

THE ROLE OF AGRICULTURE IN DEVELOPED ECONOMIES: NEW TENDENCIES

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1. Introduction

The present study deals with the role of agriculture in developed economies. On one hand we try to show how the traditional vision of decline of the sector must take into account the heterogeneity of the phenomenon. On the other hand, it underlines the need to consider the multiplicity of the objectives in the analysis of the relationships between the economic activities, and the agricultural uses of the natural resources.

The study is part of a wider research program to study the evolution of sectorial performances. The dynamics of consumption, the increasing sensitivity regarding the impoverishment of natural resources, and the reform of the Common Agricultural Policy, are all determining factors for the complex phenomena that become apparent under empirical observation. When dealing with such problems theoretical questions and economic statistics intertwine; modern econometrics places extreme importance on the microeconomic bases of specification: for our purposes it is necessary to underline how environmental economic-quantitative models, although they are valuable, still assign agriculture with the traditional role of producer of mercantile goods (Botteon et Alii, 1994, p. 457). The simple empirical surveys proposed are to be seen as an attempt to enrich the analytical perspective adopted to deal with activities linked to the use of agricultural resources. The basic idea is that it is appropriate to give space to microfounded studies aimed at wider analyses.

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Abstract

This study concerns the role of agriculture within the developed countries. We point out the traditional view about declining importance of agricultural activities which should be modified by taking in account the heterogeneity of those activities. ARIMA models have been estimated to describe the heterogeneity of the declining importance of GDP with respect to EU's countries. Given the framework mentioned, a case study concerning the willing to accept (WTA) the set-aside proposes an attempt to consider the different behaviours of farmers.

Résumé

Cette étude traite le rôle de l'agriculture dans les pays le plus développés. Après avoir déliné le déclin de l'importance des activités agricoles, nous chercherons à mettre en évidence la très grande hétérogénéité de ces activités qui pourtant n'est pas considérée dans la mesure du PNB. Des modèles ARIMA ont été estimés pour décrire la hétérogénéité du déclin de l'importance de l'agriculture dans les pays de l'UE. Dans la deuxième partie de l'étude, on expliquera un exemple d'attitude des agriculteurs pour ce qui concerne leur disponibilité vers l'acceptation des différents niveaux des prix pour le set-aside.

2. Methodology

The general picture referred to in this study is that of the well-known phenomenon of the progressive decline of the economic importance of the agricultural sector. Although many commentators have opportunely pointed out the inadequacy of the Gross Domestic Product (GDP) as a measurement of the level of well-being and development (Musu and Siniscalco, 1993, p. 56; Repetto, 1990, p. 8), the progressive reduction of agricultural GDP as a percentage of the total GDP is an irrefutable fact. In this study we have tried to describe this phenomenon so as to convey its possible uniformity on a European scale. For this purpose ARIMA models were calculated, on the series of relations between agricultural GDP and total GDP for all the countries of the European Union: the data are annual and refer to the period 1961-1993. Moreover, for Italy, models were calculated relative to the period 1890-1993, but using the Added Value, the results are clearly not comparable. However it is possible to underline how the reduction of the importance of agriculture is a heterogeneous phenomenon over time.

Reference is made to this general picture throughout the empirical study, carried out using an exercise of contingent valuation with a random group of farmers with farms localised in envi-

ronmentally sensitive areas near the Trasimeno Lake (idro land in the centre of Italy). Through meetings with farmers bidding games were set up concerning the possibility of realizing a set aside for a public payment from time to time contracted with individual farmers. The farmers were all aware of the current interventions foreseen by the Reg. EEC 2078/92 but none of them had yet subscribed to the program.

The relation between the two study sections can be found in the attempt to enrich the microeconomic bases of the sector studies, and, in that sense, the analysis of the evaluation of the entrepreneurs is an indispensable preliminary step.

3. Decline and evolution of agriculture

Introduction

In **table 1** the estimated ARIMA models are illustrated: as can be seen, in nearly all the cases the residuals were sufficiently uncorrelated (Ljung-Box Q test) but disnormal. Almost normal residuals are associated to the models concerning the series of the relation Agricultural Added Value/total Added Value for Italy (1890-1941) and to the series of the ration agricultural GDP/total GDP for Denmark.

If the models concerning GDP are considered, considering the fact that the

small amount of data is an intrinsic limit on the application, the prevalence of the models (0,d,q) can be noted, while only in the cases of Greece and Italy are the best models those of the type (p,d,0).

For Italy we used the Added Value relative to the period 1890-1993: in the first model, which refers to the entire period, the Second World War years were excluded. The models calculated for two sub-periods (1890-1941 and 1946-1993) show clear differences, as is obvious from the necessary differentiation imposed for the first model.

A complex outline of reference

The basic preceding observations are intended to underline that the reduction of the importance of agricultural activity is a generalised phenomenon in the studied economies, but characterised by significant differences between nations and over time. Such heterogeneity, if confirmed, seems to ask for, rather than just the definition of the most appropriate indicators, a study of the causes and the circumstances which are behind it⁽¹⁾.

To explain this statement it may be useful to refer to the usual accounting models for the economic system using input-output tables. The identification and the quantification of the aggregate (Agribusiness) have led to the setting-up, in the course of time, of a rich collection of knowledge that has enabled to provide some light on the ways of determining the interindustrial relations of strategic importance.

However, even leaving aside the inherent questions concerning the current availability of such statistical information, stress should be laid on the fact that, in such a context of representation, it is not so easy to take into consideration the organisational innovations that have been characteristic of the agroindustrial productive process over the last decade. Similar input-output coefficients, for example, can refer to very different organisational structures, whose definition is better described by the research into the minimum transactional costs, rather than the maximisation of net output defined on the base of traditional production functions.

In the same way, the implementation of the tables, so that they can take into account the relations between productive activities and the consumption of environmental resources (Schafer D. and Stahmer C., 1989), precisely because it is based on the possibility of representing from an accounting point of

view the economic importance of environmental protection, makes it even more urgent to ensure the correct

⁽¹⁾ The development of research foresees an increase in the amount of data the classification of estimated models (see: Piccolo, 1990).

Table 1.a Declining importance of agricultural economic activity in European Union - ARIMA models estimated.

Series	Models	Akaike Information Criterion
1. AgrAV/TotAV		
Italy:		
1890-1993	$-0.02893 + (1 + 0.30364 B) \text{ LOGDt} = a$ (0.0071) (0.0966)	-188.046
1890-1941	$\text{LOGDt} = -0.0073 + (1 - 0.499 B) \text{ at}$ (0.0059) (0.125)	-107.97
1946-1993	$\text{LOGZt} = (1 - 0.34448 B) \text{ at}$ '(0.1406)	-92.97
2. AgrGDP/Tot GDP (1961-1990)		
Belgium	$\text{LOGDt} = (1 + 0.13154 B) \text{ at}$ '(0.197)	-58.83
Denmark	$\text{LOGDt} = -0.01754 + (1 - 0.27868 B) \text{ at}$ '(0.0133) (0.193)	-49.77
France	$\text{LOGZt} = (1 - 0.07833 B) \text{ at}$ '(0.192)	-90.01
FGR	$\text{LOGDt} = (1 - 0.2857) \text{ at}$ '(0.185)	-66.45
Greece	$(1 + 0.43201 B) \text{ LOGZt} = \text{at}$ '(0.172)	-76.01
Ireland	$\text{LOGZt} = (1 + 0.194 B - 0.247 B) \text{ at}$ '(0.193) (0.199)	-57.26
Italy	$(1 + 0.265 B) \text{ LOGZt} = \text{at}$ '(0.185)	-98.33
Netherlands	$\text{LOGDt} = (1 - 0.07594 B) \text{ at}$ '(0.197)	-81.08
Portugal	$\text{LOGDt} = (1 + 0.11986 B) \text{ at}$ '(0.194)	-66.88
Spain	$\text{LOGZt} = (1 - 0.29186 B) \text{ at}$ '(0.193)	-114.21
United Kingdom	$\text{LOGZt} = (1 - 0.28066 B) \text{ at}$ '(0.185)	-88.59

Table 1.b Declining importance of agricultural economic activity in European Union analysis of residuals of ARIMA models.

Series Analyzed	Prob. of Q test at the lags:				Skewness	Kurtosis	Shapiro-Wilk's
	6	12	18	24			
1. AgrAV/TotAV							
Italy:							
1890-1993	0.44	0.8	0.85	0.538	-0.70	1.93	0.96
1890-1941	0.78	0.29	0.63	0.631	-0.41	2.90	0.96
1946-1993	0.16	0.52	0.8	0.837	-1.16	1.72	0.92
2. AgrGDP/Tot GDP (1961-1990)							
Belgium	0.42	0.08	0.11	0.209	0.17	-0.23	0.96
Denmark	0.15	0.09	0.24	0.447	-0.78	2.13	0.95
France	0.56	0.48	0.35	0.523	0.82	0.85	0.95
FGR	0.58	0.63	0.43	0.663	0.61	0.13	0.96
Greece	0.15	0.25	0.31	0.513	-0.46	-0.53	0.95
Ireland	0.08	0.11	0.34	0.614	-0.10	0.22	0.98
Italy	0.27	0.19	0.31	0.611	0.07	-0.13	0.98
Netherlands	0.65	0.8	0.71	0.306	-0.15	-1.00	0.96
Portugal	0.35	0.39	0.53	0.488	-0.03	-0.47	0.98
Spain	0.61	0.64	0.89	0.961	-0.17	-0.72	0.98
United Kingdom	0.57	0.84	0.77	0.632	-0.59	0.35	0.92

Source: our elaboration from OCSE and ISTAT data.



analysis and evaluation of the relations between agricultural use and the state of the stock of natural resources.

It therefore seems necessary to examine the sectorial dynamics to describe the characteristics that should define the enriching of the bases of systematic analysis of the relation of agriculture with the economic system and its role or indeed roles.

The evolution of agricultural economic activity has been fairly intense over the last decades. It is appropriate, first of all, to stress the circumstance that the reorganisation of the sector is marked by the emergence of new forms of connection between production, transformation and consumption. Networks between companies, increasingly numerous and intensive, enable appropriate responses to the dynamics of demand, and, on the other hand, with a higher level of efficiency than in single companies. Such an organisational transformation at least partly modifies the traditional confines of agriculture.

Next, it should be noted that the recent analytical horizon of research has modified, and attention is now being concentrated on the need to define the possible ways of development based on the notion of sustainability (Beltratti, 1994; Venzi, 1989). Such a new perspective summarizes a group of theoretical and real questions with reference to the context of the relations between farmers and the environment broadly speaking.

One extremely important aspect in this field is the attribution to agriculture of "multiple function systems, in which, beside the traditional productive function of material goods, another function of growing interest is added, which is that of the production of services (for example, recreational)" (Cannata, 1989, p. 93-94). In such a perspective the balance of costs and social benefits concerning the primary activity appears

to be incomplete and often the object of disagreement more political than scientific. It is worthwhile underlining that recent contributions suggest a situation of the relation between agricultural activity and natural resources which is much more complex than that which emerges from the mere consideration of the emission of pollutants. The difficulties in evaluating the contribution of agriculture to the maintenance of the stock of natural resources are perhaps all too well known, and, often, they derive from unresolved questions of economic analysis rather than real limits of calculation methodology. In this sense the survey on the behaviour of firms seems to be the obvious beginning for a study into the microeconomic foundations to the relations of the overall system.

A third tendency which must be taken into consideration is linked to the reform of the Common Agricultural Policy and, in particular, to the promotion of quality production. Without entering into the merits of the historical causes which are at the roots of this new direction, it should here be underlined that the specific productive process has very particular connotations, which distinguish it from the predominant mass productions. The emphasis on the use of local resources, while on one hand referring to the theme of endogenous development and widening the horizon of that development to the context of rural territory, on the other hand makes it necessary to consider the lesser degree of efficiency – or in any case the degree of local efficiency – that must be associated with such production.

Figure 1 attempts to summarize the observations made until now: in entirely qualitative terms it proposes a comparison between the activity of mass goods production, of quality and of the preservation of the environment.

The economic value of the entire agricultural activity should result from the values of the single activities, and enable the taking into account, for example in the field of different territories, the relations between them. The plan is merely indicative and, moreover, many studies have contributed to define its important quantitative aspects. What we want to underline, absolutely, is the circumstance that the reality of the agricultural and agroindustrial productive processes currently has characteristics that are extremely articulated and complex, probably not always leading to a uniform picture: moreover this complexity is recognised by the expectations in the valorisation of the local resources and in the possibility of local development.

The following empirical survey seeks therefore to study this complex picture.

4. The empirical analysis

An introduction

Taking land out of use, and in return obtaining financial compensation, without doubt represents one of the most important innovations in agricultural politic intervention, since it has contributed to the passage towards a use of agricultural resources which no longer seeks to maximise output. The reward for non-cultivation is aimed to compensate for or reduce the loss of income that the farmer undergoes, following an estimate directly linked to the productivity of the land: in this case the compensation expected by farmers should express directly the difference between productivity before and after the decision. In the light of what has already been written, the study of the evaluation of the firms on the suitability of the reward stimulates a certain interest, since if the farmers are only interested in the profitability of the resources they own – intersets which are obviously consistent with an evaluation of the performances of the sector in terms of GDP – then the subjective evaluations should correspond exactly to those foreseen in terms of the reduction of the net farm income.

Moreover, evaluations which differ from these would require a different kind of study and theoretical consideration.

On the basis of the complexity we have mentioned, the hypothesis is that the subjective evaluation of farmers – in this case study concerning the land factor – can differ, even quite considerably, from those foreseeable on the basis of the imposed reduction of net farm income.

Figure 1 A simple framework of rural and agricultural activities.

Efficiency's degree	Price of intermediate output	Price of final output	Environment impactness (defense costs)	Economic value of activity
Commodities' Production Process				
Network (+)	Increasing	Decreasing	(+)	Decreasing
Production of quality's products				
Tradition (-)		Increasing	(-)	Increasing
Environment preservation and sustainability				
Constant (*)			(-)	Increasing

(*) see Pan J., (1994).

Case study: estimating willingness to accept by logit models

A first objective of the analysis was to identify the probability of adhesion to the growing levels of compensation. For this reason the willingness to accept (WTA) the rewards was determined, for the provision of an environmental service which is the set-aside. The level of probability P* was calculated using a LOGIT model in which the dicotomic dependent variable Y could

assume the value = YES in the case of acceptance and NOT in the case of refusal of the proposed reward. The basic assumption is that individuals who were going to carry out a set-aside with a level of reward x resulting from individual contract making would have carried out the set-aside with rewards equal to $x + n$ with $n > 0$. In the following table 2 the basic variables of the analysis are given: percentages of growth for the basic reward foreseen by Reg EEC. 2078/92; cumulative

frequencies of adhesion at various levels of reward; dependent and independent variable, frequency counts. In table 3 the parameters and the statistics of the model are given.

Concerning our first objective, only when the level of the reward is above 60% more than the reward foreseen by Reg. 2078, is the probability of adhesion to the voluntary program of set-aside 48%, that is to say close to a level of indifference (50%).

A second objective of the analysis was to understand if the farmer in the bidding game followed a rational logic of the maximisation of income, in which case the ratio Rn_{ante}/Rn_{post} would have to be near to unity. The contract making would have to reach a level necessary to compensate for the loss of income due to the set-aside.

To check this second aspect we calculated the net incomes of single farms. The elaborated data were known by the farmers themselves because all of the farms were part of the FADN of the EEC.

Following this we calculated the ratio Rn_{post}/Rn_{ante} which however had a high degree of variability with an oscillation range from 0.80 to 2.6. Only in very rare cases was the ratio close to unity.

5. Hypothesis for the interpretation of the results

Venzi (1989, p. 57) has recently drawn the attention of agricultural economists to the fact that activities linked to agri-



Table 2 Case study variables.

% increment of premium	Frequency counts	Dependent variable
10	2	Yes
20	5	Yes
30	7	Yes
40	10	Yes
50	15	Yes
60	22	Yes
10	48	Not
20	45	Not
30	43	Not
40	40	Not
50	35	Not
60	28	Not

Table 3 Case study variables.

Model: logit=	- 3.45419 + 0,53046 * K	
Stad. err.	(0,46403)	(0,010111)
p-level	0,00002	0,000375
Loss function:	Maximum Likelihood	
Chi sqr.	33,106	
K =	frequency counts	
P* =	[exp(logit) / (1+exp(logit))]	

culture are among the principal utilisers of natural resources: land, in that it is the raw material for most agricultural production, is a factor of production that makes possible – through the use of work and capital – both the realisation of material goods and the supply of services in the sense introduced by Cannata (1989). If therefore it can be supposed that the farm considers the land available for cultivation a resource with an unmodifiable quantity over short term, one can try to formulate an interpreting hypothesis of the above results, referring to the analyses of McKelvey (1989).

It is assumed that the rate of productive use of the land is $Q(t)$ and that the use of the cultivation is expressible in markets terms as a function of the rate:

$$(1) U(Q) = Q W(Q)$$

in which the market price W of the output Q depends on the rate of cultivation. Therefore, one can deduce, that the unit value of output is linked to the distribution between the cultivated surface and the residual surface (set-aside). It is assumed that the unit cost of the cultivation $c(x)$ is independent from $Q(t)$ and that, moreover, because of the usual pattern to U of the cost curve, the reduction of the output implies that $c(x)$ grows with the amount of non cultivated land.

Given that for the time t_0 the quantity of non cultivated land is x_0 and given a particular "profile" of the use of the land $Q(\cdot)$, then the Present Value of the cultivation, given that r is the interest rate, is:

$$(2) PV [x_0, t_0; Q(\cdot)] = \int [U(Q) - C(x)] \exp[-r(t-t_0)] dt$$

The identification of the best solution requires, as already noted, the introduction of the dual price of the current availability of the resource (land), which enables the calculation of the rate of net instant income of the cultivation using the Hamilton formula:

$$(3) H(t) = U(Q) - C(x)Q - \Gamma$$

which Γ indicates the dual price. From (3), assuming that the optimum rate of cultivation is positive, we deduce the marginal rule of equality between the marginal utility and the unit costs:

$$(4) U'(t) = C(x) + \Gamma$$

in which $U'(t)$ is the marginal utility and the dual price evolves over time following the differential equation:

$$(5) d\Gamma/dt - r = C'(x) Q$$

In conclusion McKelvey (1989, p. 61) identifies two circumstances:

- i) if the cost of the use of the resource is always inferior to the maximum price of the output (choke price), then the use of the resource is complete and the dual price is positive (*malthusian case*);
- ii) in the other cases the use finishes leaving a residual availability of the resource, with a null dual case (*ricardian case*).

The answers obtained from the survey of farms can be divided into two groups. A first group of farms considers that the marginal productivity of the land is compensated for fairly by the current reward, so that their condition is unaltered by the decision to reduce the quota of cultivated land: the dual price of their resource should be considered null. The second group, referring to the malthusian case, assigns a positive dual value to the land, so that it requires an increase in the reward to exclude cultivation, or, in other terms, it would increase the land surface currently cultivated.

Reference has been made to the analysis of McKelvey (1989) in a manner which is perhaps arbitrary: the attempt is simply to draw attention to the fact that the empirical results seem to bring into question two essential economic aspects: the nature and the form of single functions of use and of cost. Since it is not reasonable to suppose that the differences found – in the field of the sample and concerning the level at which the reward is fixed – are due to the diverse quality of the land, then what prevails are either the expectations of the farms concerning the valorisation of the resources owned, or their availability, the internal organisational structure and the relations with the external unities. In this perspective we consider that the differences that have emerged must be explained in terms of the results that these expectations have on the on the costs of production and on the functions of utility.

6. Conclusive observations

This study makes some observations concerning the role of agriculture in developed economic systems, and has tried to show how the heterogeneity of the productive reality must be taken into consideration to correctly describe this role. In this sense both the inter-industrial organisational innovations and the use of natural resources must be taken into particular account. From this point of view, just the measure of

GDP seems inadequate, if the farm decisions are to be interpreted in relation to the functions of utility and of cost deriving from the interrelations between agriculture, natural resources and related economic activities.

One duty of the research study is therefore to examine the behaviour models of farms, so as to prepare an adequate basis for sectorial analysis.

Concerning the current agro-environmental measures, it is possible to come to some conclusive considerations. In the first place, the level of compensation foreseen by Reg. EEC. 2078/92 is considerably lower than the expectations of the farmers and therefore the level of adhesion expected is extremely low. Low levels of adhesion bring about a localisation of the interventions, which are very fragmented over the territory, which in turn reduces their beneficial effects on the environment.

Therefore, turning to voluntary interventions to safeguard the environment and based only on the compensation for income, although it allows further advantages from the political point of view, and for managing political consensus, only reaches extremely low levels of effectiveness. ●

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