DOCUMENTS DE TREBALL
DE LA FACULTAT DE CIÈNCIES
ECONÒMIQUES I EMPRESARIALS

Col·lecció d'Economia

Driver costs in small firms: empirical analysis for farms*

Josep Maria Argilés and Josep Garcia Blandón

Address for correspondence:
Departament of Accounting
Facultat de Ciències Econòmiques i Empresarials
Universitat de Barcelona
Avda. Diagonal 690
08034 Barcelona
Phone: (0034) 934021957, 934021957
Fax: 0034 934029099
Emails: josep.argiles@ub.edu

* Acknowledgements:
We wish to express our gratitude to the Xarxa Comptable Agrària de Catalunya for providing the data that made this paper possible.

Abstract:

The agricultural sector has always been characterized by a predominance of small firms. International competition and the consequent need for restraining costs are permanent challenges for farms. This paper performs an empirical investigation of cost behavior in agriculture using panel data analysis.

Our results show that transactions caused by complexity influence farm costs with opposite effects for specific and indirect costs. While transactions allow economies of scale in specific costs, they significantly increase indirect costs. However, the main driver for farm costs is volume. In addition, important differences exist for small and big farms, since transactional variables significantly influence the former but not the latter. While sophisticated management tools, such ABC, could provide only limited complementary useful information but no essential allocation bases for farms, they seem inappropriate for small farms.

Key words: cost behavior, Activity based costing, farm management accounting, small firms

JEL: M10, M40, M41

Resum:

El sector agrícola sempre s’ha caracteritzat pel predomini de petites explotacions. Aquestes es veuen en la necessitat de fer front a una creixent competència internacional i, en conseqüència, a la necessitat de contenir els seus costos. Aquest treball realitza una anàlisi empírica sobre el comportament dels costos a l’agricultura utilitzant dades de panel.

Els resultants evidencien que els costos es veuen significativament afectats per les transaccions causades per la complexitat de les explotacions. Els efectes són diferents en els costos específics i en els indirectes. Mentre que la complexitat genera un estalvi en els costos específics, com a conseqüència de les economies d’escala, els costos indirectes es veuen significativament augmentats. Això no obstant, el principal inductor dels costos trobat en aquest treball és el volum. Els resultats mostren diferències importants entre les explotacions petites i les grans.

Es conclou que tècniques sofisticades com ara l’ABC són una eina complementària i útil per a la gestió de les explotacions agrícoles, però no poden substituir als tradicionals criteris d’imputació de costos basats en el volum, i no són apropiades per a les explotacions agrícoles més petites.

1. Introduction

The agricultural sector has always been characterized by a predominance of small firms. Over the last decades, the number of farms has decreased significantly. International competition and the consequent need for restraining costs are permanent challenges for farms. Understanding cost behavior is a major issue in management accounting and a serious concern for policymakers and farmers interested in improving their management and survival.

Recent literature in management accounting provides a new framework for understanding cost behavior. Miller and Vollmann (1985) stated that the real driving force behind manufacturing overhead costs is not production volume but transactions. Cooper and Kaplan (1987) and Johnson and Kaplan (1987) suggested that many of the transactions that drive costs are determined by the complexity of firms. Hayes and Clarke (1985) stated that complexity has adverse effects on costs and productivity. While Foster and Gupta (1990) did not find significant empirical relation between overhead costs and complexity in manufacturing plants. Abernethy et al. (2001) came to the same conclusion but as regards increasing costs and product diversity in a case study of five firms. On the contrary, Banker and Johnston (1993) did find empirical evidence with a sample of U.S. airline firms. Finally, Banker et al. (1995) found a stronger positive relation between overhead costs and transactions than between these costs and volume.

While previous studies have focused on overhead cost drivers for industrial technologically advanced firms using data of a single year, other kind of costs as well as small firms or operators with low level of complexity, such as farms, have been usually excluded from cost accounting research.

It is argued that maintaining required procedures for obtaining information, such as record keeping and accounting, may represent an unnecessary burden for small firms (Small Business Research Trusts, 1996), but it is also believed that refined management tools such as activity based costing (ABC) can work as effectively for them as it does for large companies and it does not require a great commitment of time or financial resources (Hicks, 1999). Argilés and Slof (2003) found empirical evidence that the use of accounting in farm management is a persistent factor in explaining differences in performance.

This study checks hypothesis about cost behavior at a farm level. Understanding cost behavior is an interesting information and decision-making tool for a strengthened agricultural sector surviving in an increasingly competitive international environment. Results also cast key questions for small firms and for sectors with predominance of small operators. The article analyses the influence of size in cost drivers. The use of panel data series, instead of a single cross-sectional analysis, is another contribution of this study.

The remaining of the article is organized as follows: section 2 describes the Farm Accountancy Data Network (FADN), section 3 formulates the research hypothesis, section 4 explains model specification, section 5 describes the sample employed, section 6 discusses results, and concluding remarks are made in section 7.

2. The Farm Accountancy Data

FADN was created in 1965 by Regulation (EEC) 79/65 of the Council in the context of the Common Agricultural Policy (CAP), which has been one of the cornerstones of the European economic and political integration process. Today FADN collects accounting information at the level of individual farms, gathering annual data from a rotating sample of professional farms across all member states.

FADN data are collected through a questionnaire called the "Farm Return," from a variety of sources, such as bank statements, invoices, etc. The Farm Return is the core of the FADN data collection procedure and is filled out by the farms with the assistance of specialised local accounting offices.

The information obtained through the Farm Return is coded and transmitted to the European Commission. It is then summarised in reports similar to balance sheets and income statements and published by the European Commission at aggregated terms.

Table 1 displays the classification of costs employed by the FADN. Definitions used in FADN are detailed and explained in European Commission (1997, 1998). Thus, total inputs reflect costs linked to the agricultural activity of the holder and related to the output of the accounting year. They include intermediate consumption, depreciation and external factors.

Intermediate consumption includes specific costs and overheads. Specific costs represent crop-specific inputs –seeds and seedlings, fertilizers, crop protection products, other specific crop costs–, livestock-specific inputs –feed for grazing stock and granivores, other specific livestock costs– and specific forestry costs. Farming overheads include supply costs linked to productive activity but not linked to specific lines of production.

Code SE360 corresponds to depreciation of capital assets over the accounting year. It is determined on the basis of the replacement value

"External factors" correspond to remuneration of inputs which are not property of the holder: work, land and capital. Wages and social security charges of wage earners, including insurances, are summarized as “wages paid”**.** Rent paid for farm land and buildings and rental charges are the second item of external factors, being the last interest and financial charges paid on loans obtained for the purchase of land, buildings, machinery and equipment, livestock, circulating capital, and interest and financial charges on debts. Interest subsidies are not included in this item.

FADN was only conceived as a complementary source of statistical information about farm income for policy makers, not as a tool to be used by farmers or other stakeholders, or to fulfill accounting standards (European Commission, 1991). However, it has started to keep the role of standard-setter in practice (Poppe and Beers, 1996, p. 18), and for a considerable part of those farms cooperating in the network, it has revealed itself as a useful tool for other purposes, including management decisions (Argilés and Slof, 2001).

The cost classification employed in FADN has not been conceived according to the traditional criteria of direct/indirect or fixed/variable. However, the labeled “specific costs” can be considered as direct and variable, while the rest as overhead. We will refer to them as specific and indirect respectively.

Schmitt (1991) stated that agriculture is still predominantly organized by family farms in advanced western economies, and consequently family work is an important share of total work in farms. Different authors (Hopkins and Heady, 1982; Bublot, 1990; Malassis, 1958; Launay, Beaufrere and Debroise, 1967) discussed the need of including family work in farm costs, and suggested some methods for its valuation. FADN offers data about the work employed in the farm, distinguishing the part corresponding to the work put in by the members of the family, but considers only costs corresponding to non-family work. In spite of the fact that the need for including family work in cost valuation is widely recognized, FADN does not usually do it.

3. Hypothesis development

According to the traditional model of cost behaviour, where costs are described as direct and indirect, it is generally assumed that direct (labeled specific in our data source) costs are related with volume and are predominantly variable. The following obvious hypotheses are then formulated:

H1: Specific costs are positively associated with volume.

H2: The most important driving force for specific costs is volume.

Overhead costs do not vary in the short run with changes in production volume. In the short run, when production expands, the organization finds ways to manage the new situation, by using up previous excess capacity. Employees can work longer and harder, machines can be run faster and some less urgent activities can be deferred. However, in the long term, pressure on additional expending would be exerted and organizations would adapt their structure to changes in activity.

H3: While indirect farm costs are positively associated with volume, they are less sensitive than specific costs.

As we have seen, Cooper and Kaplan (1987) and Johnson and Kaplan (1987) suggested that many of the transactions that drive costs are determined by the complexity of firms. The more complex is a firm, the more it requires transactions, and therefore complexity would be expected to be positively associated with costs.

H4: Indirect farm costs are positively associated with complexity.

Literature on activity based costing focuses on the growth in overheads and their changing nature. It is argued that shifting away from volume-driven overhead costs will improve their management. It is also considered that they should be allocated according to the transactions caused by the growing complexity of the firms. However, other than overhead costs are out of the scope of activity based costing literature. They are related to product units, and it is assumed that they are volume-driven and that transactions do not concern them.

H5. It would not be expected specific farm costs to be positively associated with complexity.

Existing empirical evidence from large complex companies operating in advanced technological environments shows that the real driving force behind overhead costs is transactions. As small firms are not big enough to reach a minimum level of complexity, and the agricultural sector is not highly technologically advanced, then there are not obvious arguments to defend the pre-eminence of transactions over volume in costs. Thus the following hypothesis can be formulated:

H6: Indirect farm costs are more associated with volume than with complexity.

Firms increase transactions when they grow in complexity, but usually they become more complex when growing in size, even if they do not change the nature of their business. Increase in size is in itself a source of complexity. If managers do not implement appropriate decisions through force of habit, existing firm procedures and operations will introduce complexity into daily operations as volume of business increases.

H7: Transactional variables will be less influential in small farms than in big farms.

4. Theoretical development

Model specification

Similar to that used by Banker et al. (1995), we specify the following multivariate regression model to estimate the relation between costs (c), volume (v), and transactional or complexity variables (t):

$$c = B_0 \cdot v^{\beta_v} \prod_{k=1}^{k} t_k^{\beta_{tk}} \qquad (1)$$

Taking the natural logarithm of Eq. (1) yields the following linear

$$C = \beta_0 + \beta_v \cdot V + \sum_{k=1}^{k} \beta_{tk} \cdot T_k \qquad (2)$$

model:

where the capital letters represent the natural logarithms of the corresponding variables (ln x; $x = c, v, t$) and $\beta_0 = \ln B_0$. Tests concerning the significance of variables employed in explaining transactional costs are conducted by examining the β coefficients. If overhead costs increase with volume or transactional variables, then these coefficients should be positive, and negative otherwise.

The multiplicative model reflects the notion that the impact of an increase in a transactional or volume variable on costs ($\delta c/\delta t_k$ or $\delta c/\delta v$) is greater when the levels of other variables are higher.

On the other hand, farm costs also depend on other variables. Type of farming is a technological determinant for farm costs. Location in mountains, less-favored or usual zones influence costs through availability and price of factors. Time brings about variations in prices, technological changes and factor endowments. Therefore, control variables were added to the model indicating type of farming (*F*), geographical location (*L*), and year (*Y*):

$$C = \beta_0 + \beta_v \cdot V + \sum_{k=1}^{k} \beta_{tk} \cdot T_k + \sum_{j=1}^{j} \beta_{Fj} \cdot F_j + \sum_{m=1}^{m} \beta_{lm} \cdot L_m + \sum_{n=1}^{n} \beta_{Yn} \cdot Y_n \qquad (3)$$

Variables in the equation

The article analyses the behavior of farm costs. Thus, the dependent variable is total costs (*TOTCOST*), which is divided into specific costs (*SPECIFCOST*) in FADN terminology, and total indirect costs (*TOTINDIRECT*), the latter including opportunity cost of family work (*FWUREF*) and registered indirect costs (*INDIRECT*).

Opportunity cost of family work was calculated multiplying the annual units of family work –provided by the FADN– by the reference income of its corresponding year. The Spanish Ministry of Agriculture sees the reference income as equivalent to the gross annual earnings of non-agricultural workers, and publishes this valuation yearly. This means the income that farmers could obtain in alternative jobs. *SPECIFCOST* corresponds to specific costs of table 1, while *INDIRECT* includes farming overheads, depreciation and external factors.

Costs are expected to be positively associated with volume measured with the output (*OUTPUT*) of the farm.

As we have seen above, Cooper and Kaplan (1987) and Johnson and Kaplan (1987) suggested that many of the transactions that drive costs are determined by the complexity of firms. The number of products (*NUMPROD*) yielded in the farm and hectares per product

(*UAA/NUMPROD*) reflect complexity. The more complex a farm is, the more it requires transactions, and therefore both variables are expected to be positively associated with costs. Anderson (1995) found that manufacturing overhead costs are positively associated with product mix heterogeneity. However, ambivalent effects operate with respect to the second variable. In addition to that increase, a higher number of hectares per product would require more operations. Nevertheless, economies of scale would mitigate this increase, or probably reduce it with respect to a minimum level of hectares per product.

Following FADN methodology, four dummy variables indicate that a farm operates the corresponding type of farming when these variables equal to one, and zero otherwise: *EXTENSIVE* for farms with predominantly field extensive crops, *PERMANENT* for predominantly permanent crops, *PIGPOULTRY* for predominantly granivore (pigs and poultry) production, and *DAIRYDRYSTOCK* for dairy and drystock production, while mixed type of farming is the default category. In the geographical context of our sample, where water shortages and dry weather are frequent, agricultural land is very scarce, and livestock is usually produced in intensive capital endowed farms, mixed farms are expected to require more costs than field and permanent crop, while less than those specialized in livestock.

Two dummy variables indicate the location in less-favored (*LESSFAZONE*) and mountain zones (*MOUNTZONE*) when its value equals one (and zero otherwise), while the default category is for farms located in what we label as "usual zones". As for the latter, they usually have more land available, more farmhouse consumption, some resources are less scarce, prices are lower, etc. Therefore, negative signs are expected for coefficients of these variables.

Four dummy variables control for the existence of significant changes in costs across the period studied, indicating *YEAR90*, *YEAR91*, *YEAR92* and *YEAR93* that the observation belongs to the corresponding year when its value equals one (and zero otherwise), while the default variable is for 1989. As monetary values were deflated and expressed in current terms of 1989, there is no assumption on the sign of their associated coefficients.

5. Sample

The regional FADN office in Barcelona provided us with five year data (1989 to 1993) from 170 Catalan farms. Attempts to get a later panel data than this did not succeed. We believe that it does not raise a major objection to our research, because the purpose is not to perform a descriptive study, but to validate timeless hypothesis of cost behavior.

We have excluded 37 farms because there was no data about their utilized agricultural area, and therefore it was not possible to calculate their corresponding ratio of hectares per product.

Monetary values were deflated and expressed in constant values of 1989.

Graphic plots of dependent variables in terms of independent variables reveal the existence of better linear relation between these transformed logarithmic variables than with the untransformed.

Table II offers some descriptive magnitudes about our sample. Costs were stable for the period studied, presenting specific costs a minor drop. Spanish farms had to make a great effort to improve competitiveness when the country joined the European Economic Community, particularly Catalan farms specialized in products scarcely protected by the

Community. Output presented decreasing but variable values across the period, reflecting the influence of random market and climatic effects.

According to statistics of the *Institut d'Estadística de Catalunya* (1992, 1998), the farm censed in Catalonia were 99,320 in 1989 and 76,126 in 1993. Distribution by farming type was very similar for both years. In 1993, 17.9% of farms were oriented to extensive crops, 6.7% to horticulture, 45.1% to permanent crops, 9.4% to dairy and drystock, 4.7% to granivores and 16.3% to mixed farming. As can be seen in table II, our sample approximately fits to population in extensive and permanent crops, but there are certain deviations in drystock, granivores, mixed farming and horticulture, which is not present in the sample. The regional FADN is very concerned with obtaining information about granivores, which are very important in Catalonia, in spite of the fact that their production is mainly performed by mixed farms.

It can be considered that, despite certain differences, our sample is representative of population, and it is valid to draw inferences and conclusions in general terms.

Partial correlations between transformed logarithmic continuous independent variables are low, suggesting that collinearity will not affect results.

6. Empirical results

We estimated a linear regression model for every dependent variable. The highest value of variance inflation factors is 3.099, indicating that collinearity is unlikely to affect our inferences. Variance inflation factors, condition indexes and variance proportions of variables suggest that multicollinearity does not affect estimations. As Durbin-Watson statistics indicated the typical autocorrelation for independent variables throughout the period studied, we performed panel regression estimations, thus correcting autocorrelation disturbances. The estimation method assumes disturbances to be heteroscedastic and contemporaneously correlated across panels.

Panel regression estimations are displayed in table III. All models present a significant goodness-of-fit.

All coefficients in column (A) present the expected signs for total costs estimations. Output influences total costs significantly: increasing with positive variations and decreasing otherwise. As expected, extensive and permanent crop type of farming show significant lower costs than mixed type of farming with $p<0.01$ (granivore type of farming significantly higher with $p<0.1$), the same as in mountain and less-favored zones location with respect to usual zones. Transactional variables do not influence total costs significantly.

Detailed analysis of different costs provides interesting results. The regression in column (B) represents estimations for specific costs. The model explains about 87% of the total variability. The significant positive sign for transformed output variable validates hypothesis H1. When this variable is dropped from the model, its explanatory power significantly falls to 63%, while the explanatory power of the model is not almost reduced by the exclusion of transactional-complexity variables, thus validating hypothesis H2. All type of farming and farm location variables present the expected sign, in spite of the fact that only extensive and permanent crop type of farming and location in less-favored zones are significant with $p<0.05$. Estimations for transactional variables validate hypothesis H5. The significant negative sign for ln(*UAA/NUMPROD*) suggests the existence of economies of scale in utilization of specific inputs when hectares per product increase. When few hectares per product are available the farm requires more consumption of these inputs than when more hectares are available, thus suggesting that specific inputs are inefficiently used in the first case, and relatively efficiently used otherwise. Although specific costs are mostly direct and variable, the existence of inefficiencies suggests that farm consumption of these inputs does not follow a proportional pattern. On the other hand, there is no significant association for product diversification and specific costs with $p<0.1$.

The model estimated in column (C) explains about 70% of variability in total indirect costs. The transformed variable for output presents a significant (with $p<0.01$) positive value of 0.3194544, which is far lower than the corresponding value for the same variable when the dependent variable is specific cost (1.205756), thus validating hypothesis H3. Confidence interval at 95% is also notably lower: from 0.2750228 to 0.363886 for total indirect costs compared with 1.109916 to 1.301597 for specific costs. The significant positive signs of transactional-complexity variables with $p<0.01$ validate hypothesis H4. When adjusted variable for output is excluded from the model, its explanatory power drops notably to about 48% of the variation in total indirect costs, clearly above the tiny reduction in explanatory power when transactional variables are excluded, thus validating hypothesis H6.

It is interesting to analyze both components of total indirect costs separately, whose estimations are displayed in columns (D) and (E). Opportunity family work costs are far less sensitive to volume and to transactional variables than registered indirect costs. To a great extent family work is a fixed cost. Farmers use their own work as far as possible, and as a last resort employ alternative inputs. Opportunity cost of family farm work is significantly related with changes in volume with $p<0.05$, but coefficient estimated presents a low value. To a greater extent, this cost is significantly associated to the management complexity that the number of product entails (with $p<0.01$), with the intensive work that dairy farms require (with $p<0.01$), or with extensive farms (in terms of work required) located in mountain zones (with $p<0.05$). Estimations for registered indirect costs (column E) confirm validations of H3, H4 and H6. Significant positive coefficients of transactional variables with $p<0.01$ provide evidence of influence of complexity in indirect costs for small simple firms like farms. Significant negative coefficients for location variables (with $p<0.1$ and $p<0.01$) confirm expectations about availability of cheaper prices for indirect inputs in these zones with respect to usual zones. Significant positive coefficient for granivore type of farming (with $p<0.1$) is congruent with capital intensive endowment for this type of farming.

Estimations excluding residual cases yielded by standardized residuals were performed again. Results displayed in table IV reassure and slightly improve those of table III. Estimations confirm expected coefficient signs, usually slightly improving their significance. With respect to volume and transactional variables, estimations reaffirm results of table III, slightly improving the significance of coefficients in three cases. When outliers are excluded, the negative association of product diversification with specific costs becomes significant with $p<0.1$, suggesting the existence of economies of scale in these costs when farms produce a wider variety of products. Hectares of agricultural land per product significantly influence, with the expected positive sign, opportunity costs of family work with $p<0.1$, while the expected positive influence of output on these costs becomes significant with $p<0.01$.

The sample was partitioned into large and small-size sub-samples using the median of European Size Units (ESU) to examine the effect of size on cost drivers. The ESU is a unit of measurement of the economic size of the agricultural holdings used in the European Union for statistical purposes. Standard results of FADN provides data about this variable. ESU defines the economic size of an agricultural holding on the basis of its potential gross added value. It is calculated assigning predetermined values of gross value added to the different lines of production of the farms. One ESU is equal to approximately 1,200 ECU-currency of standard gross margin. This standardized measure of size is homogeneous for different types of farming, and considered the appropriate criteria in order to present and analyse the results, establish the sampling plans and weight the results, define a method for classifying agricultural holdings which was common to all the countries of the Union, etc (European Commission, 1998). Such a method was established in 1985 by Commission Decision EEC/85/377.

We first calculated the ESU mean for every farm for the five years period, and the median was calculated from these means. We re-ran panel regressions on the resulting large- and small-size samples. Results displayed on table V, for the three basic groups of costs employed in the study, validate hypothesis H7. There are fundamental differences between small and big farms with respect to transactional variables. Columns (A) and (D) show that specific costs were not significantly influenced by transactional variables in small farms, while the negative sign for ln(*UAA/NUMPROD*) is significant with $p<0.01$ in big farms. This means that a minimum size is necessary to obtain economies of scale in specific costs when hectares per product increase. Smaller farms do not obtain savings in consumption of specific inputs because they do not reach a minimum level of operations. On the contrary, bigger farms get synergies in specific costs because they are able to attain a high level of hectares per product even when maintaining various products.

Columns (C) and (F) on table V display results for registered indirect costs. Small farms are too simple to reflect the influence of transactions in indirect costs. As bigger farms attain sufficient level of complexity, transactional variables significantly influence registered indirect costs (hectares per product with $p<0.01$, and number of products with $p<0.1$). The opportunity costs of family work are equally influenced by transactional variables in both small and big farms, as columns (B) and (E) reflect. Increasing number of products introduces considerable farm management complexity in both types.

It is interesting to point out that specific and registered indirect costs of bigger farms are more sensitive to changes in volume (presenting higher values in their corresponding coefficients) than those of smaller farms (showing lower values in coefficients). Volume does not influence opportunity cost of family work in bigger farms, while it does in smaller farms. There are some explanations for these findings. In smaller farms, a considerable portion of outputs obtained is used as inputs to other production, while bigger farms are more market-oriented, thus purchasing a greater portion of inputs from outside. Smaller farms tend to substitute purchased inputs with family work, specially as a means of facing production increases, to a greater extent than bigger farms. Finally, the share of family farm work to total farm work is greater in smaller than in bigger farms.

Significant positive influence of permanent farms on registered indirect costs in bigger farms provides an unexpected outcome. An explanation for this surprising finding is that bigger permanent type of farming usually corresponds to intensive irrigated fruit farming, while smaller permanent type of farming, to extensive non-irrigated fruit farming. The former requires more investments and inputs than the latter.

Differences in signs and significance levels for temporal variables between both sizes of farms reflect the extreme pressure that concurrence puts on smaller farms and their difficult daily survival task. Small farms are more compelled to reduce costs than bigger.

7. Conclusions

This article validates several hypotheses about cost behavior. In spite of the fact that small firms, for instance farms, do not have a great degree of complexity, indirect costs are significantly influenced by transactions generated by this small complexity. Product diversification and hectares of agricultural land per product significantly increase registered indirect farm costs. Management complexity related to product diversification induces significant increase in work force employed by farmer. Product diversification is the most common decision implemented by farmers to reduce risk from climatic and other random factors that affect farming. Therefore, important conclusions may be drawn from this finding, and subsequent decisions could be implemented. Because specialization will reduce indirect costs, farmers might take advantage of benefits of specialized crops trying to reduce risk through alternatives decisions. Costs of insurances should be considered and balanced with costs of product diversification. Agricultural associations could play an important role in mitigating costs of complexity, for example sharing facilities, investments and external factors.

We found empirical evidence of inefficiencies in consumptions related to specific costs for decreasing hectares per product. Therefore, transactions caused by complexity have twofold contradictory influences in total costs: reducing specific costs (not well defined for increasing number of products) and increasing indirect costs. Global effect on total costs will depend on cost composition, but it was not significant in our sample. Our results suggest policymakers and stakeholders should implement specific policies addressed to farms with big areas per product trying to mitigate indirect costs coming from complexity. Improving communications, facilities, opportunities and accessibility to markets in mountainous and less-favored zones, will allow farmers to take advantage of cheaper costs, with consequent establishment and viability of farming activities. Special policies addressed to specific type of farming should be considered.

The fact that our findings show marked differences between small and big farms, suggests that size should be also considered by policymakers. While costs in the former are not fundamentally affected by complexity, in bigger farms it allows economies of scale to develop with respect to specific costs, and increases in registered indirect costs. Product diversification is a burden for both types of farms in terms of family work. Purchased inputs are far less sensitive to changes in volume in small than in big farms, because the former tends to compensate purchased inputs with family work. Consequently, opportunity cost of family work is more sensitive to changes in volume in small than in big farms. On the other hand, smaller farms use more outputs as inputs inside the farm.

On the ground of cost calculation, empirical results indicate that volume is the main driving force for costs, thus suggesting that traditional simple allocations based on volume are appropriate inexpensive proxy criteria for cost information and disclosure with respect to farms. More sophisticated management tools, such as ABC, would provide only limited complementary useful information, but no essential allocation bases, as for big, complex and technologically advanced firms.

Opportunity for extensive research is opened to small firms and operators from other economic sectors.

References

Abernethy, Margaret A., Anne M. Lillis, Peter Brownell and Paul Carter, P., 2001, ‘Product Diversity and Costing System Design Choice: Field Study Evidence’, *Management Accounting Research*, 12, 261-279.

Anderson, Shanon W., 1995, ‘Measuring the Impact of Product Mix Heterogeneity on Manufacturing Overhead Costs’, *The Accounting Review*, 70(3), 367-387.

Argilés, Josep M. and Eric J. Slof, 2001, ‘New Opportunities for Farm Accounting’, *European Accounting Review*, 10 (2), 361-383.

Argilés, Josep M. and Eric J. Slof, 2003, ‘The Use of Financial Accounting Information and Firm Performance: an Empirical Quantification for Firms’, *Accounting and Business Research*, 33(4), 251-274.

Banker, Rajiv D. and Holly H. Johnston, 1993, ‘An Empirical Study of Cost Drivers in the U.S. Airline Industry’, *The Accounting Review*, 68(3), 576-601

Banker, Rajiv D., Gordon Potter, and Roger G. Schroeder, 1995, ‘An Empirical Analysis of Manufacturing Overhead Cost Drivers’, *Journal of Accounting and Economics*, 19, 115-137.

Bublot, Georges, 1990, *Économie et Gestion de l'Exploitation Agricole. Volumes I et II*, Lovaina: Université Cathólique de Louvain.

Cooper, Robin and Robert S. Kaplan, 1987, ‘How Cost Accounting Systematically Distorts Product Costs’, in William J. Bruns and Robert S. Kaplan, (eds.), *Accounting & Management: Field Study Experiments*, Boston, MA: Harvard Business School Press, pp. 204-228.

European Commission, 1991, *The Calculation of Economic Indicators Making Use of RICA (FADN) Accountancy Data*, Luxemburg: Office for Official Publications of the European Communities.

European Commission, 1997, 'Data Definitions and Instructions for the FADN Farm Return', *Community Committee for the Accountancy data Network*, RI/CC 1256 Prov.

European Commission, 1998, 'Definition of Variables Used in FADN Standard Results', *Community Committee for the Accountancy data Network*, RI/CC 882 Rev. 6.

Foster, George and Mahendra Gupta, 1990, 'Manufacturing Overhead Cost Driver Analysis', *Journal of Accounting and Economics*, 12, 309-337.

Hopkins, John A. and Earl O. Heady, 1982, *Contabilidad y Control de Explotaciones Agrícolas*, Barcelona: Reverté.

Hayes, Robert H. and Kim B. Clark, 1985, 'Explaining Observed Productivity Differentials between Plants: Implications for Operations Research', *Interfaces*, 15(6), 3-14.

Hicks, Douglas T., 1999, 'Yes, ABC Is for Small Business, too', *Journal of Accountancy*, August, 41-43.

Institut d'Estadística de Catalunya, 1992, *Cens Agrari 1989. Vol 3: Maquinària, Emmagatzematge, Mà d'Obra, Marge Brut i Orientació Tècnico-Econòmica*, Barcelona: Institut d'Estadística de Catalunya.

Institut d'Estadística de Catalunya, 1998, *Estadística de l'Estructura de les Explotacions Agràries 1995*, Barcelona: Institut d'Estadística de Catalunya.

Johnson, H. Thomas and Robert S. Kaplan, 1987, *Relevance Lost: the Rise and Fall of Management Accounting*, Boston, MA: Harvard Business School Press.

Launay, Raymond, Jaen P. Beaufrère, and Gérard Debroise, 1967, *L'Entreprise Agricole. Analyse. Diagnostique, Prévision*, París: Librairie Armand Colin.

Malassis, Louis, 1958, *Économie des Exploitations Agricoles*, París: Librairie Armand Colin.

Miller, Jeffrey G. and Thomas E. Vollmann, 1985, 'The Hidden Factory', *Harvard Business Review*, 5, 142-150.

Poppe, Krijn J., and George Beers, 1996, 'On Innovation Management in Farm Accountancy Data Networks', *Agricultural Economics Research Institute LEI*, 535, 1-37.

Schmitt, Günther, 1991, 'Why Is the Agriculture of Advanced Western Economies Still Organized by Family Farms? Will this Continue to Be So in the Future? ', *European Review of Agricultural Economics*, 18, 443-458.

Small Business Research Trust, 1996, *NatWest Quaterly Survey of Small Business, 1*, London: Small Business Research Trust.

Table I.
Cost clasification in the FADN

Code	Description
SE270	Total inputs
SE275	Intermediate consumption
SE281	Specific costs
SE336	Farming overheads
SE360	Depreciation
SE365	External factors
SE370	Wages paid
SE375	Rent paid
SE380	Interest paid

Table II.

Descriptive statistics (monetary values expressed in pesetas in current terms of 1989)

	Year 1989	Year 1990	Year 1991	Year 1992	Year 1993
Mean values for farm:					
Total output	8,860,459	8,281,251	7,943,445	8,093,184	7,966,990
Total costs	9,689,534	9,459,243	9,039,533	9,007,220	9,231,065
Specific costs	5,256,501	4,834,611	4,550,107	4,501,628	4,629,434
Total indirect costs	4,433,034	4,624,632	4,489,425	4,505,592	4,601,631
Opportunity cost of family work	2,242,069	2,239,428	2,285,456	2,316,311	2,389,946
Rest of indirect costs	2,190,964	2,385,203	2,203,969	2,189,281	2,211,686
Utilized agricultural area (hectares)	23,69	23.61	23.61	24.0	24.1
Hectares per product	7.45	8.03	6.62	6.3	6.6
Number of products	3,6	3.42	3.68	3,7	3,7
Number of farms in the sample:					
Located in (number and %):					
Mountain	8 (4.7%)	8 (4.7%)	8 (4.7%)	8 (4.7%)	8 (4.7%)
Less-favoured	68 (40.0%)	68 (40.0%)	68 (40.0%)	68 (40.0%)	68 (40.0%)
Normal	94 (55.3%)	94 (55.3%)	94 (55.3%)	94 (55.3%)	94 (55.3%)
Type of farming (number and %):					
Field-extensive	30 (17.7%)	30 (17.7%)	27 (15.9%)	25 (14.7%)	27 (15.9%)
Permanent	83 (48.8%)	81 (47.6%)	82 (48.2%)	81 (47.6%)	79 (46.5%)
Dairy and drystock	6 (3.5%)	7 (4.1%)	6 (3.5%)	6 (3.5%)	7 (4.1%)
Pig and poultry	22 (12.9%)	21 (12.4%)	21 (12.4%)	23 (13.6%)	25 (14.7%)
Mixt	29 (17.1%)	31 (18.2%)	34 (20.0%)	35 (20.6%)	32 (18.8%)

Table III.
Estimations relating costs to volume and transactions (t-statistics in parentheses).

Variables	Coefficient (pred. sign)	(A) ln(TOTCOST)	(B) ln(SPECIFCOST)	(C) ln(TOTINDIRECT)	(D) ln(FWUREF)	(E) ln(INDIRECT)
Constant	?	6.521842 ***	-3.643952 ***	9.877942 ***	13.05012 ***	3.995776 ***
		(20.63)	(-4.77)	(27.93)	(25.44)	(5.69)
Year:						
YEAR90	?	-.0443718 *	-.1174402 **	-.0060675	-.0095763	-.0196315
		(-1.77)	(-2.03)	(-0.30)	(-0.43)	(-0.62)
YEAR91	?	-.0159847	.0168544	.009713	-.0001555	-.0378893
		(-0.71)	(0.30)	(0.49)	(-0.01)	(-1.00)
YEAR92	?	-.0363694	-.019923	-.0003085	.0004653	-.0750615 *
		(-1.41)	(-0.30)	(-0.01)	(0.02)	(-1.78)
YEAR93	?	.0198241	.1155052 *	.0366904	.0324595	-.053263
		(0.79)	1.78)	(1.63)	(1.10)	(-1.23)
Type of farming:						
EXTENSIVE	-	-.2355939 ***	-.2800023 **	-.0752749	-.1583507 *	-.0049192
		(-4.03)	(-1.98)	(-1.15)	(-1.67)	(-0.04)
PERMANENT	-	-.1489526 ***	-.83311 ***	.0827128	-.0597614	.1468324
		(-2.76)	(-6.39)	(1.37)	(-0.69)	(1.23)
DAIRYDRYSTOCK	+	.1006987	.0740042	.2834319 ***	.5708851 ***	-.0030707
		(1.08)	(0.33)	(2.70)	(3.74)	(-0.01)
PIGPOULTRY	+	.1083309 *	.185535	.0783675	-.046248	.2290476 *
		(1.75)	(1.24)	(1.14)	(-0.47)	(1.69)
Location:						
MOUNTZONE	-	-.3593177 ***	-.1495222	-.3873444 ***	-.358852 **	-.3264664 *
		(-4.15)	(-0.72)	(-3.95)	(-2.51)	(-1.68)
LESSFAZONE	-	-.1268208 ***	-.2970306 ***	-.1871076 ***	.0672932	-.5759275 ***
		(-3.16)	(-3.07)	(-4.12)	(1.02)	(-6.39)
Volume:						
ln(OUTPUT)	+	.6146815 ***	1.205756 ***	.3194544 ***	.0813163 **	.6272963 ***
		(30.36)	(24.66)	(14.09)	(2.47)	(13.94)
Transactions:						
ln(UAA/NUMPROD)	+	-.012632	-.1550569 ***	.1420326 ***	.0180503	.2789755 ***
		(-0.55)	(-2.82)	(5.52)	(0.48)	(5.47)
ln(NUMPROD)	+	-.0447373	-.1670084	.2174088 ***	.2172916 ***	.296047 ***
		(-1.02)	(-1.57)	(4.45)	(3.08)	(3.08)
Adjusted R-squarre:						
Complete model		0.891 ***	0.865 ***	0.693 ***	0.231 ***	0.694 ***
Excluding volume		0.595 ***	0.632 ***	0.478 ***	0.213 ***	0.469 ***
Excluding transactional variables:		0.888 ***	0.849 ***	0.638 ***	0.205 ***	0.648 ***

Table IV.

Estimations relating costs to volume and transactions with outliers deleted (t-statistics in parentheses).

Variables	Coefficient (pred. sign)	(A) ln(TOTCOST)		(B) ln(SPECIFCOST)		(C) ln(TOTINDIRECT)		(D) ln(FWUREF)		(E) ln(INDIRECT)	
Constant	?	6.206084	***	-3.315424	***	9.751645	***	12.74011	***	3.86693	***
		(21.47)		(-4.79)		(28.98)		(30.88)		(5.93)	
Year:											
YEAR90	?	-.0600938	***	-.1044363	**	-.0241096		-.0142111		-.0510428	*
		(-2.60)		(-1.98)		(-1.31)		(-0.66)		(-1.83)	
YEAR91	?	-.0208891		-.0040727		.0043938		.0048351		-.0386443	
		(-0.96)		(-0.08)		(0.23)		(0.22)		(-1.08)	
YEAR92	?	-.0536323	**	-.0254656		-.0052768		.0085057		-.0725016	*
		(-2.18)		(-0.45)		(-0.25)		(0.32)		(-1.86)	
YEAR93	?	.010885		.0781975		.0330898		.0570305	**	-.0491513	
		(0.44)		(1.28)		(1.48)		(2.25)		(-1.23)	
Type of farming:											
EXTENSIVE	-	-.2149128	***	-.3661559	***	-.0656875		-.0895667		.0142685	
		(-4.06)		(-2.88)		(-1.06)		(-1.17)		(0.12)	
PERMANENT	-	-.1489526	***	-.9338288	***	.0874585		.0021533		.155839	
		(-2.76)		(-7.89)		(1.53)		(0.03)		(1.41)	
DAIRYDRYSTOCK	+	.0388622		.0184003		.216729	**	.5213239	***	-.103199	
		(0.45)		(0.09)		(2.12)		(4.26)		(-0.52)	
PIGPOULTRY	+	.0957388	*	.1345205		.0711825		-.0448326		.216697	*
		(1.71)		(1.00)		(1.09)		(-0.56)		(1.72)	
Location:											
MOUNTZONE	-	-.3313133	***	-.1677994		-.3688825	***	-.3722365	***	-.2921179	
		(-4.23)		(-0.90)		(-3.96)		(-3.23)		(-1.62)	
LESSFAZONE	-	-.1208943	***	-.2423919	***	-.182986	***	.0008738		-.5468607	***
		(-3.32)		(-2.80)		(-4.23)		(0.02)		(-6.49)	
Volume:											
ln(OUTPUT)	+	.6350335	***	1.1878	***	.3280851	***	.1014478	***	.6364542	***
		(34.34)		(26.85)		(15.21)		(3.84)		(15.21)	
Transactions:											
ln(UAA/NUMPROD)	+	-.0143974		-.1415032	***	.1396598	***	.0529624	*	.2687066	***
		(-0.70)		(-2.88)		(5.72)		(1.75)		(5.67)	
ln(NUMPROD)	+	-.047262		-.160975	*	.2135674	***	.1834171	***	.2875155	***
		(-1.19)		(-1.69)		(4.62)		(3.22)		(3.22)	
Adjusted R-squarre:											
Complete model		0.906	***	0.883	***	0.718	***	0.298	***	0.721	***
Excluding volume		0.597	***	0.653	***	0.485	***	0.259	***	0.477	***
Excluding transactional variables:		0.903	***	0.865	***	0.661	***	0.271	***	0.674	***

Table V.

Estimations relating costs to volume and transactions for small and big farms (t-statistics in parentheses).

Variables	Coefficient (pred. sign)	Small farms (under median European Size Unit)			Big farms (above median European Size Unit)		
		(A) ln(SPECIFCOST)	(B) ln(FWUREF)	(C) ln(INDIRECT)	(D) ln(SPECIFCOST)	(E) ln(FWUREF)	(FC) ln(INDIRECT)
Constant	?	-.9824482	12.6534 ***	5.517601 ***	-5.730644 ***	13.7337 ***	3.81185 ***
		(-0.88)	(17.92)	(5.29)	(-5.05)	(15.87)	(3.88)
Year:							
YEAR90	?	-.1711244 *	-.040206	-.090143 **	-.0436203	.0164818	.0367071 *
		(-1.84)	(-1.22)	(-2.18)	(-0.79)	(0.55)	(0.77)
YEAR91	?	.0101358	.018198	-.0923654 *	.0346076	-.0268982	.0120746
		(0.12)	(0.60)	(-1.71)	(0.56)	(-0.76)	(0.25)
YEAR92	?	-.0606265	-.0146069	-.1318813 **	.0198776	.0118243	-.0267228
		(-0.58)	(-0.42)	(-2.11)	(0.31)	(0.27)	(-0.51)
YEAR93	?	.1552858	.0394575	-.1098581 *	.0602311	.0173516 **	-.0116334
		(1.58)	(1.25)	(-1.69)	(0.75)	(0.33)	(-0.21)
Type of farming:							
EXTENSIVE	-	-.0218339	-.2138983	-.127216	-.1691813	-.1896204	.1170404
		(-0.08)	(-1.31)	(-0.52)	(-1.09)	(-1.61)	(0.88)
PERMANENT	-	-.761802 ***	-.1353461	.0495536	-.574097 ***	-.0587689	.37579 ***
		(-3.62)	(-1.02)	(0.25)	(-3.54)	(-0.48)	(2.68)
DAIRYDRYSTOCK	+	.4617848	.3200662	.0541153	-.0043362	.618556 ***	.0475878
		(0.82)	(0.89)	(0.10)	(-0.02)	(3.61)	(0.24)
PIGPOULTRY	+	.9146782 ***	-.1406992	.0046165	-.0596805	-.0186479	.2593876 **
		(2.87)	(-0.71)	(0.02)	(-0.40)	(-0.16)	(2.01)
Location:							
MOUNTZONE	-	-.0258765	-.2491848	-.4234095	-.5111508 *	-.4599763 **	-.1453612
		(-0.08)	(-1.27)	(-1.47)	(-1.74)	(-2.04)	(-0.57)
LESSFAZONE	-	-.4163933 ***	.1336139	-.7017252 ***	-.0216951	-.0581694	-.3090324 ***
		(-3.03)	(1.49)	(-5.36)	(-0.17)	(-0.59)	(-2.75)
Volume:							
ln(OUTPUT)	+	1.005992 ***	.1040023 **	.563355 ***	1.340597 ***	.0411848	.6407621 ***
		(13.34)	(2.19)	(8.07)	(19.74)	(0.80)	(10.91)
Transactions:							
ln(UAA/NUMPROD)	+	-.1234504	.0857638	.1400928	-.1883798 ***	-.0191754	.2465307 ***
		(-1.19)	(1.28)	(1.42)	(-2.85)	(-0.38)	(4.30)
ln(NUMPROD)	+	-.1195192	.2299756 **	.0479095	-.2255998	.257808 **	.2229652 *
		(-0.71)	(2.22)	(0.32)	(-1.51)	(2.29)	(1.75)
R-squarre:							
Complete model		0.7550 ***	0.1968 ***	0.5066	0.8806 ***	0.2715 ***	0.6098 ***