IDENTIFYING FACTORS FOR DAIRY FARM SURVIVAL IN ITALY: A DISCRIMINANT ANALYSIS

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Abstract

Considerable reduction in both the number of farms and the cattle population is the phenomenon that best characterizes the current status of the dairy sector in the EU. This study examines the main structural variables in a sample of 819 family farms in an effort to determine whether there is a link between these variables and farm survival capacity. Based on the information collected from a questionnaire, the study sets out to construct a discriminant analysis model to explain and forecast evolution of the farm structure in the Italian dairy sector.
The model proposed correctly discriminates around 65% of the sample farms. Survival capacity is positively affected by the size and financial resources of the farm and its degree of specialization. Production efficiency level, on the other hand, has very little effect. Farm survival is, however, largely determined by the availability of family based labour at null or very low opportunity cost.

Résumé

Les diminutions importantes tant du nombre des exploitations que du cheptel bovin sont les phénomènes qui caractérisent le plus l'évolution récente du secteur laitier et fromager de l'UE. Cette étude prend en considération les principales variables structurelles d'un échantillon de 819 fermes familiales pour enquêter sur l'existence d'un lien entre ces variables et la capacité des exploitations de rester en activité. Sur la base des informations recueillies à l'aide d'un questionnaire, le travail vise à mettre en oeuvre un modèle d'analyse discriminant pour expliquer et prévoir l'évolution de la structure entrepreneuriale du secteur.
Le modèle proposé discrimine correctement environ 65% des exploitations de l'échantillon. La capacité de survie s'avère influencée positivement par la dimension économique de l'exploitation et par son degré de spécialisation. Par contre, le niveau d'efficacité technique de la production semble avoir peu d'importance. Toutefois la permanence du producteur sur le marché est surtout déterminée par la disponibilité de travail familial à coût faible ou nul.

1 - Introduction

The gradual but constant decrease in the number of farms and the concentration of production in a very small percentage of those that continue to exist are among the major factors underlying long-term agricultural evolution in western economies. Though there are considerable differences from country to country, the clear predominance of the family farm and the continual decrease in the number of farms are common traits in agriculture in developed nations. At the individual farm level we see the coexistence of two farming philosophies: the first is «industrialized, professional and responsible for large part of the country's production though involving a minority of the farms working in an agro-industrial context. The second has multiple activities, is non-professional and struggles on thanks to the combined income generated by farming and non-farming work. This latter type of farm contributes minimally to overall national production» [Pedrini 1994, 12].
These factors are equally active in Italian agriculture whose farm structure, though maintaining the unenviable European primacy for number and fragmentation, has, over the years, been subjected to some major changes. Sufficient here, for example, to mention that the number of farms has decreased by 30% between 1961 and 1990 [Fanfani 1993, 174]. Based on the latest official census figures, a mere 1.1% of farms (30,000) now supplies almost 40% of marketable production. Just 10% of the farms (300,000) generates two thirds of total output as opposed to 48% in 1970. We should add that over 80% of this two thirds is achieved by family farms that are, therefore, the fulcrum point for both professional and non-professional farming [Barberis 1994, 203-4].
The agricultural economist must thus face two types of problem: he must not merely explain why is the agriculture of advanced Western economies still organized by family farm [Schmitt 1991, 443], but also why the dichotomy between the two forms is so sharp. What, in fact, we note is a nucleus of competitive farms whose numbers are extremely small as opposed by an infinity of farms that are no longer productively viable and completely cut off from market needs. This research project, entirely empirical in design, method and intent, sets out to discuss a number of elements relating to Italian dairy farm survival. Though we will concentrate on the process of natural selection involved, we equally intend to investigate the problem «upstream» from the main topic outlined here-ie, what factors are common to the farms that display long term survival capability whether at a professional or non-professional production basis.
Information generated by a questionnaire filled out by a sampling of animal rearing farms was used to construct a discriminant analysis model to validate the possibility of explaining and forecasting the evolution of the survival and natural selection processes for the farms based on a knowledge of the main structural and productive variables. Our study, therefore, sets out to discriminate the individual farm on the basis of the level of probability the model assigns to each as regards survival or extinction. In addition to purely informational purposes, the ability to identify farms with higher survival potential responds to major policy needs.
Before going into a more detailed account of the empirical research in section 3, it might be useful to discuss the concept of a «viable farm» and a «successful farm». The purpose here is to delimit the scope of our research and to remove any equivocal considerations. Section 4 illustrates and comments on the results of the discriminant model.

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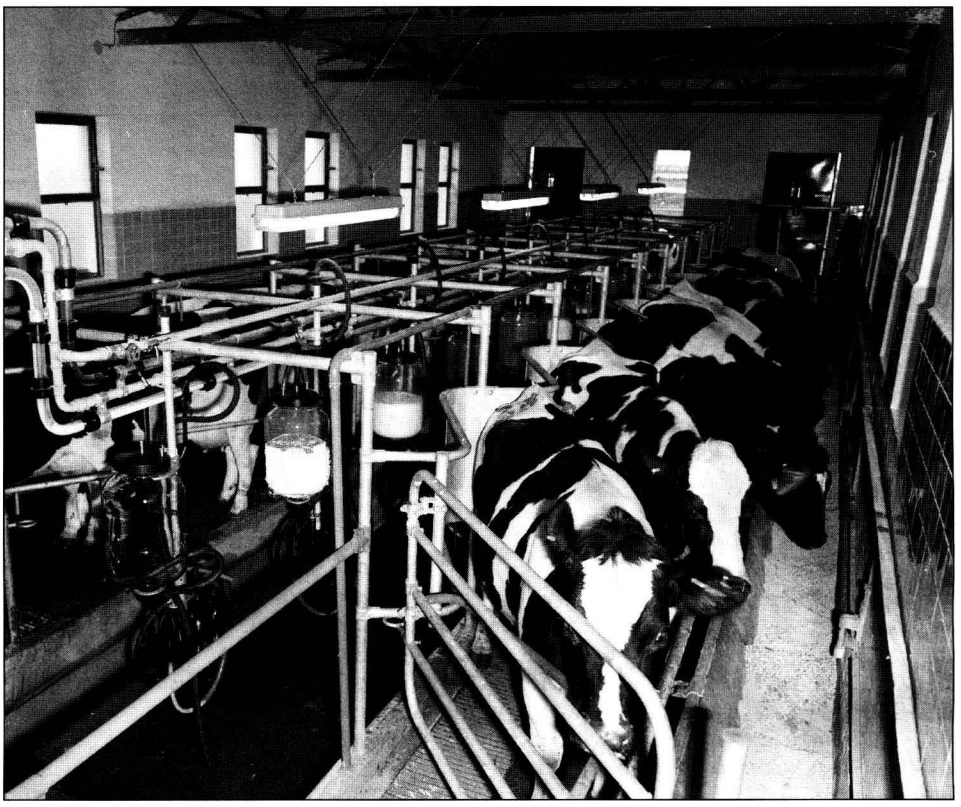
2 - «Viable», successful and surviving farms

When classifying farms in economic terms and more so when matters of agricultural policy are involved, the literature refers to «viable» and, more recently, «successful» farms. Though these two categories do not overlap, also because the opinion of various authors about them are in no way univocal [Prestamburgo 1973; Pennacchi 1993], in general terms these categories set out to delineate the essential characteristics of the farm best adapted to comply with defined economic policy goals. For the «vital» farm, the accent is normally placed on its ability to reward the productive factors at their market price. For the «successful» farm, on the other hand, what is typically required is the achievement of a complex of socio-economic goals.
It should be immediately pointed out that the discriminant model developed here, since it includes all the farms that did not stop operations during the time span considered, is a screening process whose mesh is far larger than the two classes of «viability» and «success» and, as a result, the farms covered by this discriminant analysis are not exemplars on which to model future farm structures in the field. The notion of «viable» and «successful» farm adds little, we feel, that is new to the state of the art knowledge about farm structure and its potential for growth. Without going into this in great detail, a number of considerations can be made.
Let's accept, from the many available, Prestamburgo's definition of a «viable farm» as one that «permits production factors to be rewarded at market price and to obtain a non-negative profit [Prestamburgo 1973, 181]. Given the ongoing and generalized under-rewarding of the factors used in agriculture, on the basis of this definition practically every farm would be considered as «non-viable». Referring more specifically to the Italian situation, if family labour were to be paid for at current cost, also a tenth of the professional level farms would unlikely achieve a positive or even null profit situation. But these farms, which cannot be classed in the «viable» category, not only exist but are the professional productive base for Italy's agriculture.
As with the «viable» category, it is not easy to find a non-banal or unambiguous definition in literature of the «successful» farm. In a recent work summarizing the terms of the discussion, Olsson notes that the reason for this is because there are, in fact, as many types of success as there are farmers [Olsson 1988, 251-2]. For Olsson, the successful farm entrepreneur and hence, a successful farm, is one who succeeds in achieving at one and the same time both a collective or social and an individual goal or series of goals. The former is established by the social environment, the community-ie, by factors external to the farm and is common to all the individuals that work within the same environment (objective success). The latter is strictly linked to individual preferences and may have very different connotations from one farmer and another (subjective success). This distinction between collective and individual goals offers the advantage of highlighting how the successful farm, since it is halfway between economics and sociology, is impossible to define precisely and is thus useless from a heuristic point of view.
At this point, it should be clear that the fact that a farm merely continues to exist within its market, professionally or non-professionally, is not enough to classify it as «viable» in Prestamburgo's sense or «successful» in Olsson's sense. This could only be the case if the farmers acted exclusively on the basis of economic criteria and the socio-economic system were entirely free from any friction or sticking points. And these are conditions almost always violated in the reality that is agriculture. The «viable» farm, thus, becomes for us a category that embraces all the farms that survive-ie, those that are able, thanks to a variety of forms of adaptation, to continue in existence long term.



3 - An empirical investigation

The EU's economic policy in the field of dairy products, given the substantially stable supply, has caused profound changes in the dairy farm structure. Among these, the decrease in both the number of farms and dairy cattle (see **table 1**) is particularly interesting.
This phenomenon, though it affects all EU member countries, is especially severe within the Mediterranean area and, above all, in Italy. Here, during the latter half of the 1980's, though individual production quotas were not in force, farms with dairy cows and the number of these latter, decreased at higher than average annual rates −10% for the former and 4% for the latter.
In these pages, we will examine some of the main structural and production variables based on a sample of dairy farms. Our purpose here will be to discover elements for or against the existence of a link between these variables

Table 1 ***Changes in the EU's dairy sector.***

	Milk production (000 t)	TAV %	Farms (000 n.)	TAV %	Dairy cows (000 n.)	TAV%
UE	'86-'91	–1,7	'87-'91	– 6,9	'87-'91	–3,2
North UE	«	–2,1	«	– 6,2	«	–3,0
South UE	«	0,3	«	– 7,7	«	–3,7
Italy	«	0,7	«	–10,7	«	–4,3

Source: own calculations on EUROSTAT data.

Remarks: North = B, DK, D, F, IRL, L, NL, UK; South = G, S, P, I; TAV = Average annual rate of change.

and the survival capacity of the farms. Our study covered 819 farms located in northern Italy and belonging to Consorzio Emiliano-Romagnolo Produttori Latte - «*Granarolo-Felsinea*» (CERPL) which collects the milk to be used for direct consumption as a food product. Though what we have here is not a probabilistic sampling, it is, nonetheless, a block of farms that is well able to represent the actual farm situation subject of our research (see **table 2**)(1) . Between 1990 and 1993, 554 of these farms gave up dairy cattle rearing. In the following pages we will attempt to determine the common traits of the 265 farms that remained active in the field.

3.1 - Data and model specification

Knowledge of the factors on which farm survival depends and, hence, the ability to identify which farms have higher survival potential is extremely important within a context of farm policy definition and application. Discriminant analysis can be a useful instrument in such a research project. Based on a linear combination of n independent variables, discriminant analysis allows individual subjects to be classed in one or more reciprocally exclusive groups. Once the independent variables have been defined and given a set of explanatory variables, a score is given to each case or farm under examination. On the basis of these scores, each case can be assigned to a pre-defined group [Norusis 1988a, 187]. Each farmer in the sampling was asked to respond to a questionnaire from which data relating to a number of farm variables-eg, resources, animal rearing technology, production results, age of farmer and his forecast for future milk production levels (see **table 3**) was collated. Based on whether the farm was still active or not in 1993, each block of data was assigned a dependent, dichotomic variable(2). To achieve model specificity and in order to select for the model only variables with significant link to survival capacity, the heterogeneity of the two groups of farms had to be validated for each trait using independent population variance t test(3). The signs listed for the different variables indicate that increased farm survival capacity can be hypothesized as the variants for the following structural traits increase: size, level of technical efficiency, degree of specialization and increased animal rearing intensity.

In discriminant analysis, variables coefficients are calculated so as to ensure that dependent variable scores are as similar as possible within the group and as dissimilar as possible between groups [Norusis 1988, 188](4). On the basis of

Table 2 ***Characteristics of 819 farms 1990.***

		Average	Standard deviation
Total annual milk production	L / year	69386.03	13941.53
Total acreage	ha	22.2	42.7
Dairy cows	n.	17.0	24.6
Barn workers	n.	1.8	0.8
Average annual milk cow	L / year	3857.9	2150.3
Average dairy cow per hectare	n.	1.4	8.0
Type of housing: permanent	% cases	92	
Type of milking:no automatic transport to the chiller	% cases	93	

Source: own calculations on CERPL data.

Table 3 ***Discriminant model variables (expected sign).***

Total annual milk production	*PT*	(+)
Average annual milk cow production	*PMv*	(+)
Average annual milk barn worker production	PMa	(+)
Total acreage	*T*	(+)
Dairy cows	*C*	(+)
Barn workers	*L*	(+)
Fodder acreage / Total acreage (%)	*Sf*	(+)
Dairy cows per ha of total acreage	*Vh*	(+)
Dairy cows per barn worker	*Va*	(+)
Farmer age	*ET*	(–)
Type of housing (*dummy*)	*TCN*	(+)
Production level forecasting (*dummy*)	*PRV*	(+)

Source: own calculations on CERPL data.

(1) The farms discussed in this study are mainly in the Emilia-Romagna, Lombardy, Veneto and Marche regions of Italy. Slightly over half are in the plain and the remaining 45% is divided among foothills (35%) and mountain (10%). For more detailed information on sampling make-up, refer to articles cited [Ansaloni 1993; 1995]. The research was carried out by CERPL to meet in-house needs for information on its associated farms. For our purposes, however, the sampling must to taken as probabilistic since it is consistent with the data from the latest Census on dairy farms located in the same geographical area.

(2) Observations on the type of housing and forecasts on future production levels were changed to convenience variables: permanent housing = 0; open housing = 1; production decrease = 0; increase or unchanged production = 1.

(3) For quantitative data, the t test can be used to assess the significance of the difference between the mean for the two groups or populations here independent and, depending on the situation, with the same or different variance (associated or independent t-test respectively). Following the «*p value*» approach when the hypothesis is tested, once the significance level of the test has been specified (a = 0.05), whenever p is greater than a, the null hypothesis, H_0 , must be accepted for the absence of significant differences between the mean of the two groups and vice-versa in the opposite case [Berenson-Levine 1989, 339-88].

(4) Since not all the farmers answered the questionnaire fully, the number of observations used in the model is less than the total observations. This means that 717 out of 820 farms could be included. Of these 717, at the end of 1993 276 were still active while 441 had stopped animal rearing work.

these coefficients, we can classify the individual cases-ie, we calculate a score for each farm which can then be assigned, with a determined probability of error, to one of the two groups.

4 - Results and conclusions

We should first take a closer look at the results of the variance test which is the preliminary stage to specifying the model (see **table 4**). There are significant differences between the two groups of farms as regards individual quantitative traits. There are, however, two major exceptions: averages yield per cow and the number of cows per hectare. Thus, the phenomenon of farm closing substantially affected all farms without reference to their technical efficiency and their animal rearing intensity. In particular, average productivity per animal, normally assigned significance as a synthetic efficiency index for the entire farm, does not appear top have any link with individual farm survival potential. Both these variables were therefore eliminated from the discriminant model.

The discriminant model thus elaborated was able to classify correctly around 65% of the farms that remained active and 68% of those that closed. Wilks statistics indicate that the average score between the two groups is significantly different and this confirms the hypothesis that the groups are formed from farms with different structural characteristics. Hypotheses on the direction of the influence of each variable on farm survival level were all confirmed. Here too, however, an important exception was the overall production level which shows a negative sign (see **table 5**). The low ability of the model to assign the farms to the correct group indicates the need for additional fine tuning. The dichotomic nature of farm structure could be a first source of error. The existence of small, non-professional farms whose decision to continue or cease activity is entirely unrelated to technical and economic criteria, reduces model performance since it is specified on the basis of strictly economic variables. In many cases, farm continuation in the animal rearing business can be more easily explained simply by the availability of zero-cost labour. But the interpretation of this result can be pushed even further. On this basis, it can be maintained that even for highly professional farms it is not enough to take the financial balance sheet into account to explain satisfactorily a decision to continue to work or to close down. In this context, it is extremely interesting to note the slight importance farm technical efficiency and average milk production per cow per year had on farm survival potential. To use discriminant analysis as an operational instrument, different models must be constructed for the kinds of farming entrepreneurship most widespread within the territory. An awareness of a set of variables not directly linked with technical and economic aspects is equally important.

Agricultural economic literate is replete with attempts to classify the farmer entrepreneur([5]). From our point of view, based on the results of our research, the most commonly found types of entrepreneurship can be identified by applying two criteria: the degree of technical and economic professionalism and the extent of farm capital. The categories identified include the following types of entrepreneurs: the non-professional with

([5]) See also the following authors: Evans 1949, 336 quoted in Karayannis 1990, 257; Rushton & Shaudys quoted by Pennacchi 1993, 14; Renborg & Fock 1977 quoted by Olsson 1988, 246; Olsson 1988, 254; Huirne-Dyhuizen-King-Harsh 1933, 63.

Table 4 ***Quantitative variables hypothesis tests: «t» test.***

VARIABLE	F value	2 Tail P.	Method	t Value	2 Tail P.
PT	3.00	0.000	Separate Variance Est.	–2.33	0.020
Pmv	1.52	0.005	«	–0.04	0.967
PMa	1.51	0.000	«	–2.70	0.007
T	1.32	0.000	«	–2.60	0.010
C	3.65	0.000	«	–3.97	0.000
L	1.47	0.000	«	–3.44	0.001
Sf	2.73	0.000	«	–4.66	0.000
Vh	1.54	0.000	«	–0.96	0.340
Va	1.82	0.000	«	–4.39	0.000
ET	1.21	0.063	Pooled Variance Est.	3.53	0.000

Source: own calculations on CERPL data.

Table 5 ***Discriminant model results.***

DISCRIMINANT FUNCTION COEFFICIENTS:

a	*PT*	*T*	*C*	*L*	*TCN*	*Sf*	*Va*	*ET*	*PRV*
–1.778	–0.001	0.019	0.025	0.178	0.573	2.107	0.017	–0.022	1.070

AVERAGE SCORES:

Farms still in activity		Farms stop activity
Score = 0.387		Score = - 0.242
Wilks' lambda statistic = 0.913	Chi-squared = 63.89	Significance = 0.000

CLASSIFICATION RESULTS:

		Predicted group membership	
Farms stop activity	N. of cases	441	68.7%
Farms still in activity	–	276	59.4%
Percent of «grouped» cases correctly classified = 65.1%			

Source: own calculations on CERPL data.

a very small farm, the professional who runs an average size farm, the professional who runs a very large farm.
The non-professional entrepreneur is normally a farmer-owner rarely with more than 30 animals. Frequently, farming is a part-time job. Farm capital is abundantly amortized. All too often plant and equipment is outdated and production techniques obsolete. The main goal of this kind of farmer is to use production factors somehow or other. Precisely for this reason, in this type of farm, work shifts from resource to condition for the subjective goal. Frequently, the mere availability of any member of the farmer's family to perform the cow barn work is enough to justify continuation. We can say that animal rearing activity for this kind of farmer is «while stocks last»-ie, it will continue as long as a member of the family is willing to do the cow barn work. When this availability ceases due to old age or illness, the animal rearing activity will be abandoned.
The professional entrepreneur running a medium sized farm is usually a owner aged between 45 and 55 with a herd of 30-50 dairy cows. Compared with the average, the production technology used is intensive with plant and equipment more at technology's leading edge and higher level animal genetic selection. The highly intense production techniques used is proof that this type of farmer tends above all to increase the economic dimension of his farm. This behaviour is largely justified by the fact that he foresees a successor in his business – usually a working age son. For this farmer, analysis of total production costs to evaluate the results and the business decisions made is not a typical instrument or philosophy. In fact, he does not normally include the cost of his work or that of his family members as part of his total production costs. There are two basic reasons why growth in animal rearing is at high risk for this kind of farm: first, production costs are only slightly below market price and any drop in prices will make the farm unable to cover its variable costs. The second stems from the exaggeratedly positive idea this type of farmer entrepreneur has of his professional capabilities, production and marketing ability.
The third type of farmer entrepreneur is a full-time professional owner of a medium to large size farm. His investments are in proportion to real production needs. Capital plant is up-to-date and this is highlighted, for example, in his animal breeding work by the use of instrument insemination and systematic application of genetic selection. The work is done by paid workers. This farmer is helped in the running of the farm by a successor, typically a son and his production strategy is quality specific and entirely open to market needs. Thus, for example, he is aware of work contract problems, belongs to Farmer Associations and is very much alive to the need to control supply. His decisions are based on analysis of his statement of accounts which is his ongoing instrument to determine his effective productive situation. His continuation in farming is justified as long as his work produces income. This type of farmer views animal rearing as an industrial activity worth his while to practice as long as it generates profit. For the future, this type of farmer entrepreneur could be among the most productive dairy farmers in Italy since he runs a farm large enough to minimize production costs, make technological and innovative plant investment cost effective and thus guarantee high quality standards for his products.
The topic of animal rearing farm growth is particularly important because it offers the opportunity of contributing to discussion on some fundamental questions such as the future of a proportion of farming families, the possibility of State action to improve farming income and, lastly, Italy's ability of respond to the demand for animal sourced food products. Our decision to analyse the growth of the dairy farm by examining a number of economic elements should not give the idea that the farmer can be reduced to some form of engineer whose problem is to identify the best production technological formula and then apply it correctly. We believe that growth is change and, in order to be able to interpret it, we must know all aspects involved in the farm's productive activity including those of a sociological nature. To achieve «success», it is not enough merely to possess the resources. Something more is required and it would appear that this depends as much on luck as it does on accepting challenges and risks. The current scarcity of domestic milk supply imposes on Italian dairy farmers a very real need for change. ●

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