Olive oil market stabilisation scheme for the Mediterranean region

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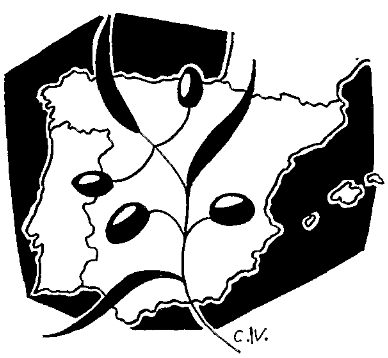


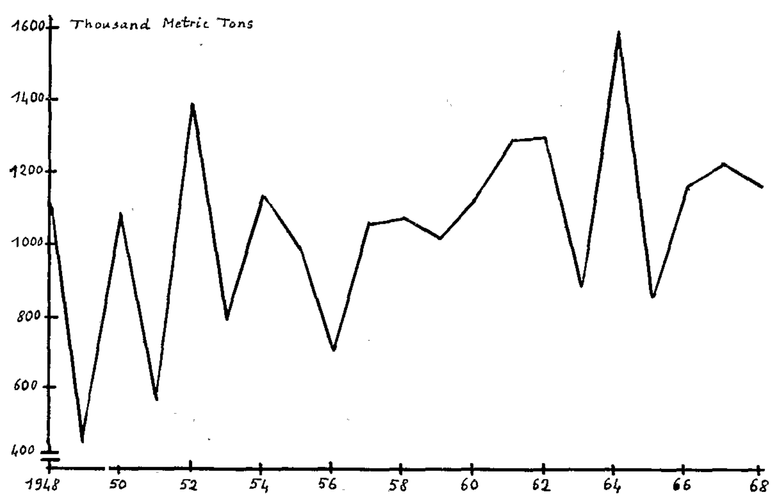
A major feature of the international olive oil economy is its instability. Market instability is caused mainly by the irregular production pattern of the olive tree which results in large fluctuations in olive oil supplies from one year to the next. This production irregularity displays a two-year cycle. That is, a high production year is usually followed by a low production year and vice versa (Figure 1). Although it may be possible to lessen the yearly variations in olive yelds by improving cultivation and tree slection, it is expected that the cyclical olive production pattern of the past will continue to repeat itself in the foreseeable future.

Several International Olive Oil Agreements have been in operation since 1956 with one of their primary objectives being that of market stabilication. However, very little study has ben made of economic feasibility, scope and contribution fany specific stabilization scheme (4). The objective of this paper is to define, estimate and appraise the performance of a hypothetical buffer-stock scheme which would reduc the disadvantages due to fluctuations of olive oil market supplies. This study is designed to provide some quantitative guidelines as to the extent of stability which can be achieved and to specify the most relevant economic considerations which would affect the opration of such (or similar) stabilization schemes.

PRODUCTION CYCLE AND MARKET INSTABILITY

Despite the normal commercial stocking of olive oil in high production years and the withdrawals of these stocks in low production years, the cyclical production pattern has had a pronounced effect on market supplies, prices and the flow of olive oil trade. The fluctuating market supply and erratic prices of olive oil have placed olive oil at a disadvantage in competition with other cheaper oils which are abundantly supplied. In this respect, it is argued that a substancial share of the olive oil market has been lost to other oil substitutes in years when olive oil market supplies were unusually low and prices were unuasually high (5). This process of substitution has tended to be irrever-

Fig. 1. — *Annual Olive Oil Production in the Mediterranean Region 1948-1968*[1].



(1) The coefficient of variation in annual production for this period is about 28 per cent.

(1) The Mediterranean region, specified in this study includes the seven major olive oil producing countries: Spain, Italy, Greece, Turkey, Morocco, Tunisia and Algeria.

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sible. In other words, the continuous instability in olive oil price over time has caused a shift in the consumption pattern in the direction of other soft oils (6). This situation has been intensified by the fact that other soft oils have been available at stable prices and that there have been no coordinated and stable trade policies for olive oil among producing and consuming countries, despite the olive oil agreements.

Olive oil is a regional product. Nearly all the world's production is produced and consumed in the countries surrounding the Mediterranean. On the average, 95 per cent of the world's production and 89 per cent of the world's consumption of the commodity is concentrated in the Mediterranean region (specified earlier) plus Portugal. Imports of olive oil by non-Mediterranean countries are negligible and have shown no sign of growth over the last 20 years. These account for less than six per cent of the region's production.

This market situation is markedly different from that of other primary products which are internationally traded. For example, products such as cocoa, coffee and rubber are produced in a large number of developing countries while consumed in developed countries. Hence, any attempt to stabilize the markets for these products requires the participation of a large number of countries (7). Whereas, in the case of olive oil, the major exporting (producing) countries are also the major importing (consuming) countries. Therefore, the full participation of only a relatively few countries is required for an effective operation of any stabilization scheme.

When compared with other international stabilization measures, those for olive oil should give primary emphasis to assuring the stability of market supplies rather than trying to fix prices. This is due to the fact that fluctuations in annual production are chiefly responsible for the existing instability in the olive oil market.

Although improvement of technical production knowledge and management skills might reduce the intensity of olives production variations, the two-year production cycle appears to be persistent. Explicit attempts to counteract this cycle through a market stabilization scheme might achieve considerable degree of stability in market supplies, prices and incomes with perhaps some modest gains to the industry.

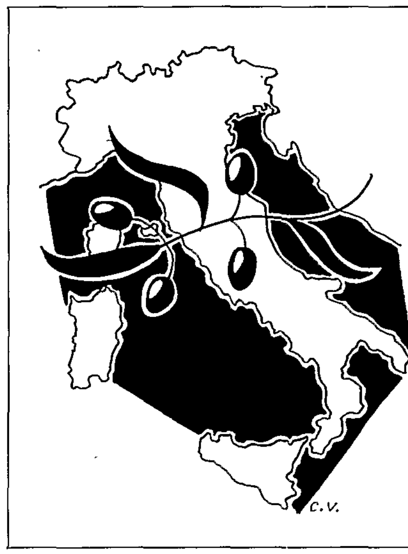
HYPOTHETICAL BUFFER-STOCK SCHEME

For the reasons mentioned above, a buffer-stock mechanism seems to be the most attractive scheme for achieving market stability. The usual mechanism of a buffer-stock scheme is to stock the commodity when the production is unusually high and/or the price is unusualy low, and to dispose of the commodity when the situation is reversed (8). A national or regional buffer-stock agency could be established to perform stocking (buying) and disposal (selling) operations. These operations could be carried out under the supervision of an administration responsible for market stability. The magnitude and timing of stocking and disposal of the commodity would have to be determined in the light of previously established marketing and price objectives.

An olive oil buffer-stock scheme could be established under the existing International Olive Oil Agreement and administred by the Olive Oil Council (9). In fact, such stabilization schemes are continually being proposed and debated within the Council. However, very little is actually known about the economic feasibility or the rsources needed to establish and operate a buffer-stock system.

The objective of this paper is to test the effectiveness of a hypothetical buffer-stock in achieving stability measured either by supply, price and/or annual returns.

Although the acceptance of such a stabilization scheme by the major producing and consuming sectors of the industry is considered a necessary perequisite for its operation, the consumer welfare considerations which might result from such a scheme are not specifically analysed in this paper. However, a recent article by Benton F. Massel (see ref. 9) has shown that price stabilization brought about by a buffer-stock could provide a net gain to both producers and consumers (10).



THE MODEL

For the purpose of illustration the theoretical model of a stabilization is shown in Figure 2. Supply in year 1 (S_1) and year 2 (S_2) represent the two year cycle of olive oil production. The supply in any given year is not responsive to market prices (P), i.e. perfectly inelastic. Demand (D) is responsive to market price, i.e. has some elasticity, but does not shift through the two year production cycle. Supply shift caused by the production cycle is solely responsible for equilibrium price fluctuations from (P_1) in year 1 to (P_2) in year 2.

The introduction of a stabilization scheme would shift the supply curve S_1 to S^*_1 by withholding stocks from the market in year 1. In year 2, the disposal of those stocks would shift the supply curve from S_2 to S^*_2. Prices would be P^*_1 and P^*_2 rather than P_1 and P_2. In year 1, P^*_1 is the floor price established in advance by the scheme and P^*_2 is the realized price in year 2. Complete stability would occur if P^*_1 were equal to P^*_2. It would be possible for P^*_1 to be higher than P^*_2 if the stocking and disposal activity were large enough. Total returns realizd with the scheme over the two-year period are $(OQ^*_1 . OP^*_1) + (OQ^*_2 . OP^*_2)$.

The degree of stability feasible under this buffer-stock scheme depends uniquely upon the price elasticity of demand for olive oil during the period of its application and the floor price objective. Elasticity specifications would determine the extent of price response to quantity changes during the introduction of market stabilization measures... i. e. stocking and disposal of olive oil. In year 1, price response is defined as the difference between the desired floor price and actual price which might have been achieved in the absence of stabilization measures. An estimate of this response would have to be know in advance in order to determine the quantities which must go into stocks in that year. The schme is tested in the following analysis against certain elasticity assumptions which are drawn from real historic market conditions and applied to the recent production cycle of 1964-65.

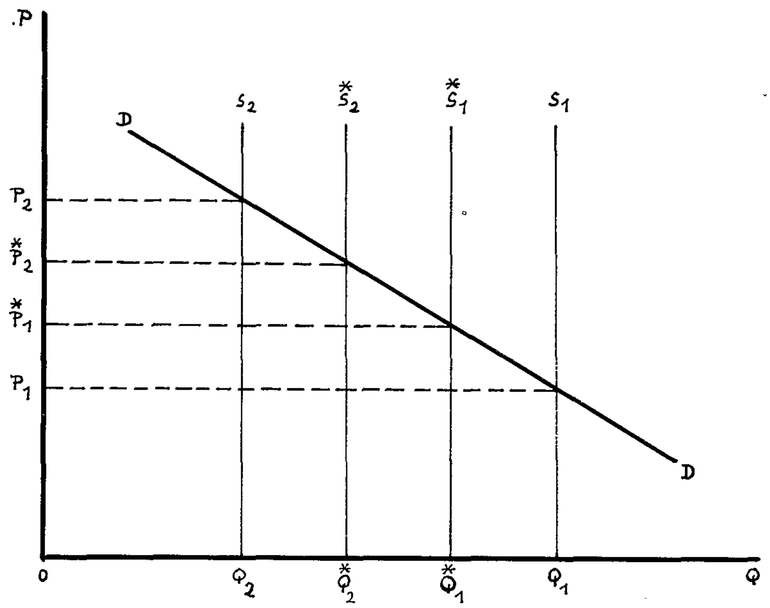
Operation of Butter-Stock — The Case of 1964-1965

With this model the buffer-stock authority could exercise its marketing role in the following manner. When a peak crop year was apparent the buffer-stock authority would need to enter the market as a buyer (11). Actual purchases would not have to be carried out immediately after harvest, but it must coincide as to uphold the floor price announced at the beginning of the production season. The authority would need to know the maximum quantity it ought to buy which would depend on the floor price decided and the expectations of the demand elasticity in operation in that year.

The case of the recent two-year olive oil production cycle of 1963/64 and 1964/65 is selected to estimate what would have been the impact of a buffer-stock scheme on the stability of supplies, prices and annual returns. Marketing year 1, 1964, is considered a typical peak year in a production cycle. Regional production in that year reached 1699 thousand metric tons in comparison with 895 in the previous year and 1123 tons average production during the last five years. Average international price realized in that year was 588 dollars per ton in comparison with 871 in the previous year and 647 average price during the last five years. In marketing year 2, 1965, production was markedly low, 849 thousand metric tons and the corresponding price was 662 dollars per ton.

A minimum floor price, above the actual price of 588 dollars per ton realized in year 1, would have been desirable for that year. Since it is difficult to reach an agreement on a specific floor price by olive oil producing and consuming countries, several floor prices were considered. These prices were selected within the range of actual prices realized in 1964 and 1965. The question is now what would have been the quantity of stocks necessary to achieve a specific floor price, given supply in year 1 was equal to 169 tons and actual price of 588 dollars per ton? In this case an assumption of a most

Fig. 2. — *Olive Oil Market Stabilization Scheme. The Basic Model.*



probable elasticity of demand in that year must be made. Maximum quantity of stocking necessary to achieve the decided floor price was derived on the basis of these assumptions (12). All stocks withheld from the market in year 1 were disposed of in year 2 in addition to the production of the later year. The price which would have been achieved in year 2 depends on the price elasticity of demand prevailing in that year.

The overall impact of this buffer-stock scheme under various floor price and elasticity of demand assumptions is evaluated with respect to stability in annual supplies, prices, and incomes and gross gains or losses expected from this scheme.

The cost of buffer-stock operations is not incorporated directly in this analysis. These costs include storage, interest on the funds used in buying the stock, transportation, insurance and administrative expenses. Total operating costs have to be compared against the expected gain (or loss) from the scheme in order to determine the net gain (or cost) from stability (13).

The Stability of Market Supplies

The primary mechanism of the two-year buffer-stock scheme is to with old the commodity (stock) from the market during a high production year and release (dispose of) it during the following low production year. By definition, the stocking operations must coincide with the high end of the production cycle and the disposal operations must coincide with the low end of the production cycle. Hence, the fluctuations in market supplies over the two-year period are reduced.

The magnitude of stock generation in year 1 and price range in year 2, under given assumptions of floor price and elasticity combinations, are shown in table 1. For example, under floor price assumption of 610 dollars and stocking year elasticity of - 0,8, the stock generation required in year 1 to achieve this floor price is equal to 49 thousand tons. This represents about 3 per cent of actual production in that year. The corresponding price range in year 2 is equal to 617-650 dollars, depending on the elasticity assumption. The required stocks for the operation of the scheme, represent an addition to the normal market stocking which actually occured in the two-year period (1964-1965).

It is evident from table 1 that the higher level of floor price desired the larger quantity of stocks that must be accumulated in order to achieve it. The size of the stocks required also increases with the increase in the demand elasticity in the stocking year. The minimum and maximum elasticity assumptions yielded a considerable difference in the size of required stocks. For example, in order to maintain a year 1 floor price level of 610 dollars per metric ton, 49 thousand metric tons, or 3 per cent of production, must be stocked under the minimum elasticity assumptions in comparison with 123 thousand metric tons, or 7 per cent of production, under the maximum elasticity assumptions. Hence, the size of demand elasticity during the stocking year is very important for the estimation of the size of stocks required to achieve a specified price goal.

The impact of the stocking and disposal operations significantly changes the overall stability of market supplies. For example, since the production in year 2 is only half of the production in year 1, the disposal of the stocks represents a significant addition to the production year 2. If one per cent of the production in year 1 is stocked, its disposal in year 2 represents an addition equivalent to about two per cent of the production of the second year. Hence, while the magnitude of stock might be relatively small in a high production year, its impact is more significant in a low production year.

The Stability of Prices

The effectiveness of the scheme upon the price stability objctive is demonstrated by table 2. The floor price of 612 dollars per metric ton would achieve a maximum degree of price stability if year two elasticity is equal to that in year one. In this case, the year two year two elasticity is equal to that in prices are almost equal to the floor price, and price fluctuations would be completely eliminated. It is also clear that the lower the floor price specified for year on the higher will be the price achieved in year two. If it is desirable from the standpoint of olive oil utilization and production to have higher prices in year two than in year one, then a lower floor price than 612 dollars should be selected.

TABLE 1

Olive oil buffer-stock scheme : stock generetion and the range of price achieved in year 2 under various assumptions as to floor price and minimum and maximum elasticity combinations (1)

Floor Price	Minimum elasticity combinations			Maximum elasticity combinations		
	Stock 10^3 M.T.	% of Prod.	Year two PriceRange U.S. dollars	Stock 10^3 M.T.	% of Prod.	Year two PriceRang U.S. dollars
600	27	2	636-655	68	4	637-646
610	49	3	617-650	123	7	619-635
620	70	5	599-646	175	10	603-625
640	110	6	568-637	276	16	575-607

(1) Minimum elasticity combinations are defined as all elasticity combinations in which the elasticity in the stocking year equals —0,8. Maximum elasticity combinations are defined as all those in which the elasticity in the stocking year equals —2,0. All elasticities between —0,8 to —3,2 at 0,2 intervals are tested for the disposal year with the restriction that disposal year elasticities must be equal to or greater than those in the stocking year.

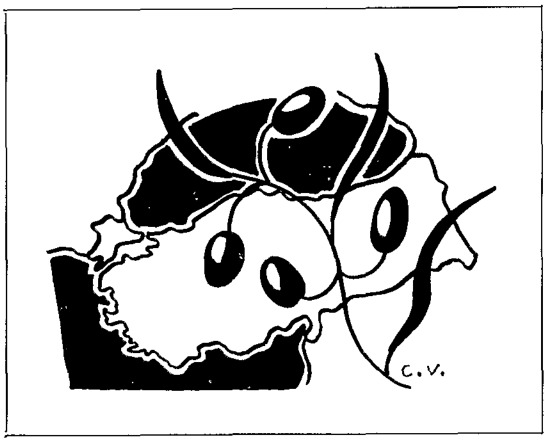


TABLE 2

Olive oil buffer-stock scheme : range of year two prices under selected floor price and elasticity assumptions (1964-1965)

	Floor Price in Year 1 (1964)	When Year 2 elasticity is equal to Year 1 elasticity (1)	Price Range in Year 2 (1965)	When Year 2 elasticity is greater than Year 1 elasticity (2)
Without scheme	588		662	
With scheme	600	636-637		639-656
	602	632-633		636-654
	604	629-630		632-653
	606	625-626		629-652
	608	621-622		626-651
	610	617-619		623-650
	612	613-616		620-650
	614	610-612		617-649
	616	606-609		614-648
	618	603-606		611-647
	620	599-603		608-646
	640	568-575		583-637

(1) Elasticity range for both years is —0,8 to —3,2.
(2) Year one elasticities range from —0,8 to —2,0.
Year two elasticities go up to —3.2.

TABLE 3

Olive oil buffer-stock scheme : fluctuation in total annual returns under various floor price and elasticity of demand assumptions (1) actual fluctuation = 437 million dollars

Floor Price	Elasticity in stocking year	Elasticity in disposal year			
		1.4	2.0	2.6	3.2
		(in million U.S. dollars)			
600	0.8	436	432	430	429
	1.4	420	413	410	407
	2.0	—	395	389	386
610	0.8	435	428	425	422
	1.4	406	394	388	383
	2.0	—	360	351	345
620	0.8	435	425	420	416
	1.4	393	376	366	361
	2.0	—	327	314	305
640	0.8	435	419	411	405
	1.4	368	341	326	316
	2.0	—	263	242	228

(1) Assumption — elasticity in the disposal year is equal to or greater than elasticity in the stocking year.

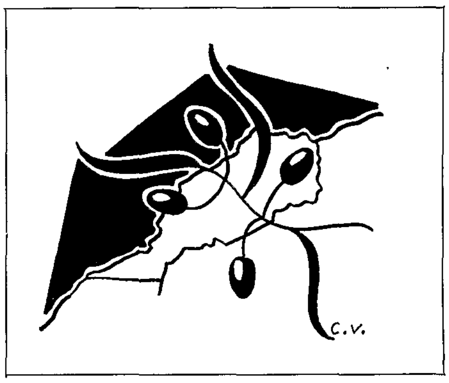


TABLE 4

Olive oil buffer-stock scheme : gross gains in producers' incomes over the two years period under various floor price and elasticity of demand assumptions (1)

Floor price (U.S. dollars)	Elasticity in stocking year	Elasticity in disposal year			
		1.4	2.0	2.6	3.2
		(in thousand U.S. dollars)			
600	0.8	9 162	13 005	15 085	16 389
	1.4	670	7 379	11 024	13 313
	2.0	—	1 682	6 894	10 174
610	0.8	16 565	23 477	27 232	29 592
	1.4	735	12 777	19 362	23 514
	2.0	—	1 865	11 287	17 249
620	0.8	23 777	33 642	39 023	42 411
	1.4	406	17 563	27 002	32 974
	2.0	—	1 087	14 596	23 183
640	0.8	37 685	53 141	61 627	66 990
	1.4	1 272	25 521	40 415	49 897
	2.0	—	2 936	18 385	32 045

(1) Elasticity in the disposal year is greater than or equal to elasticity in the stocking year.

Under the assumption of higher demand elasticity during the disposal year, the price range achieved in year two is considerably wider than under the equal elasticity assumption. A floor price of 614 dollars per metric ton now seems to be most consistent with high stability and with the maintenance of higher prices in the disposal year than in the stocking year.

Considering the possible combinations of year one and year two elasticities, 610 dollars appears to be an appropriate maximum floor price which minimizes the year one-year two price difference and remains significantly below the expected lowest year two price. At this floor price, the *maximum* year-to-year price fluctuation is 40 dollars compared with the actual fluctuation of 74 dollars. This is substantial reduction in the price fluctuation over the two-year period.

Expected prices in year two show a marked tendency to increase as the difference in demand elasticities between year one and year two increase. Price achieved under those conditions maintain a substantial margin over the floor price but continue to be lower than the actual price realized in year two without a buffer-stock scheme.

The Stability of Annual Returns

The effect of a buffer-stock scheme on the variability of producers' incomes is evaluated against the actual income fluctuations (14) (table 3). A modest reduction in annual income fluctuations could be achieved by an income averaging mechanism supplementing the buffer-stock scheme. A conceptually simple income averaging mechanism is to withhold from the producers the value of the stocks acquired in the stocking year. The full value of the stocks sold in the following year is paid back to the producers. On this basis, the difference between 1964 and 1965 in annual returns to producers from olive oil marketing was calculated and is shown in table 3.

Substantial gains in income stability could be achieved in cases where the difference between year one and year two elasticities is considerable. Of course, the provision for advances to producers for stocks withheld during the stocking year will increase fluctuations in total returns to a higher level than shown.

The Gains or Losses from the Scheme

Total gains to producers' incomes, or the absence of losses achieved from the operation of a buffer-stock scheme constitutes an important element in its performance. Table 4 shows the gross gains over the two-year period under specified floor price and elasticity assumptions.

The magnitude of gross gains depends upon the floor price and the elasticities of demand during the stocking and disposal operations. Stocking in a market characterized by less elastic demand and disposing in a market characterized by more elastic demand generally will lead to gains The more the elastic the demand in the disposal year, given elasticity in the stocking year, the higher will be the gain. The converse situation (not tested) will lead to losses.

Under a floor price of 610 dollars per metric ton, considered feasible in light of previously mentioned objectives, the gross gains range between 1 to 30 million dollars. A slight increase in the elasticity of demand during the disposal year results in a considerable increase in gross gain from the stabilization scheme.

The gross returns shown need to be compared with the total costs of operating the schme in order to determine its net performance. For example, if total costs of stabilization storage for a year reaches about 15 per cent of the sales proceeds of the stocked oil and the minimum floor price desired is 610 dollars per metric ton, a modest net gain could be achieved if the elasticity in the disposal year is at least 0,2 higher than that of the stocking year.

*
* *

The magnitude of market stabilization feasible under a hypothetical buffer-stock scheme is evaluated for the two-year period of 1963/64 - 1964/65. This period is distinctly characterized by a typical cycle of high-low production years. This study has shown that the performance of such a scheme largely depends on the extent of objectives to be achieved and the leve of price elasticities of demand in operation during the two-year period. For example, the higher the floor price desired the larger the quantity of stocks must be generated in order to achieve that price. Similarly, the higher the elasticity of demand during the stocking year, the larger the quantity of stocks must be generated in order to achieve a specific floor price.

Although there is no exact approach to determine the precise level of elasticity of demand for olive oil during any two-year period, there is strong evidence which suggests that this elasticity lies in the moderate elastic range at about — 1,3 (15). A change in the olive price of 1,0 per cent is associated with a change in quantity demanded of 1,3 per cent in the opposite direction. In other words, olive oil quantity adjustments to price changes, or vice versa, are not as severe as in most other staple food products which characterized by inelastic demand. In this case the likely magnitude of stocking operations and their impact shoud be relatively easy to determine on the basis of this bench mark elasticity.

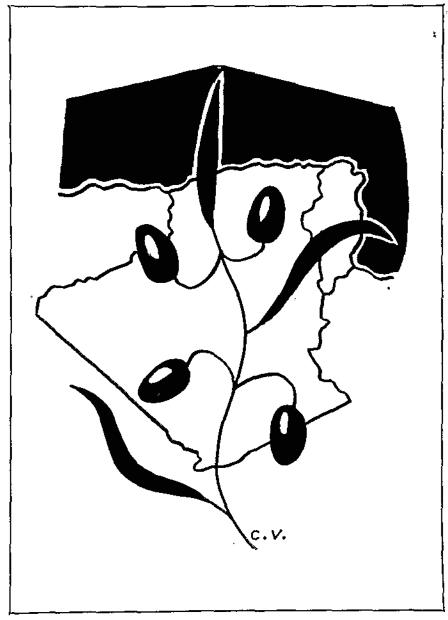
The operation of the tested scheme suggests a floor price of about 610 dollars per metric ton which might have been most practical during the stocking year (1964). Considerable price stability could have been achieved during the two-year period at about 610 dollars in the stocking year and maximum price range of 617 to 650 dollars in the disposal year. This is in comparison with the actual price realized of 588 dollars in the first year and 662 dollars in the second year (16).

Some improvement in the stability of annual incomes could be achieved under a buffer-stock supplemented with an income averaging mechanism. This mechanism might be conveniently applied by withholding the value of stocks from the producers until they are sold.

Although it is not the explicit purpose of the hypothetical scheme to achieve incomes gains, a successful mechanism is the one which avoids considerable losses to the industry. Gross gains shown must be compared against the total cost of the buffer-stock operations. Evidence suggests that a modest net gain is possible under the most probable olive oil market conditions.

Comparable stability objectives could have been achieved through a buffer-stock mechanism during earlier olive production cycles. These cycles could have been easily identified in advance in accordance with previously established marketing rules and stability objectives. For example, the beginning of a production cycle or peak production year could be defined where production is 20 or 30 per cent higher than average production in the last five years. Since the olive production cycles were not perfectly systematic, market intervention by the stabilization authority would been restricted to certain cyclical production years (e.g. 1950, 1952 and perhaps 1954 and 1962) and not every other year.

Finally, this paper has shown that the irregularity of olive oil market supplies caused by the olive production cycle could be reduced. A regional buffer-stock scheme based on withholding and disposing of stock could achieve a considerable degree of market stability. Given the nature of the olive oil market, withholding of stocks in peak production year and its complete disposal in the following low production year will achieve a substancial stability in market supplies, prices and incomes. Such stability operations could also result in a modest gain to the industry as a whole. In the long run, a stable olive market would tend to encourage a better resource allocation within the producing region.



NOTES

(3) Different explanations are usually given as to the persistence of the production cycle. The biological nature of tree growth, cultivation practices and the severity and variability of the climatic and soil conditions are perhaps the most important causes of the olive production cycle.

(4) The first International Olive Oil Agreement was signed in 1956. Signatories were three importing countries (Belgium, France and the U.K.) and seven exporting countries (Greece, Israel, Libya, Morocco, Portugal, Spain and Tunisia). Second and third similar agreements were signed in 1963 and 1969 respectively. Additional countries joined these agreements— Algeria, Argentina, Italy, Turkey, United Arab Republic, Syria and Dominican Republic.

(5) The pattern of soft oil imports of the Mediterranean region over the last 20 year period strongly supports this argument. An ordinary least squares estimate of regional soft oil import demand has been computed. The estimated function supports the hypothesis that soft oil imports are negatively associated with regional olive oil production. See A. Osama Al-Zand (1, pp. 64-75).

(6) Due to the lack of reliable utilization data, no serious study has been made to measure the cross elasticity of demand for olive oil and other competing soft oils. However, one study for the EEC shows that while cross elasticity of demand for olive oil with respect to the price of any other soft oil substitute is non-significant (i.e. approaches zero), the cross elasticity of demand for any soft oil with respect to olive oil price is highly significant (i.e. approaches one). See Dieter Elz, *Oilseed Product Needs of the European Economic Community 1970*. United States Department of Agriculture, Washington, D.C., May 1967, p. 125.

(7) For example, the International Coffee Agreement of 1959 was established " to secure a judicious balance between supply and demand... ". Nearly all countries with coffee interests are member states. Each member country participates in the agreement as either producer (exporter) or consumer (importer) of

the commodity. The producing countries are largely located in the tropical and semi-tropical areas of Africa and South America, while consuming countries are concentrated in the temperate areas of Europe and North America. See: *International Economic Institutions*, by M.A.G. Meerhaeghe, John Wiley and Sons, Inc., New York, 1966, pp. 205-206.

(8) One of the major provisions of the International Tin Agreements of 1956 and 1961 was the formation and maintenance of a buffer-stock. Tin buffer-stock operations were the only one of their kind which have been used to achieve market stability under international agreement. The International Tin Council was authorized to buy the product (stock) when its price falls to or below a specified minimum level (floor price) and to sell (dispose) as long as the stock lasts or as the price remains at its upper limit (ceiling price). See: *International Economic Institutions, op. cit.*, pp. 212-223.

(9) The Olive Oil Council is the administrative arm of the International Olive Oil Agreements. The eleventh session of the Council held in Madrid in November 1964 submitted stabilization proposals to member countries. The proposals constitute a regional exchange and storage of olive oil among surplus and deficit producing countries. Although these proposals have been ratified by most member countries, actual exchange of olive oil among deficit and surplus countries has never taken place.

(10) Also see (3), (12) and (13).

(11) Peak crop years can be predicted in advance. Individual country crop estimates are usually made several months in advance of the olive harvest season beginning in the fall. These estimates are often revised until the size of the crop is fairly well known after about two months from the beginning of the harvest.

(12) In addition to errors in the estimates, elasticities vary along a stable or slowly shifting demand curve. The reciprocal of the price flexibility is considered as the price elasticity of demand for olive oil. For this purpose several linear demand functions were estimated using price as the dependent variable. Within the range of the price extremes observed over the past 15 years, estimates of price elasticity fell within the range of —0.8 to —3.2. The set of elasticities assumed to be applicable in the stocking year (high production—low price) was in the range of —0.8 to —2.0, while that assumed to be applicable in the disposal year (low production—high price) was in the range of —0.8 to —3.2. All possible combinations, at 0.2 intervals, lying within these ranges were considered, along with several assumed floor prices. The number of elasticity combinations considered was restricted by ignoring those in which the disposal year elasticity was less than that in the stocking year. In this paper a summary of elasticity combinations within the above ranges along with selected floor prices is presented. See Appendix B for least squares estimates of price flexibilities and Appendix C for complete computational procedures of the hypothetical buffer-stock scheme in Al-Zand (1). An average price elasticity of demand for olive oil has been estimated at —1.7 by Dieter Elz in his study *Oilseed Product Needs of the European Economic Community*, 1970. Page 176.

(13) It was reported that the imputed interest on the funds used in buying stocks accounts for about 50 per cent of the total costs, while the cost of physical storage accounts for about 20 per cent. A rough estimate suggests that the total costs of stabilization storage for a year might reach approximately 15 per cent of the sale proceeds of the oil stocked. See O'Hagan (11, pp. 7-8).

(14) Total producer's income over the two year production cycle is assumed to be equal to quantities produced in each year multiplied by corresponding prices—i.e. $(OQ_1.OP_1) + (OQ_2.OP_2)$ in figure 2.

(15) See Al-Zand (1, pp. 124-127 and pp. 197-198).

(16) There is no general agreement among major producing and consuming countries on a floor price. Recently, a price equal to 640 dollars per metric ton has been suggested as the minimum acceptable price. It is evident from the foregoing analysis and subsequent price trends that this suggested price might be too high for feasible stability objectives in the olive oil industry. A price ceiling is not imposed under the buffer-stock scheme examined. The entire quantity of stock is assumed to be marketed (disposed) in the second year despite the level of market price realized.

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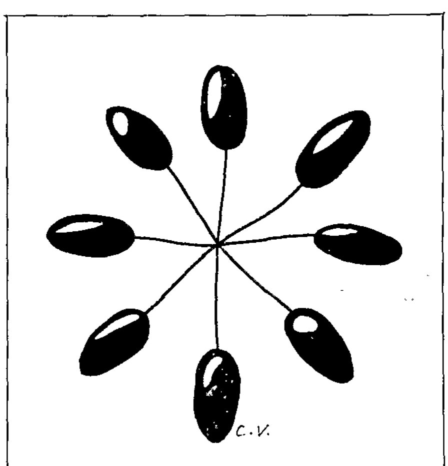


APPENDICE I

THE OPERATION OF A HYPOTHETICAL BUFFER - STOCK SCHEME 1963/64 - 1964/65

The two-year hypothetical Buffer - Stock Scheme is conceived under the following procedures:

Given:

P_1 = price in year 1 (high production year) = \$ 588 per ton.

P_2 = price in year 2 (low production year) = \$ 662 per ton.

Q_1 = quantity produced in year 1 = 1 699 thousand tons.

Q_2 = quantity produced in year 2 = 849 thousand tons.

π_1 = floor price fixed for year 1.

E_1 = elasticity applicable in year 1.

E_2 = elasticity applicable in year 2.

Solve for:

R = amount of stocks needed to be generated in year 1.

π_2 = price resulting in year with the scheme if all stocks are sold.

The are elasticity of demand in year 1 under the operation of a buffer - stock scheme can be visualized as follows:

$$E_1 = \frac{\Delta Q_1}{\Delta P_1} \cdot \frac{P}{Q}.$$

Where:

E_1 = arc elasticity of demand in year 1.

ΔQ_1 = change in quantity supplied after stocking.

ΔP_1 = change in price after stocking.

P = average price before and after stocking.

Q = average quantity before and after stocking.

ΔQ = —R quantity of stocks needed to be withdrawn.

$P_1 = \pi_1 - P_1$.

In terms of algebra the above factors appear as:

$$P = \frac{P_1 + \pi_2}{2} = \text{average price with the}$$

introduction of floor price in year 1.

$$Q = \frac{Q_1 + (Q_1 - R)}{2} = \text{average quan-}$$

tity with the introduction of stocking operations in year 1.

Hence:

$$\frac{P}{Q} = \frac{P_1 + \pi_1}{2Q_1 - R}.$$

and

$$E_1 = \frac{\Delta Q_1}{\Delta P_1} \cdot \frac{P_1 + \pi_1}{2Q_1 - R} \qquad (1)^1$$

(1) $E_1 = \frac{-R}{\pi_1 - P}\frac{P_1 + \pi_1}{2Q_1 - R}$

$$E_1 = \frac{-R(P_1 + \pi_1)}{2Q_1\pi_1 - 2Q_1P_1 - R\pi_1 + PR}$$

$$E_1(2Q_1\pi_1 - 2Q_1P_1 - R\pi_1 + P_1R) = -RP_1 - R\pi_1$$

$$2E_1Q_1\pi_1 - E_12Q_1P_1 = -RP_1 - R\pi_1 + E_1R\pi_1 - E_1P_1R$$

$$2Q_1E_1(\pi_1 - P_1) = R(-P_1 - \pi_1 + E_1\pi_1 - E_1P_1)$$

$$R = \frac{2Q_1E_1(\pi_1 - P)}{\pi_1(E_1 - 1) - P(E_1 + 1)}.$$

Given value for specific floor price (π_1) and elasticity in stocking year (E_1), the quantity of stocks needed to be generated (R) in order to achieve the specified floor price is:

$$R = \frac{2Q_1E_1(\pi_1 - P_1)}{\pi_1(E_1 - 1) - P_1(E_1 + 1)} \quad (2)$$

Similarly, the arc elasticity of demand in year 2 is as follows:

$$E_2 = \frac{R}{\pi_2 - P_2} \cdot \frac{P_2 + \pi_2}{2Q_2 + R} \quad (3)$$

From computed values of R from (2) and given values of elasticity in year 2 (E_2), the elasticity formula (3) would give the price resulting with the disposal operations:

$$\pi_2 = \frac{P_2[R(E_2 + 1) + 2Q_2E_2]}{R(E_2 - 1) + 2Q_2E_2} \quad (4)$$

In application various sets of elasticity combinations were used in the stocking and disposal years. The range of elasticity coefficients tested is from —0,8 to —2,0 in the stocking year and from —1,0 to —3,2 in the disposal year.

Annual Fluctuation in Total Returns

Without the scheme:

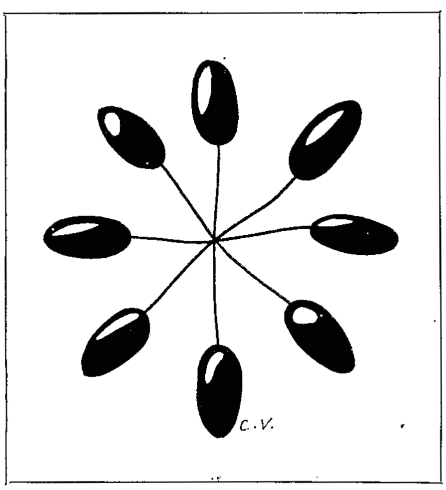
588 (1699) — 662 (849) = $ 436 974 000.

With the scheme:

$\pi_1(Q_1 - R) - \pi_2(Q_2 + R)$.

Gross Gains (Losses)

$[\pi_1(Q_1 - R) + \pi_2(Q_2 + R)] - (Q_1P_1 + Q_2P_2)$.



APPENDICE II

APPLICATION OF A RUFFER-STOCK SCHEME TO COUNTERACT

PRODUCTION CYCLES IN THE FUTURE

The key variables which must be considered in appraising the feasibility and usefulness of a buffer-stock scheme for future application are the following:

P_1 = The price which might be achieved without stabilization measures in the forthcoming high production year. This price can be estimated in light of prices realized in recent years of comparable production and demand conditions. Allowance might be made to account for any deviations in market conditions.

π_1 = The floor price objective agreed upon during high production year. By definition, price stability objective can only be applied if P_1 is estimated to be lower than π_1. The magnitude of the difference between P_1 and π_1 can be used as an indicator whether stabilization scheme is necessary. For example, when the magnitude of the price difference is considerably larger than the standard deviation of international prices achieved over the past years then a buffer-stock scheme to bring up price to the minimum floor level would be desirable.

Q_1 = Estimate of quantity of olive oil which is expected to be reached in the peak crop year (year one). Production estimate can be made well in advance of the harvest season. This estimate is usually revised and a reliable estimate can be obtained at the beginning of the harvest season. A peak of a cycle can be easily identified when production is significantly higher (e.g. more than 30 per cent) than average production in recent years. The assumption here is that the quantity produced in a peak year is considered as the quantity supplied in that year. Changing in commercial stocks is assumed to be continued as normal.

E_1 = Elasticity of demand which is appliable in year one. A range of elasticity between —0.8 to —2.0 can be considered as the most likely estimate in a peak production year. It is properly assumed that the price elasticity of demand for olive oil over any period of production cycle is not constant. The variations in the elasticity of demand for this product is largely induced by the extreme fluctuations in supplies and especially influenced by the severity of the production cycle.

R = Amount of stocks needed to be generated in order to maintain a minimum price π_1, and given the above variables.

In year two an estimate of the expected price (π_2) can be made on the basis of the following variables:

Q_2 = Estimate of quantity of olive oil expected in the low end of the production cycle. The quantity produced in the second year plus the commercial and buffer stocks (R) will make the total supply of the commodity in this year.

E_2 = Elasticity of demand which would be applicable in year two. At all times, elasticity is expected to be significantly larger than the elasticity in the stocking year (year one). The most likely range of this elasticity is assumed to be between —1.0 to —3.2.