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Cost stickiness revisited: Empirical aplication for farms

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Abstract: This article reviews previous research regarding cost stickiness and performs an empirical analysis applied to a sample of farms. It recognizes that modelization of cost stickiness is a particular case of representation of cost variations as a function of output variations. It also discusses methodological issues and analyses cost stickiness for all registered farm costs and opportunity costs of family work. Costs exhibit a considerable level of rigidity. Even for variable costs, a decrease in activity involves a lower decrease in costs than the amounts involved when activity increases. While registered indirect costs slightly decrease when activity decreases, opportunity costs always increase. The study provides empirical evidence that cost stickiness is significantly reduced with better management decision practices.

JEL Classification: M10, M40, M41

Keywords: Cost behavior; Cost stickiness; Farm management accounting.

Resumen: Este artículo parte de los trabajos realizados previamente sobre la histéresis de los costes, realizando una aplicación empírica a una muestra de explotaciones agrícolas. La modelización de la histéresis de los costes es un caso particular de la representación de las variaciones de los costes en función de variaciones en la producción. El trabajo discute cuestiones metodológicas de esta modelización y analiza la histéresis de los costes para todos los costes registrados en la contabilidad de las explotaciones agrícolas, así como para los costes de oportunidad del trabajo familiar. Los resultados muestran que los costes presentan un elevado grado de rigidez. Incluso los costes variables disminuyen menos cuando la producción se reduce de lo que aumentan cuando ésta crece. Mientras que los costes indirectos registrados disminuyen ligeramente cuando la producción disminuye, los costes de oportunidad del trabajo familiar siempre aumentan. Asimismo, el estudio aporta evidencia empírica de que la histéresis de los costes se reduce significativamente cuando se aplican mejores prácticas de gestión.

Palabras clave: Comportamiento de los costes, Histéresis de los costes, Gestión de explotaciones agrícolas.

COST STICKINESS REVISITED: EMPIRICAL APLICATION FOR FARMS

1. INTRODUCTION

Over the last decades agriculture has experienced a continuous decrease in the number of farms. International competition and the consequent need of restraining costs are permanent challenges for farms. Understanding cost behavior is an essential issue of management accounting and a major concern for policymakers and farmers interested in improving farm management and survival.

In the traditional model of cost behavior, costs are described as fixed or variable with respect to changes in activity. It was generally assumed that variable costs change proportionately with changes in activity, and that fixed costs, while remaining invariable in the short term, are also related with activity in the long term.

Recent literature in management accounting provides a new framework for understanding cost behavior. Cooper and Kaplan (1998) alleged that overhead costs raise more with increases in activity volume than they fall with decreases. This type of cost behavior is labeled “sticky”, and “stickiness” the correspondent effect. Noreen and Sonderstrom (1994, 1997) and Anderson et al. (2003) found empirical evidence in hospital service departments and industrial firms respectively. Balakrishnan et al. (2004) and Calleja et al. (2006) tested also different hypothesis about cost stickiness. However, the measures employed by previous studies to explain cost variations as a function of activity volume variations have some methodological flaws when hey are applied to sectors with predominant small firms such as agriculture.

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 cost management can work as effectively for them as it does for large companies (Hicks, 1999). Argilés and Slof (2003) found empirical evidence that the use of accounting in farm management is positively associated with performance. Understanding cost behavior is an interesting information and decision-making tool for a strengthened agricultural sector surviving in an increasingly competitive international environment.

This study contributes to understanding farm cost behavior. It checks hypothesis about cost stickiness using farm data and performs empirical research on cost behavior.

The interest of the study is fourfold. It reviews the methodology employed in previous studies suggesting alternative measures for the variables in the model. We distinguish between different kind of costs: overhead, including all registered farm costs and opportunity costs of family work. Through a sample of Catalan farms we conclude useful questions for sectors with predominance of small firms. It has never been performed similar study for Spanish firms or farms.

The structure of the article is as follows: section 2 describes the Farm Accountancy Data Network (FADN), section 3 formulates the research hypotheses, section 4 deals with model specification, section 5 describes the sample, 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). FADN today collects accounting information at the level of individual farms, and gathers data every year from a rotating sample of professional farms across all member states.

FADN collects data through a questionnaire, called the “Farm Return”, and is filled out by farms with the assistance of specialised local accounting offices. The information obtained through the Farm Return is coded and transmitted to the European Commission. The European Commission summarizes information in reports similar to balance sheets and income statements and publishes them at aggregated terms.

European Commission (1997, 1998) explain in detail the classification of costs by the FADN. The cost classification was not conceived according to the traditional criteria of fixed/variable. However, the FADN label “specific costs” fully presents characteristics of variable costs, while the rest are indirect and mainly fixed.

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. For the rest of the costs (we will label them “registered indirect”) FADN distinguishes farming overheads, depreciation and external factors. Farming overheads include supply costs linked to productive activity but not linked to specific lines of production. Depreciation and fixed assets are calculated in current values at the end of the accounting period. External factors correspond to remuneration of inputs that are not owned by the holder: work, land and capital.

FADN was only conceived as a complementary source of statistical information about farm income for policy makers and not as a tool to be used by farmers or other stakeholders, or to fulfil accounting standards (European Commission, 1991). However, it has become considered to fulfil the role of standard-setter in practice (Poppe and Beers, 1996, p. 18).

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

3. HYPOTHESIS DEVELOPMENT

Sticky costs occur because there are asymmetric adjustments of resources when activity increases and decreases.

Costs downward adjustment is more difficult than upward adjustment because firms face difficulties in removing committed resources. Managers usually delay adjustments because they believe that the drop in demand or activity is only temporary. Together with the reduction in costs associated with a decrease in the activity, there is an increase in some costs, as for example severance pay for employees, returns of materials and services, organizational adjustments, etc. Other minimum costs, as for example maintenance or general services can not be avoided. Small simple firms with a minimum structure are paradigmatic examples of flexibility. In spite of the fact that small firms are usually more flexible than big complex ones, they cannot completely avoid stickiness. In the specific case of farms, unpredictable climatic random effects are able to cause downwards in output, while harvest seasonal costs were already incurred.

On the other hand, farmers cannot avoid minimum maintenance costs of biological assets even when their performance decreases.

H1: We expect an effect of stickiness for indirect costs. That is: the increase in indirect costs given by an increase in activity is greater than its decrease when activity decreases.

Variable costs behave proportionally to activity, and it is assumed that equal increases in variable costs will be usually expected when activity increases as decreases in variable costs when the same decrease in activity occurs. However, in the specific case of farms, random climatic conditions often reduce farm output, while many of the specific costs have been already incurred. As farm output is often harvested at the end of the accounting year, stickiness effect could be expected for farms.

H2: While we do no expect an effect of stickiness for variable costs in firms because of their nature, due to the special nature of the agriculture, we can expect that stickiness for variable costs also exists.

Although stickiness in specific costs would be effective, the consequence of this effect would be relatively less intense than the stickiness in indirect costs. Specific costs are very sensitive to changes in activity, while indirect costs are subject to important rigidities. Fixed costs are mainly linked to structural characteristics. They substantially increase as a consequence of managers' policies, usually through investment decisions, recruiting, etc. The decrease of these costs is also subjected to delayed downsizing adjustment decisions. The same would be expected for farms.

H3: Stickiness would be more important, in relative terms, for indirect costs than for specific costs.

Changes in activity may be perceived as a short-term market effect. Farmers facing a downturn in activity may wait to assess whether the change has short or long-term effect, before they adjust resources to the decrease in activity. Over longer periods, farmer's assessments about the permanence of a change in activity become more certain and consequently resource adjustment becomes more drastic. Farmer reaction is greater over longer periods. Therefore, cost stickiness is likely to be less pronounced when observed over greater aggregations of periods.

H4: We expect a less pronounced stickiness effect with the aggregation of periods.

Cost stickiness basically occurs because managers do not take decisions to remove resources that are not utilized when activity falls. Increasing quality in decision-making would likely reduce cost stickiness. Better information would entail optimal decisions, while the lack of information would not allow appropriate ones. On the one hand, when activity increases, uninformed decisions would instigate less-adjusted investment decisions. On the other hand, when activity decreases well-informed decisions would likely allow faster and better-fitted resource adjustments.

Mitchell et al. (2000) concluded that the analysis of information system in small firms is still in its infancy. Small firms do not usually collect information because they perceive formal procedures, such as record keeping and accounting, as unnecessary (Small Business Research Trust, 1996). However, Lybaert (1998) observed a positive relation between the extent of information use and the performance of SME's. Specifically, the keeping of accounts is not widespread in agriculture. Consequently, farmers usually take decisions based on low quality information, whose efficiency could be significantly improved with accounting-based information (Argilés, 2001). Garcia et al. (1983) and Streeter (1990) found that farms that carried out financial accounting were more likely to improve cash flow projections, production choices, electronic information systems and decision making. Farmers using financial information would have a better tool to analyze their business than farmers that do not do it, thus taking more appropriate decisions with respect to interpreting increasing activity, committing resources in response to output growth and downsizing them when activity decreases. Accordingly, a better information system would optimize resource adjustments minimizing cost stickiness.

H5: We expect a lower cost stickiness effect when decision-taking is improved through higher quality information.

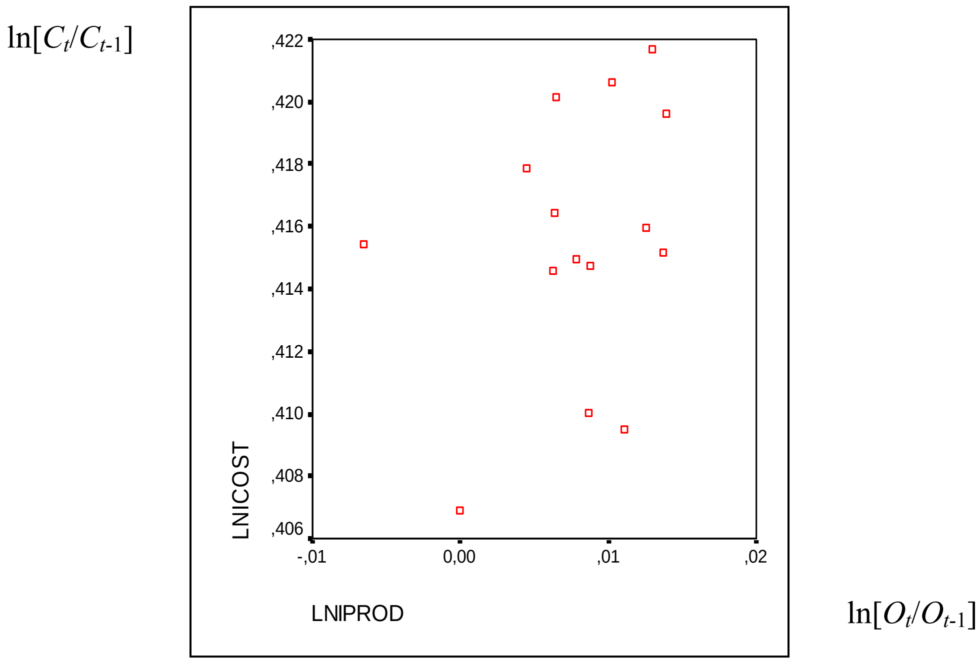
4. THEORETICAL DEVELOPMENT

The theoretical development of this paper begins with the discussion of previous research. Then we propose the models to estimate and finally we define the variables included in the model.

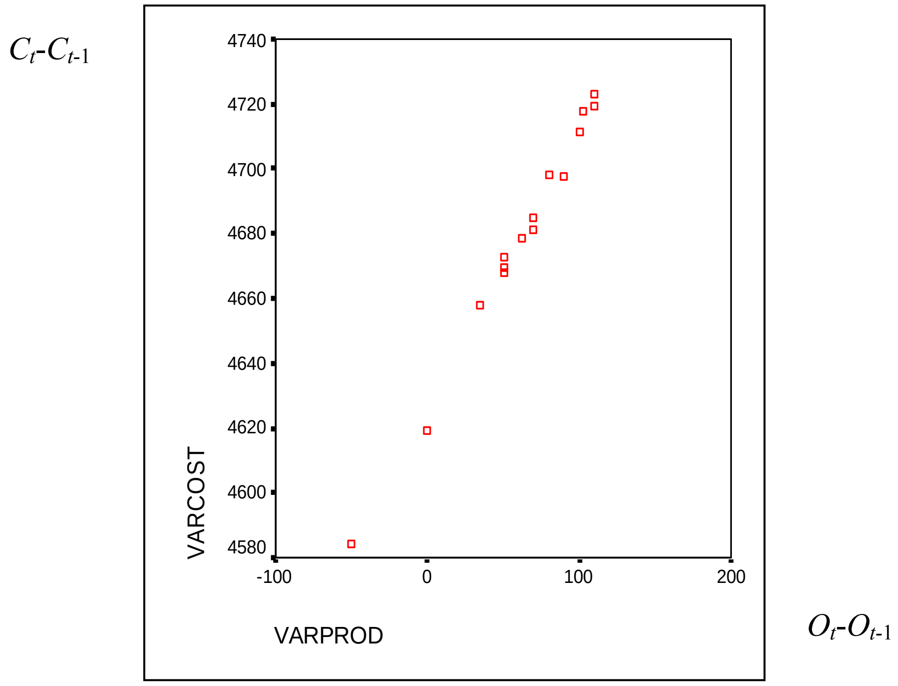
4.1. Model discussion

Empirical papers investigating stickiness have measured cost and sales variations in relative terms through indexes. However, there are alternative measures of volume and cost variations to adequately estimate cost behaviour, and specifically stickiness. Cost stickiness is a complex subject that should be addressed cautiously, selecting the appropriate measure depending on sample characteristics. In the specific case of small farms predominating in agricultural sector, investment decisions as well as random factors from climate conditions and market fluctuations bring about striking changes in output and costs. When simulating a combination of moderated/big changes (from one to the following year) in the constant term (fixed costs) and the independent variable (output) of a typical function cost, no defined pattern would be found in the plot of observed variables in logarithms of relative changes (displayed in graphic 1), while a defined pattern would be found for changes in levels (displayed in graphic 2).

Grahic 1. Plot of cost and output variations in logarithms of relative terms for simulations of combinations of big/moderated changes (from one to the following year) in the constant term (fixed costs) and the independent variable (output)



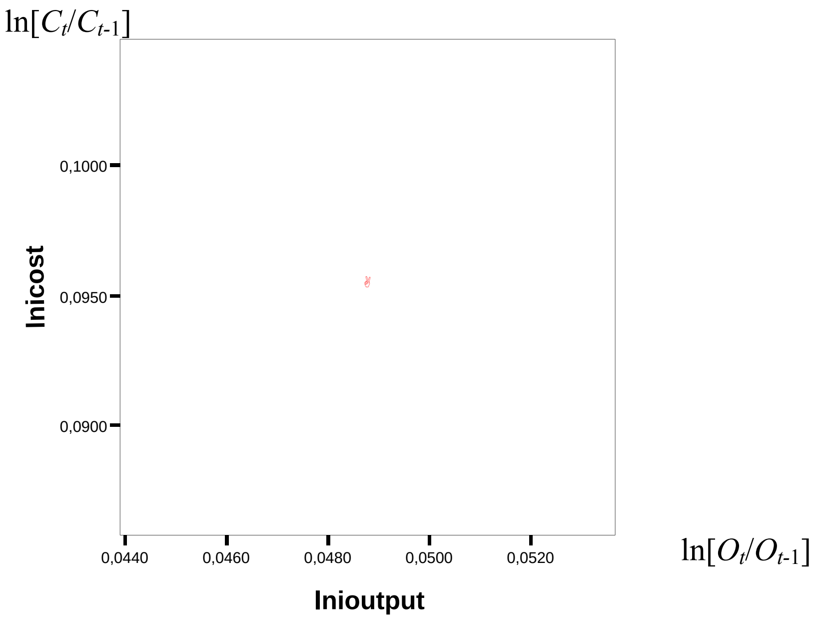
Grahic 2. Plot of cost and output variations in level terms for simulations of combinations of big/moderated changes (from one to the following year) in the constant term (fixed costs) and the independent variable (output)



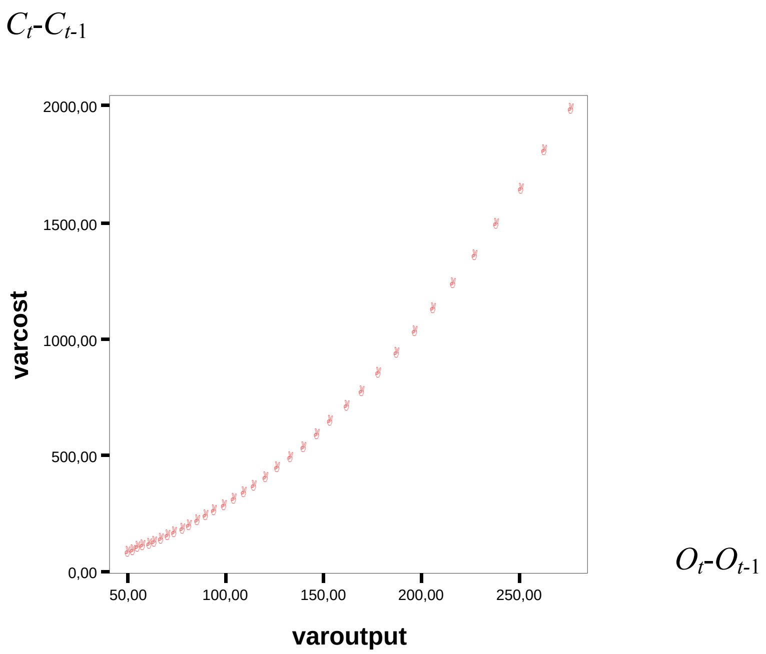
On the other hand, agriculture is also characterized by the predominance of small farm business with minimum management and influence. Such a situation could be labeled as sector dominance, where farms perform mainly according to sector trends and evolution. Given farm size, they usually have short room for moving apart from sector variations in output and costs. In this case, as it can be seen in graph 3 the plot of volume and cost variations in relative terms yield a single point, without showing any kind of relationship. However, as graph 4 shows, when variables are measured through differences in levels a well defined pattern is obtained.

According to Potesta (2002) the use of Ordinary Least Squares procedure to estimate a pooled data model tend to generate several problems, being the most common that errors tend to be serially as well as contemporaneously correlated and heteroscedastic. To deal with these complications we have used the Paks-Kmenta method that estimates the pooled data model through Generalized Least Squares based on less restrictive assumptions about the behavior of the error term.

Graph 3. Plot of cost and output variations in logarithms of relative terms for simulations of equal relative cost and output variance (sector dominance).



Graph 4. Plot of cost and output variations in level terms for simulations of equal relative cost and output variance (sector dominance).



4.2. MODEL SPECIFICATION

Following Anderson et al. (2003) our model enables measurement of the costs response to changes in volume, discriminating between periods when output increases and decreases. The interaction variable *DECR* takes the value of 1 when output decreases between period t–1 and t, and 0 otherwise. We define the reduced model as:

$$VARC_{i,t/t-1} = \beta_0 + \beta_{v1} \cdot VARO_{i,t/t-1} + \beta_{v2} \cdot \left[DECR \cdot VARO_{i,t/t-1}\right] + \varepsilon_{i,t} \quad (1)$$

As discussed earlier, we defined variables as absolute values of variations between period t and t–1, where *VARC* indicates variations in costs and *VARO* indicates variations in output for farm i.

Farm costs also depend on farm characteristics, such as the type of farming (F) and geographical location (L), which likely affect empirical results when a heterogeneous sample data of farms is used. Thus, conclusions would not be properly drawn without controlling for these variables. Agriculture is usually affected by yearly circumstances (Y) of random climatic conditions, market fluctuations and contextual factors that are expected to influence cost variations. Thus, controlling for these factors we specify the following corresponding enlarged model:

$$VARC_{i,t/t-1} = \beta_0 + \beta_{v1} \cdot VARO_{i,t/t-1} + \beta_{v2} \cdot \left[DECR \cdot VARO_{i,t/t-1}\right] + \sum_{j=1}^{j} \beta_{fj} \cdot F_{i.j} + \sum_{m=1}^{m} \beta_{lm} \cdot L_{i,m} + \sum_{n=1}^{n} \beta_{yn} \cdot Y_{i,n} + \varepsilon_{i,t} \quad (2)$$

This model provides the basis for our test of cost stickiness. If the traditional fixed- and variable-cost model is valid, upward and downward changes in costs given changes in output will be equal and consequently β_{v2}=0. Because of *DECR* takes the value of 1 when output decreases between periods t–1 and t, the sum of the coefficients, $\beta_{v1}+\beta_{v2}$ measures the monetary value decrease in costs with a monetary value decrease in output. If costs are sticky, the variations of costs with output increases should be greater than the variation with output decreases. Thus the empirical hypothesis for stickiness, conditional on $\beta_{v1}>0$ is $\beta_{v2}<0$.

4.3. VARIABLES IN THE EQUATION

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

We calculate the opportunity cost of family work 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* represents labeled "specific costs" in FADN. They are basically variable costs. *INDIRECT* includes farming overheads, depreciation and external factors.

Equations (1) and (2) are built with variables indicating variation of values. Therefore, *VTOTCOST*, *VESPECIFCOST*, *VINDIRECT* and *VFWUREF* represent, respectively, variations in costs: total, specific, registered indirect, and opportunity costs of family work.

Farm output measures output. *VOUTPUT* represents variations in output and *DECR·VOUTPUT* the transformed variable for variations in output, where *DECR* takes value of 1 when volume decreases and 0 otherwise.

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 production (pigs and poultry), 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 show higher costs than field and permanent crop, and lower than those specialized in livestock. However, we do not formulate any prior hypothesis with respect to the association between output and cost variation.

Two dummy variables indicate the location in less-favored (*LESSFAZONE*) and mountain (*MOUNTZONE*) zones when its value equals one and zero otherwise, while the default category is for farms located in what we label "usual zones". As for the latter, they usually have more land available, more farmhouse consumption, some resources are less scarce, prices are lower, etc. Then, farms located in mountain and less-favored zones should show lower costs, but we can not make any specific assumption with respect to relation between output and cost variation.

As agriculture is often influenced by random climatic effects and market fluctuations and contextual factors, it is worth controlling for time. Four dummy variables control for the existence of significant relations between volume and cost variations across the studied period, 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 year 1989. As monetary values were deflated and expressed in current terms of 1989, and no prior information is known about significant disturbances in those years, there is no assumption on the sign of their associated coefficients.

5. SAMPLE

The regional FADN office in Barcelona provided us with five years data (1989 to 1993) on 170 Catalan farms. Monetary values were deflated and expressed in constant values of 1989.

Table 1 offers some descriptive magnitudes about our sample. Costs were stable for the studied period, presenting a minor drop for specific costs. 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 supported by the Community. Output presented decreasing but variable values during the studied period, reflecting the influence of random market and climatic effects.

According to statistics from the *Institut d'Estadística de Catalunya* (1992, 1998), the farms 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 we can see in table 1, our sample approximately fits population in extensive and permanent crops, but there are some deviations in drystock, granivores, mixed farming and horticulture, the latter not present in the sample. The regional FADN is concerned about obtaining information about granivores, very important in Catalonia, in spite of the fact that its production is mainly performed by mixed farms.

We consider that, despite the mentioned differences, our sample is representative of population, and it is valid to draw inferences and conclusions from it.

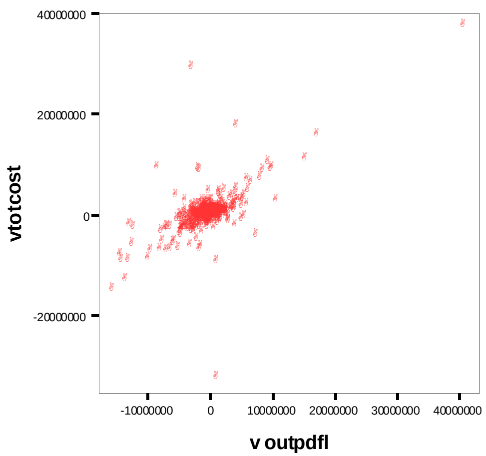
Table 1
Descriptive statistics (monetary values expressed in pesetas in current terms of 1989)

	Year 1989	Year 1990	Year 1991	Year 1992	Year 1993
Mean values for farm:					
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
Registered indirect costs	2 190 964	2 385 203	2 203 969	2 189 281	2 211 686
Opportunity cost of family work	2 242 069	2 239 428	2 285 456	2 316 311	2 389 946
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%)

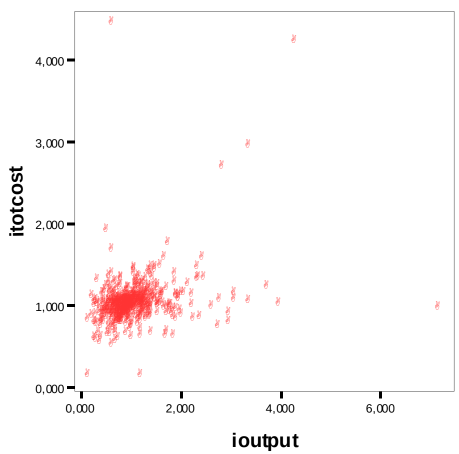
6. EMPIRICAL RESULTS

Graphs 5, 6 and 7 suggest variations in absolute terms as the appropriate measure for our data sample, as there is a linear relation between variables, while indexes of variations in relative terms, either transformed logarithm or untransformed, would not properly capture stickiness. Plots suggest that agriculture is characterized by small operators, very similar in cost structure, none of them owning dominant market position, and for the most part performing the average common trend. In addition, farms usually bear big relative variations, in investment and output, as discussed in section 4.1.

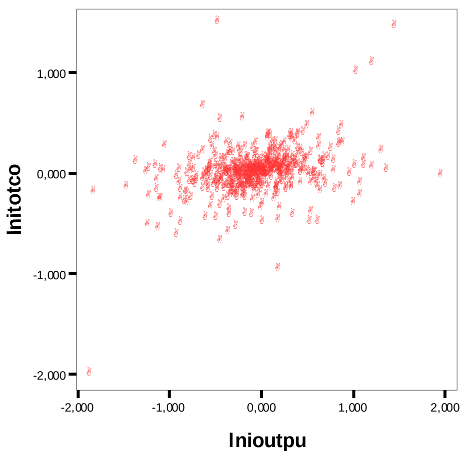
Graph 5. Plot of output and cost variation (in absolute terms)



Graph 6. Plot of output and cost variation (in relative terms: as the ratio of *t* year values to *t-1* year values)



Graph 7. Plot of output and cost variation (in transformed logarithm values of graph 2 indexes)



We have estimated reduced and enlarged models through generalized least squares, assuming heteroscedastic and correlated errors. Tables 2 and 3 display estimations for reduced and enlarged models where variations are expressed in relative terms. No significant coefficients of (*DECRE·VAROUTPUT*) seem to reveal that these models do not adequately reflect stickiness. On the contrary, the corresponding estimations for this variable in table 4 reveal that stickiness effectively exists and is adequately reflected with variables expressing variations in absolute terms.

Considering our sample features, it is more appropriate to use cost and activity volume variations expressed in absolute terms. Following explanations will refer to estimations performed with these variables.

Panel A of table 4 displays panel regressions corresponding to reduced model. Estimations detect stickiness in registered indirect costs, opportunity costs of family work and the sum of total costs, but not in specific costs, confirming hypotheses H1 and H3. H2 is not supported for the reduced model.

Panel B of table 4 displays panel regressions for the enlarged model. As they basically confirm estimations of reduced model and provide more comprehensive results, we will focus our comments on this table.

Columns (A), (B), (C) and (D) of panel B of table 4 evidence significant stickiness in all kinds of costs, thus confirming results of panel A of table 4, with the exception of specific costs.

Estimations for β_{v1} and β_{v2} in column (A) support the existence of stickiness in registered indirect costs with $p<0.01$, thus confirming hypothesis (H1). Coefficient β_{v1} indicates that indirect costs increase 0.0966 monetary values when output increases 1, while they do not almost reduce (only 0.0107 monetary units: combined value of $\beta_{v1}+\beta_{v2}$), in relative terms, given the same output reduction. These figures reveal a great level of rigidity in registered indirect costs: almost no reductions in these costs are obtained with a decrease in output. A reasonable explanation for the significant negative sign for dairy and drystock type of farming is that higher increases in output are followed by lower increases in registered indirect costs, thus suggesting the existence of economies of scale in this type of farming.

Table 2.
Estimations for variations of costs (t-statistics in parentheses). Models with variations in relative terms: transformed variables ln[C_t/C_{t-1}] and ln[V_t/V_{t-1}]

Panel A: Reduced model:

Variables	(A) VINDIRECT		(D) VTOTCOST	
Constant	-.0262684	*	-.0129703	
	(-1.72)		(-1.58)	
VOUTPUT	.114332	**	.2063348	***
	(2.24)		(7.06)	
DECR·VOUTPUT	.0173959		-.0481174	
	(0.22)		(-1.12)	
Log Likelihood	-210.1702	***	148.2409	***

Panel B: Enlarged model:

Variables	(A) VINDIRECT		(D) VTOTCOST	
Constant	.0505508		-.0452	*
	(1.52)		(-1.91)	
Year:				
YEAR91	-.0276879		.0438184	
	(0.69)		(1.30)	
YEAR92	-.0210456		.0316612	
	(-0.57)		(1.26)	
YEAR93	-.0227312		.0649182	***
	(-0.61)		(2.89)	
Type of farming:				
EXTENSIVE	-.0790844	**	-.0357773	*
	(-2.38)		(-1.88)	
PERMANENT	-.0850334	***	-.0017968	
	(-3.22)		(-0.12)	
DAIRYDRYSTOCK	-.0312902		-.0002244	
	(-0.59)		(-0.01)	
PIGPOULTRY	.0139487		-.0045986	
	(0.40)		(-0.23)	
Location:				
MOUNTZONE	-.0031587		-.0045524	
	(-0.07)		(-0.18)	
LESSFAZONE	-.0519895	**	.0077172	
	(-2.55)		(0.67)	
Stickiness:				
VOUTPUT	.1792114	***	.1993121	***
	(3.49)		(6.63)	
DECR·VOUTPUT	-.079244		-.0391626	
	(-1.02)		(-0.88)	
Log Likelihood	-196.4147	***	155.7915	***

Significance levels: *p<0.1, **p<0.05, ***p<0.01

No estimations for VFWUREF and VSPECIFCOST because the panels are not balanced for these variables.

Table 3.
Estimations for variations of costs (t-statistics in parentheses). Models with variations in relative terms: untransformed variables C_t/C_{t-1} and V_t/V_{t-1}

Panel A: Reduced model:

Variables	(A) VINDIRECT		(C) VSPECIFCOST		(D) VTOTCOST	
Constant	.9180692	***	.7387765	***	.9081196	***
	(21.87)		(7.20)		(35.65)	
VOUTPUT	.0995356	***	.3464716	***	.1150956	***
	(3.35)		(5.08)		(6.49)	
DECR·VOUTPUT	-.0144499		.0058139		-.0351163	
	(-0.39)		(0.06)		(-1.52)	
Log Likelihood	-327.4772	***	-930.5727	***	13.86234	***

Panel B: Enlarged model:

Variables	(A) VINDIRECT		(C) VSPECIFCOST		(D) VTOTCOST	
Constant	1.01829	***	.5084138	***	.89237	***
	(15.06)		(3.80)		(22.72)	
Year:						
YEAR91	-.0493661		.4225084	***	.0389163	
	(-0.90)		(2.75)		(1.07)	
YEAR92	-.0099296		.118822		.0242198	
	(-0.16)		(1.53)		(0.74)	
YEAR93	-.0411435		.2617501	**	.0342475	
	(-0.80)		(2.51)		(1.25)	
Type of farming:						
EXTENSIVE	-.0774868	**	.104102		-.0493288	**
	(-1.97)		(1.02)		(-1.98)	
PERMANENT	-.0799163	***	.0664371		-.0218674	
	(-2.62)		(0.83)		(-1.13)	
DAIRYDRYSTOCK	.0078176		-.0090731		.0314649	
	0.12)		(-0.06)		(0.79)	
PIGPOULTRY	.0194738		.1442524		.0098336	
	(0.48)		(1.37)		(0.38)	
Location:						
MOUNTZONE	-.0361557		.1432584		-.0257404	
	(-0.69)		(1.03)		(-0.77)	
LESSFAZONE	-.0171764		.0763739		.0238017	
	(-0.72)		(1.19)		(1.56)	
Stickiness:						
VOUTPUT	.0949702	***	.3498476	***	.1113024	***
	(3.18)		(4.97)		(6.27)	
DECR·VOUTPUT	-.0255099		.0151988		-.0378245	
	(-0.68)		(0.16)		(-1.62)	
Log Likelihood	-319.1544	***	-925.0638	***	20.99696	***

Significance levels: *p<0.1, **p<0.05, ***p<0.01

No estimations for VFWUREF because the panels are not balanced.

Table 4.
Estimations for variations of costs (t-statistics in parentheses). Models with variations in absolute terms: variables C_t-C_{t-1} and V_t-V_{t-1}

Panel A: Reduced model:

Variables	(A) VINDIRECT		(B) VFWUREF		(C) VSPECIFCOST		(D) VTOTCOST	
Constant	-59133.93	**	-16985.67		-67536.9		-153543.1	***
	(-2.02)		(-0.94)		(-1.45)		(-2.78)	
VOUTPUT	.0984031	***	.0479176	***	.6352238	***	.787414	***
	(7.61)		(6.24)		(31.19)		(31.40)	
DECR·VOUTPUT	-.0910379	***	-.0811343	***	-.037577		-.2066983	***
	(-4.24)		(-1.32)		(-1.16)		(-5.36)	
Log Likelihood	-10 405.36	***	-9 841.674	***	-10 604.38	***	-10 803,81	***

Panel B: Enlarged model:

Variables	(A) VINDIRECT		(B) VFWUREF		(C) VSPECIFCOST		(D) VTOTCOST	
Constant	210 564.2		-103 818.9	*	-295 842	*	-40 925.61	
	(1.08)		(-1.69)		(-1.73)		(-0.16)	
Year:								
YEAR91	-381 009.6		58 870.82		2 371.33		-325 374.6	
	(-1.07)		(0.87)		(0.01)		(-0.76)	
YEAR92	-239 858.5		43 811.24		-53 527.31		-263 076.3	
	(-1.28)		(0.77)		(-0.38)		(-1.09)	
YEAR93	-177 730.2		96 579.02	*	297 293.2		202 659.9	
	(-0.97)		(1.74)		(1.42)		(0.74)	
Type of farming:								
EXTENSIVE	-135 464.4		-18 593.01		143 809.6		-173 339.5	
	(-1.33)		(-0.36)		(1.03)		(-1.02)	
PERMANENT	-71143.42		20361.6		306005.6	***	133287.4	
	(-0.88)		(0.49)		(2.74)		(0.98)	
DAIRYDRYSTOCK	-339 653.6	**	118 248.6		313 401.2		551 169.8	**
	(-2.03)		(1.41)		(1.40)		(1.99)	
PIGPOULTRY	7 231.995		-53 590.59		29 860.36		-122 577.1	
	(0.07)		(-0.99)		(0.20)		(-0.68)	
Location:								
MOUNTZONE	37 429.92		-97 999.29		-9 819.834		-71 058.42	
	(0.27)		(-1.41)		(-0.05)		(-0.31)	
LESSFAZONE	2 457.464		51 437.46		-76 515.37		-112 623.4	
	(0.04)		(1.63)		(-0.92)		(-1.09)	
Stickiness:								
VOUTPUT	.0966363	***	.0506556	***	.6468503	***	.793151	***
	(6.33)		(6.32)		(29.60)		(28.50)	
DECR·VOUTPUT	-.0859282	***	-.0875914	***	-.0732603	**	-.2215624	***
	(-3.13)		(-6.30)		(-1.97)		(-4.72)	
Log Likelihood	-10 407.94	***	-9 834.342	***	-10 598.24	***	-10 799.2	***

Significance levels: *p<0.1, **p<0.05, ***p<0.01

Results in column (B), panel B, of table 4 largely confirm hypothesis H1. The estimated value of β_{v1} (t-statistic = 6.32) indicates that opportunity cost of family work increased 0.0506 monetary units per 1 monetary unit increase in output. The combined value of $\beta_{v1}+\beta_{v2}$=-0.0369 (t-statistic of β_{v2} = -6.30) indicates that even when output decreased (1 monetary unit), opportunity cost of family work increased all the same (0.0369 monetary units), although slightly less than in output increasing. When activity falls down, farmers try to substitute external purchased inputs with increases in their own work. Performance of minimum maintenance tasks is an additional reason that explains this behavior.

Contrary to estimations shown in panel A of table 4, significant estimations for β_{v1} and β_{v2} in column (C) with p<0.05 support the existence of stickiness in specific farm costs when controlling for other variables, thus confirming hypothesis H2. When the enlarged model is considered stickiness also appeared for specific costs. Coefficient β_{v1} indicates that specific costs increase 0.6468 monetary values when output increases 1, while they decrease only 0.5736 (combined value of $\beta_{v1}+\beta_{v2}$) when the decrease in output is 1. Climatic conditions often entail reductions in output at some point of the period, when many of the costs have already been incurred. However, stickiness is not as pronounced in specific costs as it is in indirect and opportunity costs, thus confirming hypothesis H3. Because specific costs are essentially variable, and contrary to registered indirect and opportunity costs, β_{v2} coefficient presents lower relative value (0.073) with respect to β_{v1} coefficient (0.646) in this type of costs. Significant positive sign for permanent crops suggests a phenomenon of saturation. Especially evident in fruits and citrus, increasing levels of fertilizers and crop protection are needed as a consequence of intensive farming and plague resistance.

According to estimations for all costs, total costs present also a significant pattern of stickiness, as showed by column (D) of panel B of table 4.

Results performed excluding observations in which the value of any variable is in the top or bottom 0.5% of its distribution (not displayed) do not essentially change. This results in a reduction of twelve observations.

Table 5.

Estimations for variations of costs (t-statistics in parentheses) for aggregated periods. Enlarged models with variations in absolute terms: variables C_t-$C_{t\text{-}1}$ and V_t-$V_{t\text{-}1}$.

Variables	Variations for two aggregated periods			Variations for three aggregated periods		
	(A) VINDIRECT	(B) VFWUREF	(C) VSPECIFCOST	(D) VINDIRECT	(E) VFWUREF	(FC) VSPECIFCOST
Constant	118 129.3	-15 301.99 ***	172 813.4	525 085.7	134 482	-20 740.85
	(0.42)	(-0.10)	(0.43)	(1.40)	(0.64)	(-0.04)
Year:						
YEAR92	-56 768.94	7 029.024	-1 394.013			
	(-0.56)	(0.13)	(-0.01)			
YEAR93	-16 824.71	-886.4448	51 488.44	42 072.67	-18 783.07	43 206.76
	(-0.178)	(-0.01)	(0.27)	(0.50)	(-0.43)	(0.25)
Type of farming:						
EXTENSIVE	-2 010.937	105 298.7	-266 300.5	-964 741.9 **	268 096.3	-410 954.1
	(-0.01)	(0.64)	(-0.59)	(-2.31)	(1.17)	(-0.70)
PERMANENT	-62 775.84	94 958.31	4 570.595	-244 994.9	51 168.08	316 454.9
	(-0.27)	(0.73)	(-0.52)	(-0.75)	(0.29)	(0.68)
DAIRYDRYSTOCK	-537 591.1	1 062 186 ***	-2 743 666	9 356.483	804 243.9 **	-1 983 000 **
	(-0.88)	(2.98)	(-3.10)	(0.01)	(1.99)	(-2.07)
PIGPOULTRY	178 914.2	-255 906	547 551.3	-298 585.1	-333 798.2	1 187 664 **
	(0.66)	(-1.63)	(1.25)	(-0.75)	(-1.53)	(2.09)
Location:						
MOUNTZONE	-393 288.7	-697 952.9 *	309 498.3	-501 363.5	-501 402.4	-148 406.5
	(-0.53)	(-1.67)	(0.37)	(-0.61)	(-1.04)	(-0.17)
LESSFAZONE	-32 567.63	6 188.238	-276 659.8	-292 713.7	-284 249.8	-174 882
	(-0.10)	(0.03)	(-0.74)	(-0.80)	(-1.33)	(-0.44)
Stickiness:						
VOUTPUT	.1287099 ***	.0216998 ***	.6989526 ***	.1451014 ***	.0252886 **	.6819188 ***
	(9.40)	(2.72)	(34.65)	(6.61)	(2.00)	(25.22)
DECR·VOUTPUT	.0082472	.005793	.0055177	.025794	.0079813	.0209817
	(0.40)	(0.49)	(0.18)	(0.82)	(0.44)	(0.54)
Log Likelihood	7 902.854 ***	-7 609.547 ***	-8 154.808 ***	-5 327.84 ***	-5 120.986 ***	-5 466.825 ***

Significance levels: *p<0.1, **p<0.05, ***p<0.01

Table 5 displays estimations for the enlarged model using two and three year variations. We can observe that β_{v2} coefficients in table 5 decrease their absolute value with respect to their values in table 5, and they are not significant with $p<0.05$, thus confirming hypothesis H4. There is no stickiness when the aggregated period is longer than a year.

In order to test the reduction in cost stickiness with better decision-taking, we performed a survey about the use of the accounting information provided by FADN in management decisions. FADN was created as a complementary source of statistical information for policy makers and not as a tool to be used for farmers. They participate voluntarily in the accounting network to provide a sample of statistical information, but some of them make use of the reports for other purposes, including decision-making. With the support of the regional FADN office in Barcelona, we collected data on the use Catalan farmers made of FADN reports on their farms. FADN reports are similar to standard annual reports and the accounting principles used are similar to IAS41. We sent short questionnaires to five agencies keeping records of a total of 170 farms that had remained in the FADN sample for a period of five years. As the farms participate in a rotating representative sample on anonymity condition, it was not possible to send questionnaires directly to farmers. FADN liaison officers filling out the questionnaire have frequent and close contact with the assigned farms. We received replies from all five agencies, covering all 170 farms (850 yearly observations). One hundred and twelve (560 yearly observations) farms participated in the sample only for statistical purposes, but the remaining 58 (290 yearly observations) used financial reports for farm management.

Table 6 displays separate estimations for both types of farms: t-statistic values of β_{v2} suggest that farms that usually use accounting information in their decision-making processes do not present stickiness in specific and indirect costs, while the rest of the farms, effectively present stickiness in this kind of costs, thus confirming hypothesis H5 on reducing stickiness with the improvement of management practices. However, opportunity costs of family work show a different pattern. According to estimations, better managed farms do not reduce opportunity costs when activity falls (in fact these costs slightly increase under this circumstance), because adjustments in capacity are so drastic that additional family work must compensate purchased resources.

Table 6.

Estimations for variations of costs (t-statistics in parentheses) for different types of management. Enlarged models with variations in absolute terms: variables C_t-$C_{t\text{-}1}$ and V_t-$V_{t\text{-}1}$.

Variables	Farms that use accounting information for management decissions[1]			Farms that do not use accounting information for management decissions		
	(A) VINDIRECT	(B) VFWUREF	(C) VSPECIFCOST	(D) VINDIRECT	(E) VFWUREF	(FC) VSPECIFCOST
Constant	491 224.3	-50 560.51	-432 886.3	66 361.82	-94 297.98	-237 327.5
	(1.05)	(-0.65)	(-1.39)	(0.72)	(-1.10)	(-1.50)
Year:						
YEAR91	-1 275 210	-19 245.62	288 964.9	82 644.18	113 196.5	-18 291.51 *
	(-1.34)	(-0.21)	(0.74)	(1.25)	(1.27)	(-0.09)
YEAR92	-667 268.8	102 211	92 146.59	-23 550.3	14 374.74	-120 415.5
	(-1.48)	(1.08)	(0.33)	(-0.28)	(0.21)	(-0.91)
YEAR93	-615 128.3	-12 613.08	238 109.2	35 557.31	135 932.2 *	243 501.3
	(-1.35)	(-0.17)	(0.53)	(0.40)	(1.88)	(1.18)
Type of farming:						
EXTENSIVE	-116 778.4	51 811.72	367 501.8	140 310.8 *	-51 657.02	-37 792.57
	(-0.42)	(0.97)	(1.45)	(-1.69)	(-0.71)	(-0.32)
PERMANENT	311 560.8	-24 930.88	290 922.4	-146 985.1 **	-14 400.07	191 435.4 *
	(1.18)	(-0.50)	(1.26)	(-2.19)	(-0.25)	(1.96)
DAIRYDRYSTOCK	1 111 896 *	12 064.17	255 710	-594 765.2 ***	144 870.1	-104 628.2
	(1.83)	(0.11)	(0.45)	(-5.14)	(1.42)	(-0.63)
PIGPOULTRY	358 032.2	-60 104.78	-150 043.3	-254 445 ***	-68 221.29	259 640.9 *
	(1.47)	(-1.24)	(-0.64)	(-2.64)	(-0.81)	(1.86)
Location:						
MOUNTZONE				41 054.33	-69 691.38	-1 149.152
				(0.51)	(-0.99)	(-0.01)
LESSFAZONE	218 190.2	-8 278.236	-132 764	-31 984.88	82 516.23 **	25 170.62
	(0.94)	(-0.20)	(-0.70)	(-0.69)	(2.05)	(0.39)
Stickiness:						-.3090324 ***
						(-2.75)
VOUTPUT	.065427 **	.0627674 ***	.7392333 ***	.1019725 ***	-.0119465	.4377315 ***
	(2.58)	(7.89)	(26.27)	(5.94)	(-0.74)	(14.69)
DECR·VOUTPUT	-.0349581	-.0807832 ***	-.0430957	-.0730688 ***	-.0530164 **	-.1566422 ***
	(-0.66)	(-5.52)	(-0.79)	(-2.63)	(-2.19)	(-3.63)
Log Likelihood	-3 636.876 *	-3 298.905 ***	-3 642.862 ***	-6 551.716 ***	-6 489.901 ***	-6 845.07 ***

Significance levels: *p<0.1, **p<0.05, ***p<0.01

1. *MOUNTZONE* dropped due to collinearity

7. CONCLUSIONS

This article reviews and discusses previous research in modelling cost stickiness. It recognizes that cost stickiness modelization is a particular case of representation of cost variations as a function of volume variation. It distinguishes specific characteristics for agricultural sector that require an alternative way to model them. Besides, it acknowledges that representation of cost variations and specifically cost stickiness is a complex matter that requires further research and cautious interpretation. Model specification used in previous research does not work under certain conditions.

According to sector and sample characteristics used in this study, we have selected the most appropriate method, not only to estimate cost stickiness but also to validate different hypotheses and basic postulates about it.

The study analyses other costs than mere overhead: it includes all registered farm costs and opportunity costs of family work.

Empirical results support the prevalence of sticky behavior in all costs even in variable costs. In contrast with the commonly established model of fixed and variable costs and the belief of small firms flexibility, our results recognize the role of managers in adjusting committed resources when changes in activity take place. Managers can recognize and control sticky costs. They may reduce stickiness by making appropriate contracting or management decisions, as for example outsourcing, sharing investments or personal contracts with other farmers through associations. Even small firms, as for example farms, face considerable rigidities. Lightweight in small firms by itself does not assure automatic response of costs to changes in activity. On the contrary, optimal adjustment requires management monitoring and consequent decisions. Empirical evidence shows a considerably lower level of stickiness when the decision process uses more refined information systems.

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