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Innovation, environmental commitment, internationalization and sustainability: A survival analysis of Spanish marine aquaculture firms

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ABSTRACT

The objective of this paper is to analyse the factors that determine Spanish aquaculture firm survival to improve understanding of the sector dynamics. Specifically, this paper focuses on marine aquaculture enterprises and evaluates how internationalization, the environmental commitment of the firm, and the ability to innovate, as well as other factors such as a firm's financial and accounting information, may be associated with the decisions by Spanish aquaculture firms to remain in the industry.

The empirical analysis, conducted over the 2007–2014 period, is based on the Cox proportional hazard model. Our main findings reveal that those firms that have an environmental commitment are less likely to exit the industry than those that have no such commitment. Furthermore, our results also highlight the positive effect of economic profitability and long-term solvency on the survival of the firms and the negative effect of the age of the firms. Finally, we find that the investment in R & D activities and the internationalization of the firms did not contribute significantly to the model, indicating that they are not crucial factors for the survival of the firms.

1. Introduction

Aquaculture represents a fast-growing global sector because of the increasing demand for fish products and the decline in catches of many commercial species resulting from the poor state of fishery resources (FAO, 2012). Nevertheless, aquaculture production in Europe has experienced stagnation in the past decade (JRC Technical Reports, 2012; FAO, 2014), and the low number of new licences issued in recent years is a clear sign of the difficulties the sector has encountered in expanding.

The main hindering factors in further EU aquaculture development are i) competition for space at a local level in more economically active coastal areas, that is to say, in areas with more touristic use of the coastline, ii) lack of clear priorities for the development of the sector, iii) fragmentation of competences for the authorization of aquaculture sites, iv) diverging interpretations and applications of environmental legislations causing uncertainty for potential investors, v) limited access to seed capital or loans for innovation in a risky context, vi) pressure from imports, and vi) public criticism based on perceived environmental impact (Kaiser and Stead, 2002; Hedley and Huntington, 2009; OECD, 2010; Hofherr et al., 2012; Scientific Technical and Economic Committee for Fisheries (STECF), 2013; European Commission, 2013;

OECD, 2014; STECF, 2014; Ertör and Ortega-Cerdà, 2015; Gibbs, 2009; Hofherr et al., 2015).

Furthermore, other environmental factors, such as diseases that spread to natural stocks and the use of antibiotics and chemicals, among others, could limit the growth of the aquaculture sector. For example, the use of a wide variety of antibiotics in aquaculture may lead to the proliferation of antibiotic resistance among pathogens infecting both cultured animals and humans. In the latter case due to the possible presence of residual antibiotics in fish meat and fish products, as well as, the development of antibiotic resistance in bacteria in the environment (Serrano, 2005; STECF, 2014; Ottinger et al., 2016).

Nevertheless, the fishing and aquaculture sectors play an important strategic role in coastal areas of the European Union (EU), and many coastal communities rely on these sectors for their income due to limited economic diversification possibilities (Natale et al., 2013).

To develop effective policies to achieve an environmentally, socially, and economically sustainable aquaculture sector, it is crucial to have a better understanding of aquaculture farmers' behaviour and the factors that drive their decisions to exit or stay in the industry.

In this sense, the present study provides new evidence regarding the factors that determine Spanish aquaculture firm survival, especially the effects of internationalization, the environmental commitment of the

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firm, and its ability to innovate.

We offer evidence regarding how the environmental commitment of firms affects firm duration. In fact, although the environmental impacts of marine aquaculture within the EU are regulated and managed by several European Commission (EC) directives, such as Marine Strategy Framework Directive (MSFD; 2008/56/EC), and Maritime Spatial Planning Directive (MSPD; Directive 2014/89/EU), among others, that address issues such as water quality, biodiversity protection and sustainable development, aquaculture enterprises should be encouraged to improve their environmental performance and to develop voluntary initiatives that go beyond the minimum legal environmental protection requirements.

Thus, it is recognized that the communication of the social and environmental dimensions of the company plays a key role in the sustainable development of organizations and therefore should be investigated in more depth (Bonsón and Bednárová, 2014). This paper analyses whether firms with an environmental commitment are less likely to exit the industry than those with no such commitment. The analysis highlights the necessity of understanding the impact of environmental commitment on Spanish aquaculture firm survival.

Furthermore, advanced research and technology must also help the aquaculture industry become environmentally sustainable. Thus, the ability to innovate is considered a factor that distinguishes firms that outperform their counterparts (Danneels, 2002; Hamel, 2000; O'Connor and Rice, 2001).

The factors that influence the probability of the firm's survival in the market have been evaluated in the empirical literature. These factors have traditionally been the size and the age of the firms (Jovanovic, 1982; Evans, 1987; Dunne et al., 1989; Dunne and Hughes, 1994; Audretsch and Mahmood, 1995). The role played by innovation has been initially addressed by Audretsch (1991) and Audretsch and Mahmood (1995). Nevertheless, most of these empirical studies have been applied to manufacturers and firms in the service sector.

This paper's objective is to contribute to the analysis of the factors that impact the survival of Spanish aquaculture firms in the market. Thus, the research reported in this paper analyses how environmental commitment, internationalization and innovation ability, as well as other factors, may be associated with the decisions of firms to remain in the sector.

This analysis is innovative for several reasons. It is the first study on the factors that affect the exit decisions of marine aquaculture firms. Moreover, it relies on a methodology which, although is well-known in health sciences and industrial organisation, has rarely been applied to fishery economics. Finally, it uses a unique data set obtained from the Iberian Balance Sheet Analysis System (SABI) database, which no other researcher has analysed in relation to the probability of firm survival. One advantage of using the SABI database is the availability of individual companies' financial and economic data and information on their location and level of internationalization, as well as exhaustive balance sheet information and other firm characteristics.

Moreover, we used information on whether the company conducts research and development (R&D) activities or discloses information about its environmental performance on its website, i.e., shows an environmental commitment in response to stakeholder demands for environmental responsibility. According to Joffre et al. (2017), the innovation plays a significant role, however, it faces an increasing criticism regarding its social and ecological sustainability practices and the, resulting in further challenges to future innovation processes. Although a few empirical studies have looked at the role of innovation in order to get a better understanding of the survival of the firms, in the case of aquaculture firms this is the first study to do so.

The remainder of the paper is organized as follows. In Section 2, we intend to give a brief description of the European and Spanish aquaculture industry. In Section 3, we analyse the data and discuss the methodology of the survival analysis. Then, in Section 4, we present the results and, finally, in Section 5, we summarise the primary findings of

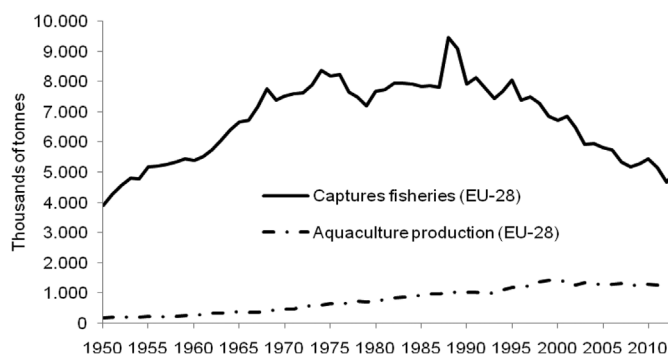


Fig. 1. Capture fisheries and aquaculture production in the EU-28 (excluding aquatic plants), 1950–2013. Source: FAO.

this article.

2. Description of the European and Spanish aquaculture industry

Aquaculture continues to be a strategic sector for Europe, as it provides significant quantities of fish and molluscs, which contribute to the food supply and decrease dependence on sea product imports; this dependence was caused by the significant increase in the consumption of marine products and the decrease in catches by European fleets. In the past two decades, EU aquaculture production has nearly doubled, from 11.54% of total EU fish production in 1990 to 19.74% in 2013. The record was 21.3% in 2012 (see Fig. 1).

The EU plays an important role in the global trade of fishery products. The EU-28 per capita consumption is 24.9 kg/year, well above the global average of approximately 19 kg/year. Moreover, countries such as Portugal, Lithuania and Spain have consumption levels well above the European average (56.8 kg/year, 43.4 kg/year and 42.4 kg/year, respectively).

Spain is first among aquaculture producers in the EU, with 223.7 thousand tonnes produced in 2013, followed by France, the United Kingdom, Italy and Greece (Table 1). Nevertheless, EU aquaculture production declined by 13.34% during the 2000–2013 period due to the reduction in production in countries such as Spain, France and Italy. The five countries with the highest levels of aquaculture production comprise approximately 74.85% of EU aquaculture production. Only

Table 1
Main aquaculture EU-28 producing countries (2000–2013).
Source: FAO

Member states	Production (thousands of tonnes)				
	2000	2005	2010	2013	2000–2013 (%)
Spain	309,229	219,335	252,351	223,707	–27.66%
France	266,770	244,880	224,400	201,860	–24.33%
United Kingdom	152,485	172,813	201,091	194,630	27.64%
Italy	213,525	181,101	153,494	162,620	–23.84%
Greece	95,418	106,208	121,244	144,595	51.54%
Netherlands	75,231	71,370	66,945	60,410	–19.70%
22 other member states	289,887	276,687	264,827	251,210	–13.34%

Member states	Value of total production (€ million)				
United Kingdom	368.90	495.47	622.13	802.70	117.59%
France	340.04	538.94	696.50	713.26	109.76%
Greece	233.05	343.86	470.22	681.58	192.46%
Italy	357.16	475.69	353.62	418.28	17.11%
Spain	265.76	246.80	416.33	407.55	53.35%
Netherlands	85.53	99.35	113.45	138.12	61.48%
22 other member states	580.93	656.76	784.50	824.51	41.93%

Note: Aquatic plants not included.

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