Economic Position of Oils and Fats in the War and Post-War Periods*

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THE economics of oils and fats, the subject given me for discussion at this meeting, is broad enough to cover all economic phases of the oils and fats industry. However, I propose to limit myself to a discussion of questions bearing on the economic outlook. The discussion will be divided into three sections, covering the present situation, the American oils and fats position when war in Europe ends, and the outlook for some representative post-war year, centering perhaps about the year 1950.

In war time, oils and fats are commodities of critical importance. Europe, normally an importer, today is suffering from a serious lack of fats for both food and technical uses. The loss of the Far East as a source of supply of coconut oil, palm oil, and tung oil—to name a few of the important items—has resulted in serious inconvenience in our own country, and in Canada, Mexico, Central America, the Caribbean countries, and the United Kingdom. In addition, the German occupation of fertile portions of western and southern Russia created an urgent need for imports in a country normally self-sufficient in oils and fats.

Before the war, exports from the Far East amounted to more than 3 billion pounds of oils and fats annually. Another billion pounds of oil has been lost temporarily as a result of cessation of whaling activities. These losses in total supplies, so far as the United Kingdom and the Western Hemisphere are concerned, have been largely offset by the blockade of most of continental Europe and by increased production of fats on this continent and in South America.

The Situation in 1944

THE year 1944 will be marked by a record production of fats in the United States. More than 11 billion pounds will be produced from domestic materials this year compared with 8.2 billion pounds in 1939. Thus, since the outbreak of war in Europe, total output has increased by approximately 3 billion pounds, or 35 percent. The gain in output of vegetable oils has been relatively large, with a 75-percent increase in production since 1939 as compared with an increase of about 25 percent in animal fats. The most striking gains have been in output of soybean oil, linseed oil, lard, grease, and tallow. On the other hand, fairly sizable reductions in output of butter, cottonseed oil, and marine animal oils have occurred.

In contrast to the sharp increase in total domestic production, imports of oils, fats, and oil-bearing materials have declined about 50 percent since 1939. The decrease in imports has been chiefly in coconut oil and copra, palm oil, olive oil, and tung oil. Other notable reductions have occurred in imports of marine animal oils, babassu kernels, and perilla oil. These losses have been partly offset by increased imports of sunflower oil from Argentina.

The Brazilian babassu crop, which is potentially very large, has made a poor showing in the war period. The basic reason for this appears to be the diversion of much of the agricultural labor force of Brazil to the production of rubber and to other activities.

After writing off the loss in imports, the net gain in domestic supplies of oils and fats resulting from increased production since 1939 amounts to about 2 billion pounds.

Against this gain have been marked increases in civilian, military, and export demands. Exports to foreign countries and shipments to United States territories, including the fat contained in margarine, shortening, and soap, totaled about ½ billion pounds in 1939. The allocation made by the War Food Administration for total exports and shipments this year amounts to nearly 1.8 billion pounds, which would indicate an increase in exports since 1939 of over 1 billion pounds. Most of the increase is represented by exports under lend-lease to Russia, the United Kingdom, and British forces overseas. More than half of the total quantity of oils and fats going out of the country will be lard. Substantial quantities of edible oils (including edible linseed oil), shortening, margarine, and butter also will be shipped. Scheduled exports of soap and industrial oils are comparatively small.

Domestic requirements have also expanded. Total takings by civilians and the military are estimated at about 10.4 billion pounds in 1944 compared with 9.6 billion pounds in 1939, a gain of 800 million pounds. Civilian consumption of food fats under rationing and other controls will be moderately lower this year than in 1939, and the use of industrial oils for some civilian products such as paint and floor coverings will be less. But purchases by the military forces will be considerably larger than in 1939.

Since the pre-war period, some significant changes have occurred in manufacturers' use of fats. Excluding butter and lard, manufacturers will process about 5 percent more oil and fat for food products in 1944 than in 1939, and about 25 percent more for nonfood products. The largest percentage gains will be in margarine, synthetic rubber, lubricating and cutting oils, core oils, and soap.

THE principal reason for the increase in manufacture of margarine is the reduced supply of butter. A decrease in shortening is explained largely by the very marked gain in production of lard that has occurred in recent years. Production of paints and related products for civilian purposes has been curtailed as a part of the war program. The use of fats in soap for civilians is limited; but, in the absence of consumer rationing, total soap requirements are greater now than they were in the pre-war period.

Changes have occurred also in the kinds of oils and fats used. Coconut, palm, palm-kernel, and babassu

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oils have virtually disappeared from manufactured food products. Their place has been taken mainly by hydrogenated soybean oil and peanut oil. Cottonseed oil continues to occupy an important place in the food-product field. The quantity of hard tropical oils going into soap has been sharply reduced, with domestic animal fats—grease, tallow, and lard—taking up the slack. Increased quantities of rosin also are going into soap. In the paint, varnish, and floor covering fields, the use of tung oil has been drastically reduced, perilla oil has practically disappeared, and supplies of oiticica oil, castor oil, fish oil and soybean oil for drying-oil products have been severely limited. As a result of these reductions, linseed oil has come back to the position it held 30 years ago as the principal oil for almost all uses in the drying-oil field.

Prices of fats and oils are now under ceiling control. Wholesale prices of fats and oils as a whole have risen about 77 percent since 1939, with approximately the same percentage gain for food fats and oils as a group as for nonfood items as a group. Among the food fats and oils, the wholesale price of butter at Chicago has gone up 60 percent since 1939; refined peanut oil at New York 75 percent; corn oil 76 percent; soybean oil 102 percent; cottonseed oil 112 percent; and prime steam lard at Chicago 115 percent. Among the soap fats, the price of No. 1 tallow at Chicago has advanced 65 percent since 1939; grease 69 percent; crude coconut oil at New York 78 percent; and crude sardine oil, Pacific Coast, 117 percent. Among the drying oils, linseed oil at New York has advanced 62 percent since 1939 and tung oil 86 percent. Despite these advances, prices of oils and fats are only slightly higher than in the 1920's, and are considerably below the peak prices reached during the last war.

Situation When War in Europe Ends

TURNING to the future, the next significant development affecting the position of oils and fats in this country probably will be the reopening of the continental European market to world trade. It is possible, of course, that war may end in the Orient before it ends in Europe. In that case, changes in the international picture for fats would be different than those outlined here. But in common with the most widely expressed belief, it is assumed that active hostilities will cease in Europe some time before they do in the Far East.

Continental Europe, excluding Russia, is the largest consuming and importing area for oils and fats in the world. Before the war, approximately 10 billion pounds of oils and fats were produced annually in this area and nearly 5 billion pounds were imported.

Production of fats from land animals, which made up about two-thirds of total European production before the war, has been reduced as a result of a shortage of imported animal feed, although the reduction in fat output has been tempered by large-scale diversion of fluid milk to butter and by the production of synthetic fats. Production of marine animal oils has been reduced also. As a partial offset to these reductions, output of oil from oilseeds has been expanded, perhaps doubled, since the war began. But oil produced from such products as cottonseed, flaxseed, rapeseed, soybeans, and sunflower seed represented only 6 or 7 percent of the total fats produced in continental Europe before the war. Production of olive oil, which representeed 18 to 20 percent of total output in pre-war years, probably has not changed greatly.

No one can say precisely what the production of fats will be in Europe in the first full year following the defeat of Germany. Some recovery in production of animal fats may occur, but the upswing in this field probably will get under way slowly. Destruction of crops and facilities as a result of military operations and deliberate scorching might be an important factor in reducing the production potential. Altogether it seems likely at that time that total output for the Continent, excluding Russia, may be 5 to 15 percent less than in pre-war years, or in round numbers possibly 9 billion pounds.

Allowing for growth of population, total requirements on the Continent, not including Russia, in the first year after the defeat of Germany would be something over 15 billion pounds, if consumption were to be restored to the full pre-war level. Under these conditions approximately 6 billion pounds of imports would be needed. Merely to restore consumption of 75 percent of the pre-war standard, over 2 billion pounds of imports would be needed. These imports would be in addition to those now being taken by the United Kingdom and Russia.

WORLD exports of oils and fats, counting production of whale oil as an export item, amounted to about 10 billion pounds annually in pre-war years. Net exports from the area now under Japanese control, namely the East Indies, Philippines, Manchuria, Chosen, China, Indo-China, Thailand, Malaya, and Burma, amounted to about 3⅓ billion pounds, or about one-third of the total supply entering international trade. Exports from the South Pacific Islands, including New Guinea, amounted to about 160 million pounds. Australia and New Zealand accounted for nearly 600 million pounds, mostly butter and other animal fats. India and Ceylon and other areas in the Middle East contributed approximately 900 million pounds, Africa about 2.1 billion pounds, and South America nearly 1.6 billion pounds. In addition, production of whale oil, largely in the Antarctic Ocean, contributed over 1 billion pounds annually to world trade, or more than 10 percent of the total.

Exports from the Japanese-controlled area have been lost temporarily, and the quantity of whale oil produced has declined to negligible proportions. Against these losses may be listed two facts. North America has changed from a net importing to a net exporting position, and exports from South America could be increased. The quantity of exports available in 1944 apparently totals between 5 and 6 billion pounds. Allowing for some increases in supplies, net exports, excluding the Japanese-controlled area, could reach 6 billion pounds in 1945. Most of these would go to Europe. To restore consumption in Europe, including the United Kingdom and Russia, fully to pre-war levels would require 9 or 10 billion pounds of imports.

European import requirements for fats in the first year after the war may be met through a number of agencies—Foreign Economic Administration, Army, United Nations Relief and Rehabilitation Administration, and national or private importers. Whatever

agencies undertake the job, there is certain to be a big increase in the demand for imported oils and fats when the Continent is reopened to trade. Competition for available supplies in exporting areas will be strong, and unless international price agreements embracing all purchases are reached and adhered to, prices in such surplus-producing areas as Africa and South America are likely to advance above present levels. These agreements could be similar to those now in effect among the United States, the United Kingdom, and Canada operating through the Combined Food Board. If it is assumed that the bulk of Far Eastern supplies of oils and oil-bearing materials continues to be held under Japanese control, then it is probable that the world demand for imports outside the Japanese sphere would exceed the world supply of exports at prices now prevailing. Among other things, this would mean an increase in the demand for exports from the United States and difficulty in maintaining even the present restricted volume of imports into the United States. This condition might be expected to last at least 1 year and possibly 2 to 3 years in varying degree. The resumption of Antarctic whaling and the reopening of the Far East as a source of supply would bring almost immediate relief on the supply side, although time would be required to restore the full pre-war volume of exports from the Far East. Damage to collection centers and port facilities will be severe in areas in which intensive military operations are carried out, and much regrouping of plantation labor undoubtedly will be needed.

The Situation in 1950

A SOMEWHAT different set of circumstances will confront American producers and processors of oils and fats 5 or 6 years hence when world demand and supply are not so badly out of balance as they are likely to be immediately after the war. Let us look ahead to 1950, when, it may be assumed, Far Eastern sources of supply will be restored and wide-scale whaling activity will be resumed.

One of the first set of factors to be considered is the level of general business activity, employment, and incomes in the United States and in other important consuming countries. No one can foretell accurately whether we shall be fully employed, partly employed, or in a condition of serious depression in 1950. Let us examine the two extreme assumptions, namely, full employment and a high level of business activity and income on the one hand, and a condition of serious depression on the other.

Under conditions of full employment we might expect a national income in the United States of around 140 billion dollars annually, not much less than in the current year of peak war production. This figure is arrived at partly by definition of the situation, and partly by examining the trends in total population, working force, and productivity of labor. The general level of commodity prices is assumed to differ little from that in 1943.

Under this set of assumptions, annual per capita consumption of visible food fats, including butter, margarine, lard, other shortening, and oils, has been estimated at 54 pounds compared with 48 pounds per capita in 1935-39. With a population of 144 million this would give a total domestic consumption of food fats in 1950 of about 7.8 billion pounds, 25 percent more than in the pre-war period. Domestic consumption of oils and fats for nonfood purposes, such as soap, paint, lubricants, and so on, has been estimated at 3.9 billion pounds, up 35 percent from the pre-war level. Total domestic consumption of food and nonfood oils and fats would be about 11.7 billion pounds, which would exceed that in any year to date. The nearest approach to this level was in 1941, a year of inventory building, when domestic disappearance totaled 10.8 billion pounds.

To support such a high level of consumption and to maintain exports at about the pre-war rate, domestic production and imports in 1950 would necessarily be greater than in the pre-war period. If a net balance of imports over exports of about 1⅓ billion pounds is assumed—a balance not greatly different from that in 1939—requirements for domestic production of oils and fats in 1950 would total about 10.5 billion pounds. This would be almost as high as the peak war production of slightly over 11 billion pounds expected in 1944.

In terms of specific commodities, it might be expected that about two-thirds of the total domestic production under a high level of employment in 1950 would be animal fats and oils, including marine oils. This presupposes a comparatively large output of both butter and lard. The remaining third of domestic production, approximately 3.5 billion pounds, would consist chiefly of cottonseed, soybean, linseed, corn, and peanut oils. The most notable departure from the pre-war position would be in the expansion of soybeans and soybean oil. Under conditions of full employment, the acreage of soybeans harvested for beans might reasonably be expected to total about 10 million acres in 1950. This would compare with 11 million acres of soybeans harvested in 1943 and 4 million acres harvested in 1939.

A DISTINCTLY less optimistic view for 1950 would place national income at about 55 billion dollars, with a condition of severe depression. Prices of agricultural commodities would be much lower than they are now, perhaps as low as they were in 1932. Consumption would not fall so far from the full prosperity level. Net imports probably would be somewhat smaller than under more prosperous conditions, and domestic production, especially of soybean oil and linseed oil, very likely also would be lower.

So much for the demand side of the picture. On the supply side, measured in terms of world production trends, it is possible that the marked upward movement in output of tropical and semi-tropical oils and whale oil, which had such a depressing effect on prices of oils and fats in 1939 and 1940, may be resumed when the war is over. But several years probably will be required to restore Far Eastern plantations to pre-war efficiency, and a definite limitation on output of whale oil may be reached in the next 4 or 5 years. Then, too, European production of animal fats by 1950 may just be reaching the early war level. It may be recalled also that world population is trending upward and that per capita consumption of oils and fats is still capable of great expansion. On the whole, it does not seem likely that restoration of the upward trend in world output of oils and fats will have proceeded so far by 1950 as to have a serious

price-depressing effect. But considering the great production potential in tropical regions, it is possible that by 1955 or 1960 world production of fats may be over-large in terms of prices considered by producers to be fair and reasonable.

PUBLISHED INFORMATION

Continental Europe's Wartime Food Balance, J. H. Richter, Foreign Agriculture, U. S. Department of Agriculture, Office of Foreign Agricultural Relations, April 1943.

Fats and Oils in the War, Karl Brandt, War-Peace Pamphlet No. 2, Food Research Institute, Stanford University, California, June 1943.

The Fats and Oils Situation, monthly, U. S. Department of Agriculture, Bureau of Agricultural Economics.

Animal and Vegetable Fats and Oils, annual, U. S. Department of Commerce, Bureau of the Census.

Factory Production and Consumption, and Factory and Warehouse Stocks of Animal and Vegetable Fats and Oils, monthly, U. S. Department of Commerce, Bureau of the Census.

Foreign Commerce and Navigation of the United States, annual, U. S. Department of Commerce (not available since 1941).

Oils and Fats: Production and International Trade, in 2 Parts, International Institute of Agriculture, Rome, 1939.

International Yearbook of Agricultural Statistics, International Institute of Agriculture, Rome.

Statistical yearbooks of foreign countries.

Review of the Oilseed, Oil and Oil Cake Markets, annual, Frank Fehr & Company, London.

UNPUBLISHED INFORMATION

United States foreign trade statistics, beginning 1942, U. S. Department of Commerce, Bureau of the Census (not available for publication).

Fats and Oils: Allocation IV, January 1 to December 31, 1944, by quarters, War Food Administration, Office of Distribution, January 25, 1944 (confidential).

Notes on the Stabilization of Oxidized Fats by Steam Deodorization With Phosphoric Acid or Commercial Lecithin[1]

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Introduction

COMMERCIAL lecithin has long been known as an antioxidant for fats and oils, having been patented for this purpose by Bollman (1) in 1926. Olcott and Mattill (7) have demonstrated that cephalin rather than lecithin is the active substance in the commercial product, and have attributed its activity to an ionizable hydrogen atom in the phosphoric acid group. Phosphoric acid itself is recognized as an antioxidant in the patents issued to Eckey (2), and Richardson, Vibrans, and Andrews (9). It has been shown by various investigators (4, 6, 10) that antioxygenic activity is not peculiar to phosphoric acid, but is a property of acidic substances in general.

It has been well established that acids are not antioxidants when present alone in fats, but are capable of enhancing the antioxygenic activity of tocopherols or other antioxidants of the phenolic type. Recently Golumbic (3) has advanced a logical explanation of the synergistic action of certain acid-type antioxidants with tocopherols. Since tocoquinones, one group of the oxidation products of tocopherols, may be recyclized to tocopherols by treatment with mineral acids (5), it is suggested that phosphoric acid and other acidic antioxidants are able to prolong the induction period of oxidizing fats by continuously regenerating tocopherols during the course of oxidation. Conversion of tocoquinone to tocopherol by phosphoric acid was actually observed by Golumbic in a fat to which tocoquinone had been added, but not in a natural oxidized fat.

The present investigation was prompted by certain observations relative to the effect of commercial lecithin on the stability of deodorized shortenings and other fats. It was observed by one of the authors some years ago, and is probably generally known in the industry, that lecithin added to fat before it is steam deodorized is equally as effective as lecithin added after deodorization. Actually, it is advantageous to incorporate the lecithin before deodorization. By this procedure the lecithin can contribute no flavor or odor to the fat and, since the surface-activity of the lecithin is destroyed in deodorization, the treated fat is not inclined to foam. Recently it has been noted in this laboratory that vegetable fats of poor stability respond somewhat more favorably to lecithin treatment in the deodorizer than fats of good stability. Since the poorer-keeping fats generally contain relatively large amounts of tocopherol oxidation products, this naturally suggests the possibility of tocopherol regeneration occurring in the deodorizer.

In this communication are reported certain observations made during an investigation of combined deodorization and treatment with lecithin or phosphoric acid, particularly for the stabilization of oxidized fats.

Preparation of the Samples and Methods of Testing and Analysis

THE vegetable oils used in these experiments were commercially refined and bleached, but hydrogenated and deodorized in the laboratory. The oxidized samples were prepared by aerating the oil at 105° to 110° C. until the desired peroxide value was reached. All deodorizations were carried out at 400° F. (204° C.), with a deodorization time of 45 minutes. Stability tests were conducted by the Swift aeration method, at 110° C., keeping-times being recorded in terms of the number of hours required for the sample to develop a rancid odor. Where small amounts of phosphoric acid were to be added to oils before deodorization, the acid was first absorbed on an acid-washed grade of diatomaceous earth, according to the method of Eckey (2). The general procedure

[1] Presented before the American Oil Chemists' Society Meeting, New Orleans, Louisiana, May 10 to 12, 1944.

[2] This is one of four regional research laboratories operated by the Bureau of Agricultural and Industrial Chemistry, Agricultural Research Administration, U. S. Department of Agriculture.