



RESEARCH ARTICLE

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Valuation of small to medium sized companies using spatial information: An empirical example from the fruit subsector

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Abstract

The Discounted Cash Flow (DCF) model, similar to other firm valuation models, uses temporal information for a firm to forecast future results. However, the lack of temporal information for many companies hinders the application of the DCF model. To overcome this limitation, we proposed an approach based on the spatial information of the analysed companies. In particular, to get firms' valuation our approach combined both data from companies that are geographically proximal to the analysed company and data from the analysed company. Based on this approach, we provided an empirical example to demonstrate that the economic value computed with our proposal, the Spatial-Firm Economic Value, was consistent with the traditional economic value after application of the DCF model. In particular, we found a minimal difference in terms of absolute deviations between our proposal and the firm's valuation applying traditional valuation techniques. Thus, this study demonstrated the relevance of considering the spatial dimension as an additional source of information to determine firms' value in the Fruit subsector when there is not available temporal information to apply traditional valuation methods.

Additional keywords: location; firms' valuation; spatial effects; Discounted Cash Flow model; small and medium enterprises.

Abbreviations used: DCF (Discounted Cash Flows); EBIT (Earnings before Interest and Taxes); EV (Economic Value); FCF (Free Cash Flows); GDP (Growth Domestic Product); LM (Lagrange Multipliers); ML (Maximum Likelihood); NACE (National Classification of Economics Activities); ROE (Return on Equity); SABI (Iberian Balance Analysis System); SEV (Spatial Economic Value); SFEV (Spatial-Firm Economic Value); SME (Small and Medium Enterprises); WACC (Weight Average Cost of Capital).

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Introduction

The important weight of Small and Medium Enterprises (SMEs) in current productive systems and globalization has increased demand for SME valuation. The limitations associated with the reduced scale of these companies can be overcome by mergers and acquisitions, which depend on firms' valuations. Several procedures can be applied to obtain firm valuations for large companies acting in stock markets, but these techniques are limited for reduced-size companies. In fact, without access to capital markets, SME valuation methods have focused on the specific risks of these firms (Marquez-Perez *et al.*, 2017). In

particular, Rojo & García (2005 and 2006) propose a three-component method to estimate the values of reduced-size companies. Their proposal is based on the widely applied Discounted Cash Flow (DCF) model but considering a specific risk premium for reduced-size companies¹. The DCF methodology is built on the discounting of the Future Cash Flows (FCF) that will be created by the company to the present value using a discount rate. To apply this procedure, FCF, discount rates and their value drivers must be forecasted from temporal information. Thus, this methodology integrates forecasting based on the information extrapolate from firms' financial statements and econometric calculations. Although DCF is an extended

¹ Rojo-Ramírez (2014) for further details.

applied methodology for different practitioners, it has several limitations (Fernandez, 2016). One of the main limitations is the lack of available temporal information to estimate FCF. This deficiency often occurs when analysing micro-sized companies that present simplified financial statements or new companies without temporal information for an extended time period (Damodaran, 2009; Plenborg & Pimentel, 2016; Vidal & Ribal, 2017). To overcome this limitation, we proposed a method to address the values of firms based on geographical information. In particular, the financial literature highlights the relevance of geographical environmental characteristics for the behaviour of reduced-size companies. These firms tend to imitate the financial practices of their geographically proximal peers (Petersen *et al.*, 2006; Marques-Perez *et al.*, 2017). In addition, firms tend to interact with these proximal companies by establishing commercial relationships and are subject to similar financial and economic environment characteristics (Maté *et al.*, 2017). Given these considerations, our proposal was based on the DCF valuations of geographically proximal companies. Although this procedure has not been applied before, the essence is not new but is based on the procedures followed in spatial analysis when houses or land prices are considered. Regarding these studies, we concluded that land prices depend on locational characteristics. In our case, companies (as in the case of land prices) are not translatable assets. Thus, the characteristics of the environments where companies are located played a fundamental role in their valuation (Beck *et al.*, 2005). In a previous study, Occhino & Maté (2017) use spatial econometric techniques to find the spatial concentration areas of companies with similar valuations. From a confirmatory perspective, these researchers propose a regional model to estimate SME values and found that the location where the company conducts its primary activities (evaluated in terms of geographical distances from companies to different agents in their environment) has significant effects on its value. In addition, these researchers also find a spatial concentration pattern in which companies with high (low) valuations are surrounded by companies with high (low) valuations. Given the relevance of their neighbours' valuations on the valuation of each company, we proposed a method

to determine the valuations of those companies with scarce temporal information by substituting spatial data for temporal data.

To illustrate our proposal, we developed an empirical application on a sample of 280 companies in the fruit subsector located in Murcia, Spain, for which there is temporal available information. In this way, we compared the results applying the traditional valuation models with our proposal. Based on this sample, we applied spatial econometric techniques to determine the set of *spatially comparable companies*. Once these firms were identified for each company in the sample, we approached the valuation of a company by computing the average value of their spatially comparable companies. In this way, we had two valuations for each company in the sample: one computed by applying the traditional DCF for SMEs with temporal information and the other computed with geographical information. Comparing the two values revealed a gap between them. To reduce this gap, we applied the spatial approach by adding some firm specific characteristics of each company. When we integrated both the spatial and specific firm information, we obtained a valuation that was closer to the value obtained from the traditional DCF.

Material and methods

Let us suppose that we need the valuation of a company without available temporal information. To overcome this limitation, we proposed an approach based on geographical information and the steps presented in the Figure 1.

Identifying the objective company for which we need the valuation based on spatial information

Reduced-size companies have more opacity in their information (Koller *et al.*, 2010). These companies are not obliged to present complete financial statements in the registers but can offer a simplified version in the majority of cases. The available information might not allow the value to be computed based on the DCF. This procedure is based on the prediction of future cash flows, usually using firms' historical information. The

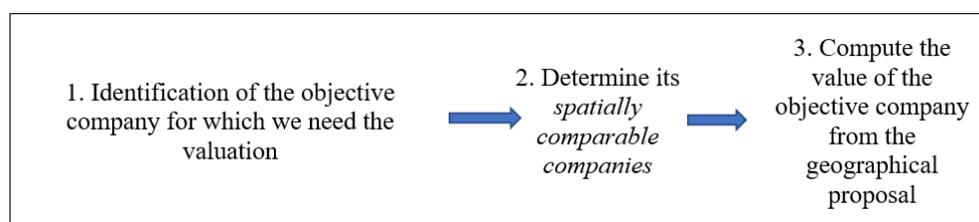


Figure 1. Different steps for the approach based on geographical information.

value of each firm is focused on the FCF generated by operating activities (Rojo & Garcia, 2006; Dönbak & Ukav, 2016). In fact, using the DCF model, the Economic Value (EV) is computed discounting the FCF that the firm will create in the subsequent years using a discount rate k . The discount rate is usually assumed to be the weight average cost of capital (WACC). The EV for each company for the year t is calculated as in (1).

$$EV_t = \sum_{i=t+1}^l \frac{FCF_i}{(1+k)^i} + \frac{RV_l}{(1+k)^l} \quad (1)$$

where l represents the number of years from which we are estimating the future cash flows; RV represents the residual or continuing value (Jennergren, 2008; Ribal *et al.*, 2010); and FCF is the future cash flow calculated for each company in t using the following equation (2).

$$FCF = EBIT(1 - \tau) + D\&A + Imp - \Delta WC - I \quad (2)$$

In this equation, EBIT is the earnings before interests and taxes, D&A represents the depreciation and amortization, *Imp* represents impairments, ΔWC evaluates the changes in working capital, and I measures the investments in non-current assets. To estimate FCF for the next l years, we undertook a regression analysis based on the historical data of these companies. In particular, we considered net sales, operating cost, interest expenses, income taxes, fixed cost of investments, replacement cost of investment and working capital investment as initial value drivers in the model². With this information, we applied a balanced panel data to estimate the FCF for each firm of the sample. Following Gentry & Reilly (2007), we forecasted the FCF assuming a linear relationship between sales and the related cost of sales, administrative expenses and other expenses. Also depreciation was assumed to be closely related to the performance of firm net fixed assets. In this sense, the best practices in forecasting assume all assets, accounts payable and other current liabilities are a function of the sales so we made a linear regression of the sales and, starting from these data we estimated all the elements that compose the FCF.

The discount rate k is computed following the proposal of Rojo & Garcia (2005, 2006) and Rojo-Ramírez (2014) for non-listed companies. In contrast to the previous literature, these authors added a specific risk premium to the resulting rate from the capital asset pricing model (CAPM) to take into account the higher risks of non-listed companies. In particular, Rojo &

García (2005, 2006) computed the expected return of equity (k_e) by adding a three component method based on: the risk-free rate (R_f), the market risk premium (P_m) and a specific risk premium (P_e) (Eq. 3).

$$k_e = R_f + P_m + P_e \quad (3)$$

R_f and P_m are computed according to the traditional literature (Damodaran, 2002; Baginski & Wahlen, 2003), and P_e is calculated as shown in (4):

$$P_e = \beta_i * P_m \quad (4)$$

where β_i is computed as the ratio of the standard deviation of financial profitability of firm i after interest and taxes to the standard deviation of market returns. With (7) and (8), we can estimate WACC (k) by using (5):

$$k = k_e \frac{E}{E + D} + k_d(1 - \tau) \frac{D}{E + D} \quad (5)$$

where k_d is the costs of debt, E is the equity of the company, D is its financial debt, and τ is the effective tax rate.

Thus, the previous method is applicable in those companies with available temporal information. In this sense, the estimation of FCF will require a forecast analysis for which data along a number of years are involved.

Determining spatially comparable companies

The first step of our proposal is to identify spatially comparable companies. This definition is based on the financial literature on evaluation methods of multiples, which suggests that it is possible to extrapolate information using a group of similar companies as a reference. This peer group should consist of at least two and up to a maximum of ten comparable companies (Schreiner, 2009). A comparable firm is one with financial indicators that are similar to the firm being valued (cash flows, growth potential and risk). When the comparable companies are more similar to the firm being valued, the degree of comparability is greater, and they provide more information (Eberhart, 2001). Ideally, we could estimate the value of a firm by examining how an exactly identical firm (in terms of risks, growth and cash flow) is valued. In most analyses, researchers define comparable firms as other firms in the objective firm's business or businesses. The implicit

² It is common the use of the Earnings Before Interest and Taxes (EBIT) of the firm as starting point to calculate the FCF but, in general terms, revenue growth tends to be more persistent and predictable than earnings growth because accounting choices have a far smaller effect on revenues than they do on earnings (see Stowe *et al.*, 2007; Damodaran, 2009).

assumption is that firms in the same sector have similar risk, growth, and cash flow profiles and therefore can be compared with considerably more legitimacy (Damodaran, 2016). If there are sufficiently numerous firms, this list is pruned further using other criteria, such as considering only firms of similar size. In this context, the distinction between small and large firms can make significant contributions (Alford, 1992). In general, large firms are less risky because their international scope gives them better access to customers and produces recurring revenues. Furthermore, economies of scale and economies of scope provide potential cost savings. However, *what is the role of the geographical element in this context?* Schreiner (2009) recommends choosing comparable companies from the same country or region for two reasons. First, the main competitors of small firms are typically other regional players. Second, and more importantly, small firms depend heavily on the economic situation of the region in which they operate. The financial literature provides several examples concluding that the financial decisions of geographically proximal SMEs are interconnected. This result can be explained by the fact that reduced-size companies work with asymmetric information by reducing their capacity to make financial decisions (Marques-Perez *et al.*, 2017). Thus, SMEs are more likely to mimic the financial policies of their neighbours to improve their performance (Reppenhagen, 2010).

Thus, considering the relevance of geography for SMEs, we defined spatially *comparable companies* by selecting companies' functionally different criteria (size or the main activity of the company) and then adding the geographical factor. To include spatially comparable companies, we considered the geographically proximal companies to the objective company for which we were computing the value. *How many neighbouring companies should be included as spatially comparable to each examined company?* There is no general answer; it is dependent on the specific characteristics of the territory, including population density and/or economic development, where the analysed company is located. Here, our proposal was based on the application of spatial econometric techniques to determine the number of spatially comparable companies that should be considered in each case. In particular, we established a neighbourhood based on the geographical distance between companies. We considered s closer companies to be neighbours to each company i , with s reflecting the dependency order in firms' valuations or, in other words, the number of neighbours with valuations interconnected between them. To determine s , we applied Moran's I test for spatial dependence (Moran, 1950). This test measures the overall spatial autocorrelation of a variable. Thus, the test evaluates

whether the value of a variable in a unit i (in this case, a company) is similar to the others surrounding it. The null hypothesis indicates that there are no spatial associated patterns. A positive and significant result of Moran's I test indicates clustering, whereas a negative and significant value indicates dispersion. Formally, Moran's I test follows Eq. (6) (Moran, 1950). After standardization, Moran's I test asymptotically follows a normal distribution:

$$I = \frac{n \sum_{i=1}^n \sum_{j=1}^n (x_i - \bar{x}) w_{ij} (x_j - \bar{x})}{S_0 \sum_{i=1}^n (x_i - \bar{x})^2} \quad (6)$$

where x_i and x_j represent the value of the variable x in different companies with $i, j = 1, 2, \dots, n$. \bar{x} is the average value of the variable x , and w_{ij} represents the (i, j) -element of the weight matrix (W). This matrix connects units (companies) in the analysed sample. In particular, we defined W as a binary weight matrix in which elements w_{ij} take a value of 1 if companies i and j are neighbours and 0 otherwise. By definition, the elements in the main diagonal are equal to 0. Based on the geographical distance, we considered that each company i is connected with its s nearest neighbours. This is an exogenous criterion that prevents endogeneity. To identify the most adequate s value, we developed an iterative procedure in R software to compute Moran's I tests for the different companies in our sample by considering different s values. Then, we selected the s value that maximizes the significance of Moran's I test for all companies. Finally, S_0 is the sum of all elements of the matrix W , and n is the number of observations.

Computing the value of the objective company from a geographical proposal

Once the s value was identified, we assessed the Spatial Economic Value (SEV) of company i by applying Eq. (7):

$$SEV_i = (\sum_{m=1}^s EV_m) / s \quad (7)$$

where EV is the economic value of each company by applying the DCF procedure, and s is the number of closer neighbours for which firms' valuations are interconnected in the analysed territory where the companies are located.

Results

Database and sample

To show our proposal, we used the SABI database (Iberian Balance Analysis System), which provides financial and accounting information on Spanish

companies. We chose reduced size companies in the agrarian sector by following the National Classification of Economic Activities (NACE, 2007³). In addition, we selected companies located in the province of Murcia. From this database, we got a sample of 831 agrarian reduced size companies. We eliminated observations relating to companies without available information, with anomalies in their financial statements, for example, negative values in their sales or assets that distort firms' behavior. Thus, we got a sample of 511 reduced size agrarian companies covering information over the period from 2010 to 2014. Finally, to obtain a homogeneous sample of comparable companies, we selected those companies in the fruit subsector obtaining a final sample of 280 fruit companies. Table 1 shows the sample distribution for different sizes, sectors and ages.

Small companies account for 61% of the sample. In addition, there is a high percentage of companies that have been in business for less than 25 years. Finally, the productive activity in Murcia is concentrated in the fruit subsector, which represents 54% of the sample.

Variables: Economic valuation based on the DCF model

To evaluate the EV for each company, we applied the DCF model (1) with $t = 2015, \dots, 2019$ and $l = 5$. To

estimate the FCFs for the next five years (2015-2019), we determined the evolution of its main components based on the historical sales of each company in the sample and a regression analysis to extrapolate future sales. Once future sales were estimated, FCF (2) were computed by applying the mean of the annual past values of the proportion (ratio) that each FCF component represents with respect to historical sales (Gentry & Reilly, 2007). The discount rate (k) is estimated by applying (5) with the costs of debt (k_d), calculated as the ratio of interest expenses to the financial debt of the company. The cost of equity (k_e) is computed from (3), where the risk-free rate (R_f) is represented by the 10-year government bond interest rates⁴. The market risk premium (P_m) is the average historical differential between the market returns and the risk-free rates during the previous years. We obtained these data from Damodaran's webpage⁵, which provides the market risk premiums by industry and country. The specific business risk (P_j) was computed by Eq. (4), where the financial profitability of firm i after interest and taxes (*i.e.*, ROE) was obtained from firms' accounting information and market return values from Damodaran's webpage. Finally, we calculated the residual value (RV) by applying the Gordon model, which assumes that FCFs will grow at a constant rate (g) after the estimation period. Analytically,

Table 1. Sample characteristics of agri-food companies in Murcia. Average values (2010-2014) in percentages on the total value.

	Cases ⁽¹⁾	%	
SIZE⁽²⁾			Definition
Micro	312	61	Less than 10 employers
Small	159	31	From 10 to 50 employers
Medium	40	8	From 51 to 250 employers
TOTAL	511	-	
SUB-SECTOR			NACE code⁽³⁾
Cereals	85	16	111, 4621
Fruits	280	54	112,122, 123, 124, 125,4631,1032,1039
Meat	53	10	141,1053,1054
Support	33	6	161,162, 1091
Other activities	60	14	NACE codes corresponding with the agri-food sector and not included before
AGE⁽⁴⁾			Definition
Middle age	349	68	From 5 to 24 years
Old	162	32	more than 25 years

⁽¹⁾Cases represent the count of which firms operate in covering the 511 cases in the sample. ⁽²⁾European Commission on 6 May 2003. ⁽³⁾NACE, 2009 (<http://ec.europa.eu/eurostat>). ⁽⁴⁾Following Berger & Udell (1998) and the characteristics of our sample, we established two groups based on their age: middle-aged firms and old firms. There are not companies in the sample with less than 5 years old.

³ http://ec.europa.eu/eurostat/ramon/nomenclatures/index.cfm?TargetUrl=LST_NOM_DTL&StrNom=NACE_REV2a

⁴ We obtain this information from www.datosmacro.com, which provides financial information for different Spanish markets.

⁵ http://pages.stern.nyu.edu/~adamodar/New_Home_Page/home.htm

$$RV_1 = FCF_{1+1} \frac{(1+g)}{(K-g)} \quad (8)$$

where g was assumed to be 1.5%, which was the long-term GDP growth expected for Spain in the next 20 years (PricewaterhouseCoopers, 2013).

Economic value based on spatial information

To illustrate our proposal to determine the SEV, we developed a simulation analysis based on the available sample of agrarian companies. In particular, we selected reduced-sized fruit companies with to obtain a homogeneous sample of comparable firms (Eberhart, 2001). After we selected these companies, we obtained a sample of 280 firms for which we computed the EV by applying the DCF approach. Table 2 shows the EV distribution according to the characteristics of certain firms in the sample.

Table 2 shows positive relationships of the size and age of the company with economic value. This result coincides with the previous literature, which states that larger and older companies enjoy the advantages of economies of scale and greater market presence, leading to positive results for these companies and higher values (Chen, 2010). The next step was to examine the spatial autocorrelation Moran's I test for the examined sample. Table 3 shows this result.

We found p -values of less than 0.05 with $s = 8$. Therefore, the null hypothesis of non-spatial autocorrelation was rejected, indicating that fruit firms' values were related to their neighbours' economic values when neighbour orders higher than 8 were considered. However, what was the optimum s value to determine spatially comparable companies? To determine the s value that best fits the spatial economic value (SEV) definition (7) and minimizes the absolute difference of EV-SEV, we developed an iterative process that maximizes the spatial autocorrelation structure in the sample by maximizing the significant value for Moran's I test. By applying this procedure, we determined that

Table 2. Economic value distribution for the fruit subsector (in logarithm).

		Mean	SD
Size ⁽¹⁾	Micro	6.8807	1.5919
	Small	8.4215	1.5430
	Medium	9.6274	1.5919
Age ⁽²⁾	Young-Middle Age	7.2444	1.7111
	Old	8.4718	1.7134

⁽¹⁾European Commission on 6 May 2003. ⁽²⁾Following Berger & Udell (1998) and the characteristics of our sample, we established two groups based on their age: young-middle-aged firms (10 to 24 years) and old firms (more than 25 years). There are not companies in the sample with less than 5 years old.

$s = 11$ minimizes the absolute difference between procedures with EV-SEV = 0.0804. Thus, to obtain the SEV for reduced-size fruit companies in Murcia for which there is no available temporal information, we could compute the SEV by applying (7) with $s = 11$.

Limitations of the spatial economic valuation

Regarding the previous literature, we found that the different valuation models are based, in addition to market characteristics, on the firms' own characteristics. Thus, an important limitation of the SEV is that it is based only on external information without considering firms' specific characteristics. Thus, by applying only spatial information, we could obtain a positive valuation of a company that has negative financial ratios. To overcome this limitation, we modified our initial proposal by combining both spatial information and financial information. In particular, we proposed a general spatial specification by defining a spatial first-order autoregressive model with first-order autoregressive disturbances, as in Eq. (9) (LeSage & Pace, 2010).

$$y = \rho W_L y + X\beta + u \text{ with } u = \lambda W_E u + \varepsilon \quad (9)$$

In this equation, y represents a (280×1) vector of the economic valuations from the DCF method for

Table 3. Moran's I test for EV.

K	Moran I	p-value
1	0.6261	0.2656
2	-0.3154	0.6237
3	-0.1213	0.5482
4	0.2270	0.4102
5	0.4146	0.3392
6	1.2783	0.1005
7	1.4847	0.0688
8	2.1738	0.0148
9	1.8841	0.0297
10	1.7961	0.0362
11	2.0297	0.0211
12	2.0405	0.0206
13	1.9131	0.0278
14	1.7963	0.0362
15	1.8793	0.0301
16	1.7922	0.0365
17	1.7765	0.0378
18	1.6220	0.0523
19	1.7230	0.0424
20	1.8371	0.0330

each fruit firm i in the sample, $i=1, \dots, 280$, and X is the $(280 \times (r+1))$ matrix containing a constant term and a set of variables r that takes into account the firm's financial characteristics. In particular, we include indebtedness as measured by the debt equity ratio (DEBT), which was calculated as total liabilities over total assets. Profitability was computed as the profitability ratio (PROF) with net operating income divided by total assets. Sales growth (CCTO) was computed as the annual sales growth rate, SIZE as the logarithm of total assets, and AGE as the logarithm of the number of years of the company since its constitution. W_L and W_E were (280×280) spatial contiguity matrices that define the connections between the companies in the sample; u was a (280×1) vector of the spatially correlated residuals, and ε is a (280×1) vector of normally distributed errors with mean zero and variance σ^2 . Spatial interaction effects were tested by the coefficient ρ , which represents the spatial lag coefficient, and λ , which measures the spatial autocorrelation for the residuals u . To estimate this model, we applied the maximum likelihood (ML) (Elhorst, 2010). In addition, we applied the Lagrange multipliers (LM) tests to contrast the spatial structures in the model. The null hypothesis of the LM tests evaluates the absence of spatial correlation. In particular, there are two LM tests, LM-LAG and LM-ERR. The first contrasts the existence of spatial correlation in the dependent variable ($W_L y$), whereas the second (LM-ERR) contrasts the existence of spatial autocorrelation in the error term ($W_E u$) (Anselin *et al.*, 1996). Florax & Former (1992) propose selecting the adequate spatial structure by comparing these LM tests. In this sense, if the LM-LAG is significant and the LM-ERR is not, then the best spatial structure is a spatial autoregressive form in the dependent variable. However, if the LM-ERR is significant and the LM-LAG is not, then the spatial autocorrelation in the error term is considered. Finally, when we obtained significant values in both spatial structures (LM-LAG and LM-ERR), we estimated the model (9). Table 4 shows the results for this estimation, which differed from those of an OLS model without spatial behaviour.

The first two columns in Table 4 show the OLS estimation for firms' economic values (EVs) that includes firms' specific characteristics. We obtained a positive and significant sign for the explanatory variables, as expected according to the previous literature. Regarding the spatial behaviour of this model, we computed the LM tests. The LM-LAG test was positive and significant, thus revealing the existence of a spatial lag structure in the model, whereas the LM-ERR was not significant. Thus, the specification (9) was transformed into an SAR model, as in (10), where the spatial weight matrix (W_L) was a row standardized

weight matrix that is based on the s closer neighbours, and $s = 11$ (according to the results we obtained in the previous section).

$$y = \rho W_L y + X\beta + \varepsilon \quad (10)$$

The third column in Table 4 shows the estimation results of the SAR specification. We obtained a spatial lag parameter that was positive and significant ($\rho=0.1914$, $p=0.007$). Thus, from the coefficients of the SAR model, we could estimate the value of a company without temporal information by combining the spatial and firm information. In particular, for a company i , we applied the following equation (11) to obtain the spatial-firm economic value (SFEV).

$$\widehat{SFEV}_t = 0.1914W * EV_t + 0.9141 * CCTOV_{t-2} + 0.0112 * DEBT_{t-2} + 0.0473 * PROF_{t-2} + 0.4325 * AGE_t + 0.8088 * SIZE_t \quad (11)$$

Comparing economic values

The average value for the absolute deviations between the SFEV and the EV computed by applying DCF for the fruit companies in the sample was $SFEV-EV = 0.00075$, which was lower than the absolute difference calculated as $SEV-EV = 0.0804$. Thus, we obtained a better approach when both the spatial and firm characteristics were considered in estimating the EV of a company without an extensive amount of temporal information. Specifically, we found that all variables considered have significant effects on firms' valuations. Sales growth and SIZE were significant at 5%, whereas indebtedness, profitability and age are significant at 10%.

Discussion

The aims of this study were to test and propose a method to estimate the EV for firms that have short temporal histories of available data or for which it is difficult to obtain information. In contrast to previous studies, we considered financial and economic variables as well as environmental variables. We observed the best results when we considered both spatial and firm characteristics to estimate the EV of a company without an extensive amount of temporal information. In this sense, we observed that companies in the fruit subsector with similar values tend to be grouped in the territory; consequently, it is possible to use the EVs of comparable firms as a reference. To obtain the best estimation, it is necessary to adjust this value for a coefficient that takes into consideration the firm's intrinsic characteristics (age, size, indebtedness,

Table 4. Ordinary least square (OLS) and spatial autoregressive model (SAR) estimations. Dependent variable economic value (EV)⁽¹⁾.

Variable ⁽²⁾	Valuation model (OLS estimation)	Spatial valuation model (SAR estimation)			
Constant	-0.6671 (0.832)	-2.1749*** (0.083)			
CCTO	0.9141*** (0.000)	0.9665*** (0.000)			
PROF	0.0473** (0.013)	0.0474** (0.010)			
DEBT	0.0112** (0.005)	0.0117** (0.003)			
AGE	0.4325** (0.056)	0.4481** (0.042)			
SIZE	0.8088*** (0.000)	0.7966*** (0.000)			
rho (ρ)	--	0.1914 (0.007)			
Spatial dependence tests for OLS estimations					
LM-ERR		0.3081 (0.578)			
LM-LAG		3.5887** (0.058)			
LR test (POOL-OLS vs SAR)		3.661** (0.022)			
Correlation coefficient					
	CCTO	RE	DEBT	AGE	SIZE
CCTO	1	0.2041 (0.001)	0.0271 (0.068)	-0.1449 (0.021)	-0.0750 (0.235)
RE	-	1	-0.1808 (0.004)	-0.0041 (0.948)	-0.0284 (0.268)
DEBT	-	-	1	-0.1731 (0.003)	-0.0745 (0.219)
AGE	-	-	-	1	0.4756 (0.000)
SIZE	-	-	-	-	1

⁽¹⁾To avoid endogeneity we have instrumented financial ratios DEBT and PROF and CCTO by lagging them two years. ⁽²⁾Variables defined in the text. POOL-OLS refers to Ordinary Least Square estimation. SAR is the Spatial Autoregressive Model. LM represents the Lagrange Multipliers tests and LR the Likelihood Ratio test. *p*-values in brackets. *, **, ***: significant at 10%, 5% and 1%, respectively.

profitability and sales growth). Our results are justified by the previous literature on multiple methods, which suggests extrapolating information using a group of similar companies as a reference (Eberhart, 2001; Schreiner, 2009). The implicit assumption is that firms that have similar risk, growth, and cash flow profiles can be compared with considerable legitimacy (Damodaran, 2016). To obtain a more precise estimation, it is advisable to consider firms in the same sector and same region that are heavily dependent on the economic situation of the region in which they operate (Schreiner, 2009). Our test gave a positive sign for all variables

considered, and it is a first step in the analysis of the spatial firms' valuation.

Our study presented a proposal for SMEs' valuation and demonstrated the importance of considering the spatial dimension as an additional source of information in the Fruit subsector. This study opens up a new field for further research. Using this spatial perspective, it is possible to obtain valuations for small and medium-sized companies and/or companies without available information complementing missing financial data. Nevertheless, our study has limitations that provide opportunities for further exploration. Our

sample is composed by companies in the fruit subsector thus future research in this area should consider other scenarios and different subsectors to overcome this limitation.

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