PRICE AND WELFARE IMPLICATIONS OF MARKET-WITHDRAWALS IN THE EUROPEAN ECONOMIC COMMUNITY

- A quantitative analysis for the market of apples and pears -

Hannes Weindlmaier and Secondo Tarditi*

1. Introduction

The development of the European Economic Community led to common policies for most agricultural commodity markets. These market policies are primarily destined to maintain equilibrium between supply and demand at price levels being acceptable for both producers and consumers.

The various measures applied for the regulation of markets exercise heavy impact on market prices and on trade flows between regions and countries. In addition, the incomes of the producers of the regulated commodity on the one hand and the welfare of the consumers on the other hand are influenced quite often in opposite directions and vary from region to region.

Given this situation, it seems to be of general interest to provide some quantitative estimates on the consequences of particular market regulations. In the present study quantifications of price and welfare implications are attempted for the withdrawals of apples and pears in the European Economic Community.

Market interventions of this kind have been carried out in some of the EC countries to stabilize prices for farmers at a minimum level. This becomes necessary, as in the last decade European supply of apples and pears has grown much faster than the corresponding demand, leading to surplus quantities at least in some years. Because of the high price flexibility of fruits, such surplus situations gave rise to severe decreases of producer prices.

2. The methodological approach and the data base

To quantify the consequences of withdrawals for different regions as well as for different society groups it is first necessary to find out, to which extent market equilibria, interregional flows and prices are influenced. In this study, the market forces determining prices and equilizing demand and supply for apples and pears among the different European production and consumption areas are represented by a spatial price equilibrium model. For both commodities and for the 10 regions distinguished, the model incorporates linear price prediction functions and fixed supply quantities. This makes it possible to solve the models with quadratic programming. 1/ The results of the

* University of Stuttgart-Hohenheim, Western Germany and university of Siena, Italy.

1/ For the theoretical basis of this approach and for possible model formulations compare Takayama and Judge (1971).

models are then used to quantify the welfare consequences for the different market participants and for different regions, employing the concept of economic surplus.

Studies of European market policy problems, using related techniques, have been carried out previously by Dean and Collins (1966) and by Zusman et. al. (1969) who investigated the market for oranges.

2.1 Basic assumptions

The model developed is basically a static and spatial model. Only short run interrelationship between production and consumption regions are taken into account.

Apples and pears are assumed to form a more or less independent market, which can be analyzed without simultaneously including other substitutes resp. complementary commodities of these two products and also ignoring possible interdependencies with the rest of the economy. Furthermore, in formulating the model we abstract from the different grades and qualities of apples and pears and also from the differences existing between the periods of a market season.

2.2 Regional demarcation

The European market examined by our model includes the 12 countries with the main importance for the international trade of apples and pears in Europe. To keep down the size of the model the United Kingdom and Ireland, as well as Sweden and Norway, have been aggregated to one region.

The not explicitly included European countries are either of negligible importance with respect to the international trade of apples and pears or their international trade is not governed by market forces (e.g. in the Eastern European countries). The production and withdrawal quantities of the model regions are presented in Table 1.

2.3 The price prediction functions

Different price prediction functions have been computed for each country using various specifications and different reference periods. Besides the usual criteria in choosing the best equation we selected those which had the most reliable price-quantity parameter, since the results of the quadratic programming model depend on it to a great extent. (Table 2).

Significant cross elasticities between the price of apples and the consumption of pears have been found only for Belgium-Luxemburg and for the Netherlands, while cross elasticities between the price of pears and the apple consumption have been detected for Germany, Italy, the Netherlands, and for Denmark.

Table 1: Market production and withdrawals of apples and pears (1000 tons)

Country	Apples				Pears			
	1969/70		1970/71		1969/70		1970/71	
	Production	Market withdrawals	Production	Market withdrawals	Production	Market withdrawals	Production	Market withdrawals
UEBL	283	17.6	221	4.7	55		92	12.7
France	1457	63.0	1454	85.4	403		447	20.0
Germany	2047		1299	4.8	337		528	0.2
Italy	1082	80.0	1203	41.6	1594	148.8	1842	554.3
Netherlands	375	22.9	375	43.7	85	0.2	154	55.8
Denmark	110		105		10		14	
UK-Ireland	239		250		55		70	
Austria	230		219		55		54	
Switzerland	188		155		45		42	
Sweden-Norway	200		184		38		33	

Table 2 : Selected price prediction functions for apples and pears in national currencies

Country	Price prediction functions for apples						Price prediction functions for pears					
	Reference period	Estimated coefficients				R^2	Reference period	Estimated coefficients				R^2
		Constant term	Apples kilo/capita	Pears kilo/capita	Trend or other [3]			Constant term	Pears kilo/capita	Apples kilo/capita	Trend or other [3]	
UEBL	1956-71	9.728	- 0.203**	- 0.096		0.49	1951-71	5.021	- 0.428**		+ 2.073LT	0.59
France	1956-71	1.460	- 0.05 **			0.63	1956-71	1.290	- 0.097			0.85
Germany	1961-71	1.322	- 0.016**		- 0.290T**	0.87	1961-71	1.744	- 0.041**	- 0.007**	- 0.669LT**	0.90
Italy	1961-71	110.686	- 4.447			0.46	1956-71	123.462	- 4.447**	- 0.350	+28.965LT	0.83
Netherlands	1956-71	0.972	- 0.025**	- 0.013	+ 0.010T*	0.87	1956-71	0.767	- 0.412**	- 0.007		0.81
Denmark	1965-71	3.255	- 0.124		+ 1.227D	0.55	1965-71	3.268	- 0.329	- 0.049	- 0.896QPE	0.91
UK-Ireland [1]	1956-71	17.954	- 0.693*			0.25	1956-71	16.816	- 0.940			0.72
Austria	1962-71	9.031	- 0.056		- 0.317T*	0.39	1962-71	10.637	- 0.408		- 0.275T*	0.47
Switzerland	1956-71	1.194	- 0.099**		- 0.068QAE**	0.49	1956-71	0.450	- 0.319		+ 0.173LT*	0.32
Sweden [2]	1956-71	1.869	- 0.024			0.23	1956-71	2.197	- 0.103			0.11
Norway [2]	1956-71	2.015	- 0.043*		- 0.305LT*	0.34	1956-71	1.591	- 0.217**		+ 0.216LT*	0.87

** Significant at a 99 per cent level
* Significant at a 95 per cent level
1) The used function is equivalent with the function estimated for the UK
2) The functions have been aggregated by weighting parameters with population
3) The following exogeneous variables have been included : T denotes a linear trend
LT denotes a logarithmic trend
D denotes a shift variable (1 in years with yields above average and 0 else)
QAE denotes the total European production of apples except in Switzerland in million tons
QPE denotes the total European production of pears except in Denmark in million tons

2.4 Transportation rates and tariffs

In Table 3 the estimated transportation costs per unit between the basing points chosen for each of the 10 regions and the estimated tariffs of the non EEC countries in 1970/71 are shown.

The transportation rates per ton and km have been estimated on the basis of a survey of transportation costs of 50 different exporting firms. The tariffs are own estimates based on the existing information or seasonal tariff rates, quotas, and import taxes.

2.5 The formal model for the determination of optimal allocations

Given the assumptions and specifications of the previous section, we can state the formal characteristics of the model. The following notation will be used:

i, j denote supply and demand regions, $i,j=1,\ldots,10$

k denotes the type of fruit, $k=1,2$

f denotes the number of exogeneous variables in the price prediction functions

x_i^k denotes supply of fruit k in supply region i

x_{ij}^k denotes the quantity of fruit k shipped from supply region i to demand region j

t_{ij}^k denotes the unit transportations costs for shipping fruit k from supply region i to demand region j

n_{ij}^k denotes the import tariff for fruit k imported in demand region j from supply region i

Table 3 Transportation costs for relevant routes[1] and import tariffs for apples and pears in 1970/71
(US-dollar per ton)

Importing countries / Exporting countries	UEBL (Bruxelles)	France (Paris)	Germany (Frankfurt)	Italy (Florence)	Nether-lands (Utrecht)	Denmark (Kobenhavn)	UK-Ireland (Manchester)	Austria (Wien)	Switzer-land (Bern)	Sweden-Norway (Stockholm)
UEBL (Bruxelles)							29.50			
France (Limoges)	19.57	11.71	26.66		27.26	50.92	36.71		27.44	70.00
Italy (Ferrara)	35.50	33.94	28.57	4.68	38.99	46.02	56.35	21.98	16.51	65.03
Netherlands (Utrecht)	5.03					23.98	27.54			43.05
Import tariffs apples						36	71	18	57	175
pears						57	69	18	53	230

1) The city names in brackets refer to the basing points representing the regions

$\bar{p}_i^k$ denotes the equilibrium price of fruit k in demand region i

$\bar{p}^{ik}$ denotes the equilibrium price of fruit k in supply region i

Price prediction functions

$$(1) \qquad p_i^k = \alpha_i^k - \Sigma_k \beta_i^k y_i^k - \Sigma_f \gamma_{if}^k z_{if}^k$$

The price of fruit k in demand region i is a function of the quantity demanded, $y_i^k, k=1,2$ and of the f exogeneous variables z_{if}^k. α, β and γ are parameters with α and $\beta > 0$. When combining the exogeneous variables with the constant term we get

$$(2) \qquad p_i^k = \alpha_i^{*k} - \Sigma_k \beta_i^k y_i^k$$

Since the coefficient matrix formed by our price prediction functions is not symmetric, we employ the concept of maximizing "net social monetary gain"[1] for formulating the model:

$$(3) \qquad \text{Max } F(y_i^k, x_{ij}^k, \bar{p}_i^k) = \quad \text{Maximize:}$$

$$\Sigma_i \Sigma_k (\alpha_i^{*k} - \Sigma_k \beta_i^k y_i^k) y_i^k \quad \text{Total European social revenue for apples and pears over all regions}$$

$$-\Sigma_i \Sigma_j \Sigma_k (t_{ij}^k + \pi_{ij}^k) x_{ij}^k \quad \text{minus the sums of transportation costs and of tariffs}$$

subject to the restrictions stipulating perfect competition

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1) Compare Takayama and Judge (1971,p.250)

(4) $\alpha_i^{*k} - \Sigma_k \beta_i^k y_i^k \leq \bar{p}_i^k$

for all i and k

The market demand price of fruit k in region i is less than or equal the equilibrium price(no profit)

(5) $\bar{p}_j^k - \bar{p}^{ik} \leq t_{ij}^k + \pi_{ij}^k$

for all i,j and k

The price difference of fruit k between demand region j and supply region i is less than or equal the transportation costs t_{ij}^k plus the tariff π_{ij}^k

(6) $y_j^k \leq \Sigma_i x_{ij}^k$

for all j and k

The quantity of fruit k demanded in region j is less than or equal the sum of inshipments

(7) $\Sigma_j x_{ij}^k \leq x_i^k$

for all i and k

The sum of outshipments of region i is less than or equal the amount of fruit k supplied

(8) $y_i^k , x_{ij}^k , \bar{p}_i^k \geq 0$

for all i,j and k

The variables in the optimal solution must be nonnegative.

2.6 The analysis of welfare implications

One way to evaluate the overall welfare effect of certain policies to society would be to compare the values of the objective functions which result in the models for alternative economic situations. However, this gives only an overall picture an welfare consequences. What is interesting in addition are the likely redistribution effects between the relevant society groups (producers, consumers, public sector) and also between different countries. To get some information in this direction, we adopt the concept of economic surplus to evaluate the desirability of the investigated policy, using the individual demand and supply functions incorporated into the models as a basis 1/.

Three components of economic surplus have to be distinguished, i.e. producers income, government revenue and consumers gain. Winch (1965, p. 422) states that a net gain or loss, which is derived from aggregated market demand curves is an accurate measure of the gain or loss of social welfare only if society is indifferent to the redistribution effects involved. If the redistribution is considered good in itself, aggregation underestimates a net gain or overestimates a net loss. If redistribution is considered bad, the results overestimate a net gain or underestimate a net loss. Therefore, the fact of redistribution has to be held in mind when interpreting our results.

3. Empirical results 2/

Ex post models for the seasons 1969/70 and 1970/71 were run. These two seasons have been interesting examples as they showed significant differences in the total European supply of apples and pears and also with respect to its regional distribution.

For validation purposes model runs have been carried out with input date describing the real situation of the season investigated. The results of these models with respect to regional prices, consumption quantities and interregional flows corresponded with the relevant real values to an extent which we thought to be sufficient to allow the use of the models for policy analysis.

In Table 4, the changes of producer prices and of the components of economic surplus which occur in case of withdrawals are presented.

Coinciding with general economic theory, the results show an overall negative welfare effect of withdrawals.

1/ For a discussion of the employed concepts compare Winch (1965), Dean and Collins (1966) and Berry (1969).

2/ Details on the data base and empirical results for the policy measures and economic developments investigated may be found in the forthcoming publication by Weindlmaier and Tarditi (1976).

Table 4 Estimated price changes and implications on welfare for individual groups and countries from withdrawals[1] of apples (A) and pears (P) in some EEC countries 1969/70 and 1970/71

Country	Fruit	1969/70					1970/71				
		Change of producers price	Producers income	Government revenue	Consumers gain	Net gain or loss	Change of producers price	Producers income	Government revenue	Consumers gain	Net gain or loss
		per cent	million dollars				per cent	million dollars			
UEBL	A	+ 12.2	+ 2.1	- 1.3	- 2.2	- 1.4	+ 6.9	+ 1.1	- 0.2	- 0.6	+ 0.3
	P	+ 8.5	+ 0.5		- 0.6	- 0.1	+ 19.6	+ 2.0	- 0.7	- 1.2	+ 0.1
	Σ		+ 2.6	- 1.3	- 2.8	- 1.5		+ 3.1	- 0.9	- 1.8	+ 0.4
France	A	+ 6.8	+ 6.4	- 4.5	- 4.6	- 2.7	- 7.9	+ 1.4		- 5.5	- 4.1
	P	+ 9.1	+ 3.3		- 3.4	- 0.1	+ 19.8	+ 4.9		- 6.6	- 1.7
	Σ		+ 9.7	- 4.5	- 8.0	- 2.8		+ 6.3		- 12.1	- 5.8
Germany	A	+ 5.1	+ 9.5		-11.3	- 1.8	+ 5.9	+ 7.6	- 0.2	- 12.1	- 4.7
	P	+ 11.5	+ 3.7		- 4.8	- 1.1	+ 42.8	+ 18.7		- 19.9	- 1.2
	Σ		+13.2		-16.1	- 2.9		+ 26.3	- 0.2	- 32.	- 5.9
Italy	A	+ 6.9	+ 4.8	- 5.7	- 4.2	- 5.1	+ 8.1	+ 5.7	- 2.0	- 4.9	- 1.2
	P	+ 15.5	+10.8	- 12.1	-13.3	-14.6	+112.9	+ 79.4	-31.6	- 68.1	- 40.3
	Σ		+15.6	- 17.8	-17.5	-19.7		+ 85.1	-33.6	- 93.	- 41.5
Netherlands	A	+ 13.9	+ 3.6	- 1.6	- 2.9	- 0.9	+ 18.5	+ 3.7	- 2.1	- 0.9	+ 0.7
	P	+ 8.8	+ 0.7		- 0.5	+ 0.2	+ 64.5	+ 3.7	- 3.2	- 5.4	- 4.9
	Σ		+ 4.3	- 1.6	- 3.4	- 0.7		+ 7.4	- 5.3	- 6.3	- 4.2
Denmark	A						+ 0.0				
	P	+ 6.6	+ 0.1	- 0.1	- 0.2	- 0.2	+ 30.2	+ 0.6	- 0.2	- 0.7	- 0.3
	Σ		+ 0.1	- 0.1	- 0.2	- 0.2		+ 0.6	- 0.2	- 0.7	- 0.3
UK-Ireland	A	+ 2.8	+ 1.1	- 2.2	- 1.4	- 2.5					
	P										
	Σ		+ 1.1	- 2.2	- 1.4	- 2.5					
Austria	A	0.0	0.0				+ 5.3	+ 1.3	- 0.3	- 1.8	- 0.8
	P	+ 10.2	+ 0.6	- 0.1	- 0.9	- 0.4	+ 65.0	+ 3.3	- 0.4	- 4.1	- 1.2
	Σ		+ 0.6	- 0.1	- 0.9	- 0.4		+ 4.6	- 0.7	- 5.9	- 2.0
Switzerland	A	+ 3.4	+ 0.8	- 0.6	- 1.0	- 0.8	+ 4.1	+ 0.9	- 0.7	- 1.0	- 0.8
	P	+ 0.0	+ 0.0				+ 13.4	+ 0.7	- 1.0	- 0.9	- 1.2
	Σ		+ 0.8	- 0.6	- 1.0	- 0.8		+ 1.6	- 1.7	- 1.9	- 2.0
Sweden-Norway	A	+ 3.8	+ 2.1	- 1.9	- 2.3	- 2.1	+ 3.7	+ 2.0	- 2.1	- 2.4	- 2.5
	P	+ 3.2	+ 0.4	- 0.8	- 0.5	- 0.9	+ 13.8	+ 1.5	- 3.0	- 1.9	- 3.4
	Σ		+ 2.5	- 2.7	- 2.8	- 3.0		+ 3.5	- 5.1	- 4.3	- 5.9
All-countries	A		+30.4	- 17.8	-29.9	- 17.3		+ 23.7	- 7.6	- 29.2	- 13.1
	P		+20.1	- 13.1	-24.2	- 17.6		+114.8	-40.1	-126.8	- 54.1
	Σ		+50.5	- 30.9	-54.1	- 34.9		+138.5	-47.7	-158.	- 67.2

1) For the quantity of withdrawals see Table 1.

However, the main reason for withdrawals is to stabilize prices at a price level higher than a free market price would be. In other words, a redistribution of incomes to the producer side is the basic objective. This redistribution needs not necessarily to be a loss to the consumers in the long run, if the intervention has the task to stabilize markets in case of extraordinary fluctuations, e.g. if through an extremely high harvest prices would fall to a level, at which some producers are forced to get out of the business. Intervention in such cases contributes to continuous market supply, which most likely is also in the interest of the consumers.

Given the redistribution objectives of interventions the comparison between the change in producer incomes on the one hand and the necessary public funds on the other is of specific interest. It can be easily derived that in any regional market the raise in producer incomes will be higher than the corresponding spendings of revenues only in the inelastic range of the demand function. If at all, only in such a case withdrawals can be a useful market policy tool.

Obviously, these conditions were fulfilled in 1969/70 and 1970/71. The raise in producer incomes exceeds the spendings of the governments by 19.6 million dollars in 1960/70 and by even 90.8 million dollars in the season 1970/71. Further it should be noticed that the producers of those countries, in which no withdrawals are taken out of the market, also benefit from this measure: In 1969/70, pears were withdrawn only in Italy. Even though, the total benefit through this measure is shared about fifty to fifty between Italian producers and the producers in the other European countries. On the other hand, Italian consumers bear about 55 per cent of the total loss to consumers. In Italy, the funds necessary for intervention also were higher than the net gain to the producers of that country. Therefore, to distribute total withdrawals of that season between the countries would probably have been less costly.

To our opinion, this result calls for financing the market interventions through EC funds, perhaps employing some specific key for the contributions of each country. Of course, this statement is not relevant, if national governments incent a steady surplus production.

4. Concluding remarks

In this study a spatial price equilibrium model is formulated and applied to analyze regional interdependencies between markets and to obtain perfect competitive structures for the apple and pear markets under different economic conditions. To evaluate the welfare consequences of withdrawing apples and pears from markets of the EC, the concept of economic surplus is applied. Although the employment of this concept for the evaluation of policy decisions is questioned by some economists, to our opinion a cautious interpretation of the results obtained adds substantially to the findings of spatial equilibrium models. With respect to the empirical results of our study we showed that the withdrawals of apples and pears in 1969/70 and 1970/71 fulfilled their primary objective of increasing farm incomes, yet

causing an overall negative welfare effect. As a temporary measure, withdrawals appear to be a valuable instrument. While the positive effects for producers are distributed among producers of all countries, the costs of the withdrawals accrue in the countries in which the withdrawals are carried out and also the consumers lose most there. Hence, financing through common funds appear to be justified.

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