Working papers

New Trends in accounting and management

University of Lleida

Department of Business Administration

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OBJECTIVES

The collection pretends to be an instrument of diffusion of the current research. Research realised in the field of Business Administration, by members of the Universities and visitingresearchers. This research has to be original and no previouslypublished in another review or book. This publication pretends to announce the current state of the research with the aim that it was argued and improved from the suggestions received.

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DETERMINANTS OF THE PROFITABILITY OF PIG PRODUCTION IN SPAIN

Abstract

The pig industry in Spain has undergone significant development characterized by an increase in production, exports and productivity of pig farms. The purpose of this paper is to identify the financial and location factors that drive the profits of pig producers. These factors refer to the company, the industry and the territory where they are located. The data used comes from a sample of 1,810 Spanish entities that provided unbalanced panel data for the period 2003-2018. The study made it possible to detect the factors that most influence the profitability of pig producers, taking into account the possible existence of endogeneity problems between some of the variables analysed. The results have implications for CEOs of farms, they will have more information to assess the factors influencing business performance.

Keywords

Pig farming industry, financial profits, pork integration agreement, business effect, industry/subsector effect, territory effect, panel data, endogeneity.

1. INTRODUCTION

Within Spanish livestock farming, pork is the sector with the greatest economic significance, representing 39% of final livestock production, as well as 14% of final agricultural production (MAPAMA, 2019). It has undergone considerable development in recent decades, providing around 14% of the GDP from industry, nearly 1.4% of the national GDP and creating nearly 300,000 direct jobs and over 1,000,000 indirect jobs.
Many investors, attracted by its competitive profitability, decided to invest in the business (Pindado & Alarcon, 2015). The majority of pig farms used an intensive method that implied keeping the animal in closed facilities. Nowadays, intensive exploitations account for around 84% of registered farms. The development has given rise to a growth in the number of farms with a greater productive capacity, which has increased the industrialisation of the sector.

Given its economic impact, this study aims to obtain the determining factors of the profitability of leading pig producers. Previous papers that have analysed this subject have focused their attention on a sector-based economy, whereas there are very few studies at business level (Pindado & Alarcon, 2015), especially in regard to agri-food companies (Elango & Wieland, 2014; Schumacher & Boland, 2005; Chaddad & Mondelli, 2013 and Zouaghi et al., 2017).
Companies dedicated to pig farming form part of a complex industrial sector, characterised by a high number of small and medium enterprises (Goldszmidt et al., 2011) that, in certain regions, create centres of activity, with family-owned businesses in rural areas (Pindado & Alarcon, 2015). In this regard, when the economy of a region is mainly linked to agri-food production, it can positively influence the profitability of its companies (Baráth et al., 2021; Hirsch et al., 2017; Giusti & Grassini, 2007). Indeed, when businesses are near production and sale points, their geographical location can provide advantages and favourable conditions in the availability of human and natural resources (García-Alvarez-Coque et al., 2013).
According to previous evidence, there is diversity in the financial profits between companies belonging to the same industry, which leads us to wonder what the differentiating factors are (Claver et al., 2002; Pindado & Alarcon, 2015). Studies related to strategic management have demonstrated the relevance of diverse specific factors, in terms of both industries and businesses, which act as profit drivers (Chaddad & Mondelli, 2013). Thus, in literature there is a wide range of results on the industry's effects on the profitability of companies. In this way, existing impacts can be observed that range from 1% in a study on the food industry in the EU, which analyses factors such as the market concentration index (HHI) or the growth in the number of companies in the industry (Hirsch et al., 2014), to impacts close to 17.5% in related studies in Central American countries (Ketelhön & Quintanilla, 2012), which incorporate random effects in industries, businesses and countries. However, in literature on strategic management there is consensus that the effects of the company contribute between 20.8% and 82.3% (Molina-Azorin et al., 2010) to the variance in benefits. Nevertheless, research has been scarce at a geographical or territorial level (Zouaghi et al., 2017). Notable exceptions are the works by Lasagni et al.

(2015) and Tamminen (2016), who found evidence of significant relationships between the location and the company's performance.

This study aims to identify factors that boost the financial profits of pig producers. As far as we know, there is no study in literature that identifies these factors in the pig farming industry. For this purpose, the study is approached in three levels: company, industry/subsector and territory. Economic-financial variables are used that have been obtained from the information about balance sheets and information about individual characteristics regarding the environment and location of companies. The analysed data come from an unbalanced panel of Spanish companies observed during the 2003-2018 period. The statistical treatment was carried out by applying statistical tools for panel data, in order to detect the factors that most influence profitability, bearing in mind the possible existence of endogeneity problems between some of the analysed variables. Furthermore, with the purpose of increasing the power of the study and, given the high percentage of missing data that exists (53.15%), new data imputation techniques were applied, based on the use of principal components (Josse & Jusson, 2012, 2016). The use of these techniques avoided having to delete a significant part of the analysed companies, which increased the representativeness of the study and weakened the possible existence of survivorship biases.

The rest of the paper is organised as follows: the explanation of the data, their characteristics and composition are in section 2; the methodology, based on the dynamic regression model with unbalanced panel data is in section 3; the results obtained are in section 4; the results are discussed in section 5, justifying them from an economic-business perspective and, in particular, showing whether or not they are consistent with previous literature. Finally, the final conclusions are presented in section 6.

2. DATA AND VARIABLES

The SABI (Iberian Balance Sheet Analysis System) database was the main source for obtaining the data on the companies. This database is generated by Bureau van Dijk and contains financial information about Spanish companies. Many previous studies use activity headings in accordance with the Statistical classification of economic activities (Hirsch & Gschwandtner, 2013). Given the specific nature of this research, the primary activity of the firms analysed is the 'Raising of swine/pigs' (CNAE-NACE 0146) and were located in any province throughout Spanish territory during the 2003-2018 period inclusive. This classification was made up of pig farming companies, from birth until the animals are slaughtered and were therefore focused on their production. All kinds of companies were considered, of all sizes, whether or not they were family-owned, thus increasing the level of generality of the results obtained.
Initially, a total of 1,810 companies were observed, with a total of 28,960 observations. Subsequently, the database was cleaned, deleting atypical data of the sample so as to prevent biases in the results obtained and increase their robustness. In particular, the observations with profitability below -100% and above 100% were eliminated. Furthermore, the companies with a number of missing data equal to or greater than four of the variables at company level during the analysed period were also deleted. For the remaining cases, the

missing values in both the variables at company level and the profitability itself were imputed, if sufficient information was available. The imputation process was carried out with the R package missMDA (Josse & Husson, 2016), which performs a principal component analysis (PCA) with incomplete data and selects their number by minimising the mean squared error of prediction of the data observed, based on the estimated data using the calculated components. For this purpose, the imputePCA function was employed, which uses a regularised iterative PCA algorithm described in Josse & Husson (2012). After carrying out these depuration processes, the definitive sample contained 1,806 companies with a total of 19,748 observations. This sample represented 2% of the estimated total population of pig farms existing in Spain.

The definitions of the analysed variables, as well as their descriptive statistics are displayed in Table 1.

Table 1. Descriptive study of the analyzed variables

Variable	Definition	Mean	Median	StdDev	Min	Max	Skewness	Kurtosis
ROA	Return on Assets	0.0338	0.0314	0.1155	-1.0014	0.9951	-0.42	14.38
LSize	Log(Size)	6.47	6.43	1.39	-0.21	12.50	0.05	1.29
Age	Age	11.39	10.00	9.69	0.00	68.00	0.93	1.04
Incr_Sales	Increase of Sales	0.1365	0.0365	0.6640	-0.9997	9.9141	6.18	57.49
Liquidity	Liquidity Ratio	1.75	1.16	1.77	0.00	10.00	2.06	4.54
Indeb	Debt Ratio	0.73	0.74	0.39	0.00	9.63	4.39	62.99
HHI	Herfindahl-Hirschman Index	158.69	165.33	28.84	120.06	218.46	0.23	-0.96
LSales_Sector	Log(Sales Sector)	14.79	14.80	0.35	14.15	15.35	-0.16	-1.14
IncrFirm	Increase of firms	0.0172	-0.0886	0.4264	-0.5938	0.8824	0.53	-0.81
Unemp	Unemployment rate %	15.01	14.09	7.34	3.03	42.31	0.65	-0.13
EdPrim	Primary education level %	47.28	47.75	8.99	27.10	68.30	-0.16	-0.55
EdSec	Secondary education level %	21.42	21.59	3.05	12.48	28.54	-0.27	-0.05
EdHigh	Higher education level %	31.30	29.91	7.25	18.00	49.74	0.53	-0.42
Foreign	Foreign Rate %	10.09	10.66	4.57	1.39	21.09	-0.01	-0.72
Density	Population Density	531.06	44.80	1599.76	0.90	17041.50	5.55	41.77

The company's profitability was analysed by the ROA (Return on Assets), a ratio expressed in a percentage that is calculated as earnings before interest and taxes (EBIT) divided by the total assets. In some studies, this ratio is called into question as a profitability measurement (Fisher & McGowan, 1983; Long & Ravenscraft, 1984), since it is unable to reflect the company's real profit, due to possible accounting manipulation in financial statements; there are other alternatives for measuring performance, such as the added economic value (EVA), developed by Stern Steward & Co. However, the ROA is an indicator that surpasses EVA

when analysing profitability (Biddle et al., 1997) due to the information it contains on the company's performance, coupled with the availability of data and the possibility to compare it with previous studies (Hirsch et al., 2014; Gaganis et al., 2015).

Figure 1 displays the evolution of the mean profitability throughout the analysed period:

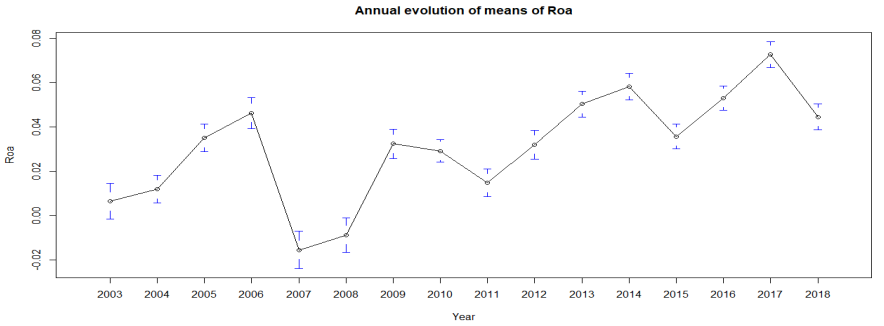

Figure 1. Annual evolution of the mean profitability (2003-2018)

It was observed that after a drop in the mean profitability in 2007, during which mean profits of -1.55% were reached as a consequence of the crisis, there was a growing trend after that year with an estimated average compound annual growth rate of 3.29% cumulated between 2007 and 2018. The reasons for this evolution obeyed a notable restructuring in the sector in recent years, during which there was a marked decrease in the number of small pig farms. At the same time, there was an increase of large pig producers due to takeovers and/or mergers of those that already existed, which led to an increase in production and the census, as well as the average profitability for the period (MAPAMA, 2020).
To explain the evolution of profitability, the following explicative or independent company-level variables were used:
• the size of the company measured by using the Napierian logarithm of the total assets;
• the age of the company (in years);
• the increase in sales;
• the liquidity ratio measured with the logarithm of the quotient between current assets and current liabilities;
• the logarithm of the debt ratio, which divides the total debt (both long- and short-term) between the company's total assets.

Figure 2 displays the annual evolution of the mean values of these variables:

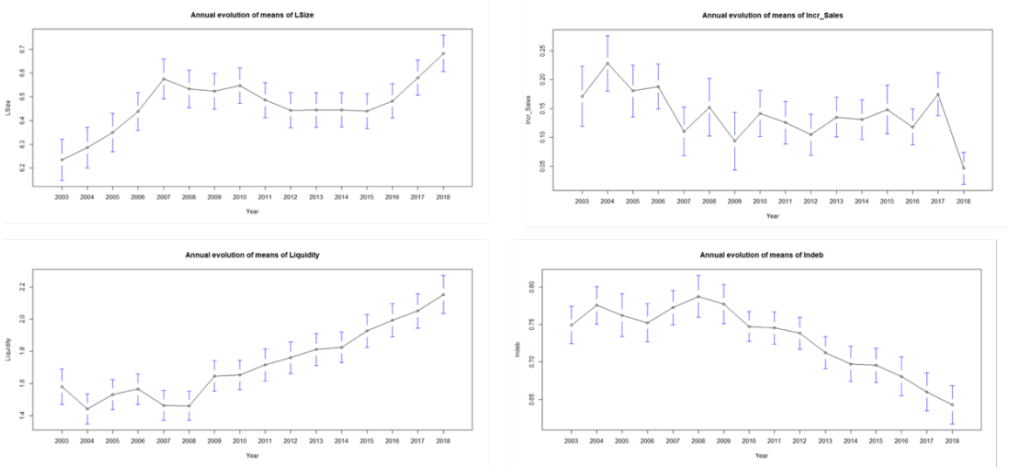

Figure 2: Annual evolution of the average values of the company variables
(from top to bottom and from left to right: size, increase in sales, liquidity and indebtedness)

During the 2007-2015 period, a stable trend was observed in the evolution of the mean values of the variables, in terms of the size of the companies, followed by a growing trend from 2016 to 2018 (Figure 2). The sales increase was stable and positive (around 10%), except in recent years, when they dropped by 5%. A growing trend in liquidity was also seen from 2008, accompanied by a falling trend in the debt ratio. Indeed, the rise in pork consumption in the domestic market enabled companies to increase their cash flow entries on their balance sheets, thus improving their liquidity and showing a lower dependence on bank debt.

In our study, the size was expected to have a positive and significant influence on the ROA, given that a larger size creates returns to scale to large hog confinements, consistent with the recent dramatic increase in market share of very large farms in recent years (Yu & Orazem, 2013). Likewise, the age of the company was expected to have a negative relationship with the ROA, as companies have less capacity to react to the technology change (Baráth et al., 2021). In addition, it was estimated that the growth could help improve employee motivation, thus achieving greater productivity and leading to an increase of the financial profits. On the other hand, liquidity was expected to have a positive and significant effect on the financial profits and debt had negative implications, as while companies used their resources to reduce indebtedness, the financial expenses were reduced and, consequently, the profits grew and more resources were available to renew obsolete investments that could be more productive. The effect of some of these variables may not be linear and to compare this fact, we squared the variables and included them in the model.

With the purpose of analysing the impact of the characteristics at an industry/subsector level, we considered their concentration, size and growth. Based on previous studies, the following independent variables at this level were chosen:

• the market concentration level measured by the Herfindahl-Hirschman Index (HHI), thus a

high (reduced) value of the index is a sign of a market with a high (low) concentration and un- (very) competitive,
• the Napierian logarithm of the sales in the sector and
• the increase in the number of companies in the sector.

Figure 3 displays the annual evolution of these variables during the analysed period:

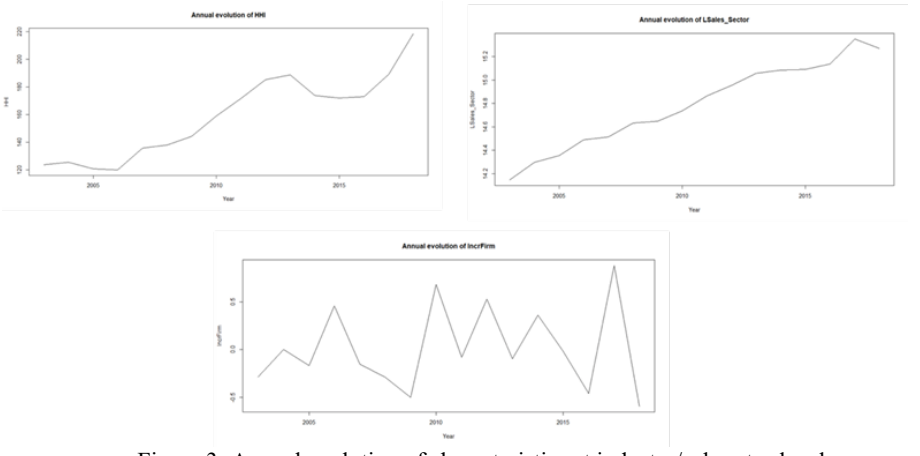

Figure 3: Annual evolution of characteristics at industry/subsector level
(from top to bottom and from left to right: HHI, industry sales and the increase in the number of companies)

It was observed that there was a clear rising trend in the concentration of the sector (especially from 2007 onwards) and a higher level of sales, and a stationary trend in the new number of companies, with consecutive rises and falls that fluctuated at an average of around -8.86% per year (see Table 2). This is due to the fact that in recent decades the pig industry had been through a restructuring process in the number of farms. Therefore, there was an increase of fairly large farms, particularly the biggest pig producers, although there was a considerable drop in the number of small farms, leading to a decrease in the total number of pig production companies. However, increased production in certain financial years could have resulted in sporadic increases in the total number of farms.

In view of the foregoing, a significant relationship in a negative sense was expected between the industry concentration index (subsector) and the company's profitability, due to these companies' predisposition to group together. Furthermore, the increase in production is expected to lead to a growth in the industry's sales and this will benefit profitability.
At a geographical or territorial level, the following independent variables were used, related to previous literature:
• the Napierian logarithm of the unemployment rate,
• the level of education estimated by using knowledge indicators, such as the educational training percentages of the population, and

• the rate of foreigners measured through the proportion of foreign-born people among the total population.
These three variables were extracted from the Instituto Nacional de Estadística (National Statistics Institute). The following was also analysed:
• population density or number of inhabitants per square metre referring to the municipality in which the company operated, whose data come from the Ministry of Development through the Digital Atlas of Urban Areas in Spain.

Figure 4 displays the annual evolution of these variables:

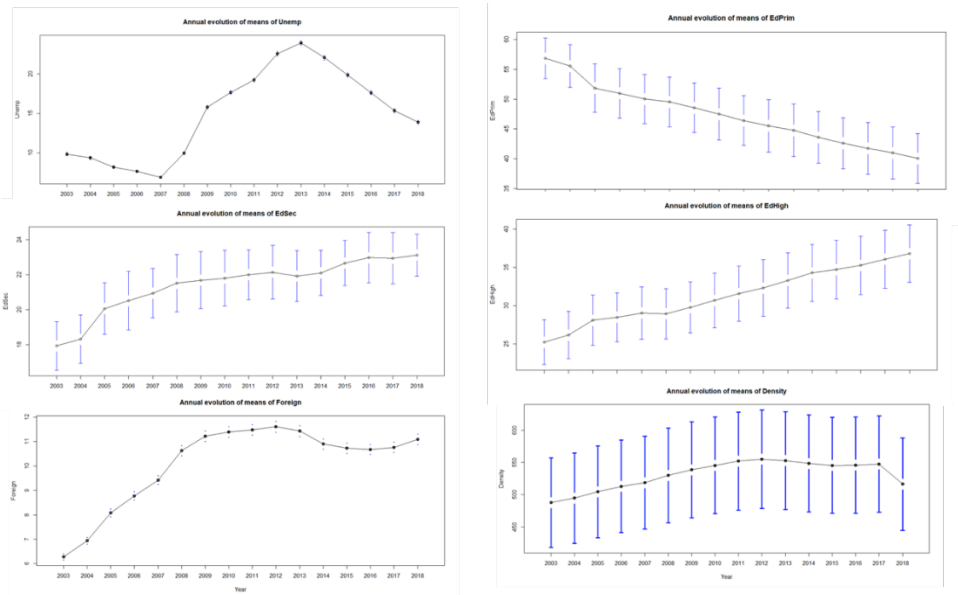

Figure 4: Annual evolution of the geographical characteristics of the companies
(from top to bottom and from left to right: unemployment rate, average values of the percentage of primary, secondary and higher education, foreign rate and density)

In 2013 the unemployment rate reached a maximum before dropping significantly. However, the population's cultural levels displayed a clear growing trend, which is expressed by a greater percentage of people with a secondary level of studies or higher, accompanied by drop in the percentage of people with primary education. The importance of this growth in the educational level makes workers tend to obtain higher educational achievements, which translates into higher productivity levels and, consequently, in higher profitability levels. In addition, from 2008 onwards, the percentage of foreigners was stable and the same thing happened with the population density, which fell slightly in 2018 (see Figure 4).

The unemployment rate was expected to have an effect related to the workforce in the area where the company was located, and this could affect its financial profits. Likewise, for the reason described in the previous paragraph, both the level of education of the town where the companies were located and the rate of foreigners were expected to exercise a growing influence on profitability. Finally, it was highly likely that the population density would have a positive influence on performance, as labour costs would possibly be lower in populated areas.
In addition, and in order to know the degree of persistence of financial profits over time, the ROA variable was delayed for a period.

3. METHODOLOGY

Previous empirical papers that study the contribution of several factors in the same result have used classic decomposition models, such as the analysis of variance or ANOVA (Hirsch & Schiefer, 2016) o the Variance Components Analysis (McGahan & Porter, 1997, McNamara et al., 2005; Rumelt, 1991). Others have chosen hierarchical linear modelling (Zouaghi et al., 2017), based on a regression model for each level of analysis, decomposing the variance at different levels.
In this article, and given that the dataset corresponded to an unbalanced dynamic panel, dynamic models were used for panel data (Baltagi, 2001; Wooldridge, 2002; Croissant & Millo, 2018), whose statistical treatment was carried out using the plm package for the R statistical computing environment (Croissant & Millo, 2008). The main advantages of this type of model is the possibility to control unobservable heterogeneity, as well as model dynamic responses with microdata. Equations with time delays of exogenous and endogenous variables can be specified, making adjustment processes possible (Arellano & Bond, 1991).
The data correspond to a non-balanced panel of N firms observed over T time periods. The dependent variable is Y (ROA) and there are K independient variables observed at company and year level X = (X1,…, XK)'; P independent variables observed at the firm level U = (U1, …, UP)'; Q independent variables observed at the year level, V = (V1,…, VQ)' and R independent variables observed at the level of geographical location and year, W = (W1, …, WR)'. In our case K=10, X = (LSize, LSize2, Age, Age2 , Incr_Sales, Incr_Sales2, LLiquidity, LLiquidity2 , LIndeb, LIndeb2); Q = 4, V = (Year, HHI, LSales_Sector, Incr_Firm)' and R = 4, W = (LDensity, LUnemp, EdPrim, EdHigh, Foreign)'.

The observed data are given by:

$$\{y_{it}, \mathbf{X}_{i,t} = (X_{i,t,1},\ldots, X_{i,t,K})', \mathbf{V}_t = (V_{t,1},\ldots, V_{t,Q})';$$

$$W_t = \left(W_{g_1(i),t,1},\ldots,W_{g_R(i),t,R}\right)' , t\in T_i\subseteq\{1,\ldots,T\};\ i=1,\ldots,N\}$$

where gr(i) = geographic location of the i-th company associated with the variable Wr (Region in the case of EdPrim and EdHigh, province in the case of Foreign and LUnemp and municipality in the case of LDensity), and Ti is the set of time periods for which the i-th

company has complete data on all variables.
The model for this study was a dynamic panel model with fixed and temporary effects given by:

$$y_{i,t} = \alpha_i + \delta_t + \rho y_{i,t-1} + \sum_{k=1}^{K} \beta_k X_{i,t,k} + \sum_{r=1}^{R} \varphi_r W_{g(i),t,r} + \sum_{q=1}^{Q} \phi_q V_{t,q} + \varepsilon_{i,t} \qquad (1)$$

$\boldsymbol{\beta}_i = (\beta_1,\ldots, \beta_K)$' reflects the effects that the characteristics of company X had on its profitability**.**

$\boldsymbol{\varphi} = (\varphi_1, \ldots, \varphi_R)$' reflects the effects of covariates W on the company's profitability, depending on the geographical areas in which it develops its activity.

$\boldsymbol{\phi} = (\phi_1,\ldots, \phi_Q)$' reflects the effects of temporal covariates V **on the company's profitability**, **depending on its sector of activity.**

$\boldsymbol{\delta} = (\delta_1,\ldots, \delta_T)$' which reflects the effect of omitted temporal variables. These effects were either fixed or random, according to whether they were correlated to the rest of independent variables of the model.

$\boldsymbol{\alpha}= (\alpha_1, \ldots, \alpha_N)$' reflects the effect of the company's fixed characteristics omitted in the model. These effects were either fixed or random, according to whether they were correlated to the rest of independent variables of the model.

ρ reflected the dynamic effects of profitability obtained in previous periods.

$\boldsymbol{\psi} = (\psi_1, \ldots, \psi_K)$' reflects the dynamic effects of covariates X on profitability.

Given the existence of possible endogeneity problems of variable Y with the characteristics of the companies fitting within variables X, the model parameters were estimated by applying the generalised method of moments (Roodman, 2009) using the first difference and sys approaches (Arellano & Bond, 1991; Arellano & Bover, 1995; Blundell & Bond, 1988). For this purpose, the pgmm function of the plm package for the R statistical computing environment (Croissant & Millo, 2008) was used.
In both cases, the delayed values of the ROA and X variables were used as tools, as well as the two-step estimation method of the variance-covariance matrix of the estimator (Croissant & Millo, 2008; Roodman, 2009), as well as the robust option to correct finite sample biases proposed by Windmeijer (2005). The program calculates the Hansen-Sargan test that compares the existence of overidentifying restrictions. It also calculates first- and second-order residual autocorrelations, as considering the fact that Arellano & Bond (1991) demonstrate the non-existence of significant second-order autocorrelations, they determine that the conditions imposed on the moments are valid; therefore, there was no evidence that the model had been badly specified. Furthermore, it calculates the Wald test to analyse the joint significance of the coefficients and, if temporal indicators are included, the Wald test analyses their joint significance.

4. ESTIMATED MODEL

The total number of pig producers analysed was N=1,806 with T=16, giving rise to 19,748 observations of the type of business per year, which was reduced to N=1,780 with T=15 and 17,308 observations of the company per year in the study of dynamic models, due to losing the first year of observations of each series. Given that the sys estimation method tends to be more efficient, the results obtained were displayed after applying this method, whose estimated model better adjusted to the data since there were no overidentifying problems (the difference with the Sargan-Hansen test was not significant) nor the second-order residual autocorrelation. The results are displayed in Table 2:

Table 2. Estimations of the parameters of the model*

Variable	Estimate	SE	Pr(>|z|)
Roa(-1)	**0.1690**	**0.0372**	**0.0000**
LSize	**-0.1041**	**0.0289**	**0.0003**
LSize^2	**0.0076**	**0.0021**	**0.0003**
Age	**-0.0038**	**0.0010**	**0.0002**
Age^2	**0.0001**	**0.0000**	**0.0106**
Incr_Sales	**0.0290**	**0.0060**	**0.0000**
Incr_Sales^2	0.0018	0.0017	0.2954
LLiquidity	**0.0107**	**0.0039**	**0.0059**
LLiquidity^2	0.0015	0.0008	0.0667
LIndeb	**-0.0765**	**0.0220**	**0.0005**
LIndeb^2	**-0.0266**	**0.0075**	**0.0004**
HHI	**-0.0003**	**0.0001**	**0.0000**
LSales_Sector	**0.0384**	**0.0067**	**0.0000**
IncrFirm	**0.0049**	**0.0015**	**0.0008**
LUnemp	**0.0080**	**0.0029**	**0.0051**
EdPrim	**-0.0019**	**0.0005**	**0.0005**
EdHigh	**-0.0020**	**0.0008**	**0.0104**
Foreign	0.0001	0.0003	0.7038
LDensity	-0.0014	0.0007	0.0585
Sargan Test	561.52		0.9999
AC (1)	-8.74		0.0000
AC (2)	-1.13		0.2593
Wald Coeff	1352.22		0.0000

* In blue, the significantly positive coefficients and in red, the significantly negative ones at 5%.

5. DISCUSSION

The results obtained show the existence of significant influences on profitability, in terms of both companies and sector/industry, and the territorial and/or geographical factors in which the company carried out its activity. These results were in agreement with previous research; thus, (Zouaghi al., 2017) Spanish agri-food companies in Navarre and Valencia were analysed, pointing out that the effects the company's characteristics added to the profit variance range between 26.3% and 48.8% of the same, which is in line with other authors (Hough, 2006; Ketelhohn & Quintanilla, 2012), and that the effects of the industry/sector in which they were included reached up to 4.2%. The territorial/geographical effects were also lower, albeit significant (Goldszmidt et al., 2011).
Below we discuss in further detail the type of influence exercised by the covariates of the study, classified according to the type of variable.

5.1. Influence of the business variables

The size of the company exercised a significant U-shaped influence, reaching minimum profits in companies with total assets of €943,000. Therefore, it was observed that up to a certain level of assets, expansion could have negative impacts on profits. Nevertheless, this trend changed as soon as the company's total assets reached a figure of nearly €1 million, thus becoming more profitable as it increased its size.
The reason for this type of effect lies in the growth of the global demand for meat, as new investments are necessary to keep abreast of the latest developments and larger facilities are required to ensure profitability. However, the investment for creating farms and/or extending those that already exist implies a cost that not everyone can afford (Chaddad & Mondelli, 2013; Hirsch et al., 2014 and Wijnands et al., 2007). Consequently, companies with a higher turnover will have greater capacity to adapt and mitigate market risks, but small entities are more exposed to these risks, which explains why there was an increasing trend to either change to the integration system and/or disappear (Domínguez & Daudén, 2018). In contrast, expanding by diversifying towards new markets is usually restricted by the capacity of the company's existing management team, as analysed in the first administrative theory of business literature (Penrose, 1959; Marris, 1964). Consequently, the management team may condition the company's trend as regards its size, as traditional livestock farmers can manage their growth up to a certain extent, but afterwards they will need a larger management team that can cover the businesses expansion.
The company's age also had a significant U-shaped effect on profitability, with minimum profitability after 19 years of activity. In line with previous research (Agarwal & Gort, 2002), we found a significant decreasing effect during the company's first years of existence. This could be due to diverse reasons: rigid organisational structures, slow growth, outdated assets (Loderer & Waelchli, 2010; Hirsch et al., 2014; Zouaghi et al., 2017), lack of quality in business innovation or inertia or bureaucracy (Majumdar, 1997), which can help reduce the ability to react to financial circumstances.
However, our results clearly showed that after an estimated age of 19 years, the companies had recovered part of their investment and renewal was more affordable. Furthermore, over time business owners had acquired greater negotiation and decision-making power in the market, which helped increase profitability.

Sales growth is considered to be an indicator related to the company's ability to compete and protect itself from cyclical fluctuations in the market (Rassier & Earnhart, 2015), as well as being a synonym for business success. Previous studies in literature have shown that the growth of sales is associated to the probability of survival, as it represents an increase in the size of the company, and the size lowers the risk of leaving the market (Delmar et al., 2013; Pál & Ferrando, 2010; Pattitoni et al., 2014; Zouaghi et al., 2017). It is also a strengthening process, where previous growth leads to future growth (Delmar et al., 2013), and the dynamics of this growth are an incentive for company employees who will not feel at risk of losing their jobs (Pattitoni et al., 2014; Zouaghi et al., 2017). After the growth, there will be an increase in both productivity and profitability, understanding sales growth as a proxy for investment opportunities and the increase of the size of the company (Pál & Ferrando, 2010). Greiner considers that this sales growth variable could have negative effects in the event of a break-up in informal relationships between employers due to increased competitiveness (Greiner, 1997).

In this study, we found a positive and clearly significant relationship, and it was estimated that a sales growth of 1% would be associated to a 2.90% increase in profitability. This multiplying effect is explained by the production increase experienced in the sector at a time when the number of farms had dropped, which had turned into economies of scale that made it possible to increase profitability. This fact, coupled with the rise in the price of pork in origin had a positive impact on profitability.

As regards the effect of the financial risk, the influence of the liquidity ratio and debt ratio were analysed. The liquidity ratio, as an indicator of the company's capacity to meet short-term payment obligations (Rees, 1995), was expected to exercise a significant, positive effect on profitability as when companies have a lower risk they have greater capacity to face their short-term debts, and are more profitable in the long run. In our case, this effect was confirmed. It was estimated that a 1% growth in the liquidity ratio leads to profitability increase of 1.07%. As a result, liquid companies are positively related to profitability. The companies have greater ability to adapt to changes as a consequence of having the necessary resources to deal with unexpected situations and short-term financial obligations (Goddard et al., 2005). It is also worth noting the weight of liquidity in certain industries linked to Iberian pigs, in which there is a dominance of verbal agreements and cash transactions (Peña et al., 2009). This relationship is observed in the models applied to quality pork clusters and processed products (Pindado & Alarcon, 2015). In these companies, the impact of the financial risk (measured as the opposite of liquidity) was mainly negative and significant in the Spanish agri-food sector (Zouaghi et. al., 2017).

The results obtained were in the same line as other empirical studies (for example, Gschwandtner, 2005; Enqvist et al., 2014; Hirsch et al., 2014; Pattitoni et al., 2014), based on the paradox that good business practices can increase the ROA and, at the same time, reduce financial risk (Bowman, 1980). Therefore, when liquidity is managed properly, short-term payment commitments can be addressed and new investments can be carried out with greater security.

Continuing with the financial risk analysis, the company's debt ratio had relevant implications for profitability. It was shaped like an inverted U, reaching a maximum in 0.2374. According to these results, taking on debt had a positive effect on profitability until

the maximum was reached but, from that point onwards, it tended to exercise a negative effect on profitability. The higher the level of indebtedness, the stronger the effect. The negative effect is due to the fact that an increase in the financial risk reduces profitability and implies lower profits; therefore, fewer resources are generated (Bowman, 1980). For this reason, a company with high debt levels could decide not to renew new productive investments for the company's performance (Garvey, 1992). In line with previous studies, companies that are not vulnerable to negative financial situations, corresponding to those that do not experience significant reductions in their financial profits during these periods, all have in common the growths of their assets and reductions in their levels of indebtedness (Grau & Reig, 2015).

5.2. Influence of the industry/subsector variables

The variables measured in terms of industry and/or subsector exercised a significant influence on the evolution of the companies' profitability. Thus, lower levels of concentration (higher number of companies) and higher sales levels in the sector were directly associated to profitability. This was justified by the synergies created by the proximity between companies. This situation led to reductions in transaction and transport costs, due to the fact that it was easy to work with suppliers in the area. Furthermore, as the integrating businesses needed to put the animals on multiple farms in order to attend to the existing demand, it led to higher markups for the farmers, which helped increase profitability. This result did not coincide with the results presented in other sectors that find a positive and significant impact between concentration and profitability (Bhuyan & McCafferty, 2013; Delmar et al., 2013; Hirsch et al., 2014; Zouaghi et. al., 2017). It must be pointed out that literature also shows that strong business dynamism can lead to instability and high volatility in the environment, which has a negative effect on profits (Misangyi et al., 2006).

In our case, the size of the industry acted as an indicator of a heavy demand and high profits (Zouaghi et. al., 2017). However, this was a circumstantial result and could have changed had there been a variation in the circumstances of the international market. Therefore, it is advisable to take these results with due precaution.

5.3. Influence of the variables of a territorial nature

In relation to territorial variables, significant influences on profitability of a different sign could be observed, with the sole exception of the percentage of foreigners in the area.

As regards the unemployment rate, our results showed a significant positive paradoxical relationship with profitability, with the opposite sign to the one found in previous literature. According to previous evidence, an increase in the regional unemployment rate reduces profitability, especially in small businesses (Bekeris, 2012). High unemployment can make businesses enter the market, with the purpose of completing their staff, which increases competition and causes profitability to drop (Fairlie, 2013). However, in our case, greater competition generates higher financial profit in this kind of company. The reason for this relationship is associated to the workforce, as the companies within this sector have a constant need to hire staff. High unemployment in a specific area can make the company's profitability increase as a result of hiring unqualified unemployed staff who probably demand lower salaries.

Previous research sustains that a higher level of education can lead to a rise in productivity, greater competitiveness and, consequently, an increase in profitability. As a result, the companies located in areas where there is a high educational level can be expected to be more productive and competitive (Usai & Paci, 2003). Nevertheless, it can have the opposite effect; in other words, when the population has a lower educational level, companies tend to be more profitable, due to the existence of workers with lower qualifications (Schiefer, 2011; Ollinger et al., 2005). In our case, a significant relationship with a negative sense was observed, regarding both the percentage of population with higher studies and the percentage of population with primary educational levels, which implies a positive relationship with the percentage of population with secondary level studies. Bearing in mind that, in general terms, the population's educational level had increased (see Figure 4), these results suggested that the level of education had an overall positive effect on profitability, and an excessively qualified workforce was not required.

In respect to foreign-born population, it was observed that it did not have a significant effect. This could have been due to the fact that foreign manpower is related to other economic activities, such as the meat industry, slaughterhouses or activities related to agriculture (Zouaghi et. al., 2017).

It was also considered relevant to examine the effect of density on the ROA, as it would determine the environment in which the most profitable companies were located and would provide information about which areas would be the most appropriate for setting up farms when investing in the business. Our results indicated that this variable exercised a slightly significant negative influence on companies' profitability, with rural areas being the most profitable. In general, companies dedicated to livestock production were located on land not suitable for development near agricultural areas, due to the proximity for accessing raw materials and the subsequent cutting of costs this implied. This feature acts as an element that leads the population to settle in the rural environment, consequently reducing the rural depopulation phenomenon (García-Moreno, 2020). The result was similar to previous studies which affirm that especially in micro-enterprises and SMEs, the rural environment is not perceived as a limitation for profitability (García-Alvarez-Coque et al., 2013; Fearne et al., 2013).

5.4. Dynamic effects on the evolution of profitability

Finally, we observed a persistence over the years that was significantly positive, although not very marked, in the evolution of the profitability, with a first-order autocorrelation coefficient of a medium-low type, with a value of around 0.17. Therefore, in respect to the ROA, effects of the past affect the present day (Hirsch et. al., 2013), as it is a sector that does not directly suffer the consequences of external negative situations and its revenue has a certain guarantee of security due to the static demand.

6. CONCLUSIONS

In this paper, certain factors were analysed that determined the profitability of pig producers in Spain during the 2003-2018 period, using statistical panel data analysis techniques. The study was based on three levels: company, industry/subsector and territory.

The economic activity of pig production within the pig industry is a business opportunity, as although it presents fairly low profitability of around 3% to 4%, it is secure and guaranteed. The dynamics of the pig industry generates groups of pig farms. Over the years, there has been an increase in the average size of these undertakings. Thus, the business shows a growth that is reflected in the constant increase in sales, both business and sector-based, meaning that greater infrastructure is necessary to cover the current growing demand. This strengthens the idea of investment, given the good circumstances and consolidation of the sector, and the business' high degree of survival. In a search to increase production capacity, pig farms obtain economies of scale that can increase profitability as soon as the volume of assets surpasses €1 million and the farms have reached an age of around 20 years. The proper management of financial risk in terms of liquidity has positive effects, whereas an excessive level of indebtedness, considering the considerable importance of fixed assets, creates risks in unfavourable economic situations, although the sector shows a strong trend to reduce its levels of indebtedness.

Furthermore, a growth has been observed in the level of activity in the sector, accompanied by a rise in the levels of profitability. This is justified by the synergies created as a result of the proximity between companies. This situation has generated profits that are reflected in lower transaction and transport costs, particularly if these companies are located in low-density rural areas. Moreover, the integrating businesses' need to put the animals on multiple farms has led to higher markups for the farmers, which has helped increase profitability.

Finally, the territorial aspects are also significant. Companies located in areas with high unemployment rates are able to reduce the costs of labour. In addition, it is more profitable to set up a company in areas where there is a dominance of people who have studied secondary education, as this leads to an improvement in business productivity, due to the fact that excessively qualified manpower is not required.

In conclusion, as there are certain factors that are decisive for companies' profitability, relevant conclusions in two areas can be drawn from the results: on the one hand, for existing management teams, to enable them to improve business performance and, on the other, for future investors that wish to undertake new investments in the industry.

Future research lines are aimed towards including new variables that have not been considered due to insufficient data and also the sector's environmental impact. These are tasks that we will have the opportunity to address in future research.

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for example: (Hall, 1946, p. 23) or (Stiglitzet al., 1986, p. 25-35).

9. References are ordered alphabetically put after work, and chronologically in the case of several works by the same author. They put in italics the name of thereview and the title of the books. The score and the order will be adjusted to the following models:

•Journal articles:

Berger, A. and Udell, G., (1992): "Some Evidence on the Empirical Significance of Credit Rationing", Journal of Political Economy, vol. 100,(5), pp. from 1047 to 1077.

• Books:
Brealey, R. and Myers, S. (2003): Principles of Corporate Finance, McGraw-Hill (ed.), Madrid.

•Book chapters:
Rymes, T. K. (1990): "On the publicness of Fiat Money", in A. Asimakopulos, R.D. Cains and C. Green[ed.]: Economic Theory, Welfare and the State, p. 409-420. London: Macmillan.
•Technical reports, communications and working papers:

Ministry of Industry and Energy (1992): Statistical mining of Spain, 1974-1991. Madrid: Ministry of Industry and Energy.

Aybar, C.etal., (2000): "Emerging Approaches around the Capital Structure: The Case of SMEs", Finance Forum VIII. Spanish Finance Association (AEFIN). Madrid, pp. 1-29.

Narula, R. and Hagedoorn, J. (1997): Globalization, Organisational Modes and the Growth of International Strategic Alliances. (Working Paper 97-017). Maastricht: Maastricht Economics Research Institute on Innovation and Technology (MERIT).

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