ACCOUNTING INFORMATION AND THE PREDICTION OF FARM VIABILITY

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ACCOUNTING INFORMATION AND THE PREDICTION OF FARM VIABILITY

Abstract:

Farms make little use of accounting and until now have been largely excluded from the scope of accounting standards. However, we hypothesize that the use of accounting-based information can significantly improve the explanation and prediction of farm viability/failure. Two dichotomous logit models were applied to subsamples of viable and unviable farms in Catalonia, Spain. One model included non-accounting-based variables, while the other also considered accounting-based variables. It was found that, when accounting variables were added to the model there was a significant reduction in deviance.

Keywords: accounting, agriculture, failure prediction, farm viability

ACCOUNTING INFORMATION AND THE PREDICTION OF FARM VIABILITY

INTRODUCTION

This paper examines the utility and importance of using accounting information for predicting farm viability.

Any firm or entity whatever will require accounting information. This should cause no raised eyebrows and no-one presumably finds the proposition contentious. Particularly in agriculture, it is generally assumed that the introduction of accounting will improve farm management and produce better farm performance (see for example Luening, 1989). However, Poppe (1991) regrets that no research has yet been able to demonstrate this, and has reported the limited use of accounting in agriculture. Moreover, To the author's knowledge there is no published empirical research as to whether the use of accounting data can significantly improve the explanation and prediction of farm viability/failure.

Olsson (1988) and Allen (1994) explain this limited use o accounting in agriculture by the lack of accounting skills by farmers, considering the predominance of the small family farm even in the agricultural production of highly industrialized Western countries (Schmitt, 1991). Poppe (1991) and Poppe and Breembroek (1992) also propose a number of other explanations. Kroll (1987) and André (1987) point out that when French farmers use accounts, it is mainly to comply with tax and subsidy requirements. Sabaté and Enciso (1997) make similar observations for Spain. Colwell and Koroluk (1990) state that an informal cash bookkeeping system is the most common accounting method used in Canada in spite of the fact that this does not indicate the true performance of the farm. Seger and Lins (1986) report similar findings in the USA. Bronstien (1995) and Crane and Leatham (1995) regard standardized accrual accounting and record keeping as necessary for the development of agricultural business in the USA. In France and the European Union (EU) tax related and economic motives encourage authorities to promote the use of accounting in agriculture (Pellerin, 1985).

The limited use of accounting in agriculture could lead to think that it is not useful for decision-making. This article aims to provide empirical evidence that accounting makes a significant contribution to explaining and predicting farm viability. We believe that this evidence reveals both the need for increased use of accounting in agriculture and for the development of accounting standards for agriculture.

Our research makes use of failure prediction models. Existing literature on these models and research into farm viability served as the starting point for our study.

The following section provides background information about farm viability and failure prediction models. We then discuss research method, defining "failure event", describing the independent variables, the logistic regression employed, the development of hypotheses and sample characteristics. We then detail our results and present conclusions.

BACKGROUND

A voluminous literature on failure prediction models has been developed since Beaver (1966) and Altman's (1968) seminal studies.

Research into failure prediction in agriculture is comparatively scarce. To the author's knowledge the earliest empirical studies in this area began with Reinsel and Brake (1966). Krause and Williams (1971), Bauer and Jordan (1971), Johnson and Hagan (1973) and Dunn and Frey (1976) used discriminant models to assess farm loan repayment. These studies were undertaken at a time in which the indebtedness of US farms was increasing and this was more and more difficult to manage (Murdock and Leistritz, 1988, p. *xiii*). The subsequent agricultural crisis and high incidence of farm and agricultural bank failures, coupled with unexpected losses by agencies providing loans to farmers during the mid 1980s, stimulated new research (Ibid.). Shepard and Collins (1982) explained farm failure at the macroeconomic level, while Grisley (1985), Griffis (1988) and Lins et al. (1987) measured the financial health of farms.

Subsequent research into attempts to cope with the financial crisis of US farms involving explicative or prediction models can be classified in three groups. Some analysts focused on the economic viability of farms: Kauffman and Tauer (1986) and Smale et al. (1986) used binomial logit models to do this, while Adelaja and Rose (1988) used a simultaneous-equation model. Another group used multinomial logit models (Lines and Zulauf, 1985), ordered logit models (Lines and Morehart, 1987; and Wadsworth and Bravo-Ureta, 1992) and a multiresponse ordered model (Carley and Fletcher, 1988) to explain and predict various degrees of financial health. The third group, from which we highlight the work of Mortensen et al. (1988), Turvey and Brown (1990) and Knopf and Schoney (1993), used binomial logit models to predict farm loan repayment. In the same group, Turvey (1991) compared the predictive accuracy of the linear probability model, discriminant analysis, logit and probit.

All these, with the exception of the last three references, were carried out in the USA, and to the best of our knowledge few of such studies have been conducted elsewhere. We also know of some research in this field in the EU. Colson and Pineau (1991) and Colson et al. (1994) made descriptive studies of financial stress on French farms. Harrison and Tranter (1989) described the evolution of the financial structure of farms in the United Kingdom during the 80s. Crabtree (1985) studied farm viability in Scotland using a simple regression model. Brangeon et al. (1994) used a logit model to explain persistent farm losses in France.

Krause and Williams (1971), aware of the difficulties in obtaining accurate accounting data with which to evaluate loan repayments, used easily employable personality indicators.

Pederson and Donovan (1990) found that more sophisticated financial loan evaluation tools, in which accounting information was taken into account, were associated with lower loan delinquency, and that such practices, when possible, were preferred by agricultural banks.

RESEARCH METHOD

The viability/failure event

Altman (1993) pointed out that failure, insolvency, default and bankruptcy are common terms used in literature on financial distress to refer to unsuccessful business. Jones (1987) reviewed the problems involved in defining the dependent variable in financial distress models. Wide range of different dependent variables has been used in the literature on failure prediction models (Rodríguez-Vilariño, 1994a).

In agriculture it is difficult to accurately estimate the number of failed farms (Davies, 1996). Before failure occurs farmers tend to emigrate or take up off-farm employment (San Juan, 1994, p. 337), and so failure is a very delated process (Colson and Pineau, 1991; and Jolly et al. 1985). Rather than failure, retirement (Fennell, 1993, p. 48) and renouncing parent's farm (Poppe and Zachariasse, 1986, p. 374) are the main reasons for the decline in number of farms and farmers, whereas officially, failure rates are comparatively very low in agriculture (Brangeon et al., 1994).

Leistritz and Ekstrom (in Murdock and Leistritz, 1988) showed that a comparatively large variety of approaches to farm failure can be found in studies applied to agriculture.

We consider punctual repayment of scheduled loans (used by Reinsel and Brake, 1966) and credit ratings on good and problem loans (used by Johnson and Hagan, 1973; Bauer and Jordan, 1971; Knopf and Schoney, 1993; Turvey and Brown, 1990 and Mortensen et al. 1988) to be ambiguous and subjective. Similarly, changes in net worth (used by Krause and Williams, 1971) also seem to provide an unsatisfactory measure of financial success. Debt-to-asset ratio (Lines and Zulauf, 1985) and positional categories of financial health (Melichar, 1985; Wadsworth and Bravo-Ureta, 1992; and Carley and Flechter, 1988) also seem arbitrary and partial measures. Seger and Lins (1986), Ofek (1993) and Phimister (1995) point out that cash flow generation, used by Grisley (1985) and Adelaja and Rose (1988), is a particularly misleading indicator in agriculture. The viability ratios of Smale et al. (1986) have the inconvenience that they use data of a single-year and require data which are not available at our data source.

Their reliance on single-year data is one of the weaknesses of the previously mentioned studies. It has been known for many years that single-year data show a marked variability, because farm activity suffers from very pronounced random effects (King, 1927; and Milhau, 1961). We defined our dependent variable over the maximum period available for our Spanish sample-data. Research by Cordts et al. (1984) and the European Commission (1991a, p. 84) found that income variability tends to be significantly reduced when a three-years period is considered.

We followed the approach of Brangeon et al. (1994) and The European Commission (1991b), which consider viability in a wider sense, as the ability of an enterprise to exist on a profitable basis over a long period. Following the Council regulation (EEC) 2328/91 of 15 July 1991, we believe that a clear cut off exists between farms where profitability is great enough to remunerate the working time put in by the family at a comparable regional wage and those in which profitability is not great enough. In the long term, when job opportunity exist, farmers of these last farms will leave farming. Identifying those of such farms that may be helped towards viability was an important goal of the Common Agricultural Policy (CAP) in the past (European Commission, 1994a, p. 53). And it seems to be important in the immediate future in the EU. Further rounds of the International Trade Organization, after 2000, and future reforms of the CAP to accommodate new EU members from Eastern and Central Europe, will lead to adapt farms of the EU to the conditions of a freer world market (Sumpsi, 1995). Some existing farms will need to modernize rapidly or face ruin.

Even though the capacity to predict viable and unviable farms may not be relevant for farm management, it is important for other agents involved in agriculture. For example, banks evaluating farm loan repayment or policymakers planning policies or grants to make farms viable. Moreover, inefficient farm behavior under risk of failure (Foster and Rauser, 1991) could be avoided when farms would be helped towards viability.

We started from the definition of farm viability employed by the European Commission (1991b). We think that we improved it, because we avoided the subjective combinations of work and capital remuneration employed in it.

We defined a dichotomous dependent variable *Y* according to the following equation:

$$g_i = \sum_{h=1}^{h=m} (FFI_{ih} - FWU_{ih} \; x \; IR_h) \qquad (1)$$

where, following to the methodology of the Farm Accountancy Data Network (FADN), FFI_{ih} and FWU_{ih} respectively represent family farm income and family work unit of farm *i* in year *h*. IR_h is the income of reference for year *h*. The Spanish Ministry of Agriculture states the income of reference as the gross annual wage of non agricultural workers. This means the income that farmers could obtain in alternative jobs. g is the farmer's net income after remunerating his work. Given the questions discussed above, we decided to convert the interesting data of equation (1) to a dichotomous variable. When $g \ddagger 0$ then $Y_i=0$ indicating that *i* is a viable farm. On the contrary, when $g_i<0$ then $Y_i=1$ indicates that over a long period *i* is a distressed farm.

Independent variables

In the first stage of our analysis we considered two groups of variables: structural and financial variables.

Two kinds of variables are usually employed in predicting farm failure: financial ratios and any other variables taken from accounting information and variables relating to characteristics of specific farm and farmers that do not meet an accounting criteria, but are easily observed and usually reflect structural and fixed characteristics of each particular farm. We also distinguish two kinds of variables. On the one hand, accounting variables are usually difficult to obtain from farms because they require accounting procedures. As previously mentioned, the use of accounting in agriculture is generally limited. On the other hand, structural variables can be obtained more easily because accounting procedures are not needed. The latter describe the structure of these farms and include such factors as farm output, acreage, livestock units, age's operator, etc.

The first criteria used for selecting variables was their theoretical importance and the existence of a prior consistent economic relationship with the dependent variable. We reviewed the most frequently used variables in previous studies, as shown in the ranking made by Laffarga and Pina (1995) based on a review of 27 famous researches. We reviewed 21 articles to obtain a ranking of the variables most commonly used in studies applied to agriculture and found that each of the following occurred more than four times: debt-to-asset ratio, dichotomous variables relating to the region in which the farm was located and its production, the number of people forming the household, the age of the farmer, and the ratio of current assets to current liabilities. However, for the purposes of our study it was not possible to obtain data for all of these variables.

Table 1 lists and describes the variables which we used as the basis of our analysis.

(table 1)

ESU, *UAA*, *LU* and *AWU* are measures of farm size. It is expected that the greater the size of the farm, the smaller the probability of failure. Big farms usually perform better than small (European Commission, 1991a; and European Commission, 1993b). However, empirical evidence is not unanimous. For example, while Reinsel and Brake (1966) and Adelaja and Rose (1988) found that the greater utilized agricultural area (*UAA*) of the farm was associated with a smaller probability of loan repayments problems, Dunn and Frey (1976) found the inverse relation.

AGE is an indicator of experience. It is generally expected that the younger the farmer the greater the probability of failure. Carley and Flechter (1988) and Lines and Zulauf (1985) found empirical evidence of it. However, Wadsworth and Bravo-Ureta (1992) and Brangeon et al. (1994) found a threshold of age where the probability of failure is the slowest and then increases.

FWU/AWU is an indicator of professionalism and is related to farm size. It is expected a positive relation with de dependent variable. The European Commission (1991a) found a better performance in the group of farms with a low share of total labour input coming from family labour.

OUTPUT/AWU and *OUTPUT/E* are measures of productivity. It is expected that the more productive farms, measured as high values in output to annual work unit or to economic size unit, will have a smaller probability of failure. Wadsworth and Bravo-Ureta (1992) and Carley and Flechter (1988) found this relation employing physical measures of productivity.

OUTPUTCO indicates the degree of product diversification of the farm. A moderate degree of diversification is expected to be associated with viability. This was partly found by Lines and Morehart (1987). Ehrenfeld (1987) confirmed also this relation. However, Kauffman and Tauer (1986) did not found a strong relation with diversification and farm success.

LIVESTOC, *IRR* and *NIRR* are dummy variables that identify the predominant style of farming. It is expected that the predominance of dry farming crops in the total crops (*NIRR*) increase the probability of failure. Dry weather and water shortages handicap farming in Mediterranean countries. The opposite relation is expected for the other variables. Previous studies used different variables of classifications of crops based on the data available to them.

NORMALZO, *LESSFAZO* and *MOUNTZO* refer to different types of farm location. It is expected that farms located in less favoured and mountain zones will have a big probability of failure, and the opposite for those located in normal zones. The European Commission (1994b) found better performance for these last farms than for the other.

D/A, *CL/CA*, *NW/FIXA*, *PLIN/O* and *DEBT/FFID* are indicators of financial status. It is expected that the more the indebtedness or the financial burdens of the farm, the larger the probability of failure. Shepard and Collins (1982) argue that the increased use of borrowed capitals makes farms more vulnerable to year-to year shortfalls in income, facing increased risk of failure. The signs in table I show this relation. The definition of some of these variables have been modified to meet the needs and the availability of data of our study. *D/A*, *CL/CA* and *DEBT/FFID* are between the most classical and frequently used variables in failure prediction models. Crabtree (1985), Davies (1996) and the European Commission (1991a) found that *PLIN/O* was significantly related with farm viability and performance.

TOEXP/AS is a measure of the expenses of the farm. It is expected that farms saving costs will be more viable. Ehrenfeld (1987) argued that farms with low percent of costs to assets (*TOEXP/AS*) had a small probability of bankruptcy.

We hypothesize that efficiency in assets use, measured by turnover of assets (*OU/AEXL*) and return on assets *(FFILI/TA*) affects viability positively. It is expected a negative relation between these ratios and the dependent variable. Turvey (1991), Turvey and Brown (1990) and Knopf and Schoney (1992) found that a high value for return on assets was significantly associated with successful loan repayment.

The logistic regression

Altman's (1968) seminal study used linear discriminant analysis. The biggest problem with this type of analysis is that it requires that explanatory variables for both groups proceed from normal populations and the same covariance matrix (Maddala, 1989, pag. 18). If this is not the case, the estimators are not consistent (Gordon and Arun, 1987).

Some of the problems deriving from unequal covariance matrices could be solved by using a quadratic, rather than a linear, discriminant model, but this can affect classification performance. Altman et al. (1977) found lower classification accuracy when using quadratic discrimant analysis, especially with the holdout sample. Furthermore, financial ratios and accounting variables usually present non-normal distributions (Jacky, 1987; and Rodríguez-Vilariño, 1994b), and as Press and Wilson (1978) pointed out, the introduction of dummy variables automatically violates the assumption of normality.

Lo (1986) showed that the logit probability model is more robust than discriminant analysis in the estimation of parameters and that it is valid under more general distributional assumptions for independent variables. Jones (1987) concluded that logit models may be slightly more accurate, and certainly no less accurate, than discriminant analysis models.

An alternative to logit are probit and recursive partitioning, but the former presents significant computational problems (Altman et al. 1981). Recursive partitioning was introduced in failure prediction by Frydman et al. (1985). Recursive partitioning does not require the assumptions of normality and an equal covariance matrix, but it fails to offer any estimation of classification probability and using this model it is difficult to ascertain the relative importance and significance of the independent variables (Altman, 1993; Jones, 1987; and Rodríguez-Vilariño, 1994b).

Since Martin (1977) and Ohlson (1980) logistic regression has been increasingly used in bankruptcy prediction and since this time logit models have dominated failure studies.

Our research was primarily designed to detect incremental improvements in the predictive and explanatory power of accounting information in agriculture. Thus, our chief criterion was that the model tested should be unbiasedly capable of predicting corporate failure. Given this goal and the questions discussed above, we decided to use logistic regression.

The dichotomous logit model assumes a logistic cumulative distribution function in the form (Greene 1993)

$$P(i) = \frac{1}{1 + e^{-bx(i)}} \qquad (2)$$

where $P(i)$ is the probability of farm i suffering distress or being unviable, $(1-P(i))$ is the probability of being viable, $x(i)$ is a vector of the measured attributes of the firm, and b is a vector of unknown parameters to be estimated.

Development of hypothesis

To test our assertion that accounting provides significant information to predict farm viability we require the best selection of structural variables to predict farm viability. On the other hand we require the best selection of accounting variable to do the prediction.

Wald forward stepwise selection procedures based on variables from table I provided two logit models. One comprising only structural variables and the other with both, structural and accounting, variables.

To test for incremental difference in predictive and explanatory power we examined the reduction in deviance caused by the introduction of accounting variables. A full explanation of this test can be found in Norussis and SPSS (1990). This test was used in similar way to ours by Richardson et al. (1998) to test recession impact on corporate failure. The formula for the test statistic is

$$l\,(b_1 / b_2) = 2lnL(b) - 2lnL(b_2) \qquad (3)$$

where $l\,(b_1/b_2)$ is defined as the change in deviance between the full model of structural and financial variables, labeled b, and the reduced model of only structural variables (i.e., the contribution of the additional accounting variable set b_1), and L is the maximum likelihood estimator for the indicated models. The statistic has an approximate chi-square distribution with k degrees of freedom, where k is the incremental difference in parameters between any two models.

The change in deviance described by the equation (3) was also used to test goodness-of-fit. In this case, the reduced model included only the intercept term while the full model included the intercept together with the independent variables used in our prediction model. The resulting change in *-2lnL* was then used to test the joint significance of the explanatory variables, also with an approximate chi-square distribution with *k* degrees of freedom indicating the number of independent variables. The term *-2lnL* is the algorithm of the maximum likelihood estimator. In addition, goodness-of-fit was ascertained by employing Z^2 statistic provided by SPSS 4.0 package and defined as follows

$$Z^2 = \sum_{i=1}^{i=N} \frac{(Y_i - P_i)^2}{P_i(1 - P_i)} \qquad (4)$$

where Y_i and P_i are the observed and predicted values. This statistic tests the null hypothesis that the model fits perfectly and also has a chi-square distribution with approximately *N-p* degrees of freedom, where *N* is the number of cases and *p* the number of parameters estimated (Norussis and SPSS, 1990).

Sample

The FADN provides annual statistics on the state of agriculture in the EU based on a sample of almost 60.000 EU farms. Data are collected by surveying a rotating sample of farms. The FADN field of observation covers professional farms as defined in the farm structure survey of the EU, and excludes smaller farms below FADN thresholds. A full description of FADN procedures and methodology can be found in European Commission (1988a; 1988b; and 1990). FADN methodology differs in some aspects from generally accepted accounting principles (GAAP) presently in force in the IAS, and from the Draft Statement of Principles issued by the SCA of the IASC (IASC, 1996). In fact, FADN does not seek to follow the GAAP. It aims to provide a rich source of microeconomic data for the development of the CAP (European Commission, 1991a, p. 1). However, it is "in a certain sense itself a standard setting body" (Poppe and Beers, 1996, p. 18). All data of farms in FADN are tested and follow the same methodology and accounting standards. FADN provides the most adequate available data that we need for our study.

FADN statistics are regularly published, but the individual farm data necessary for our study are not generally available.

The "Xarxa Comptable Agrària de Catalunya" (XCAC) is the subsidiary of the FADN in Catalonia, Spain, and follows its methodology. The XCAC provided us with data relating to the performance of 82 individual Catalan farms over 1989, 1990 and 1991. We subsequently obtained a subsample of 19 viable and 63 distressed farms for the period considered. We believe that the population studied exhibited a similar distribution of frequencies between viable and distressed farms because this both states were randomly obtained from the overall sample. The proportions were also very similar to those obtained by the European Commission (1991b). This helped us to avoid some of the methodological flaws that appear when non-random equal-share samples are used in binary state prediction models (Palepu, 1986).

The characteristics of the sample are presented in tables 2 and 3. The independent variables correspond to values for the year 1989, while the dependent variable is derived from applying data from the years 1989, 1990 and 1991 to equation (1).

We used SPSS 4.0 for data processing.

(tables 2 and 3)

EMPIRICAL RESULTS

An automatic forward stepwise wald procedure run with structural variables selected the following variables: *FWU/AWU*, *OUTPUT/E* and *NIRR*. We call the model composed by these variables "structural model". It only includes these variables because attempts to add more variables failed to provide any significant improvement to goodness-of-fit. The estimated logit parameters and goodness-of-fit are presented in table 4 as can be seen. The model presents a significant goodness-of-fit.

(table 4)

Virtually all parameters of the variables are significantly different from zero at the 5% confidence level while the constant term is not. The signs on the parameters conformed to our expectations. Higher values for family work unit per annual work unit (*FWU/AWU*) were associated with increased probability of farm failure. higher values in the ratio output to economic size unit (*OUTPUT/E*) gave higher probability of farm viability. The predominance of dry farming crops in the total output (*NIRR*) increased the probability of failure.

Table 5 shows the accuracy of predictions. The model obtained a score of 79% accuracy in classification, which is greater than that provided by a random procedure. However, accuracy was very low for the sub-sample of viable farms.

(table 5)

A second automatic forward stepwise wald procedure run with all variables in table I selected the following variables: *UAA*, *FFILI/TA*, *OU/AEXL* and *FWU/AWU*. They compose what we called our "accounting model". As occurred with the structural model, attempts to add more variables provided no significant additional goodness-of-fit.

Table 4 also shows the estimated logit parameters and goodness-of-fit. As can be seen, the model presents a significant statistical fit.

Again, all parameters of the variables were significantly different from zero at the 5% confidence level while the constant term was not. The signs on the parameters conformed to our expectations. The greater the utilized agricultural area (*UAA*) of the farm, the smaller the probability of failure. Wald parameters for this model (see table 4) show that return on assets (*FFILI/TA*) was the variable that most contributed to the model. This is the first approach to point out the importance of accounting information. We therefore hypothesized that efficiency in asset use (*OU/AEXL*) positively affects viability positively, a fact which is confirmed by the negative sign of the coefficient. Finally, expectations about family work unit per annual work unit (*FWU/AWU*) were also significantly confirmed, showing that the more professionalized the farm, the more probability of being viable.

The accounting model significantly improved the accuracy of prediction of the structural model, especially in the sub-sample of viable farms, as seen in table 5.

The structural model provided the best significant goodness-of-fit that could be obtained from the pool of structural variables initially considered. The same was true for the "accounting model" with respect to all structural and accounting variables.

To test whether the accounting model has more significant goodness-of-fit than the structural model we built a third model incorporating all variables included in the structural and accounting models. We had to use this third reference model because not all variables included in the structural model were present in the accounting model.

The Chi-square test statistic l was 28,626 (3 df) for the difference in *-2lnL* for the structural and the third models, an amount that is statistically significant with $p<0,01$. Thus, the third model significantly improved the explanation and prediction of farm failure. Comparing the accounting and third models, the l was 0,763 (2 df) for the difference in *-2lnL*, which is neither statistically significant with $p<0,01$, nor with $p<0,1$. Thus, the third model did not significantly improve the accounting model. We conclude that the accounting model significantly improved the structural model when explaining and predicting farm viability. That is, accounting offers significant incremental information for management and all other factors relating to farm viability. Therefore, in addition to farmers, agents such as banks, policymakers, public institutions and insurance companies should also take decisions based on relevant information provided by accounting data.

SUMMARY AND CONCLUSIONS

There are few works on the use of accounting in agriculture. Moreover, to the best of author's knowledge no empirical study has previously tested either the relationship between keeping accounting records and farm results, or the contribution accounting can make to predict farm viability.

We started by studying the large bibliography of existing research into failure prediction and the relatively limited number of these works which have been applied to agriculture. We defined farm viability as the ability to remunerate the working time put in by the family at a comparable wage over a long period. A reduction in deviance test was applied in order to compare two logit models. The first represented the best model built with a selected set of structural variables to explain and predict farm viability, and the second represented the best model built with structural and accounting variables. The test confirmed our hypothesis about the significant incremental value of information provided by accounting.

The share of total labour input coming from family labour, utilized agricultural area, return on assets and turnover of assets except land provide a significant model to explain and predict farm failure.

Unfortunately, we could not find a holdout sample for supporting our conclusions.

There are some reasons to explain the use low of accounting by farms. However, we concluded that accounting-based information is an important tool for assessing farm viability. Policymakers and agents involved in agriculture will get greater efficiency and effectiveness in their decisions when they base them in accounting-based information of the farms. For example, banks evaluating farm loan repayment or policymakers planning policies or grants to make farms viable, as mentioned previously.

We do not know whether the farms of our sample used accounting information for their decision-making. Furthermore, we do not know the degree to which such information may have been used by them. Consequently, it was not possible to test the relationship between the use of accounting and farm performance. However, we could assume that when this incremental information existed, consequent corrective or preventive actions could be advantageously undertaken.

Authorities and institutions should therefore promote the use of accounting in agriculture, helping to solve technical and cost inconveniences for farmers. Even so, appropriate accounting standards are a necessary pre-condition for any such developments.

Table 1. List of independent variables considered**¡Error! No se encuentra la fuente de la referencia.**

VARIABLE	EXPECTED SIGN	DESCRIPTION
Structural variables		
ESU	(-)	Economic size units (in European size units).
UAA	(-)	Utilized agricultural area.
LU	(-)	Livestock units (in standard units).
AWU	(-)	Labour units (in annual work units).
AGE	(-)	Age of the farmer.
FWU/AWU	(+)	Family work unit to annual work unit (in a per one basis).
OUTPUT/AWU	(-)	Total output to annual work unit (in ecus).
OUTPUT/E	(-)	Total output to economic size units (in ecus).
OUTPUTCO	(+)	Herfindall output concentration measure.
LIVESTOCK	(-)	Predominance of livestock in total output.
IRR	(-)	Predominance of crops typically grown on irrigated land in total output.
NIRR	(+)	Predominance of crops for dry farming in total output.
NORMALZO	(-)	Location in normal zone.
LESSFAZO	(+)	Location in less favoured zone.
MOUNTZO	(+)	Location in mountain zone.

Financial variables

D/A	(+)	Debt-to-assets ratio.
CL/CA	(+)	Current liabilities to current assets.
NW/FIXA	(-)	Net worth to fixed assets.
PLIN/O	(+)	Percent of leases and financial charges to total output.
DEBT/FFID	(+)	Percent of debt to family farm income plus depreciation.
TOEXP/AS	(+)	Total expenses to total assets.
OU/AEXL	(-)	Turnover of assets: output to assets except land (in ecus).
FFILI/TA	(-)	Return on assets: family farm income less financial charges and taxes to total assets.

Table 2. Descriptive statistics for quantitative independent variables in the sample

	VIAB0		TOTAL	
	0	1		
ESU				
Mean	34.9	16.6	20.9	**
Standard Deviation	28.6	14.6	20.1	
UAA				
Mean	21.48	13.63	15.45	
Standard Deviation	26.28	11.83	16.49	
LU				
Mean	149.87	40.15	65.57	*
Standard Deviation	187.19	90.43	127.34	
AWU				
Mean	2.26	1.56	1.72	***
Standard Deviation	1.43	.77	1.00	
AGE				
Mean	46.4	47.0	46.8	
Standard Deviation	11.3	11.5	11.4	
FWU/AWU				
Mean	.760	.865	.841	
Standard Deviation	.269	.211	.228	
OUTPUT/A				
Mean	11629900	4981164	6521725	*
Standard Deviation	8730622	7866101	8500985	
OUTPUT/E				
Mean	924145	409817	528991	*
Standard Deviation	801906	446178	585621	
OUTPUTCO				
Mean	.737	.601	.633	**
Standard Deviation	.254	.258	.262	
D/A				
Mean	.04	.05	.05	
Standard Deviation	.06	.10	.09	
CL/CA				
Mean	.08	.20	.17	
Standard Deviation	.18	.73	.65	
NW/FIXA				
Mean	1.58	1.26	1.33	**
Standard Deviation	.86	.70	.75	
PLIN/O				
Mean	3.21	24.22	19.35	
Standard Deviation	4.78	99.20	87.28	
DEBT/FFID				
Mean	.22	1.56	1.25	
Standard Deviation	.30	3.64	3.24	
TOEXP/AS				
Mean	.67	.24	.34	*
Standard Deviation	.73	.36	.50	
OU/AEXL				
Mean	1.13	.46	.62	*
Standard Deviation	.75	.43	.59	
FFILI/TA				
Mean	.16	.04	.06	*
Standard Deviation	.11	.07	.09	

Notes:

VIAB0 takes the following values: 0 for viable farms and 1 for failed farms.
Found significant differences with p<0,01 (*), p<0,05 (**) and p<0,1 (***)

Table 3. Descriptive statistics for categorical independent variables in the sample

```
                  VIAB0
             Count  ³
            Row Pct ³
            Col Pct ³                Row
            Tot Pct ³      .0³     1.0³  Total
FARMING TYPE  ÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄ´              *
                  ³     2  ³    36  ³    38
  dry              ³   5.3  ³  94.7  ³  46.3
  farming          ³  10.5  ³  57.1  ³
                  ³   2.4  ³  43.9  ³
                ÄÄÄÅÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄ´
                  ³     4  ³    10  ³    14
  irrigated        ³  28.6  ³  71.4  ³  17.1
  farming          ³  21.1  ³  15.9  ³
                  ³   4.9  ³  12.2  ³
                ÄÄÄÅÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄ´
                  ³    13  ³    17  ³    30
  livestock        ³  43.3  ³  56.7  ³  36.6
  farming          ³  68.4  ³  27.0  ³
                  ³  15.9  ³  20.7  ³
                  ÀÄÄÄÄÄÄÄÄÄÁÄÄÄÄÄÄÄÄÄÙ
             Column      19       63       82
              Total    23.2     76.8    100.0
```

```
                  VIAB0
             Count  ³
            Row Pct ³
            Col Pct ³                Row
            Tot Pct ³      .0³     1.0³  Total
ZONE       ÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄ´
                  ³     1  ³     6  ³     7
   mountain        ³  14.3  ³  85.7  ³   8.5
                  ³   5.3  ³   9.5  ³
                  ³   1.2  ³   7.3  ³
                ÄÄÄÅÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄ´
                  ³     6  ³     9  ³    15
   lessfavoured    ³  40.0  ³  60.0  ³  18.3
                  ³  31.6  ³  14.3  ³
                  ³   7.3  ³  11.0  ³
                ÄÄÄÅÄÄÄÄÄÄÄÄÄÅÄÄÄÄÄÄÄÄÄ´
                  ³    12  ³    48  ³    60
   normal          ³  20.0  ³  80.0  ³  73.2
                  ³  63.2  ³  76.2  ³
                  ³  14.6  ³  58.5  ³
                  ÀÄÄÄÄÄÄÄÄÄÁÄÄÄÄÄÄÄÄÄÙ
             Column      19       63       82
              Total    23.2     76.8    100.0
```

Notes:

VIAB0 takes the following values: 0 for viable farms and 1 for failed farms.
Found significant differences with p<0,01 (*), p<0,05 (**), p<0,1 (***).

Table 4. Estimated logistic models and goodness of fit statistics

	Structural model			Accounting model			Full (Third) model		
Variables	Coeff.	Wald	Signif.	Coeff.	Wald	Signif.	Coeff.	Wald	Signif.
Constant	-2,3107	3,1742	0,0748	1,2148	0,4892	0,4843	1,3835	0,3980	0,5281
FWU/AWU	4,3553	8,2223	0,0041	6,7729	7,6457	0,0057	6,8940	7,8477	0,0051
OUTPUT/E	-1,2E-06	4,7468	0,0294				-9,1E-07	0,6618	0,4159
NIRR	2,6156	6,5346	0,0106				-0,1353	0,0085	0,9265
UAA				-0,0554	4,8022	0,0284	-0,0609	4,0767	0,0435
FFILI/TA				-26,4555	11,9691	0,0005	-25,9500	11,0061	0,0009
OU/AEXL				-2,4944	6,9149	0,0085	-2,0701	2,5423	0,1108

Goodness of fit	Chi-Squarre	df	Signif.	Chi-Squarre	df	Signif.	Chi-Squarre	df	Signif.
-2 Log Likelihood	62,131	78	0,9056	34,268	77	1,0000	33,505	75	1,0000
Reduction in deviance	26,647	3	0,0000	54,510	4	0,0000	55,273	6	0,0000
Z^2	64,000	78	0,8732	65,161	77	0,8298	62,525	75	0,8475

Table 5. Prediction accuracies (percent correct)

	Model		
	Structural	Accounting	Full
Viable farms	42,11	78,95	78,95
Failed farms	90,48	95,24	95,24
Overall	79,27	91,46	91,46

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