

How environmental certification can affect the value of organizations? The case of Forest Stewardship Council certification

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HIGHLIGHTS

- The paper quantifies the value that FSC certification brings to a company.
- Fuzzy logic has been introduced into the discounting cash flow method to obtain the value of FSC certification.
- Fuzzy mathematics have been used in order to integrate both information about companies' size and information about the sector.
- The companies analyzed with a valid certificate experienced an increase in their value because of FSC certification.
- The implementation of the ANOVA fuzzy method shows that neither the business size nor the sector influence the relationship between FSC certification and a company's value.

SUMMARY

Forest certification appeared in the 1990's as a way to deal with forest deterioration. Currently, however, public opposition can limit its effectiveness. Business policy makers should analyze how Forest Stewardship Council (FSC) certification can affect the value of companies. Yet, the relation between financial performance and forest certification systems is a subject which has not been explored to a great extent, and the measures used for evaluating financial performance in published studies are not based on business valuation. In this study, Spanish companies with FSC certification are valued under the premises of implementation and non-implementation of FSC certification. Given the uncertainty inherent in the second option, the use of fuzzy mathematics has been considered a suitable tool. According to the results obtained, it can be concluded that regardless of size or business sector, FSC certification is effective in increasing the value of companies. The paper offers economic arguments for managers to become more environmentally responsible.

Keywords: Forest Stewardship Council, environmental certification, Financial Performance, environmental performance, business valuation

Comment peuvent affecter les certifications environnementales la valeur des organisations? Le cas de la certification Forest Stewardship Council

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La certification forestière est apparue dans les années 90 comme un moyen de lutter contre la dégradation des forêts. Cependant, actuellement, certains courants d'opposition publique peuvent limiter son efficacité. Les responsables des politiques d'entreprise doivent analyser dans quelle mesure la certification FSC (Forest Stewardship Council) affecte la valeur des entreprises. Jusqu'à présent, la relation entre les résultats financiers et les systèmes de certification forestière est une question qui n'a pas été suffisamment explorée. En revanche, dans les ouvrages publiés, les mesures utilisées pour évaluer les résultats financiers ne reposent pas sur l'évaluation des entreprises. Dans cette étude, les entreprises espagnoles certifiées FSC sont valorisées sous les hypothèses de mise en œuvre et de non-mise en œuvre de ladite certification. Compte tenu de l'incertitude inhérente à la deuxième option, l'utilisation de mathématiques floues est considérée comme un outil approprié. Sur la base des résultats obtenus, on peut conclure que la certification FSC augmente la valeur des entreprises indépendamment de leur taille ou de leur secteur d'activité. Ce travail offre des arguments économiques pour que les chefs d'entreprise soient plus responsables du point de vue environnemental.

¿Cómo pueden afectar las certificaciones ambientales al valor de las organizaciones? El caso de la certificación Forest Stewardship Council

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La certificación forestal surgió en la década de los noventa como una forma de abordar la degradación de los bosques. Sin embargo, en la actualidad ciertas corrientes de oposición pública pueden limitar su efectividad. Los responsables de las políticas empresariales deberían

analizar en qué medida la certificación FSC (Forest Stewardship Council) afecta al valor de las empresas. Hasta ahora, la relación entre resultados financieros y sistemas certificación forestal es un tema que no ha sido suficientemente explorado. Por otra parte, en los trabajos publicados las medidas empleadas para evaluar los resultados financieros no se basan en la valoración de empresas. En este estudio, las empresas españolas con certificación FSC son valoradas bajo los supuestos de implementación y no implementación de dicha certificación. Dada la incertidumbre inherente en la segunda opción, el uso de la matemática borrosa se considera una herramienta adecuada. Conforme a los resultados obtenidos, se puede concluir que la certificación FSC incrementa el valor de las empresas con independencia de su tamaño o sector empresarial. El presente trabajo ofrece argumentos económicos para que los gerentes de las empresas sean más responsables desde el punto de vista medioambiental.

INTRODUCTION

Nonstate certification programs have formed in the past decades to address social and environmental problems associated with production practices in several economic sectors (Auld and Gulbrandsen 2010). This and the rise of global private environmental governance has inspired organizations like the Forest Stewardship Council (FSC). The Forest Stewardship Council is a non-governmental organization created in 1993 to provide a worldwide forest certification system in response to the failure of the Rio de Janeiro Earth Summit. This has led to the introduction of forest management as a means of guaranteeing an adequate social, economic and environmental approach. FSC certification is the first international certification established for sustainable forest management (Foster *et al.* 2008). Its importance, especially in the majority of developed countries, is evident from the fact that 50.5% of the forest area in Europe and 33.1% in North America has been certified (Forest Stewardship Council 2019).

According Steelman and Rivera (2006) the appeal of voluntary environmental programs lies in their promise to mutually serve government, industry, and environmental interests. Moore *et al.* (2012) show that forest certification has led to essential changes in company practices related to forest management, environmental management and relations with the community. Arguably, the FSC has exerted considerable normative influence regarding the need to include multiple stakeholders as communities and indigenous peoples in forest decision making (McDermott *et al.* 2011). Indeed, FSC certification can contribute to improving the sustainable conservation of forests and to increasing biodiversity levels (World Wide Fund 2005). According to Kalonga *et al.* (2015), a FSC certified forest presents a better forest structure, adequate regeneration and lower incidence of fire. At the same time, it also plays a significant role in the improvement of relations between local communities and producers (Tsanga *et al.* 2014), in workers' morale and primarily in the company's public image. The study carried out by Tupura *et al.* (2015) concludes that it is usually external incentives rather than internal incentives and the market rather than regulations that motivate companies to adopt forest certification. FSC certification can create economic incentives for more sustainable forest management by enabling consumers to identify and target certificated producers (Blackman *et al.* 2017). Companies directly and independently facing the rigors of the free market, voluntarily adopted the FSC certification with

two initial aims: first, to obtain economic advantages; and, second to improve their forest management (Halalisan *et al.* 2018). However, its implementation can be restricted by high certification costs (Frey *et al.* 2018, Halalisan *et al.* 2018, Van Deusen *et al.* 2010), and low certification demand (Durst *et al.* 2006, Jaung *et al.* 2016).

For this reason, the relation between financial performance (FP) and FSC certification is a point of great interest. However, in comparison to the existing bibliography about other environmental certifications, such as ISO 14001, research dealing with the financial impact of FSC certification through financial measurement is relatively limited (Narasimhan *et al.* 2015). As well as this, far from making progress in this direction, the few papers to have been published obtain mixed or even contradictory results. According to the World Wide Fund (2015), there are annual benefits from FSC certification per cubic meter of certified production. It is true that results change a lot from one company to another because they are influenced by things like company size and location. Espach (2006) and Nebel *et al.* (2005) conclude that the price of FSC certified wood exported from Brazil and Bolivia was up to 50% higher. However, the Federation of Nordic Forest Owners' Organizations (Moore *et al.* 2012) conclude that forest certification will contribute to sustainable forestry management, but it does not report significant economic benefits for forest owners. Furthermore, Narasimhan *et al.* (2015) found no evidence that FSC certification had an impact on abnormal financial performance. According to Carlson and Palmer (2016), although the existence of some benefits, mainly of an intangible nature, can justify the cost carried out by certification, there is no substantial effect on either price premiums or access to the market. This opinion is shared by authors such as Bieri and Nygren (2011) or Alemagi *et al.* (2011). Klooster (2010) concludes that there is not enough evidence that FSC certification provides price premiums. Sugiura *et al.* (2012) indicate that economic changes were rather minimal, with no premium price for certified products, and other authors (Araujo *et al.* 2009, Gomez-Zamalloa *et al.* 2011, Halalisan *et al.* 2013) also indicate that no economic advantages are associated with premium prices for certified wood. Galati *et al.* (2017) conclude that the operation costs necessary to obtain FSC certification are only partially compensated, not by an increase in the selling price of certified products, but by the company's ability to establish new business relationships with a consequent increase in sales.

In this context and in order to contribute to clarifying this issue, this study aims to develop a new methodology to analyze how FSC certification affects the value of companies. It should be noted that the quantification of Financial Performance through business valuation, as presented in this paper, is absolutely innovative. On the Web of Science, no previous studies can be found that use business valuation in their analysis of the FSC certification-FP relationship. Nevertheless, business valuation is not used as a measure of FP because it is in itself innovative or because of the growing importance for firms to set goals in terms of value, but rather because it takes into account different accounting and financial aspects (Rojo and Garcia Perez-de-Lema 2006), which makes it much better than any of the other FP measures.

Regardless of the FP measure used, the subjectivity present in any of them should be considered, and business valuation is no exception. To undertake a business valuation it is necessary to carry out several financial and accounting assessments. This is only possible accepting the subjectivity nature of the variables that appear on them, but also the subjectivity in the valuation itself (Brotons and Sansalvador 2018). Thus, the model used should be able to include this subjectivity in its formal approaches, and the ideal reference framework to do this is fuzzy logic (Zadeh 1983). The fuzzy logic theory is based upon the notion of relative graded membership and so are the functions of mentation and cognitive processes. The utility of fuzzy sets lies in their ability to model uncertain or ambiguous data (Sivanandam *et al.* 2007).

First, this paper develops a new method, which, through different tools provided by fuzzy logic, makes it possible to quantify the effect that firms' commitment to FSC has on companies' value. Following this, the results of the applied methodology in companies with FSC forest management certification in Spain has been presented.

The main contribution of this paper lies in the newly methodology for analyzing the FSC certification-financial performance relation as well as in the empirical study carried out.

MATERIAL AND METHODS

The aim of the proposed model is to determine whether the FSC certificate contributes to companies' value. To do so, a group of companies certified for a minimum period of three years was selected. The value of FSC certification is obtained by the difference between the value of a company with this certificate and its value under the assumption that it does not have it. Therefore, two valuations are required for each of the companies under analysis.

The valuation of each company is made through the net cash flow method. To apply this method correctly, the company's life "i" is divided into two components called: time horizon, for which detailed cash flow projections are made (f_i^T), covering a period of "T" years; and residual value (R_i^T) which covers the rest of the firm's life. The discount rate used is 'r'. Thus, the company's value "i" is obtained according to expression (1)

$$V_i = \sum_{t=1}^T f_i^t \cdot (1+r)^{-t} + R_i^T \cdot (1+r)^{-T} \tag{1}$$

Where the company's residual value "i" (R_i^T) can be obtained from the company's growth rate for the residual period (g) and the cash flow for the last year of the time horizon (f_i^T) according to (2).

$$R_i = f_i^T \cdot (1+g) \cdot (r-g)^{-1} \tag{2}$$

Estimation of value in the time horizon

In this case, it is necessary to estimate net cash flows and discount rate and to set the duration of the time horizon. Business valuation with and without FSC certification is carried out at three years of having received the environmental certification.

Cash flows

Cash flows are estimated differently according to whether FSC certification is considered or not.

- a) The company has FSC certification. In this case, the company's growth rate is considered for the whole of the time horizon and is calculated for the three years after obtaining the certificate. To do so, the main items for the profit and loss accounts are analyzed: income, materials, staff expenses, amortization and other expenses. In order to adequately project the values, linear regressions are used between the abovementioned items and the corresponding year.
- b) The company does not have FSC certification. Future cash flows are determined by taking the last available values from the profit and loss accounts corresponding to the years prior to certification. This circumstance increases uncertainty because the profit and loss account items have to be estimated for the period after the implementation of the FSC Forest Management Certification. In this case, fuzzy mathematics is a useful tool, as it can be used for situations where there is subjectivity and uncertainty (Gil-Aluja 1990, Gonzalez *et al.* 2017, Walker *et al.* 2003).

Therefore, the company's growth rate "i" in the time horizon "T" is considered a triangular fuzzy number (TFN) $g_i^T = (a,b,c)$ which indicates that growth rate can range between a and c, with the maximum value possible in b. The belonging function of this TFN is represented by

$$\mu(x) = \begin{cases} \frac{x-a}{b-a} & a \leq x < b \\ \frac{c-x}{c-b} & b \leq x < c \\ 0 & \text{Otherwise} \end{cases} \tag{3}$$

Fuzzy Numbers are a special form of fuzzy sets on the set R of real numbers. Among the different kinds of fuzzy numbers, the utilization of simpler and intuitive forms as

TFNs is preferred. Consequently, triangular fuzzy numbers play an important role in fuzzy mathematics.

Given the uncertainty in the estimation of growth rates, the use of fuzzy logic will make it possible to incorporate information from the company itself as well as the behavior of the sector in the years after obtaining the FSC certificate. To do so, the growth rate for each of the companies belonging to the target sector before FSC certification is calculated and ordered from higher to lower. However, there must be considered that if all the variation rates are taken there would be over dispersion, so the lower extreme (a) is taken as 40 per cent and the higher extreme (c) as 60 per cent. The central value (b^*) is the mean growth rate of the three years prior to environmental certification. However, it is possible that this central value could be higher than 60 percent or lower than 40 percent. In which case, the corresponding extreme is observed; that is to say, the central value to be considered (b) will be

$$b = \min \left[\max(a, b^*, c) \right] \quad (4)$$

This growth rate is applied to average sales in the last three years prior to FSC certification, revised by the mean growth rate of the Company sector in the last three years. This procedure gathers information about the sector (extreme values a and c, to which it is not applied the expression (4)) and about the company (central value b).

Discount rate

One of the greatest problems in business valuation is determining the applicable discount rate, since the value of the company is very sensitive to the rate used. For this reason, the discount rate includes a risk premium. In several studies, this premium is situated (Dimson *et al.* 2007, Fernández *et al.* 2011) between 4.2 and 8.5%. Therefore, in order to include this variability, the premium is considered to range between 0.042 and 0.085 with the maximum value possible being the mean of both (0.0635). Thus, the TFN discount rate to be considered is: $\tilde{r} = (r_a, r_b, r_c) = (r_{free} + 0.042, r_{free} + 0.0635, r_{free} + 0.085)$; that is to say, the central value is the result of adding the mean between 0.042 and 0.085 to the risk-free rate (r_{free}), and the extremes are the result of adding the minimum value of the risk premium (0.042) and the maximum value of the risk premium (0.085) to this risk-free rate. Consequently, where the estimated cash flows are either a crisp number (company's value with FSC certification) or a TFN (company's value without FSC certificate), in both cases the result is a TFN,

Value in time horizon

The value in the time horizon for each company is obtained through the estimated cash flows discounted at the above-mentioned discount rate. Although the discount rate is a TFN, the result obtained it is not but it can be approximated by a TFN (Perrone and La Diega 1999, Terceño *et al.* 1995)

Residual Value

Residual value comprises the value of all the cash flows after the time horizon. As there is an increase in the time distance

of cash flows, it is much more difficult to estimate them, so the estimations made are much more generic. For reasons of prudent valuation the growth rate of net cash flow (g) considered is 50% of gross national product (GNP) growth in the last few years. According to Casanovas (2009), the growth can't be higher than the GNP growth. Furthermore, the discount rate used is the TFN considered in the time horizon for the valuation under both assumptions of having and not having FSC certification.

Value of FSC certification

A valuation has been obtained for each company by considering it has obtained FSC certification and it has not obtained it. In both cases, this value is the sum of the value in the time horizon and the residual value. In this way, the value of certification can be obtained as the difference between the value of a company with and without the certificate. If the value of a company with the certificate is higher, it can be affirmed that this certification contributes value to the company.

Data analysis

The increase in a company's value as a result of FSC certificate is a random fuzzy variable, since its extremes are random variables. Therefore, in order to analyze whether this certification provides value to a set of organizations, techniques combining statistical analysis with fuzzy data analysis are recommended. In particular, Wu's methodology (Wu 2005) is applied because it improves traditional methodology by introducing h-levels and optimistic and pessimistic degrees. To contrast the results by sector and size and to establish if there are any differences between organizations with valid certification and those that have abandoned certification, fuzzy ANOVA is proposed (Wu 2007).

Selection of a sample of companies

The target population of the study is Spanish companies who have obtained FSC forest management certification. As projections need minimum accounting data, the sample frame is established as the Spanish firms with FSC forest management certification on 31st December 2015 that have deposited at the Company Registry their financial statements for at least three years following the certification. The requirement of a minimum of three years of accounting information is, as concluded by Li *et al.* (2017), because the impact of ecological performance on financial performance is not immediate. It can be more than a year before companies are able to observe any effects. The only thirty companies to fulfil these conditions were selected and included in the sample.

RESULTS AND DISCUSSION

Table 1 shows the companies included in the sample, grouped according to whether they have valid certification (Table 1a) or not (Table 1b). Economic activity is indicated for each of

TABLE 1A *Companies with valid certificate: indication of sector (column 2), certification year (column 3), 2016 turnover (column 4), and 2016 Balance sheet (column 5)*

Organizations	Economic activities	FSC Certification	Turnover	Balance sheet
1	6820	2015	1 434 088	47 222 187
2	0119	2015	22 049	458 064
3	6820	2015	873 282	213 266
4	0119	2015	298 421	1 580 070
5	0149	2015	45 515	2 076 434
6	1711	2010	337 189 000	972 679 000
7	0210	2012	15 494	367 365
8	7112	2012	521 390	788 593
9	0150	2012	83 820	4 003 644
10	0146	2012	16 570	556 327
11	0142	2012	94 249	367 102
12	0 15	2012	485 018	20 465 226
13	4121	2012	1 785 255	3 191 698
14	1621	2013	61 099 055	27 742 261
15	6820	2012	35 388 000	130 171 000
16	4673	2013	46 483 000	58 228 000
17	0210	2013	322 000	1 312 000
18	0161	2013	73 838	5 616 725
19	4673	2013	26 794 551	10 876 872
20	1621	2013	592 093 194	670 226 460
21	0240	2013	424 112	375 097
22	7490	2014	279 642	443 268
23	4673	2014	6 677 991	3 777 014
24	7490	2013	301 681	159 903

TABLE 1B *Companies without valid certificate: indication of sector (column 2), certification year (column 3), 2016 turnover (column 4), and 2016 Balance sheet (column 5)*

Organizations	Economic activities	FSC Certification	Turnover	Balance sheet
25	1011	2011	28 915 404	102 480 284
26	0210	2011	3 949 228	7 105 554
27	0220	2011	406 218	444 180
28	1610	2011	7 606 144	7 493 764
29	1610	2011	6 551 560	8 053 629
30	1610	2012	3 030 060	10 560 000

the companies (through NACE Rev. 2, the classification system for economic activities most used in the European Union), the year the certificate was obtained, turnover and 2016 balance sheet.

The results from the application of the proposed methodology are summarized in table 2, which again distinguishes between organizations with a valid certificate (table 2.a) and those without a valid certificate (table 2.b).

The value of FSC forest management certification is obtained for each of the sample companies at three years from having obtained the certificate. It is for this reason that only companies certified in 2015 or earlier have been considered. The value of the company with FSC certification is calculated from the estimation of the organization's future net cash flows: the organization's rate of growth for the first five years (time horizon) being the mean rate of growth in the last few

years; and growth rate for the residual value being 50% of the rate of growth of the country's gross national product (GNP) for 1961–2017 (World Bank 2017), 1.73%. The second column of table 2 shows the first estimated cash flow. The estimation of the value of a company without certification, only differs in the methodology used in the time horizon. Its estimation is carried out using a TFN whose central value has been obtained by considering the company's growth rate prior to FSC certificate, revised by the mean growth rate of the sector (see table 2, third column).

The value of each organization has been obtained by discounting the estimated cash flows according to expressions (1) and (2). The discount rate is obtained by the TFN (5.85, 8.00, 10.15), which is the result of adding a premium risk between 4.2 and 8.5% (Dimson *et al.* 2007, Fernández *et al.* 2011, Siegel 2005) to the rate of interest on Spanish 10-year bonds for 29/12/2015 (Bank of Spain 2017). Therefore, the discount rate ranges between 5.85 (Optimistic value) and

10.15 (Pessimistic value), the most possible value being 8.00. The values of each organization with and without FSC certification, once defuzzified according to the center of gravity method, are given in columns 4 and 5 of table 2. The main methods of defuzzification are the method of the mean of maximum, the method of center of gravity and center average methods, but the center of gravity method is more commonly used (Van Broekhoven and De Baets 2006, Patel and Mohan 2002, Sakly and Benrejeb 2003). Finally, column 6 of table 2 shows the percentage variation which the FSC certification contributes to the value of each company.

As can be observed, only six of the 30 companies analyzed have not renewed certification, and only three of these six companies have managed to increase their value. In contrast, 19 of the 24 companies with currently valid certificates have increased their value. 46% of them carry out activities related to agriculture or forestry, and nine of these 11 companies have achieved an increase in their value.

TABLE 2A Companies with valid certificate: estimated net cash flow values for the first year assuming they have FSC certification and they do not have it (columns 2 and 3), company value at three years of having FSC (column 4), company value without this certification (column 5) and percentage variation in its value as a result of FSC certification (column 6)

Organizations	Estimated Net Cash Flow		Value of each organization		% Variation
	With FSC certification	Without FSC certification	With FSC certification	Without FSC certification	
1	1 139 977	866 466	13 558 910	11 664 365	16.24
2	28 737	16 593	1 603 902	437 244	266.82
3	912 164	864 166	15 183 389	14 401 869	5.43
4	405 707	370 380	11 728 802	9 521 202	23.19
5	14 748	9 349	380 506	266 065	43.01
6	81 856 567	66 185 279	2 697 624 576	958 707 994	181.38
7	-81 551	50 918	-1 227 517	1 110 439	-210.54
8	229 374	73 145	10 268 168	1 400 293	633.29
9	43 844	88 608	313 363	2 499 790	-87.46
10	79 026	48 615	2 325 744	1 334 326	74.30
11	78 316	61 808	6 409 129	1 474 189	334.76
12	397 700	90 377	11 687 114	2 540 588	360.02
13	344 021	1 404 242	1 550 830	27 605 027	-94.38
14	17 369 055	8 471 895	523 705 833	136 384 639	283.99
15	2 980 665	2 110 825	37 641 574	33 872 828	11.13
16	653 903	628 408	14 431 588	13 270 611	8.75
17	30 915	31 011	424 936	444 471	-4.40
18	92 288	74 264	4 485 324	1 643 149	172.97
19	11 529 154	12 197 604	230 053 866	221 912 348	3.67
20	231 144 266	197 980 784	5 030 212 134	4 154 555 677	21.08
21	79 991	53 198	2 452 599	947 437	158.87
22	174 267	243 981	1 473 969	2 929 220	-49.68
23	4 844 952	4 815 649	98 512 932	119 672 121	-17.68
24	137 888	56 137	9 255 826	1 212 291	663.50

TABLE 2B Companies without valid certification: estimated net cash flow values for the first year assuming FSC certification and no FSC certification (columns 2 and 3), company value at three years of having FSC (column 4), company value without this certification (column 5) and percentage variation in its value as a result of FSC certification (column 6)

Organizations	Estimated Net Cash Flow		Value of each organization		% Variation
	With FSC certification	Without FSC certification	With FSC certification	Without FSC certification	
25	8 256 793	7 444 453	139 663 145	128 646 604	8.56
26	1 648 838	3 282 890	13 368 750	83 773 743	-84.04
27	496 390	325 255	9 685 828	3 421 156	183.12
28	2 411 301	2 470 686	37 846 602	40 641 949	-6.88
29	3 644 189	3 409 175	45 517 451	42 121 480	8.06
30	2 919 442	3 148 797	52 482 652	55 003 770	-4.58

In addition, among companies with currently valid certificates, the companies dedicated to the wood and cork industries as well as the only company analyzed belonging to the paper industry show positive variations in their value. Seven of the remaining 10 companies with valid certificates, all belonging to different sectors unrelated to forestry, show increases in value.

So as not to limit this paper to being simply descriptive, a statistical analysis will now be made of the results obtained following the proposed model. The first aim is to verify whether FSC increases business value. To do so, a first contrast of the hypothesis is proposed, taking the method developed by Wu (2005) as a reference.

Hypothesis 1. The null hypothesis is: the value of the Company is not significantly altered by the FSC certification.

$$\tilde{H}_0 : \tilde{\mu} = 0$$

$$\tilde{H}_1 : \tilde{\mu} > 0$$

Since $\bar{x} - \mu_0 = 1,24 > t_{23, 0.05} \cdot S / \sqrt{23} = 1.71 \cdot 2,25 / \sqrt{23} = 0,80$, \tilde{H}_1 is intended to be accepted with some degrees. Now $n \cdot (t_{n-1, 0.05} \cdot S / \sqrt{n-1} + \mu_0) - \sum_{i=1}^n x_i^L = 24 \cdot (1,71 \cdot 2,25 / \sqrt{23} + 0) - 19,77 = -0,49 < 0$, \tilde{H}_1 is accepted at the significance level of 0.05 confidently, since confidence is 1. This procedure combines the notions of randomness and fuzziness (Wu 2005). Thus, this first contrast of the hypothesis confirms that FSC certification contributes value to companies.

As can be observed, the results obtained coincide with the findings in previous studies, which conclude that environmental actions contribute to financial profitability. Allen (1992) and Schmidheiny (1992) believe that the environmental performance resulting from promoting environmental activities can actually reduce product costs and waste, and enhance companies' financial performance. Similarly, authors like An *et al.* (1999), Ilinitch *et al.* (1998) or Steger (2000) hold that environmental intervention can significantly improve both environmental and financial performance. These authors' arguments are in line with the stakeholder theory, according to which an increase (or decrease) in environmental performance leads to an increase (or decrease) in financial performance. As Bouslah *et al.* (2010) point out, the stakeholder theory predicts that a firm might improve its

financial performance as a result of improved environmental performance through increased profits/higher future cash flows (McGuire *et al.* 1988, Waddock and Graves 1997), and/or reduced risk associated with environmental issues (Sharfman and Fernando 2008).

According to some surveys, a significant percentage of consumers would be willing to pay a premium for a product with an environmental certificate (Forsyth *et al.* 1999). Price premium is one of the points highlighted by authors like Espach (2006), Nussbaum and Simula (2005) or Nebel *et al.* (2005). In addition, Humphries and Kainer (2006) argue that forest certification gives access to new markets. Similarly, authors like Kurttila *et al.* (2000) or McDaniel (2003) argue that FSC certification leads to an increase in sales, while Cashore *et al.* (2006) have found evidence of an increase in exports of certified forest products.

However, with respect to supply, it is important to consider the extent to which forest certification increases production costs (Sedjo and Swallow 2002). To be exact, it is these costs that force smaller companies to state that in general they are less satisfied with the certification than their larger competitors (Overdevest and Rickenbach 2006). In this sense, the results obtained reveal how FSC certification is especially profitable for large companies. If the size of companies is determined according to the EU Regulation n°651/2014, only 3 of the 30 companies analyzed can be considered large companies, the rest are small and medium-sized enterprises (SMEs). This is not particularly surprising, if the fact that SMEs constitute 99.88% of the companies in Spain (General Directorate of Industries 2016) is taken into account. These three certified companies, considered large, show an increase in their value, and the only four companies considered medium-sized also experience an increase in their value. The fact that negative valuations occur among the small organizations could indicate that size influences how FSC certification affects the value of companies. In this sense, there are authors who sustain that tools for environmental sustainability can change according to the location, size, and sector of SMEs (Bakos *et al.* 2020, Testa *et al.* 2017). Therefore, in order to contrast whether there are significant differences due to size, fuzzy ANOVA method (Wu 2007) is proposed.

Hypothesis 2. The null hypothesis is: changes in Company valuation for the FSC certification are similar for all company’s sizes (large, Medium and Small).

$$\begin{aligned} \tilde{H}_0 &: \tilde{\mu}_i = \tilde{\mu}_i = \dots = \tilde{\mu}_n \\ \tilde{H}_1 &: \text{not all } \tilde{\mu}_i \text{ are equal} \end{aligned}$$

The quotation between the treatment sum of squares (SSTR) and the error sum of squares (SSE), both divided by its degrees of freedom ($r-1$ and n_T-r respectively), will be used.

$$F^* = \frac{SSTR / r - 1}{SSE / n_T - r}$$

According to the author, if $SSTR = 8.81 < \rho \cdot SSE = 35.46$, being $\rho = \frac{r-1}{n_T-r} \cdot F_{1-\alpha; r-1; n_T-r}$ with $r = 3$ and $n_T = 24$, that is, with 2 and 21 degrees of freedom, the null hypothesis \tilde{H}_0 is accepted at the significance level of 0.05 with optimistic degree $l(K_{\tilde{H}_0, 0.05}) = 1$ and pessimistic degree $h_{\tilde{H}_0} = 0$. It is also possible to conclude that the null hypothesis \tilde{H}_0 is accepted at the significance level of 0.05 with confidence degree $\min\{l(K_{\tilde{H}_0}), 1 - h_{\tilde{H}_0}\} = \min(1, 1 - 0) = 1$, being $h_{\tilde{H}_0} = \sup\{h : 0 < h < 1, F_{h; \tilde{H}_0} \geq F_{1-0.05; 3-1; 25-3}\}$. Consequently, the size of the Company does not have a negative or positive impact in the connection between its value and FSC certification. Empirical evidence has traditionally suggested that SMEs lack resources and are unaware of their impact on the environment, the potential improvements they could make, and the business benefits they could obtain, which prevents them from investing in environmental initiatives (Reyes-Rodriguez *et al.* 2014). However, authors such as Granly and Welo (2014) say that SMEs can in fact develop proactive approaches to the natural environment in alignment with their resources and capabilities. Garcia Perez-de-Lema *et al.* (2019) show that SMEs react in a hostile and dynamic business environment by strengthening their innovation strategy, and this has an impact on financial, social and environmental performance (Ezzi and Jarboui 2016). There are studies that show a correlation between the environmental effort by SMEs and organizational operating efficiency, profits and business image (Gadenne *et al.* 2009, Naffziger and Montagno 2003). In this sense, the results of our study show that environmental initiatives, like FSC certification, can positively influences a company’s financial results regardless of size.

The environmental interests of society increase the pressure on companies to manage both renewable and non-renewable resources in an economical and sustainable way. Consequently, environmental marketing strategies make their way into all sectors (Michal *et al.* 2019). As Tröster and Hiete (2018) point out, FSC certification is a perfectly valid approach towards sustainability problems in different sectors. Therefore, it is not surprising that the sample analyzed should contain organizations belonging to different sectors (agriculture, forestry, wood and cork industries, etc.). In this way and once again using Wu’s Fuzzy ANOVA (Wu 2007), it is possible to include sector as one of the variables to be considered.

Hypothesis 3. The null hypothesis is: changes in Company valuation for the FSC certification are similar for all the sectors. That is, the sector does not affect the relation between company valuation and FSC certificate.

This was done by grouping the companies according to the sections and divisions proposed by the statistical classification of economic activities in the European Community (NACE REV. 2)

$$\begin{aligned} \tilde{H}_0 &: \tilde{\mu}_i = \tilde{\mu}_i = \dots = \tilde{\mu}_n \\ \tilde{H}_1 &: \text{not all } \tilde{\mu}_i \text{ are equal} \end{aligned}$$

Following Wu (2007), if $SSTR = 17,59 < \rho \cdot SSE = 40,91$ for $r = 6$ y $n_T - r = 15$ the null hypothesis \tilde{H}_0 is accepted at the significance level α with optimistic degree $\lambda(K_{\tilde{H}_0}) = 1$ and pessimistic degree $h_{\tilde{H}_0} = 0$. It is possible to conclude that the null hypothesis \tilde{H}_0 is accepted at the significance level α with confidence degree $\min\{\lambda(K_{\tilde{H}_0}); 1 - h_{\tilde{H}_0}\} = \min(1; 1 - 0) = 1$. Consequently, the sector a company belongs does not appear as important factor in Company value – FSC certificate relationship.

The motivations that lead a company to become certified influences how companies embrace the requirements of this certification and adopt them effectively in their organizational routines (Sandholtz 2012). Several authors consider that the motivations leading to voluntarily certification influence the results that the companies obtain (Feng *et al.* 2008, Heras *et al.* 2011, Prajogo 2011). Bowler *et al.* (2015) sustain that the relation between FSC certification and financial results depends on the extent to which they adhere to certification requirements. Tuppura *et al.* (2015) consider that the sector a company belongs to influences the motivations behind FSC certification. So, in the context of this argument, one could think that sector influences companies’ financial results. However, the study carried out does not support this affirmation. Sector does not appear as a determining variable in the financial results obtained by the companies analyzed as a result of having FSC certification.

Finally, it is noteworthy that the percentage of organizations where FSC certification does not increase their value is much higher in the group of companies without valid certification (50%) than in the group of companies that maintain this certification (20,8%). In this case, one could also ask if obtaining positive results conditions, the middle- and long-term maintenance of FSC certification. In order to conclude whether there are significant differences between the two groups with respect to the value FSC certification contributes to the company, Wu’s Fuzzy ANOVA method is used (Wu 2007), establishing the following hypothesis contrast.

Hypothesis 4. The aim is to determine whether there is a difference between the value that certification contributes to companies who maintain valid certification and the value contributed to companies that have decided to abandon certification. In this way, the null hypothesis that there is no difference between the value that certification contributes to companies that have abandoned certification and those who still have valid FSC certification is contrasted against the alternative hypothesis that there are differences.

$$\begin{aligned}\tilde{H}_0 &: \tilde{\mu}_1 = \tilde{\mu}_2 \\ \tilde{H}_1 &: \tilde{\mu}_1 \neq \tilde{\mu}_2\end{aligned}$$

If $SSTR = 4.53 < \rho \cdot SSE = 18.39$ for $r = 2$ y $n_T - r = 28$ the null hypothesis \tilde{H}_0 is accepted at the significance level α with optimistic degree $\lambda(K_{\tilde{H}_0}) = 1$ and pessimistic degree $h_{\tilde{H}_1} = 0$. It is possible to conclude that the null hypothesis \tilde{H}_0 is accepted at the significance level α with confidence degree $\min\{\lambda(K_{\tilde{H}_0}); 1 - h_{\tilde{H}_1}\} = \min(1; 1 - 0) = 1$. That is to say, it can be accepted that there is no difference between the value contributed by FSC certification to companies that still have a valid certificate and the value contributed to companies that have decided to abandon certification. The results obtained seem to validate the conclusions reached by authors such as Faggi *et al.* (2014) or Rickenbach and Overdevest (2006). These authors suggest that the motivating factors that push companies into maintaining forestry certification are based on different mechanisms. Among the most relevant of these is the market mechanism, which primarily refers to economic interests, but there are other mechanisms.

CONCLUSIONS

It is true that the relation between environmental certification and financial return is not a new subject; and a large part of the bibliography takes the certification of environmental management systems ISO 14001 as a reference. However, the financial impact of FSC certification has not been so widely studied. In this way, the contribution of this paper is innovative both for the way it focuses on FSC certification and the way it defines financial return, quantifying the value that the certification brings to the company through the innovative methodology developed for this.

In order to analyze how Forest Stewardship Council certification can affect the value of companies, each organization has undergone a double valuation process: first of all, assuming that the company is certified, and later, assuming the company is not certified. The methodology proposed is the so-called discounted cash flow method, even though it has high doses of uncertainty both in the estimation of net cash flows and in the rate of discount (Rojo *et al.* 2019). For this reason, the use of fuzzy logic is a very suitable tool.

The growth rate of the companies' net sales has been used for the estimation of net cash flow in the time horizon, under the premise of FSC certification. However, under the non-certification assumption, where subjectivity and uncertainty are more present, fuzzy mathematics has been used in order to integrate both the information about companies' size and information about the sector.

Through discount cash flow, it is possible to obtain the fuzzy number "company value", considering FSC certification and not considering it. However, for comparison of the results obtained, defuzzification is necessary, approximating the TFN through specific values. In this way, it has been possible to obtain the increase or decrease in company value as a result of the FSC certification.

Finally, the research process is completed with empirical research, through which it is possible to analyze in what way FSC certification has had an impact on the certified companies. For this reason, the model developed has been applied to the group of Spanish companies with FSC forest management certification on 31st December 2015 and which have deposited their financial statements for at least three years following the certification date.

From the results obtained, it can be observed that 79.16% of the companies analyzed with a valid certificate experienced an increase in their value as a consequence of FSC certification. This percentage reaches 81.8% on considering only the companies dedicated to agricultural and forestry related activities. From the analysis of the results based on the methodology by Wu (2005), it is possible to conclude that FSC certification is effective in increasing the organizations value.

In our analysis with respect to company size, all certified companies that can be considered large or medium increase their value. However, using the ANOVA fuzzy method (Wu 2007), it can be deduced that business size does not influence the relation between FSC certificate and the companies value.

Once again the ANOVA fuzzy methodology (Wu 2007) is used to analyze whether the sector a company belongs to influences the results obtained. As with size, it is concluded that that economic activity does not influence the relation between FSC certificate and business valuation.

Finally, the fact that 50% of the companies that have not renewed FSC certification do not show any increases in their value is highlighted. This would indicate that the financial profitability of certification is of such importance that it should not be abandoned in the medium or long term. However, using the ANOVA fuzzy methodology again (Wu 2007), it is evident that there are no significant differences between the value contributed by FSC certification to the group of companies that have abandoned certification and the group that currently maintains a valid environmental certification.

Climate change is a major strategic issue for firms since it also has global environmental, social and economic implications (Littlewood *et al.* 2018). As Bryant *et al.* (2020) assert voluntary environmental certifications can play a role in the fight against climatic change, and they can help companies attain long-term sustainability objectives (Curkovic and Sroufe 2011). However, meta-analysis studies by authors like Bakos *et al.* (2020) or Albertini (2013) have demonstrated that economic benefits motivate companies in general, and SMEs especially, to implement sustainability.

The implications of this paper for companies and researchers lie in the innovative methodology proposed to quantify the FP-environmental certification relation as well as in the results of the empirical study carried out, which reveal the economic interest that Forest Stewardship Council certification has for any company regardless of size or sector. The paper offers compelling arguments for managers to become more environmentally responsible, while improving their economic and environmental performance goals.

However, there are some limitations to this research. Certification costs could be divided into direct costs, such as the cost of the certification process itself (audit, etc.), and

indirect costs related to additional management efforts related to certification (Auld *et al.* 2008). Even without going into detail, the proposed cash flow model takes into account the costs of certification recorded in accounts. But in addition, and although it is very complicated to quantify, the opportunity costs incurred as a result of meeting FSC standards must not be forgotten. For instance, through having to give up alternative economic activities (Van Kooten *et al.* 2005) or a more intensive use of the forest (Ebeling and Yasue 2009). In a future line of research, improving the model is proposed so that the valuation process could also consider these hidden costs of certification.

Another limitation is related to the sample of companies, which were all Spanish. According to different authors country specificity influences the motivations for certification, and therefore so does a company's geographical location (Tuppura *et al.* 2015, Halalisan, *et al.* 2018, Sugiura and Oki 2018). The fact that the development of the certification is not homogenous in all countries (Basso *et al.* 2018) can affect the generalization of the results obtained for companies from other countries. Consequently, in future studies it would be of interest to extend the sample of companies to include organizations from other geographical areas.

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