0.056	0.8	0.189	0.5
Other	0.050	0.7	—	—
Total	6.721	100.0	40.43	100.0

Sources: U.S. Department of Agriculture, Outlook for U.S. Agricultural Exports, November 17, 1980, and U.S. Foreign Agricultural Trade Statistical Report, Fiscal Year, Washington, D.C., December 1971.

Expectations for the 1980s

Farmers and policymakers alike expected the strong growth in agricultural exports to continue in the 1980s. Farmers bought more land and equipment to boost production and improve profits. The resulting strong demand for farmland and farm machinery helped to boost prices for both. As the decade began, farm policy was still directed toward full production, with strong export markets seen as the cure to the grain surpluses and low commodity prices of previous decades.

Continued growth in farm exports was generally expected. Typical of the optimistic forecasts was a concensus report by the Agriculture Council of America suggesting that agricultural exports in the 1980s would continue the growth of the 1970s. The report said that the "dramatic growth in U.S. agricultural exports during the 1970s was not an aberration from a normal trend but was an unambiguous indication of increasing global food and fiber interdependence."[3] It concluded that "U.S. agriculture will have the opportunity to maintain and further expand its export markets in the future."

Performance in the early 1980s

Agricultural exports have been a disappointment in the early 1980s, however, compared with both the trend of the 1970s and the expec-

[3] Agriculture Council of America, *U.S. Farm Export Strategies for the Eighties,* Washington, February 1981.

tations that were common when the decade began. Growth in the value of exports slowed below expectations in 1981, with $43.3 billion in final sales. Exports decreased to $36.6 billion in 1982, and export volume also declined. The first year of a decline in value since 1969, 1982 marked an abrupt end to the expansion in exports that dominated U.S. agriculture throughout the 1970s.

Declining farm exports reduced agriculture's contribution to the U.S. balance of trade in 1982. After peaking at a surplus of $26.6 billion in 1981, the agriculture balance of trade dipped to $21.4 billion in 1982. As the overall merchandise trade balance widened to $26.1 billion, agriculture's contribution to the balance of trade declined with other sectors.

Weakening farm exports also had negative effects on the farm sector. Net farm income in current dollars peaked at $32.4 billion in 1979 and was followed by three years of low farm earnings (Chart 2). Soft export markets have resulted in growing grain surpluses and low commodity prices which, in turn, have been a primary cause of low farm income levels. Declining agricultural exports, moreover, have reduced the demand for farmland and contributed to a decline in farmland values. Agribusinesses have felt the effect of declining agricultural exports both in lower sales of agricultural equipment and supplies and in reduced volume of grain shipments. On balance, declining exports have transformed U.S. agriculture from a period of increased investment in production and strong farm income to a period of excess capacity and farm financial stress.

SOURCES OF THE DECLINE

Several factors have combined to reduce U.S. agricultural exports in the early 1980s. These factors are a weak world economy, world debt problems, a strong exchange value of the dollar, export competition, and trade barriers. This section examines how these factors have contributed to a reduction in agricultural exports.

Weak world economy

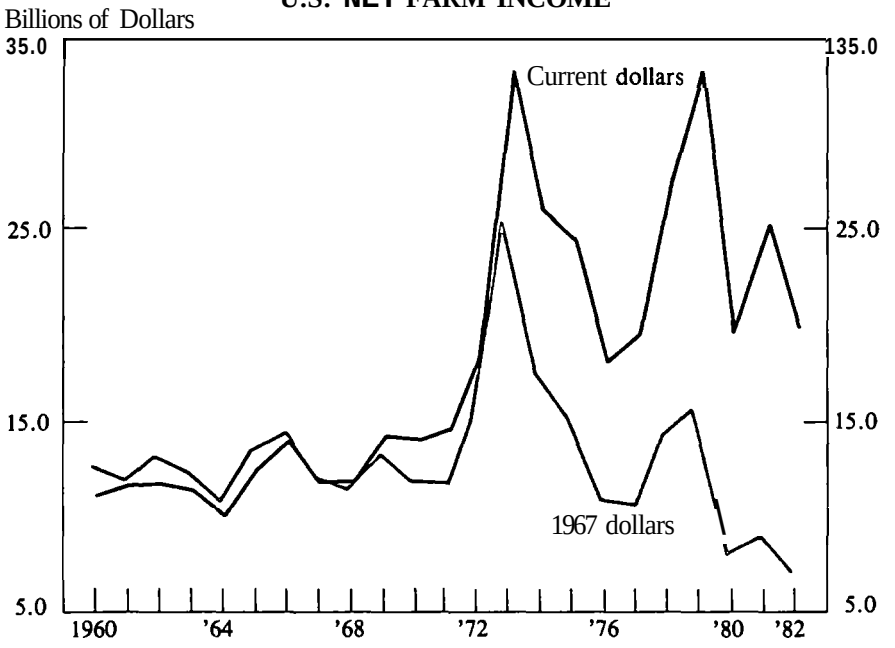
The global recession that accompanied the U.S. business downturn has slowed the growth in world food demand. Total world demand may decline for the first time in nearly a decade in 1983. The total gross domestic product (GDP) of countries in the Organization of Economic Cooperation and Development (OECD) declined last year for the first time since the 1950s. The world recession followed a decade of economic growth when OECD nations increased their GDP an average of 14 percent a year. Where total world trade in wheat and coarse grains increased an average of 7 percent a year in the 1970s, the world recession has held the growth in total trade in these commodities relatively flat for the past two years.

World debt problems

The difficulties many developing countries are having meeting their foreign debts have further curtailed their ability to import food. Less developed countries, which accounted for more than a third of U.S. farm exports in 1981, increased their foreign debt 54 percent between the yearends of 1979 and 1982.[4] Mexico and Korea, for example, which together accounted for 11.2 percent of U.S. agricultural exports in 1981, increased their combined foreign debt from $53 billion to $124 billion between the end of 1979 and the end of 1982. In the face of high real interest rates, low commodity prices for their exports, and declining world economic growth, many less developed countries (LDCs) have coped with a growing debt burden only by rescheduling debt payments. These countries

[4] *Organization for Economic Cooperation and Development, External Debt of Developing Countries, 1982.*

Chart 2
U.S. NET FARM INCOME



Source: U.S. Department of Agriculture.

borrowed heavily in the 1970s to increase their food imports, but as they have rescheduled their debts, less credit has been extended to them recently.

Exchange value of the dollar

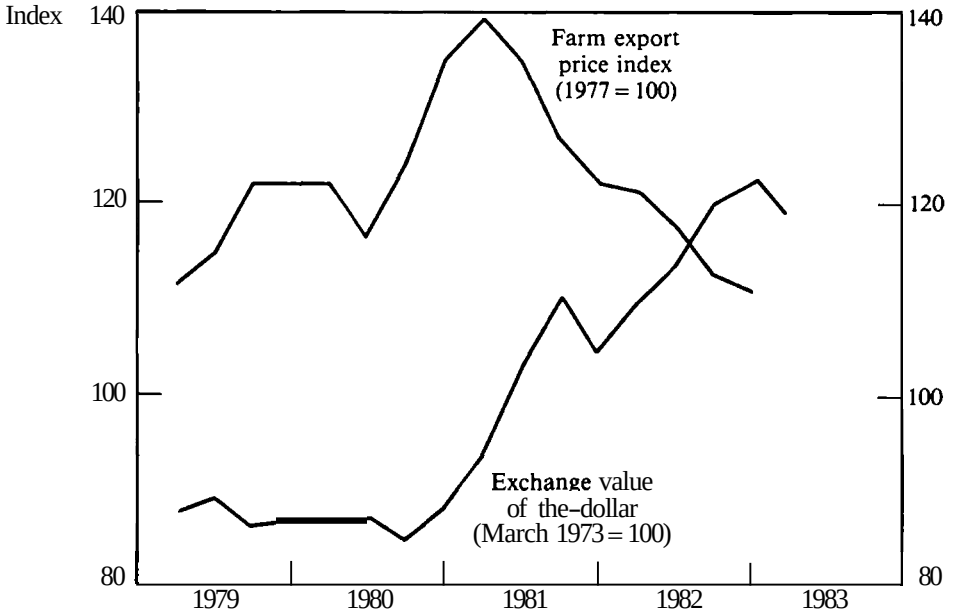
A strong dollar over the past two years has had some negative effect on agricultural exports. From its lowest point in 10 years in the third quarter of 1980, the dollar appreciated more than 40 percent against a market basket of 10 foreign currencies to its highest point in 12 years by the fourth quarter of 1982 (Chart 3). This strength of the dollar has weakened foreign demand for U.S. farm products, especially in low and middle-income countries that have been having balance of payments and foreign debt problems.

Although U.S. farm export prices have fallen steadily over the past two years as a consequence of large domestic grain supplies, appreciation of the dollar has at least partially offset the trade advantages of lower prices. From a peak in January 1981, the index of farm export prices declined 28 percent to a two-year low in January 1983 (Chart 3). The decline over this period was offset to some extent, however, by a 29 percent appreciation in the dollar. Thus, the dollar's rise in value blunted some of the competitive gains in world markets that might have been expected from falling U.S. farm prices.

Export competition

Grain exports from the United States have met stiff competition from other exporting countries in recent years. As a result of the competitive trade measures employed by these countries, the United States has lost some of the large market share that it had built up in the

Chart 3
FARM EXPORT PRICE INDEX
AND WEIGHTED AVERAGE EXCHANGE VALUE OF THE DOLLAR



Sources: U.S. Department of Agriculture and ***Federal Reserve Bulletin,*** Board of Governors of the Federal Reserve System.

1970s. Following a decade of rapid export expansion, the United States controlled more than 58 percent of all world wheat and coarse grain trade by fiscal 1980. In fiscal 1983, the United States will probably control about 51 percent.' This seven percentage point drop in market share amounts to some 14 mmt of grain valued in today's market at more than $5 billion.

The four main export competitors to the United States—Argentina, Australia, Canada, and the European Community (EC)—have increased grain production in the past decade in response to high U.S. and world grain prices. Nearly all of the increase has flowed into the world market. Wheat and feed grain production in these countries totaled 150 million tons in 1970 (Chart 4). In 1982, combined production had climbed to 220 million tons. Where they harvested 62.3 million hectares in 1970, they harvested 73.9 million in 1982. Canada, in particular, has rapidly expanded agricultural production, boosting harvested hectares by two-thirds between 1970 and 1982. It more than doubled the wheat area it harvested.

Canada, Argentina, and the EC have significantly improved their shares of the world grain market in the past three years (Table 2). Canada, to regain the market position it held a decade ago, has aggressively marketed its grain at competitive prices and with below-market credit terms. Argentina, where surpluses have been growing, has sold grain at below world market prices. Large agricultural surpluses have been building in the EC in recent years as a result of high domestic farm support prices. To reduce government-held commodity stocks, the

5 "World Grain Situation and Outlook," *Foreign Agriculture Circular,* FG-4-83, USDA, January 1983.

Table 2
WHEAT AND COARSE GRAIN WORLD MARKET SHARES
(July/June Marketing Year)

	1970-71	1979-80	1982-83
United States	38.9	58.2	51.4
Canada	15.5	10.6	13.5
Australia	11.6	10.2	4.6
Argentina	9.2	6.1	10.3
European Community	5.8	8.9	13.2
Others	19.0	6.0	7.0

Source: U.S. Department of Agriculture, *Foreign Agriculture Circular,* FG-1-83, January 17, 1983, and FG-12-73, October 26, 1973.

EC has offered generous price subsidies for farm exports and, in most cases, has sold at below world market prices. The cost of this two-pronged subsidy scheme—keeping domestic farm support prices high to encourage large food supplies and offering large subsidies to sell surplus commodities on world markets—is very high. In 1982, for example, the EC spent $7.3 billion for domestic price supports and an additional $5.6 billion for export subsidies.[6]

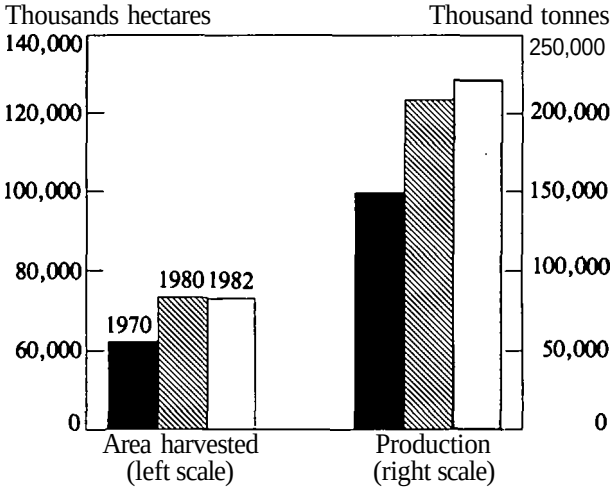
Trade barriers

Agricultural exports from the United States have been disadvantaged in the past three years by trade barriers in world markets. These barriers primarily consist of a growing number of bilateral trade agreements between export competitors and food importing nations, Japanese food import barriers, and a system of variable levies on EC food imports.

The amount of world-traded grain covered by bilateral agreements has increased considerably during the past few years. Since June 1980, the amount of grain covered in bilateral commitments has increased from 21.9 mmt to more than 32.8 mmt. More than two-thirds of this increase comes from export competing nations having locked in larger shares of the Soviet grain market. Over the same time period, the total number of bilateral trade agreements between export competitors and major world food buyers has increased from 24 to 35. Most of the new agreements have been signed by Argentina, Canada, and the EC, particularly the French.

The increase in bilateral trade agreements carries significant ramifications for the United States. Coming in the wake of the USSR grain embargo, the new agreements are evidence that the United States has lost a major share of the Soviet grain market. Moreover, the declining portion of world grain trade not covered by existing trade agreements magnifies the U.S. role

Chart 4
WHEAT AND COARSE GRAIN PRODUCTION BY COMPETING EXPORT COUNTRIES*



Source: Foreign Agricultural Service, U.S. Department of Agriculture.

* Argentina, Australia, Canada, and European Community.

6 Foreign Agricultural Service, U.S. Department of Agriculture.

as residual supplier to world grain markets. When world grain demand is weak, as it has been for the past two years, the United States is forced as residual supplier to hold a larger share of a growing world grain surplus. In fiscal 1982, the United States held more than 60 percent of the world's grain reserves, compared with only 45 percent in 1970.

Japan is the biggest buyer of U.S. farm products—more than $6.5 billion in 1981—but it remains a market with numerous barriers to entry. Japan maintains both import quotas and tariffs that affect U.S. farm products, notably beef and citrus. The Japanese government levies a 25 percent ad valorem tariff on imported beef. Since this tariff usually leaves the cost of imported beef still below domestic beef prices, additional tariff surcharges are assessed to bring prices of imported beef up to domestic beef prices. Citrus imports face high and seasonal tariffs in addition to quotas that limit imports during periods of peak demand.

Japanese barriers to food imports reflect domestic pressure to protect Japanese food producers. The farm lobby is prominent in Japan's legislative body, with the result that food import barriers change slowly and only in response to considerable pressure. Japan and the United States undertook trade negotiations in October 1982 to discuss Japanese food import restrictions, but no significant progress has been reported so far.

In addition to subsidizing its own agricultural exports, the EC imposes variable levies on agricultural imports. The levies, intended to protect European producers from low world prices, are adjusted daily with the extent of the adjustment determined by subtracting the world price for a commodity from the EC's set threshold import price. On a recent day in February of this year, for example, a levy of $107 per ton was placed in U.S. soft red wheat to bring the Rotterdam price of $159 per ton up to the EC threshold price of $266 per ton. Of U.S. farm products, wheat and feed grains are the two most affected, and the levies amount to a substantial price penalty for U.S. grains. In the case of wheat, for example, the variable levy recently has averaged nearly 70 percent of the U.S. price at delivery in Rotterdam.'

AGRICULTURAL EXPORT ISSUES IN THE 1980s

The disappointing performance of U.S. agricultural exports in the 1980s has brought several policy issues to the fore. The basic question these policies try to address is how farm exports can be stimulated in a world grain market characterized by the factors discussed above. Consumers have sometimes argued against increased farm exports on the basis that exports tend to raise domestic food prices. As noted earlier, however, stimulative export policies were pursued in the 1970s on grounds that expanded foreign markets for U.S. farm products provide a long-term cure to farm sector ills while offering significant benefits to the U.S. balance of trade.. Expanded farm exports also create nonfarm employment opportunities.

This section examines alternative policies the United States can use to stimulate agricultural exports. The alternative policy courses can be categorized as three types: market development policies, free trade policies, and trade assurance policies.

Export market development

Development of new markets for farm products is a traditional way of boosting agricultural exports. The Foreign Agricultural Service of the U.S. Department of Agriculture, in cooperation with agricultural export businesses, has facilited foreign market

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7 **Foreign Agricultural Service, U.S. Department of Agriculture.**

development for more than two decades. Past efforts have been successful in building large markets for U.S. raw grain products and cotton. The market development challenges of the 1980s appear to be livestock exports and value-added exports.

Livestock exports, including dairy and poultry, have made up only a small proportion of total farm exports. In 1982, for example, livestock exports totaled $4.2 billion, accounting for only 11.4 percent of total farm exports. Total livestock exports have grown rapidly, however, from a small base of $865 million in 1970. As a result of this growth, the United States has become a net exporter of livestock products.

Further expansion of livestock exports will require that foreign restrictions on meat imports be removed and further mechanisms be developed for exporting live animals. Meat exports from the United States face a variety of import tariffs and quotas in foreign markets. Progress in negotiations for the relaxing of these restrictions has been slow. Many countries, both developed and developing, promote their domestic livestock industries, preferring to import feed grains rather than meat. Even with lower trade barriers, U.S. meat producers may not be able to compete effectively in all foreign markets because of the low-cost rangeland available to many meat importing developing countries that are expanding their meat production. Poultry products from the United States, on the other hand, may prove to be quite competitive in world markets.

Live animal exports for herd development could become a strong export item for the United States in coming years. The United States has made significant advances in animal genetics that are increasingly in demand by developing countries wanting to improve their livestock herds. The United States exported more than 400,000 head of live breeding stock animals in 1982. These shipments, to more than 75 countries, were in contrast to only 230,000 head in 1979.[8] Much of the rapid growth in breeding-stock exports has been made possible by the increased use of air transportation, which is cost effective and minimizes animal fatigue. Development of animal handling facilities near airports, such as at Kansas City, could open the way for continued rapid growth in live animal exports.

Value-added agricultural exports present a formidable challenge to market development in the 1980s. Value-added refers to raw agricultural products that are processed before export, such as wheat flour. Less than a third of the agricultural exports in the 1970s were value-added products. Despite efforts to boost foreign sales, demand for these products has been weaker than demand for raw grain and cotton. Many food importing countries, especially less developed countries, prefer to develop their own food processing infrastructure, thus providing additional domestic economic activity and employment. While foreign sales of value-added products may be stimulated by export subsidies, demand for the products is not likely to grow rapidly because of competition from food processers in major grain importing countries.

The United States will continue to pursue foreign market development. A major food export trade fair to be held in Atlanta this year will promote the development of farm export markets. Although such actions could improve exports, other policy choices open to the United States are more likely to affect future exports.

Free trade policies

This country has argued for free world agricultural markets for the past decade.

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8 *Foreign Agriculrure.* **Foreign Agricultural Service, U.S. Department of Agriculture, November 1982.**

American farmers stand to benefit from a free trade policy because they can produce at lower cost than most of their competitors. This comparative advantage of U.S. farm products depends on domestic price supports not being placed too high relative to world prices. Farm commodity support prices become capitalized into farmland values. When support prices are high relative to world commodity prices and lead to increased farmland values, production costs in the United States rise and effectively reduce the competitiveness of U.S. farm products in world markets. A free trade policy, therefore, basically states that encouraging free world markets while producing at comparatively low cost should ensure large export markets for the United States.

To pursue a free trade policy, the United States must address three issues. It must continue efforts to remove existing world trade barriers. It must encourage world economic growth, especially in developing countries, where potential demand is greatest. And it must keep its own support prices low enough to maintain a competitive stance in world markets.

The multilateral General Agreement on Tariffs and Trade (GATT) has been the main vehicle for U.S. agricultural trade negotiations. The United States has participated in two principal types of GATT discussions. The major multilateral trade talks that are occassionally held, such a's the Kennedy and Tokyo Rounds, have been largely successful in lowering world tariffs. Food import tariffs, however, may not have been affected as much as other world traded goods. The United States also has engaged in negotiations under GATT auspices to redress unfair trade barriers and practices, such as EC export subsidies, but limited results have been achieved thus far. To lower foreign food trade barriers, the United States may have to relax some U.S. import barriers as a quid pro quo. Many argue that GATT has been unable to bring discipline to the current world agricultural markets that are encumbered with bilateral agreements, trade subsidies, and credit guarantees. The United States remains committed to trade negotiations through established GATT mechanisms to resolve trade disputes. If progress remains limited, however, the United States increasingly may turn to competitive trade measures of its own in an attempt to make trade discussions more effective.

To benefit from free world markets, the United States must also pursue policies that strengthen world economic growth. Developing countries, with rapidly growing populations and moderately growing incomes, are the primary.growth market for U.S. farm exports in the 1980s. These countries depend on trade within a strong world economy for the foreign exchange necessary to purchase food imports. Macroeconomic policies that promote economic growth in the United States and abroad, therefore, will be important to farm export growth in the remainder of the 1980s. Foreign aid grants and economic development assistance programs also may eventually produce larger markets for U.S. farm exports, even though they represent a current cost to taxpayers. In addition, food aid programs under Public Law 480 have been an effective means of helping other countries and also opening the door to expanded agricultural trade. Many countries that once were large recipients of food aid—Spain and Brazil, for example—have since become large commercial buyers of U.S. farm exports.

Keeping domestic price supports competitive in world markets is the final piece of a free trade policy. Even'if the United States succeeds in freeing world markets through trade negotiations, and if the world economy is restored to healthy growth, the United States could be at a competitive disadvantage because of pricing its farm' products above world price levels. When U.S. farm price supports are too high, they pro-

vide a world price umbrella that allows foreign farmers to increase production above their normal levels. Many analysts contend that as U.S. farm price supports ratcheted upward during the 1970s, with a significant increase in the 1981 Farm Bill, they encouraged an increase in world production and effectively priced U.S. grain out of much of the world grain market. The problem was compounded by the price subsidy measures used by the EC and others. Thus, adherence to a free trade policy may include the possibly painful decision to lower U.S. farm price supports to a more competitive level in world markets.

Trade assurance policies

To restore some of the eroded U.S. share of the world market, many in the farm community advocate trade assurance .policies that would respond to foreign com etitor . The primary trade assurance options that have been considered are export subsidies, export financing, and bilateral trade agreements.

Export subsidization would call for the United States to offer price subsidies on farm exports to make them more price competitive in world markets. Proponents of this policy argue that the only way to establish fair markets is to respond in kind to foreign competitors. The United States, in an effort to compete with EC export subsidy measures, recently concluded a subsidized sale of 1 million tons of wheat flour to Egypt, a market previously supplied by the French. Growing sentiment for trade assurance policies could lead to further price subsidy measures. A variety of export Payment-In-Kind (PIK) programs have been proposed.

Export subsidies may increase exports. These gains, however, will be earned at a high cost. The subsidized sale to Egypt illustrates the high costs of export subsidy programs. Valued at $155 million, the transaction may take a total subsidy of $135 million.[9] Moreover, the subsidy cost likely will rise because of cargo preference legislation, which requires half of the flour to be transported in U.S. ships: Nor is it clear that the United States can use subsidies without engaging the EC and other exporters in a trade war. Should such a trade war develop, costs of a subsidy program would increase and grain importing countries would be the real beneficiaries.[10] Pursuit of such a policy course would effectively give the United States a dual subsidy scheme, both domestic and foreign, such as in the EC. The combined cost of such a policy is very high and the American public might not be willing to bear the cost.

The United States has also used a credit guarantee program to boost export sales. The latest credit program enacted by Congress is a blended credit program that provides loans to foreign buyers of U.S. farm products at below market interest rates. Under the program, $350 million in interest-free loans will be provided to foreign buyers in fiscal 1983, in addition to $1.4 billion in U.S. government commercial credit guarantees. The end result is a one-fifth reduction in the effective interest rate on the $1.75 billion available. The blended credit legislation has received strong support in Congress and can be expected to continue.

A new long-term grain agreement with the Soviet Union also has strong support in the farm community. A five-year agreement with the Soviets expired in October 1981 but has twice been extended for another year. Signing a new long-term agreement is fraught with

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9 *Milling and Baking News*, Vol. *61*, No. 49, January 25, 1983.

10 A distinction can be drawn between a trade war in terms of subsidies and a trade war in terms of trade barriers. Under a subsidy trade war environment, costs for exporting nations rise, but little adjustment in trade relationships results. With trade barriers, the volume of world trade declines and significant distortions in trading patterns likely will occur.

political ramifications for the United States and the Soviet Union. Recent negotiations have not resulted in any progress toward a new agreement. The Soviets may have cooled toward a new agreement because of surpluses in world grain markets and because they have been successful in signing long-term agreements with Argentina, Canada, and the European Community. Whether a new grain agreement is signed between the two countries is far from certain at present, but both countries seem willing to continue extending the old agreement.

THE FUTURE FOR AGRICULTURAL EXPORTS

The 1980s may well turn out to be a decade of weak growth for U.S. agricultural exports. A sluggish world economy, a slow return of developing countries to financial strength, ample world food supplies, and relative strength in the dollar—all these point to slow growth for farm exports for the next few years. Weaker-than-expected farm exports have significant implications for America's farms. Without strong export markets, farm income is not likely to return to the halycon levels of the 1970s in the near future. Grain surpluses will almost certainly continue to pose a major farm problem, pointing the way to land retirement programs, such as the PIK program. As a result, farmland values are not likely to post the strong gains they showed in the 1970s.

The slow world recovery that may occur will hold back growth in world food demand for the next few years. The United States is expected to lead a world recovery in 1983, followed by the western industrial countries. According to an OECD forecast, however, economic growth of the OECD countries may average only 1.5 percent in 1983. Since developing countries, which are a primary market for U.S. farm exports, are expected to lag behind the rest of the world in recovery, foreign demand for world traded grain will likely remain weak over the next few years.

Debt problems will continue to plague developing countries until the world economy recovers and commodity prices rise. Given the magnitude of the debt problem and the prospect of a slow world recovery, some developing countries may need four to six years to work through their debt rescheduling problems. Unless the current reduction in credit available to LDCs is offset by more credit guarantees from the United States and other grain exporting nations, world debt problems will continue to limit food demand for several years.

The strength of the dollar continues to reduce demand for U.S. farm products. Although the dollar has depreciated somewhat since the fourth quarter of 1982, it remains stronger than the exchange value that prevailed throughout most of the 1970s. The response of U.S. agricultural exports to further weakening in the dollar is uncertain. A weaker dollar probably will not improve U.S. exports to the EC, where fluctuations in exchange rates are countered by variable levy tariffs on such major items as wheat and feed grains.[11] Nor would Latin American countries, which effectively peg their currencies to the dollar, be more likely to increase imports from the United States. On the whole, a weakening in the dollar would probably provide a boost to foreign demand for U.S. farm products, although a weaker dollar by itself is not likely to restore strong farm exports.

The policy course the United States takes will have a significant effect on the path of farm exports for the rest of the decade. A free trade policy combined with the development of foreign markets would likely expand export markets, but only gradually. If the United

11 This statement does not apply to soybean exports, which are not subject to an EC varible levy tariff.

States adheres to a free trade policy, it may have to critically examine its farm price supports to determine if current supports allow the United States to be competitive enough in world markets. A free trade policy also suggests that short-run expansion of farm exports will depend on a stronger world economy.

Trade assurance policies are viewed by many as offering more potential for short-run improvement in agricultural exports. But, these measures may prove costly and the prospective market gains may be illusory. Export subsidies, which appear to be gaining support precisely because of their potential for short-run market gains, impose heavy costs and they also raise the risk of market confrontation with other exporting countries. If exporting nations engage in confrontational measures to compete against one another, short-run market gains might not hold up in the longer run. Export credit subsidies might result in expanded export expansion with less danger of encouraging a trade war atmosphere. A new long-term agreement with the Soviets would be the trade assurance policy with the least budget cost, but the political cost could be high.

SUMMARY AND CONCLUSIONS

The decline in U.S. agricultural exports in recent years has been caused by various factors. The weak world economy has limited growth in world food demand and mounting debt problems have hampered export sales to developing countries. The strong dollar has raised the price of U.S. farm products to foreign buyers. Finally, the United States has faced stiff export competition and some trade barriers in world grain markets.

U.S. agricultural exports likely will not return to a strong rate of growth in the near future. Slow world economic recovery will limit improvements in world food demand. The current debt problems of developing countries may be resolved only over a period of years. Although the dollar may weaken relative to its 1982 level, it will likely remain fairly strong by historical measures. The United States will continue to encounter strong competition from other exporting nations in addition to some trade barriers in world markets. On balance, U.S. agricultural exports probably will feel the effects of some negative market factors in 1983 and for a few years afterward, but a recovering world economy may offset some of these factors as time goes on.

Although a number of factors point to weaker growth for agricultural exports, the world food supply and demand balance is a relatively fragile one. If growth in world food demand increases as the decade unwinds in response to growing world population and stronger economic growth, the United States could reenter a period of strong farm exports. The United States has remained the dominant supplier of world food products throughout the period of strong world demand in the 1970s and the period of weak demand so far in the 1980s. With a return to strong world demand, U.S. producers could supply large quantities of farm products to world markets. How well farm exports perform during the rest of the 1980s depends, however, on prudent export policies now and U.S. prices that are competitive with the rest of the world.

Wage Behavior in the United States: 1907-80

By George A. Kahn

Inflation has declined sharply in the United States since 1979, but economic growth has slipped and unemployment has reached post-World War II highs. One explanation for this unsatisfactory economic performance may be that the postwar introduction of long-term labor contracts has prevented the growth of nominal wages from adjusting downward in response to declining inflation.[1] If nominal wage growth is sticky, the slowing of inflation causes a temporary increase in real wage growth—nominal wage growth adjusted for inflation. The increase in real wage growth, in turn, causes a temporary reduction in production and employment.

This article examines the behavior of wages in the United States to determine whether the increased prevalence of long-term wage contracts since World War II has led to an increase in nominal wage stickiness. The first section defines wage stickiness and examines its theoretical implications. The article then looks for empirical evidence of changing patterns of wage adjustment, first by analyzing the basic data on wage behavior for 1907-80 and then by presenting estimates of an econometric model of wage adjustment. The findings confirm that nominal wage inertia increased as long-term wage contracts became more prevalent, thus suggesting that disinflationary macroeconomic policies are more likely than previously to be accompanied by increased unemployment.

WAGE STICKINESS AND THE EFFECTS OF DISINFLATIONARY MONETARY POLICY

The labor market is in equilibrium when the demand for labor is equal to the supply of labor. Firms' demand for labor varies inversely with the real wage—the nominal wage divided by the aggregate price level. Workers' supply of labor increases with the real wage. Equilibrium

[1] Other explanations include a lack of credibility of Federal Reserve policy, backward-looking expectations, or price rigidity. In the intermediate term when agents learn about structural changes, however, lack of credibility and rationality become less acceptable explanations for a prolonged recession. Price and wage rigidity take on more significance. For evidence on price adjustment in the United States, see, for example, Robert J. Gordon, "A Consistent Characterization of a Near-Century of Price Behavior," *American Economic Review,* Vol. 70, No. 2, May 1980, pp. 243-49, and Robert J. Gordon, "Price Inertia and Policy Ineffectiveness in the United States, 1890-1980," *Journal of Political Economy.* Vol. 90. No. 6. December 1982, pp. 1087-117.

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occurs at the unique real wage that equates the supply of and demand for labor.

Market forces ensure that nominal wages adjust in the long run to yield this equilibrium real wage, the value of which depends on, among other things, labor productivity. However, various frictions can prevent the necessary adjustments from occurring in the short run to the extent that these frictions result in sticky wages. From a macroeconomic perspective, the degree of wage stickiness is a major factor determining the response of inflation and output to changes in the aggregate demand for goods and services as caused, for example, by changes in the rate of monetary growth.[2]

Nominal wage stickiness

Nominal wage stickiness results when nominal wages do not adjust sufficiently to changes in the aggregate price level, causing real wages to deviate from their equilibrium value.' One possible cause of nominal wage stickiness is long-term wage agreements.' Unless fully indexed to inflation, the nominal wages set by long-term contracts do not adjust completely to changes in the aggregate price level over the contract period.

If nominal wages are sticky, changes in the price level resulting from changes in aggregate demand cause short-run changes in output and employment. Consider, for example, the effects of a reduction in aggregate demand. The associated decline in the aggregate price level does not lead to a commensurate decline in nominal wages. Thus, real wages increase even though there is no corresponding increase in labor productivity. The resulting rise in unit labor costs leads firms to reduce employment and output below equilibrium levels in the short run.[5] In the long run, renegotiation of wage contracts will realign nominal wages with the aggregate price level. As a consequence, equilibrium values of real wages, employment, and output will prevail in the long run, despite temporary deviations caused by nominal wage stickiness.

Nominal wage flexibility and real wage stickiness

Nominal wages are flexible when they adjust immediately to changes in the aggregate price level. Nominal wage flexibility can result, for example, either from the absence of long-term wage contracts or from wage contracts that are fully indexed to inflation. Insofar as changes in the price level are caused by changes in aggregate demand, nominal wage flexibility ensures that nominal wages adjust to keep the real wage at its equilibrium value. As a result, a flexible nominal wage helps insulate output and employment from changes in aggregate demand.

Problems can arise, however, when nominal wage flexibility leads to real wage stickiness—the failure of real wages to adjust to changes in such real economic factors as labor productivity. As with nominal wage stickiness, real wage stickiness may cause real wages, employment, and output to diverge from

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2 William Branson and Julio Rotemberg present a formal open economy theory of nominal and real wage stickiness in "International Adjustment with Wage Rigidity," *European Economic Review,* Vol. 13, No. 3, May 1980, pp. 309-32. The analysis here is similar.

3 For simplicity, this section discusses wage adjustment with variables defined as levels. Because in reality, wages, prices, and output all grow along a trend, it is preferable in empirical work to use detrended levels, rates of growth, or even detrended growth rates. Because this article analyzes cyclical wage adjustment rather than secular adjustment, detrending is not only desirable but also necessary.

4 No effort is made here to explain the existence of long-term contracts, but transactions costs must play an important part in any explanation.

5 Resulting unemployment will be involuntary *ex post* even though *ex ante,* workers and firms agree to a fixed nominal wage knowing full well its possible consequences.

equilibrium values. For example, suppose there is an increase in the relative price of an important input to the production process such as energy. For a given level of aggregate spending, the energy price increase causes both an increase in the aggregate price level and a reduction in the productivity of labor.[6] This type of supply shock will also lower the equilibrium real wage. However, if there is real wage stickiness—that is, if the increase in the price level is fully offset by an increase in nominal wages—real wages do not immediately decline to the lower equilibrium level associated with lower productivity. The delay in the adjustment of real wages to the drop in productivity will cause firms to reduce employment and output temporarily below equilibrium levels.

As sticky nominal wages prevent short-run adjustment to changes in aggregate demand, sticky real wages prevent short-run adjustment to changes in aggregate supply. Market forces ensure, however, that real wages adjust in the long run to the level consistent with labor market equilibrium.

Effects of disinflationary monetary policy

The impact of a disinflationary monetary policy that lowers monetary growth depends in part on whether wage adjustment is sticky.' Specifically, if nominal wages are sticky, a deceleration of monetary growth causes real output to decline and unemployment to increase. The reduction in monetary growth slows growth in aggregate demand, but the resulting slowdown in inflation is not reflected initially by a commensurate slowing in the growth of nominal wages. Thus, real wages increase more rapidly than productivity, causing firms to reduce output and employment.

In contrast, a disinflationary monetary policy has no adverse effect on employment and output if nominal wages and prices are completely flexible. In this case, lower growth in nominal wages fully reflects declining inflation, leaving growth in real wages, employment, and output unaffected. Thus, nominal wage flexibility reduces the real economic cost of disinflationary monetary policy, even though it may lead to real wage stickiness, which magnifies the short-run impact of changes in factors that affect labor productivity.

AN OVERVIEW OF THE EVIDENCE OF WAGE STICKINESS

This section provides an overview of some evidence on wage stickiness in the United States during the period from 1907 to 1980. By breaking the sample into three subgroups—1907-28, 1929-53, and 1954-80—and calculating sample statistics, changing patterns of economic performance can be identified. Breaking points were selected to separate the Great Depression and World War II years from the rest of the sample because of the "well known perversities in the wage and price dynamics of the period."[8] The statistical properties analyzed in this section are the volatility of individual series and the correlation of differing series.

Table 1 presents the standard deviations of annual nominal wages, real wages, and prices for each subperiod and for the full sample period. These statistics measure the volatility and secular changes in the volatility of the

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6 See Robert Rasche and John Tatom, "Energy Price Shocks, Aggregate Supply and Monetary Policy: The Theory and the International Evidence," *Carnegie-Rochesrer Conference Series on Public Policy*, Vol. *14*, Spring 1981, pp. 10-94, for a discussion of the technical assumptions necessary for declining productivity.

7 The appendix derives aggregate supply relationships and demonstrates the effects of changes in aggregate demand on prices and output under nominal and real wage stickiness.

8 Jeffrey Sachs, "The Changing* Cyclical Behavior of Wages and Prices," *American Economic Review*, Vol. 70, No. I, March 1980. p. 79.

Table 1
STANDARD DEVIATIONS OF WAGES AND PRICES: 1907-80

Variables	1907-80	1907-28	1929-53	1954-80
Prices	0.64	1.71	1.19	0.26
Nominal Wages	0.74	2.04	1.33	0.26
Real Wages	0.39	1.04	0.73	0.15

Table 2
CORRELATION COEFFICIENTS: 1907-80

Variables	1907-80	1907-28	1929-53	1954-80
Nominal Wages and Prices	0.85*	0.86'	0.84*	0.84*
Real Wages and Prices	−0.02	0.04	−0.10	− 0.29

*Significant at .05 level.

variables.[9] Real wages are measured as total compensation per hour for manufacturing workers in 1957 dollars and are inflated by the consumer price index to yield nominal wages. Prices, however, are measured by the implicit GNP deflator.

The most striking feature of Table 1 is the decline in the volatility of all variables, especially after 1953. For example, despite the recent high rate of inflation, inflationary volatility since 1954 has been remarkably low compared with the earlier periods. Volatility of nominal and real wages has also declined substantially in the most recent period.

The volatility of individual wage and price variables reported in Table 1 does not provide conclusive evidence regarding the degree of wage stickiness. The decline in variability of real wages taken by itself seems to suggest a decline in nominal wage stickiness. If nominal wage growth fully reflected the rate of inflation, then real wages would vary only because of changes in productivity and other real factors. In this case, the relatively low volatility of real wages since 1954 would be indicative of little or no nominal wage stickiness. However, the observed decline in real wage volatility could also result from the accompanying decline in the volatility of inflation even if nominal wage flexibility had declined. For this reason, an analysis of the co-movement of wages and prices provides better information on the degree of wage stickiness.

One statistic for measuring the extent to which two variables move in the same direction is the correlation coefficient.[10] The value of this statistic varies from minus one to plus one, with one indicating perfect positive correlation between the two series, zero indicating no correlation, and negative one indicating perfect negative correlation. Table 2 presents correlation coefficients for nominal wages and prices and for real wages and prices for 1907-80, 1907-28, 1929-53, and 1954-80.

The statistics reported in Table 2 show that nominal wages were highly correlated with prices for the entire sample period and for each subperiod. Moreover, the correlation did not decline significantly over time. This high and

9 Before calculating standard deviations, each series was detrended by a regression of the natural logarithm of each variable on a constant and on linear and quadratic time trends. Natural logarithms are used to minimize problems with heteroscedasticity and to allow for log-linear relationships among variables. Residuals from these regressions became the data for the analysis. Because the means of the resulting detrended variables were zero, the standard deviation of series $X_t (t=1, \ldots, N)$ is defined as:

$$\left\{\frac{1}{(N-1)} \cdot \sum_{t=1}^{N} X_t^2\right\}^{1/2}$$

10 The correlation coefficient between a series X_t and a series $Y_t (t = 1, \ldots, N)$ is defined as:

$$\sum_{t=1}^{N} X_t Y_t (\Sigma X_t^2 \Sigma Y_t^2)^{-1/2}$$

where the mean of X_t and Y_t are both zero because of detrending.

stable correlation does not support the hypothesis of significant and increasing stickiness of nominal wages. The higher the correlation between nominal wages and prices, the more closely nominal wage growth reflects changes in the rate of inflation. Thus, the high and stable correlation between nominal wages and prices seems to indicate that nominal wage stickiness was not prevalent in any of the subperiods.

The correlation coefficients between real wages and prices, however, provide more support for the hypothesis of increased nominal wage stickiness. Negative correlation between real wages and prices indicates that higher inflation is associated with lower growth in real wages, perhaps because nominal wages are sticky. Thus, the increasingly negative correlation between real wages and prices over the sample period is consistent with the view that increasing nominal wage stickiness reduced the responsiveness of nominal wage growth to inflation. However, the correlation between real wages and prices was not significantly different from zero in a statistical sense for any of the subperiods. Therefore, the increasingly negative correlation between real wages and prices could be the result of random occurrences rather than the increased nominal wage stickiness associated with a fundamental change in .wage-setting behavior.

While the nominal wage and price correlations point to the conclusion that nominal wages remained flexible, the real wage and price correlations hint at increased nominal wage stickiness. Neither result, however, decisively establishes whether there was a change in wage behavior. Simple correlations can be misleading in certain situations. For example, correlation coefficients are incapable of distinguishing between price changes resulting from changes in aggregate supply and those resulting from changes in aggregate demand, even though the source of price level changes has important implications for the associated behavior of nominal and real wages. Thus, determining the degree of wage stickiness requires a more complete model of wage behavior that takes account of supply shocks and various other factors affecting nominal and real wages.

AN EMPIRICAL MODEL OF WAGE ADJUSTMENT

Determining the type and extent of wage stickiness requires the estimation of a model of wage behavior. The model used in this article includes the factors affecting the target growth of real wages and the equilibrium growth of nominal wages. In the absence of wage stickiness, these factors would fully explain wage behavior. To allow for the possibility that stickiness also affects wages, however, the model is extended to include a description of how nominal wage growth adjusts to equilibrium.

A model of wage behavior

The model of wage behavior assumes that the demand for labor and the supply of labor depend on real rather than nominal wages. It further assumes that firms and workers decide on tafget real wage growth over the period covered by wage agreements, which are specified in terms of nominal wage growth. Determination of the target growth in real wages, $\tilde{w}$, is represented by equation 1 in Table 3. In the long run, trend growth of productivity—represented in the equation by the constant term, a , and the time trend variable, T—is a major determinant of real wage growth. However, anything that causes productivity to diverge from trend growth changes target real wage growth in the short run. For example, some analysts maintain that supply shocks in the 1970s reduced productivity and, thereby, lowered real wage growth. Government policies, such as wage and price controls, can

also change growth in real wages temporarily. These effects were captured by the inclusion of a variable, z, measuring oil and food price shocks and government policy intervention in the wage setting process. Finally, the degree of labor market tightness, as represented by q, the deviation in the growth rate of real output from trend, can influence the increase in real wages firms must pay to attract or retain workers.[11]

The model then stipulates that equilibrium growth in nominal wages, W*, is equal to target growth in real wages plus the expected rate of inflation, P^e. This is represented by equation 2. Equilibrium nominal wage growth can be interpreted as the nominal wage growth specified in recent wage agreements, which presumably reflect expectations of inflation and target real wage growth based on the information available when the agreement was reached. For wage agreements that fully index nominal wages to inflation, there is no need to incorporate the expected rate of inflation into nominal wage growth to keep growth in real wages at the target rate. Fully indexed nominal wages adjust automatically to reflect actual inflation. Comparatively few wage agreements, however, provide for cost of living adjustments, and almost none are fully indexed.[12] Thus, it seems realistic to assume that equilibrium nominal wage growth is based on the rate of inflation expected over the term of wage agreements.

Table 3
A MODEL OF NOMINAL WAGE BEHAVIOR

(1) $\tilde{w}_t = a + \gamma T + \beta z_t + \phi q_{t-1}$

(2) $W_t^* = \tilde{w}_t + P_t^e$

(3) $W_t - W_{t-1} = \lambda(W_t^* - W_{t-1})$

(4) $W_t - W_{t-1} = b_0 + \lambda(P_t^e - W_{t-1}) + b_1 q_{t-1} + b_2 z_t + b_3 T$

Definitions:

$\tilde{w}$	=	target growth in real wages
T	=	linear time trend
z	=	a vector of policy intervention variables and supply shock variables, including NRA, WWII, and NIXON price control dummies as well as the relative price of food and energy
q	=	real GNP growth as a proxy for labor market tightness
W*	=	equilibrium growth in nominal wages
P^e	=	expected inflation
W	=	actual growth in nominal wages
λ	=	coefficient of partial adjustment of nominal wage growth to equilibrium

11 Equation 1 uses the rate of growth of real GNP at the time of contract negotiation to represent labor market tightness and a time trend to represent secular movements in the underlying economic variables. Inclusion of the trend allows estimation of the short-run response of wages to cyclical fluctuations. Inclusion of the trend also implies that wage growth will eventually reflect any change in the long-run, secular rate of inflation.

Policy and supply variables control for episodes of governmental invervention in the wage-setting process and changes in the relative price of food and energy. The government intervention variables represent price and wage control programs introduced during the 1930s under the National Recovery Act, during World War 11, and during the Nixon Administration. They are represented as dummy variables. The values of these policy variables are based on the assumption that government intervention has, at most, a temporary effect on wages. Precise definitions of these variables are given in the notes to Table 4.

The variable representing food and energy prices is the difference between the rates of change of the U.S. National Income and Product Accounts deflators for personal consumption expenditures and for personal consumption net of expenditures on food and energy. Because these statistics were not compiled before 1947 and energy supply shocks were not important before then, the food and energy variable is set equal to zero for the 1907-46 period. Both the food and energy variable and the government intervention variables are defined as in Gordon, "A Consistent Characterization . . . ."

12 See Alan Blinder, "Indexing the Economy Through Financial Intermediation," Carnegie-Rochester Conference Series on Public Policy, Vol. 5, 1975, pp. 69-106, for a more complete discussion of indexation of wage and other contracts.

The model next recognizes that stickiness in nominal wages may keep actual nominal wage growth from adjusting immediately to equilibrium. This is represented by equation 3. In equation 3, the coefficient of adjustment, λ, measures the extent to which the change in nominal wage growth, $W_t - W_{t-1}$, reflects the change that would be required to achieve equilibrium nominal wage growth, $W_t^* - W_{t-1}$ If the coefficient of adjustment equals dne, nominal wage growth equals equilibrium wage growth in each period, implying the absence of nominal wage stickiness. A coefficient of adjustment less than one, however, implies that nominal wages are sticky and that a portion of any discrepancy between actual and equilibrium growth in nominal wages may persist for several periods. Nominal wage stickiness is thus characterized as partial adjustment of actual growth in wages to equilibrium growth.

This type of nominal wage stickiness might result, for example, because the U.S. labor market includes a substantial unionized sector characterized by three-year overlapping wage contracts, which are typically not fully indexed to the rate of inflation, as well as a nonunion sector in which long-term wage contracts are less prevalent. Nominal wage growth over a year, therefore, depends both on wages determined by current labor market conditions and current expectations of inflation and on wages specified in long-term contracts negotiated in each of the two preceding years, when labor market conditions and inflationary expectations may have been substantially different. Thus, the rate of adjustment of nominal wage growth to equilibrium reflects both the prevalence and duration of long-term wage contracts.[13]

All these elements of wage behavior are summarized in equation 4, which combines the three previous equations. By incorporating partial adjustment to equilibrium nominal wage growth as well as the determinants of equilibrium nominal wage growth, the equation completely represents wage behavior.

Empirical estimates of the model

Equation 4, representing the adjustment of wages, was estimated for the 1907-80 period and two subperiods.[14] Division of the sample into two subperiods, the second beginning in 1945, allowed a test of whether the growing prevalence of long-term wage contracts after World War II fundamentally changed wage adjustment.

The estimates indicate that, for the period from 1907 to 1944, nominal wage growth adjusted to changes in expected inflation within a year. Thereafter, the adjustment took significantly longer. These results suggest that an important change in wage-setting behavior

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13 Jeffrey Sachs introduced this interpretation of a partial adjustment model of wage behavior in "Wages, Profits, and Macroeconomic Adjustment: A Comparative Study," *Brookings Papers on Economic Activity,* 1979, pp. 269-332.

14 Before the estimation can be carried out, a proxy must be found for expected inflation, which is not directly observable. Under the assumption that economic agents know how prices are determined (rational expectations), expected inflation will be an unbiased forecast of actual inflation. Thus, the actual inflation rate may be used as a proxy variable for expected inflation. Because the inflation forecast error may be correlated with other right-hand-side variables, however, an instrumental variables procedure is used for estimating equation 4. Instruments include all predetermined variables in the model, as well as lagged prices and lagged money. Bennett McCallum suggests this technique in "Rational Expectations and the Estimation of Econometric Models: An Alternative Procedure," *International Economic Review,* Vol. 17, NO. 2, June 1976, pp. 484-90.

Other specifications of equation 4 were estimated. These specifications experimented with alternative detrending techniques and various labor market tightness proxies. Among the latter were the unemployment rate and the GNP gap. All the specifications tried suggested an increase in nominal wage stickiness after World War II.

did take place in the postwar period. The hypothesis of nominal wage stickiness in the 1907-44 subperiod can be rejected because the estimated value of the coefficient of adjustment, λ, is 0.916 and is insignificantly different from one (Table 4). Nominal wage growth closely shadowed equilibrium wage growth in that period. Data from the early half of the century, therefore, show no influence of long-term contracts on nominal wages. In contrast, for the 1945-80 period, the estimate of the coefficient of partial adjustment of wages falls to 0.592, which is significantly less than one.[15] Thus, empirical estimates support the view that nominal wage stickiness increased in the postwar period. Nominal wage growth in that period did not respond quickly to changes in equilibrium wage growth, possibly because of the growing importance of long-term wage contracts after 1945.

Table 4
REGRESSIONS RESULTS FOR THE WAGE EQUATION

Dependent Variable = $W_t - W_{t-1}$

Variable	1907-80	1907-44	1945-80
Constant	0.101*	−4.940	− 15.760
	(2.781)	(11.686)	(12.478)
$P_t^e - W_{t-1}$	0.908**	0.916**	0.592**
	(0.087)	(0.126)	(0.114)
q_{t-1}	0.063	0.134	−0.073
	(0.074)	(0.122)	(0.062)
NRA†	7.587**	8.466	—
	(3.491)	(4.924)	—
WWII‡	7.158	3.749	1.435
	(4.020)	(9.267)	(3.348)
NIXON§	1.477	—	0.862
	(2.954)	—	(1.227)
Food and Energy	− 0.655	—	− 0.260
	(0.686)	—	(0.339)
T	0.086	0.340	0.458
	(0.112)	(0.674)	(0.345)
Standard Error	3.043	4.248	1.193
Durbin-Watson	2.476	2.674	2.924

*Standard errors are in parentheses
**Significant at .05 level
†NRA Dummy: NRA = 0.4 for 1933, 0.6 for 1934, − 0.4 for 1935, − 0.6 for 1936, and 0 otherwise
‡WWII Dummy: WWII = 0.5 for 1943. 0.4 for 1944, 0.1 for 1945, − 0.6 for 1946, − 0.4 for 1947, 0 otherwise
§NIXON Control Dummy: NIXON = 0.5 for 1972, 0.5 for 1973, − 0.3 for 1974, − 0.7 for 1975, 0 otherwise

Empirical evidence regarding real wage stickiness is less conclusive. Since nominal wage growth immediately reflected changes in the expected rate of inflation in the 1907-44 subperiod, the estimated equation can be interpreted as explaining real wage growth in that period. Consequently, the small and statistically insignificant coefficient on the labor market tightness variable, q_{t-1}, suggests that labor market conditions did not have an appreciable effect on real wage growth for the 1907-44 subperiod. This indicates that real wages were sticky in the first part of this century. In contrast, the empirical evidence is not conclusive regarding real wage stickiness in the postwar period. The finding that nominal wage growth did not respond immediately to changes in expected inflation after World War II means the estimated equation cannot be taken as explaining real wage growth in the second subperiod. As a result, the statistically insignificant coefficients on both the labor market variable and the food and energy supply shock variable do not necessarily imply real wage stickiness in the postwar period. The results show only that nominal wage growth was independent of these real influences. Thus, it cannot be determined from the empirical evidence presented whether the real wage stickiness from 1907-44 continued in the postwar period.

[15] Equation 4, however, passes a Chow test for the stability of all the parameters together.

SUMMARY AND CONCLUSION

The degree of nominal wage stickiness increased in the United States after World War II. Because the timing of the increase coincided roughly with the introduction of three-year staggered wage contracts the finding is consistent with the view that long-term contracts cause nominal wage stickiness.

Regardless of the cause, the finding of nominal wage stickiness in the postwar period implies that the cost of disinflation has increased. A slowing of inflation brought on by a reduction in the rate of growth of the money supply causes an increase in real wage growth, which, in turn, slows growth of output and increases unemployment.

Thus, the evidence presented in this article helps to explain the recent U.S. economic experience. The progressively lower inflation accompanying reduced monetary growth since 1979 has been associated with increasing unemployment and sluggish growth in real output. A partial explanation for the adverse economic consequences of disinflationary monetary policy is the slow adjustment of wages to declining inflation.

APPENDIX

This appendix derives aggregate supply curves under nominal and real wage stickiness. It then illustrates the nominal and real consequences of a shift in aggregate demand under the two types of wage behavior. The symbols used in the appendix are not the same as those used in the text.

Figure 1 illustrates the special case of a fixed nominal wage. It is assumed that no contract is renegotiated in the short run. In panel a, labor

Figure 1

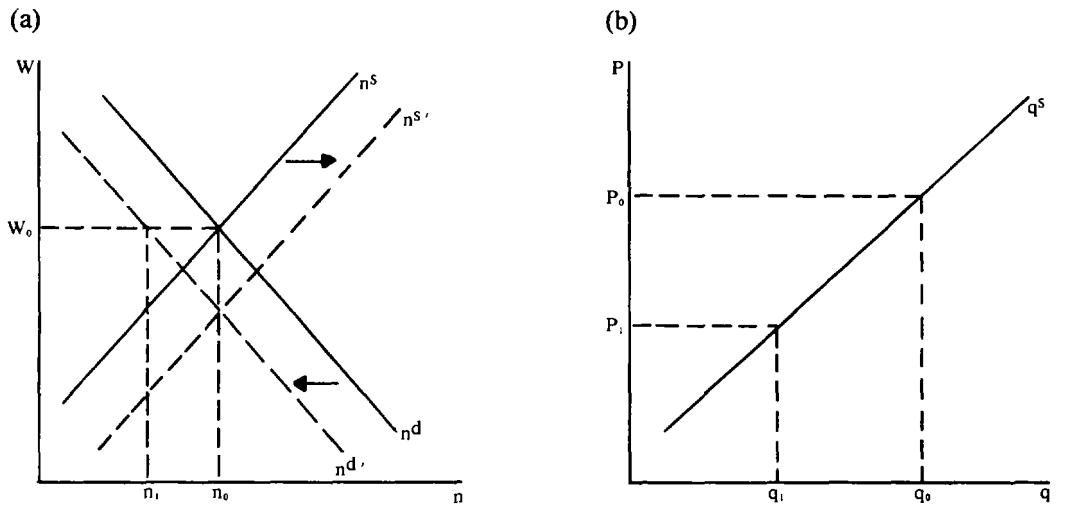
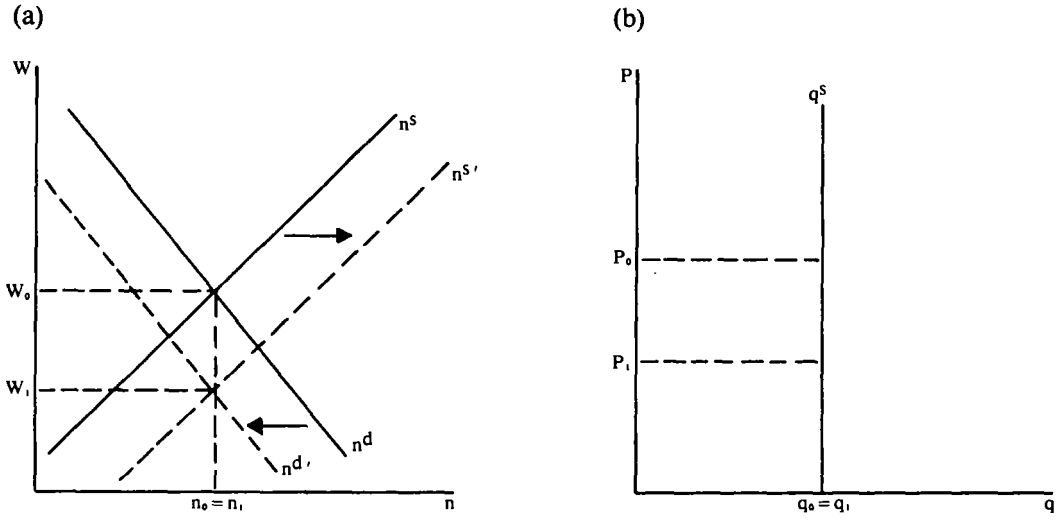


Figure 2

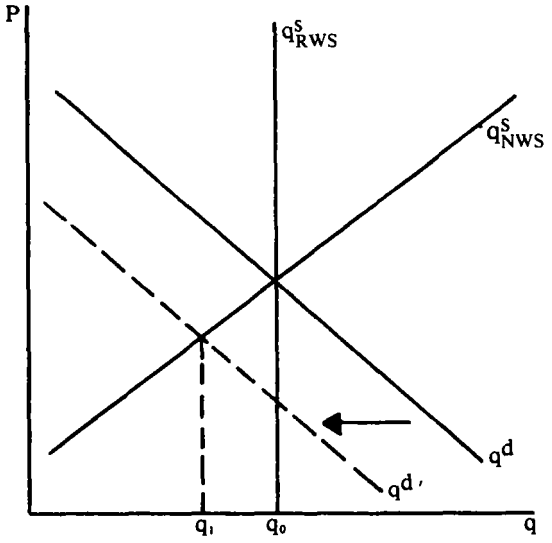


supply and demand curves are drawn as functions of the nominal wage rate. The nominal wage rate, w, is on the vertical axis, and labor supply and demand, n^s and n^d, are on the horizontal axis. With prices held constant, an increase in w increases real wages and causes workers to increase the hours they work. At the same time, an increase in real wages increases production costs and causes firms to hire fewer workers. Thus, for a particular price level, labor demand declines and labor supply increases as w increases. Under the assumption that the economy is initially at long-run equilibrium, the wage rate, w_0, and employment, n_0, are determined by the intersection of labor supply and demand. Long-run equilibrium corresponds to a situation where all contracts determine market-clearing wages.

If the price level declines in the short run, as a result of, say, a decline in the money supply, labor demand shifts down and to the left from n^d to $n^{d\prime}$. At any nominal wage rate, firms want to hire fewer workers because the associated real wage has increased. Labor supply, on the other hand, shifts down and to the right, from n^s to $n^{s\prime}$. At any nominal wage rate, workers will supply more labor, because the associated real wage is higher. If w is fixed contractually at w_0, however, the labor market will no longer clear. The new level of employment, n_1, will be determined by the value of labor demanded at the wage, w_0. As long as w_0 remains above the new long-run equilibrium, employment will decline below its full-employment level.

Because declining employment means declining output, the hypothesized fall in the price level generates a reduction in output. Panel b of Figure 1 plots the initial output, q_0, associated with the initial price level, p_0, and plots the lower level of output, q_1, associated with lower prices, p_1. Carrying out the same experiment of altering the price level and tracing out the effect of the change through the labor market to the

Figure 3



product market for all possible prices determines a short-run aggregate supply curve, q^s, that slopes upward. Nominal wage stickiness, therefore, causes a short-term decrease in production when the price level falls.

Panel a of Figure 2 depicts the same labor supply and demand curves as in Figure 1. However, the real wage, $r = w/p$, is now assumed fixed at its initial level, r_0. When prices fall as a result of, say, a decline in the money supply, nominal wages quickly fall to maintain a constant real wage. As in Figure 1, the increase in real wages shifts n^d and n^s downward, but the nominal wage rate now falls from its initial level, w_0, to a new level, w_1. Because both labor demand and labor supply depend on real wages, which have not changed, employment remains the same. As panel b of Figure 2 indicates, constant employment in the labor market translates into constant output in the product market. The short-run aggregate supply curve, q^s, is vertical, implying that any price level is compatible with employment level, n_0, and output level, q_0.[16]

Figure 3 illustrates the effect of a fall in aggregate demand on prices and real output under different short-run aggregate supply curves. When short-run aggregate supply slopes upward as a result of nominal wage stickiness, as in curve q^s_{NWS}, a downward shift in aggregate demand causes both prices and output to fall. Any policy that shifts aggregate demand from q^d to $q^{d'}$ results in a drop in prices and a short-run output loss of $q_1 - q_0$. Under real wage stickiness and a vertical aggregate supply curve, q^s_{RWS}, however, declining aggregate demand causes only prices to fall. Output remains at its original level of q_0.

16 While the real wage was initially assumed fixed at a level that clears the labor market, this assumption may not, in fact, be true. If the real wage is fixed at a level above long-run equilibrium, chronic unemployment will result. Only by chance would an inflexible real wage lead to full employment in the short run.

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