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PRODUCTION AND SUPPLY OF WINTER TOMATOES IN MAINLAND SPAIN

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PRODUCTION AND SUPPLY OF WINTER TOMATOES IN MAINLAND SPAIN

by

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INTRODUCTION

Egypt's tomato exports to the European Economic Community compete directly with exports from Spain. In the near future Spain will become a member of the EEC and will no longer be required to pay the customs tariff imposed on nonmember exporters. Since the net price to Spanish producers will increase as a result of not having to pay the tariff, it is widely expected that Spanish exports will increase. Spain's entry into the common market will thus affect Egypt's comparative advantage in exporting tomatoes. The extent of such effects will depend on the elasticity of supply of Spanish tomato exports and the new equilibrium EEC price after all market effects have been worked out.

No published estimates of the supply elasticity of Spanish tomato exports are available. It is the objective of this study to estimate the supply elasticity based on statistical analysis of published data.

DESCRIPTION OF PRODUCTION CONDITIONS IN SPAIN

Tomatoes are produced in the winter season primarily along the Southeast Coast of Spain between Alicante and Almeria. There are three principal centers of production. The northernmost is around Alicante, another is around Aquilas in the province of Murcia, and the southernmost is in Almeria. Abrupt changes in microclime within these zones affect production potential substantially.

Climate

Alicante, being the farthest north, has the coolest climate of the three zones. Temperatures reach zero degrees Centigrade frequently in December and January and limit tomato production to the October to February season. Later production is not generally feasible since cold temperatures during blossoming inhibit fruit set and diminish yields. It is generally felt that production under plastic would not successfully extend the production period into the spring in Alicante, as it does farther south. Acreage in Alicante has decreased in recent years, as can be seen in Table 1. Acreage in Murcia and Almeria has increased. The most striking change in the last decade has been the increase in tomatoes under plastic in Almeria for the February to May market. Most of the tomatoes under plastic are Marmand (ribbed) varieties for France, Switzerland, and Germany. There are about 3,000 hectares of tomatoes under plastic in Almeria, and about 400 hectares in Aguilas.

Temperature variation between the three areas is given in Tables 2 and 3.

Table 1: Acreage Planted to Tomatoes in Spain, By Province

Year	Alicante	Murcia	Almeria	TOTAL
1964-65				
Oct.-Dec.	1,900	2,100	570	6,790
Jan.-Jun.	80	320	1,820	
1965-66				
Oct.-Dec.	1,800	2,100	550	6,900
Jan.-Jun.	80	430	1,940	
1966-67				
Oct.-Dec.	1,780	2,350	580	7,130
Jan.-Jun.	70	400	1,950	
1967-68				
Oct.-Dec.	1,800	2,500	680	7,590
Jan.-Jun.	110	400	1,900	
1968-69				
Oct.-Dec.	1,900	2,000	650	6,875
Jan.-Jun.	50	325	1,950	
1969-70				
Oct.-Dec.	1,820	2,200	650	11,210
Jan.-Jun.	1,460	400	4,680	
1970-71				
Oct.-Dec.	1,900	2,025	1,366	11,731
Jan.-Jun.	1,290	550	4,600	
1971-72				
Oct.-Dec.	1,850	2,500	1,400	11,869
Jan.-Jun.	961	538	4,600	
1972-73				
Oct.-Dec.	1,400	2,750	1,400	11,980
Jan.-Jun.	423	666	5,341	
1973-74				
Oct.-Dec.	1,513	2,700	850	11,934
Jan.-Jun.	608	665	5,598	
1974-75				
Oct.-Dec.	1,194	2,686	974	10,775
Jan.-Jun.	400	720	5,400	
1975-76				
Oct.-Dec.	1,142	2,903	1,000	12,394
Jan.-Jun.	476	801	6,072	
1976-77				
Oct.-Dec.	759	3,231	1,300	11,991
Jan.-Jun.	257	800	5,644	
1977-78				
Oct.-Dec.	560	3,203	2,000	12,487
Jan.-Jun.	254	870	5,600	
1978-79				
Oct.-Dec.	713	3,450	2,500	

Source: Ministerio de Agricultura, Anuario de Estadistica Agraria, various issues.

Table 2: Absolute minimum temperatures during 1931-60 (degrees Centigrade)

Month	Almeria	Murcia	Alicante
December	2.5	-5.0	-1.6
January	1.9	-5.0	-2.0
February	0.2	-4.4	-4.6
March	2.6	-3.0	-1.0

Table 3: Absolute minimum temperatures in 1978 (degrees Centigrade)

Month	Almeria	Murcia	Alicante
December	6.0	2.8	3.0
January	4.0	2.0	-0.4
February	4.6	-1.2	1.8
March	6.6	5.6	-0.4

No area in Spain is ideal for winter tomatoes from the standpoint of temperature. Although the temperature in Almeria almost never gets down to 0 degrees Centigrade, cold temperatures often retard the growth of plant and reduce yields. The problem of temperature in Aguilas is somewhat worse, with frost a not infrequent prospect. Production through February in Murcia is possible in the open air, and production under plastic is possible through April, although after March quality tends to diminish. Morning dew and heavy winds are other troublesome climatic factors common to all three areas.

Land and Water

Land is not a restricting resource in any of the three areas of production. Land can be rented for four pesetas per square meter. Sufficient land is available for crop rotations to control disease (open air production) if necessary. The land is not particularly productive, being rocky, hilly and of rather loose texture. However, erosion is not a problem with such low rainfall, and fertilizer applications can provide adequate yields.

The limiting resource is water. In Aguilas and Almeria, the two most important areas, water is not available locally for irrigation. Water is pumped from deep wells in the hills 30 to 40 kilometers away from the production area. The wells are controlled primarily by cooperatives and private owners who sell the water as a business. The price runs from 10 to 20 pesetas per cubic meter at the wellhead in Aguilas and slightly more in Almeria. It is the responsibility of the producer to transport the water to the location of production. Again, the transport is accomplished by cooperatives or by the individual producer by tubes and pumps.

Although it is always difficult to estimate the quantity of underground water available for irrigation, it is widely believed that significant further expansion in Almeria would not be possible. The situation in Aguilas is somewhat better, although costs of piping the water from the hills are high.

There is a modest possibility of better use of existing water resources through drip irrigation. It is estimated that about 25 percent of total production in Aguilas and Almeria is now under drip irrigation. Expansion of the use of drip irrigation will be slow, since it is not always economically feasible for a small farmer to install the drip system. The initial investment in drip equipment is about 35 to 50 pesetas per square meter, or about $4,000 to $6000 per hectare. Furthermore, the installation of drip equipment implies a new set of cultural practices and a more advanced technology. Many of the producers in Almeria are of the half-hectare size, and the changeover to drip irrigation is not feasible for them. It is felt that the minimum size required for drip equipment is about a hectare. Furthermore, with production under plastic, the water requirements for drip irrigation are not much different from flood irrigation. The widespread practice of spreading four inches of sand on the surface of the ground under plastic reduces water loss from capillarity, and results in roughly the same water requirements for flood irrigation as for drip.

New Areas

One of the largest potentialities for expansion of tomato production is in the area called "Campo de Cartagena", located directly North of Aguilas. Water diverted from the Tagus and Segura rivers will provide irrigation for about 55,000 new hectares. This land will, it is widely believed, be devoted to lemons, table grapes, and melons to a large extent, but there is potential for tomato production as well. Some say that the climate is colder and more humid than in Aguilas, and thus not completely suited for tomatoes. However, there would seem to be considerable potential for tomatoes during the October to February period.

There has also been some expansion in winter tomato production on the south coast from Granada to Huelva. Although colder than the Alicante and Almeria coastline, variation in temperatures is less and the risk of severe frost is less. Production in this area is still insignificant.

Labor Costs:

Rural wages have increased faster in Spain than other prices in the last 15 years. Table 4 shows that the Index (1964=100) for wages in 1979 stood at 1,003.2, while the Index of prices received for crops rose only 373.7. Daily

Table 4: Other Variables to put in Supply Analysis for Spain

Year	(1) Index of Prices Paid (1964=100) Fertilizer	Labor	(2) Index of Prices Received[a] for other Crops	(3) Prices Received for Tomatoes[b] (German marks per 6 kg. box)	
1964	100.0	100	100.0		
1965	104.1	112.1	114.7	6.35	
1966	104.5	127.2	122.9	9.88	(1966-67)
1967	103.2	144.1	116.7	8.56	(1967-68)
1968	105.4	156.4	126.8	8.45	(1968-69)
1969	107.1	174.7	135.7	7.72	(1969-70)
1970	109.9	198.8	131.1	8.33	(1970-71)
1971	113.0	213.9	136.2	9.06	(1971-72)
1972	115.5	244.4	150.4	8.15	(1972-73)
1973	124.5	286.0	174.9	10.42	(1973-74)
1974	173.3	382.9	184.1	11.15	(1974-75)
1975	194.5	447.7	220.4	11.38	(1975-76)
1976	200.6	550.9	241.7	10.84	(1976-77)
1977	210.8	699.1	321.5	10.59	(1977-78)
1978	245.9	863.3	357.0	10.60	(1978-79)
1979	300.7	1,003.2	373.7	13.22	(1979-80)

Sources: Col. (1) and (2): Ministerio de Agriculture, Anuario de Estadistica Agraria, various issues.
Col. (3) ZMP Bilanz: Gemuse, Bonn, Germany.

Notes: [a] includes cereales, legumes, potatoes, horticulturals, fruits, wine, oil seeds.
[b] simple average of quoted weekly prices

wages for workers in horticultural crops now stands at about 1,500 pesetas per seven-hour day, plus social security plus bonuses, which puts them above 2,000 pesetas per day on a comparable eight-hour day, or about $25 per day.

After the democratic government was established the labor unions were able to push up wages very rapidly. Now it seems that with the considerable unemployment found in the economy, wages are not rising so rapidly, and labor supplies are plentiful.

Packing Costs:

Packing costs are about 100 pesetas per 6 kg. box. The tomatoes are packed and shipped in a 6 kilogram box made of wood, costing 31 pesetas each, at present. Some of the tomatoes for supermarkets are individually wrapped, and some are placed in a half-kilo bag, 12 bags to the box.

Pre-cooling at the packing plant and transportation in refrigerated trucks starts about April.

Exporting Spanish Tomatoes:

A marketing committee sets weekly export quotas for each province and each producer or coop that exports tomatoes, including the Canary Islands. These basic quotas are adjusted each year before the export season starts. The quotas serve as a basis for controlling the weekly exports according to fluctuations in expected weekly prices. If marketing conditions and prospective supplies appear to indicate that prices would fall below acceptable levels in an upcoming week, the marketing committee would require each producer to cut exports by a certain percentage. These cuts are based on a pre-determined scale according to the degree of price weakness expected. For example, if the price is expected to fall, say, 10 percent below the acceptable price, then each producer would be required to cut exports by a certain pre-determined percentage.

Up until two years ago the Spanish mainland was restricted to exporting round tomatoes only until the end of January, and only minor amounts of ribbed tomatoes after January. This restriction was imposed to allow the Canary Islands to export during their principal season without competition from the Spanish mainland. Two years ago this restriction was removed. However, quotas for each province are still in effect. These quotas are set partly according to a historical basis, and can be adjusted only slowly. Hence, Canary production during February to April will probably continue to be favored for some time. Mainland exports increased during the February to May season in recent years, (see Table 7), but mostly only for ribbed varieties. During the last two years some round tomatoes have been exported during the February to May season, but Canary markets have not as yet been severely invaded by mainland exports. Gradually, however, quotas may favor the mainland more and more, depending on the amount of political influence exerted on the marketing committee.

The striking change noted recently in mainland exports is the increase in the sale of ribbed tomatoes sold to France, Germany and Switzerland during the February to May period. Much of this production came from the recently developed plastic production in Almeria.

Transportation to Europe:

About 90 percent of the tomatoes travel to their destination by truck. The remaining 10 percent go by train. Truck transport costs from the Southeast coast of Spain to various destinations are as follows:

To U.K. - 350,000 pesetas per 18 ton truck

To Frankfurt - 290,000 pesetas per 18 ton truck

To Paris - 180,000 pesetas per 18 ton truck

The normal truck is a 20-ton rated truck, but normally carries 3,000 boxes of 6 kgs. each. Trucks must return empty.

STATISTICAL ANALYSIS

The analysis of supply in Almeria is complicated by the rapid development of production under plastic in the early 70's. Such a development constitutes a change in structure and makes the data before 1970 irrelevant for statistical supply analysis and projection. The period after 1970 is not long enough to obtain statistical results. Hence the analysis centers on the provinces of Alicante and Murcia, and Almeria is eliminated from consideration.[1]

Factors Affecting Production Decisions

There are two sets of factors that complicate the specification of a supply model:

(1) The necessity to use unobservable "expected prices" rather than current prices as the relevant decision variable

and (2) The adjustment process experienced by a farmer in arriving at "desired acreage" from "present acreage," once the decision as to desired acreage is made.

With respect to (1) above, it is generally accepted that farmers base their production decisions on "expected" future profits. How farmers form expectations as to future prices and costs is not known in detail, but recent historical information probably enters the decision process.

Some studies use a weighted average of recent realized prices to represent the farmers "expected prices," since expected prices are not observable. Some studies use the market price last year as the expected price, under the

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[1] A linear programming model for representative farms might be a more appropriate analytical model for production under plastic, since many greenhouses have substantial fixed financial investment and irreversible physical facilities.

assumption that the most recent realized price is the principal factor a farmer uses in forming an expectation of the price he will receive for his product.

This study uses the latter approach--namely the price realized last year as a predetermined variable affecting supply.

The dependent variable in this study is acreage planted. Since yields and total production are partly affected by weather, and are thus partly out of the farmers' control, they would not represent the farmers production decision as closely as acreage planted, which is under his control.

With regard to (2), once having decided the desired acreage corresponding to his expected price, a farmer may be unable or unwilling to achieve the desired production goal within one planting season,[1] but may move only partway to that value during one planting season, particularly if large changes in acreage are indicated and investment capital is limited.

Symbolically, if Y_t^* is desired acreage in year t, and Y_t is actual acreage planted, the following relationship would hold:

$$(1) \quad Y_t - Y_{t-1} = \gamma\,(Y_{t-1}^* - Y_{t-1})$$

where γ is the "coefficient of adjustment," which indicates the rapidity with which the farmer can achieve a desired acreage from an actual acreage. If $\gamma = 1$ the farmer can adjust completely within one season and $Y_t = Y_{t-1}^*$. It is presumed that $0 < \gamma < 1$. The smaller is γ the longer it takes to adjust.

Equation (1) can be written

$$(2) \quad Y_t = \gamma\, Y_{t-1}^* + (1 - \gamma)\, Y_{t-1}$$

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[1] Such things as scarcity of production resources or investment capital may preclude immediate achievement of goals.

It is supposed that Y^*_{t-1} depends on a number of other variables which affects desired acreage, such as expected price, cost, input supplies, etc. Thus

(3) $Y^*_{t-1} = a + b_1 X_1 + b_2 X_2 + \ldots + b_n X_n$

Substituting equation (3) into equation (2) we get:

$$Y_t = \gamma a + \gamma b_1 X_1 + \gamma b_2 X_2 + \ldots + \gamma b_n X_n + (1 + \gamma) Y_{t-1}$$

In other words Y_t can be expressed as a function of several decision variables and acreage in period t - 1.

With this theoretical framework as a background, the following statistical model was used.

$$Y_t = a + b_1 P_{t-1} + b_2 C_{t-1} + b_3 Y_{t-1}$$

where Y = hectares planted in Alicante and Murcia

P_{t-1} = average price of tomatoes exported to West Germany (net of transport costs), pesetas per box, divided by wholesale price index (Col. 6, Appendix Table 1)

C_{t-1} = index of cost of production in year t-1 divided by wholesale price index (Col. 8, Appendix Table 1)

Y_{t-1} = acreage in year t - 1

The data are described in notes to Appendix Table 1.

Results were as follows: (Figures in parentheses are t-ratios)

$$(R^2 = .38) \quad Y_t = 26.76 + \underset{(1.47)}{.0745} P_{t-1} - \underset{(-.31)}{.0118} C_{t-1} + \underset{(1.015)}{.2983} Y_{t-1}$$

All of the signs came out as expected and price was significant at the 83 percent level. The estimate of the adjustment coefficient (γ) turned out to be 0.7, which indicates rapid adjustment. The price elasticity of supply after full adjustment was +0.34 (long run supply) and the short run, year-to-year elasticity was 0.24.

The following alternative formulation was also tried

$$Y_t = a + b_1 \left(\frac{P_{t-1}}{C_{t-1}}\right) + b_2 Y_{t-1} + b_3 T_{t-1}$$

where

$\left(\frac{P_{t-1}}{C_{t-1}}\right)$ = ratio of net farm price to the Cost index, both lagged one year, deflated by wholesale price index (Col. 11, Appendix Table 1)

Y_{t-1} = acreage last year

T_{t-1} = temperature in November, December, January

Temperature was included as a proxy for yield, under the supposition that higher average temperatures mean better plant growth and less risk of damage from frost.

Results were as follows:

$$(R^2 = .63)\ Y_t = -36.5552 + \underset{(2.32)}{.2796} \left(\frac{P_{t-1}}{C_{t-1}}\right) + \underset{(2.68)}{.5332}\ Y_{t-1} + \underset{(2.79)}{3.6503}\ T_{t-1}$$

All variables are significant at the 95 percent level and have the expected signs. The value of the adjustment coefficient is .53 and the long run elasticity is +.55. Short run elasticity is +.29. Results from this formulation are consistent with the other formulation.

An attempt was made to include an index of prices of other horticultural products as well as wine, fruits and oil seeds, but the coefficient resulted positive, which was contrary to postulated results, so the variable was not used.

Although a longer, more complete data series would have been highly desirable, the statistical results from the present analysis seem plausible. The lack of any suitable production alternative for export tomatoes in the short run would cause the supply elasticity to be relatively inelastic. Neither the domestic market nor the export market for horticultural products is sufficiently large to absorb the production from large acreage shifts out of tomatoes into some other vegetable. In the long run, tomato producers can go into citrus or grapes, however, which do have broad international markets. The data generated in the present study definitely suggest an inelastic supply, since acreage changes are relatively small in the face of violent changes in prices and costs during the last 14 years.

Implications of Results

The CCT levied on Spanish tomatoes is about 11 percent of the wholesale price, which averages about 15 percent of the price f.o.b. packing plant. If Spain became a member of the EEC the tariff would no longer be paid and Spanish producers would view this as a 15 percent increase in net price. If our estimate of elasticity is appropriate, this would be translated into a 5 percent increase in supply. One might conclude that the tariff effects of Spain's membership on Spanish supplies would be relatively minor at least during the December to March period. Many have suggested the danger of large supply increases from Spain upon admission to the EEC.

However, there are other factors which may stimulate supply increases, such as elimination of the reference price provision, reduction of uncertainty about future EEC policy changes, etc.

Appendix Table 1: Data Used for Analyzing Supply of Winter Tomatoes in Spain

Year	Hectares Planted	(1) Price (DM/ 6 kg.)	(2) Price (pesetas/ 6 kg.)	(3) Transport (pesetas/ 6 kg.)	(4) Net price (pesetas/ 6 kg.)	(5) Index of wholesale prices	(6) Real Price	(7) Index of costs	(8) Index of real costs	(9) Price cost	(10) Temp. in Alicante (°F)	(11) P/Cost (net of tariff)
1963-64	--	6.12	91.80	39.5	52.3	.496	105	100	202	49	12.74	41
1964-65	4,400	6.20	93.00	40.0	53.0	.511	104	108	211	51	12.74	43
1965-66	4,410	6.35	95.25	40.6	54.6	.561	97	116	207	47	13.70	39
1966-67	4,600	9.90	148.50	41.3	107.2	.564	190	124	220	86	12.53	72
1967-68	4,810	8.56	128.40	42.1	86.3	.576	150	131	227	66	12.50	55
1968-69	4,275	8.49	148.58	42.9	105.68	.592	179	141	238	75	13.23	63
1969-70	5,880	7.71	137.01	43.7	93.3	.602	155	154	256	61	12.57	51
1970-71	5,765	8.33	159.35	45.3	114.05	.635	180	163	257	70	12.20	59
1971-72	5,849	9.06	180.38	46.5	133.88	.684	196	180	263	75	12.47	63
1972-73	5,239	8.15	164.30	47.7	116.6	.753	155	205	272	57	12.20	48
1973-74	5,486	10.41	226.94	50.8	176.1	.881	200	278	316	63	12.00	53
1974-75	5,000	11.16	248.64	56.4	192.2	1.000	192	321	321	60	14.17	50
1975-76	5,322	11.02	257.10	61.5	195.6	1.153	170	376	326	52	12.67	52
1976-77	5,047	10.84	287.80	68	219.8	1.351	163	455	337	48	12.67	48
1977-78	4,887	--	--	--	--	--	--	--	--	--	--	--

Source:

Column (1): Zentrale Markt-und Preisberichtstelle für Erzeugnisse der Land-forst-und Ernährungwirtschaft GmbH, ZMP Bilanz: Gemuse Bonn, Germany, various issues.

Simple average of weekly average prices October-February at wholesale markets in Germany, in Deutschmarks per 6 kilogram box.

Column (2): Column (1) multiplied by exchange rate between Deutschmark and Spanish peseta.

Appendix Table 1: (continued)

Column (3): Transport cost in pesetas per 6 kilogram box. Based on quotation of 96 pesetas per box in March 1981 from Alicante to Frankfurt, Germany. An index of gas and oil prices from U.S. Dept. of Commerce Survey of C was used to adjust the transport price corresponding to earlier years.

Column (4): Column (2) minus Column (3)

Column (5): United Nations, International Financial Statistics, various issues.

Column (6): Column (4) divided by Column (5)

Column (7): Ministerio de Agricultura, Anuario de Estadistica Agraria, various issues. An average of the index of rural wages and the index of fertilizer prices.

Column (8): Column (7) divided by Column (5)

Column (9): Column (7) divided by Column (8)

Column (10): Simple average of temperatures in November, December, and January.

Column (11): Price-Cost ratio after subtracting 11 percent tariff and 5 percent sales commission.

Notes and Explanations about the Data

The price variable is based on the average price in German wholesale markets, during the period October-January, (Column (1)) measured in Deutschmarks per 6 kilo box. The price is translated into pesetas per box (Column (2)) by multiplying by the DM-peseta exchange rate, as indicated in U.N., International Financial Statistics. An estimated transport cost (Column (3)) is then subtracted to adjust the price to conform to the packing plant location in Spain. To estimate the transport cost, the current (March, 1981) cost of transport was adjusted back through time according to a USA index of gas and oil costs. Column (4) represents net price f.o.b. packing plant in Alicante. This price was then divided by the wholesale price index in Spain to get deflated or "real" prices.

The index of costs is based on Table 4, and is a simple average of the cost index for labor and the cost index for fertilizer. Labor is known to represent about half of the cost of production. The fertilizer cost index was assumed to represent the price of inputs other than labor.