South African Avocado Growers' Association Yearbook 1987. 10:85-88
Proceedings of the First World Avocado Congress

The relationship between producer price and cost of the Spanish avocado as a parameter to forecast future supplies

J CALATRAVA, J GARCIA, L DELGADO and E ALCALA-ZAMORA
Departamento de Economía y Sociología Agrarias,
Dirección General de Investigación y Extensión Agraria
Apdo 240 14080 Córdoba

SYNOPSIS

This paper studies the profitability of avocado plantations on the basis of the analysis of the behaviour of the internal profitability rate (IPR) upon application of various price evolution assumptions. The results obtained will enable a forecast to be made by the end of this decade of the stabilisation of the avocado-planted area on the Spanish Mediterranean coast at about 6 000 ha.

INTRODUCTION

The decision to introduce new areas planted in long-life producing pluri-annual cultures is often dictated by personal judgment rather than by a rational analysis of the investment involved and has potentially long-term consequences. The *intuitively expected profitability,* ie the subjective profitability driving the decision-making individual is rather different in these cases from what could be termed the *real profitability,* ie that estimated from scientifically-analysed expectations.

The difference between intuitive profitability and that obtained analytically shows particularly clearly whenever the economic activity resulting from the decision is in a developing stage and the market for the product concerned is undergoing a structural change marked by abrupt alterations in supply and demand in search for a new equilibrium characterising the new commercial situation which the process tends to adopt. Such is the case with regard to avocados produced on the Andalusian Mediterranean coast. These have traditionally provided the producer with good profits arising from their favourable price; yet, such profits seem to be on an abrupt decline, which is logical taking into account the shift of the equilibrium position of the market, added to the increase in production and marketing costs - especially with regard to the provision of labour and power - over the last decade.

The very nature of avocado plantations as medium-term investments, as well as the current trends in this market, calls for analytical reflection on the predictable profitability of such investments in order to provide farmers with a realistic forecast of the expected financial returns on their decisions regarding the plantation, whether a new one or an extension of an existing avocado plantation.

These analytical reflections are the subject of this paper, which contains a detailed cost structure for different types of avocado plantations with price indices for the various cost components, to analyse the evolution of the profitability rate of a generic ha of avocados, planted annually between 1970 and 1990. A series of conclusions are drawn on the basis of different hypothesised behaviours of input and output prices.

As in every predictive model, the feasibility of the starting assumptions is the key element to ensure the accuracy of the conclusions arrived at. Thus, this paper deals with the degree of realism of the hypotheses postulated, which is always relative whenever medium-to-long-term situations are involved. Only the most relevant aspects of the results obtained are commented on here, although a comprehensive analysis will be made in future papers.

MATERIAL AND METHODS

The starting material consisted of four cost structures corresponding to different real situations of avocado plantations based on the Andalusian Mediterranean coast. These were analysed for their input prices and their evolution monitored over the period 1970-1986. The four structures corresponded to:

(a) Canal routed water: flat lands. Installation costs were roughly the same as plantation costs.
(b) Farmer-owned well water: farms located on slopes and requiring land terracing; gravity irrigation.
(c) Well or canal water stored in a pond for development of drip irrigation; farms on gentle slopes requiring no earth turnover.
(d) Well water pumped to a communal store; gravity-irrigated farms located on slopes; drip irrigation; piezometric head, 600m (cooperative handling of a shared irrigation system).

By way of example, Table 1 lists the components of the cost structure of the four situations considered for 1986. Such structures respond to the use of current technology for obtaining an average crop of 12 000 kg/ ha at full-scale production.

The extrapolation of the input prices beyond 1986 was carried out by analysing the evolution of the price indices of the different cost components, with certain constraints. Thus, from the trend derived by regression of the growth rate, the following hypotheses have been formulated:

(1) A constant annual increase after 1986 equal to the mean of the forecast for the first three years (1987-89) obtained by applying the least-squares model was assumed. This resulted in an annual growth rate of 7,566 per cent[1].
(2) The regression model predictions were applied at $\hat{\tau} > 5$ per cent and $\tau = \text{const} = 5$ per cent for $\hat{\tau} \leq 5$ per cent.
(3) The predictions were also applied at $\hat{\tau} > 2$ per cent and $\tau = \text{const} = 2$ per cent for $\hat{\tau} \leq 2$ per cent.

TABLE 1 Summary of the structure of plantation and cultivation costs (in pts) per ha (1986).

	Canal routed water	Pumped well water	Farmer-owned water	Repumped water
	Gravity irrigation	Gravity irrigation (terraces)	Drip irrigation (non-terraced slopes)	Drip irrigation
Plantation				
Preparation	69 030	2 547 500	1 380 100	5 870 000
Raw materials	129 550	130 950	162 350	166 200
Plantation	210 000	210 000	210 000	210 000
Labour	119 000	119 000	119 000	68 000
Total	527 580	3 007 450	1 871 450	6 314 200
Cultivation (Full-scale production)				
Raw materials (water included)	165 647	199 601	214 492	211 470
Labour	324 000	324 000	205 800	271 000
Total	489 647	503 601	420 292	562 470
Annual cultivation cost				
(pts/kg) at full-scale production (12000 kg)	40,80	41,96	35,02	46,89

All three hypotheses applied were based on a decreasing inflation prediction as the cost growth rates were actually much higher than those assumed in the three cases. The expected incomes were estimated from the high growth and production hypothesis used by Calatrava (1981) for supply forecasts, the accuracy of the estimations as a valid mean being confirmed for the period 1981-1986.

Regarding input prices following 1986, the following hypotheses were formulated[2]:

(A) The annual price increase, ΔP, was assumed to be 5 per cent for $\tau^{\wedge} \geq 5$ and equal to τ for $\tau^{\wedge} < 5$.
(B) Such an increase was assumed to be 2 per cent for $\tau^{\wedge} \geq 2$ and equal to τ for $\tau^{\wedge} < 2$.
(C) The price, in current pts, was assumed to keep constant. This would be equivalent to a continuation of the trend shown in the last few years. This was thus a rather pessimistic, unlikely hypothesis.

Just as the hypothesis regarding the predicted evolution of production costs was based on historical series of growth rates and on the assumption of future inflation rates below previous ones, the hypotheses concerning the evolution of income were based on the following facts, assumed to be very likely:

- The average price in current pts has remained constant throughout the past few years.
- No large price increases in the future would occur, unless the European market absorbed the supply of producing countries on the sole basis of the effect of publicity on demand, which would be rather unlikely, as it would involve annual shifts in the demand curve of the European market to the order of + 17 per cent, with respect to the quantities consumed at a constant price up to 1990 (Calatrava, 1984).
- Should the aforesaid publicity effect influence the demand, the current price of avocado would rise at most, to be parallel to inflation.
- For the same reason, price increases should never exceed the assumed cost increases.
- Even though the growing demand tends to push prices up, the decreasing effect of the strong supply generation would counteract the former effect to a great extent.

Because of the logical correlation one would expect between price and cost increases and inflation rates, some of the combinations resulting from the price and cost increases are rather unlikely.

After consultation with three experts and contrasting of their replies with the authors' own criteria, the following mean subjective probabilities for the occurrence of the different events were obtained, assuming the probability function of future events to be completed by the hypotheses formulated:

Cost hypotheses probability	Income hypotheses	Subjective occurrence
I	A	0,125
I	B	0,075
I	C	Unlikely
II	A	0,200
II	B	0,200
II	C	0,050
III	A	0,125
III	B	0,150
III	C	0,075

The subjective probabilities listed above were only used to make some considerations about the analysis and were always applied with the corresponding reservations.

RESULTS AND DISCUSSION

This information framework was used to obtain the various profitability measurements for hypothetical 1 ha avocado plantations set up during the different years from 1970 to 1990 in each of the four situations considered and for each of the possible combinations of income and expenditure growth hypotheses. Only the results connected with the *internal profitability rate* (IPR) are discussed here.

In every case there is a gradual decrease in the IPR. By assuming the minimum acceptable IPR to be 12 per cent:

- Only hypotheses IA, IIA and IIIB would make the planting of avocados between 1987 and 1990 profitable in the case of communal, canal routed water (a).
- Only hypotheses IA, IIA and IIIA advise for planting between 1987 and 1990 and hypothesis IA in 1990, in the case of farmer-owned water and drip irrigation (b).
- Only hypothesis IIA makes it profitable to plant in 1987 or 1988 in the case of motor-driven drip-irrigation (c).
- No hypothesis advises for planting in the case of repumped water (d).

Thus, the most favourable situation is represented by hypothesis IIA, the evolution of which can be seen in Figure 1, together with the evolution of the E(IPR), namely the expected profitability obtained from the subjective probability function for the four hypothetical plantations considered.

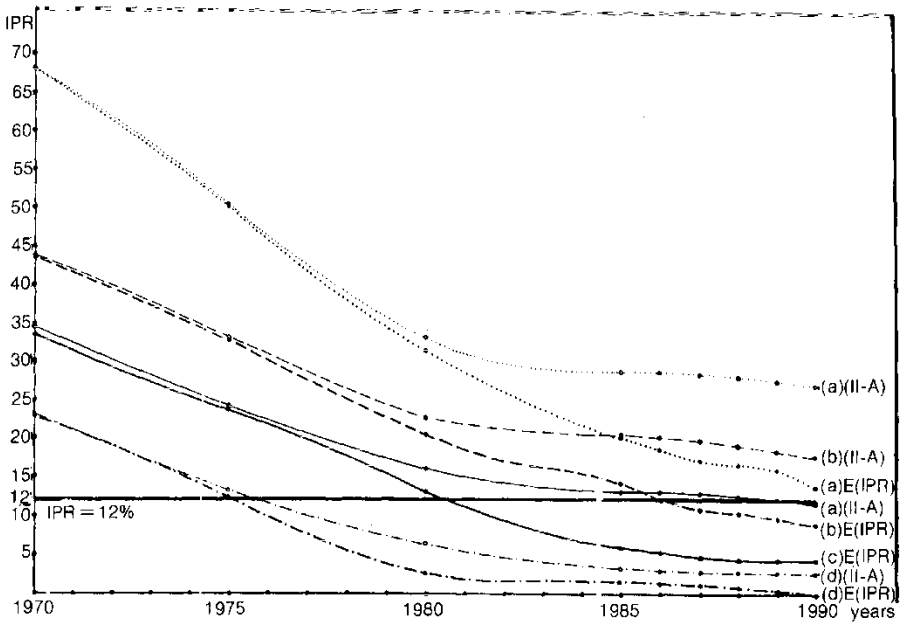

Fig 1 Most likely value of the profitability rate as a function of the subjective probability distribution of future prices and the most favourable case (IIA). 1970- 1990 series.

On the grounds of the profitability rates of the plantations set up in 1980 and 1981 and of the high inflation rate of these years, the IPR is very interesting in the case of communal, canal-routed water and of farmer-owned water with drip-irrigation; motor-driven, drip-irrigated plantations are just within the profitability limit and repumped water-irrigated plantations are unprofitable.

Is there an explanation for the fact that the aforesaid years saw the greatest plantation growth on the coast (an average 50 ha per month) in all the cases considered, the

increase having not ceased to diminish ever since (Calatrava, 1983 and 1984) and having attained much lower values in the last few months? The only plausible explanation in the opinion of the authors, is that the 1980-81 season was one of particularly high prices for avocados as a result of the export demand generated by the circumstantial decline of the Israeli supply, as well as in the fact that the earliest plantations were hardly producing full-scale and provided low or even unrealistic yields that were erroneously generalised and taken as a basis for decision making, and in more subjective elements such as imitation, mimetism, etc which had a part in the phenomenon (Calatrava, 1983b).

Why do plantations show a declining trend? Obviously because of the gradual balancing of the subjective profitability rate and the real rate as the individual involved gathers information, knowledge and experience and the earliest plantations reach full-scale production, thus providing realistic results.

In Table 2 the evolution of plantations at dates when information was available is illustrated. From the data in this Table and, assuming the subjective profitabillity to be relatively close to the real expected profitability, the cultivated avocado area will be 5 123 ha and the mean growth rate will be 12 ha/month by 1990[3]. By considering a rate of 2 per cent as indicative of area stabilisation, the cultivated area will stabilise during 1992 and 1993 at around 5 500 ha for the two provinces considered. Taking into account the scarce contribution of other Mediterranean provinces such as Valencia, Alicante, Murcoa and Almeroa to the overall Spanish avocado-cultivated area, this can be assumed to stabilise at about 6 000 ha, consistent with Calatrava's predictions (Calatrava, 1983a). Above this figure, plantation growth will be rather limited.

The supply of the Spanish Mediterranean coast by the end of the century will be between 60 000 and 80 000 tonnes. If the avocado-cultivated area of the Canaries stabilises at 1 500 ha (Calatrava, 1983a), then the mean annual Spanish supply will be about 75 000-95 000 tonnes (100 000 at the most).

All the conclusions above rely on the assumption that the evolution of prices and costs will fit some of the cases considered or a combination of them.

Some alternatives to avocado should be given due consideration. One such alternative is cherimoyas, less troublesome market-wise, and feasible to grow in zones where they can be properly pollinised. Another alternative fruit is the mango, recently introduced in areas with coastal micro-climates. Feijoas and litchis, exploited to a much lesser extent, medlars and even some citrus fruits and very early deciduous fruit trees will all undoubtedly have profitability rates similar to those of avocado and should be gradually introduced in those situations where avocado has lost or is about to lose its past profitability level.

TABLE 2 Evolution of avocado-cultivated surface on the Granada and Malaga coast[1]

Date	Source	Estimated area (ha)	Mean monthly rate of surface growth (in ha)	Per cent annual increase
1977	DGPA flight	425,7	10,77	30,37
1978 (± 1 year after DGPA flight)	SEA census	555 (Equavalent to No of trees censused by SEA)	47,15	101,94
April 1981	INIA Project 3297	2 111	44,00	54,72
March 1983	INIA Project 3297	3 170	32,40	12,26
January 1984	INIA Project 3297	3 494	24,90	8,57
September 1985	INIA Project 3297	4 018		

[1]Neither the planted surface of Almeria nor that of the Spanish Levante coast is included. The planted surface on the boundary between Cadiz and Malaga have been included in the Malaga surface.

ACKNOWLEDGEMENTS

The authors are grateful to Juan Antonio Calhas Madueno, who kindly supplied the programme for calculation of investment profitability, and to Javier Calatrava Leyva, who wrote the specific programmes for calculation of expected IPRs from subjective probabilities and the evolution of plantations.

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[1] The regression model accounting for the growth rates obtained from the cumulative indices taking account of the evolution of the different cost components was:

$$\hat{\tau} = 19{,}52206 - 2{,}289892t + 0{,}636352t^2 - 0{,}0124828t^3$$

where $\hat{\tau}$ is the predictor of the growth rate for the year t (t_o = 1969). R^2=0,099504. All the regression coefficients were significantly different from zero (α = 0,01) and F = 870,083 (significant, α = 0,001).

[2] These prices are intended as average prices for the October-April season, when virtually the whole supply of the zone studied is generated.

[3] According to these assumptions, the cultivated area in the beginning of 1987 should be 4 430 (or 4452 if another 102 ha planted in Almeria are included) and the growth rate 19 ha/month. The real rates recorded at the beginning of the year were actually somewhat lower because of the negative impact of Israel's surplus in the current campaign.