Technical efficiency of sea bass and sea bream production of european aquaculture firms

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European sea bass (*Dicentrarchus labrax*) and gilthead sea bream (*Sparus aurata*) are both an economically important cultured fish species along the Mediterranean coast. The EU is one of the largest producers of sea bass and sea bream in the world, being Greece the largest producer within the EU followed by Spain (see Table 1).

Table 1. Volume of cultured sea bass and sea bream produced in Europe (2016)

Country	Sea bass		Sea bream		Total	
	Kg	*%*	*Kg*	*%*	*Kg*	*%*
Croatia	5,310	56.4	4,101	43.6	**9,411**	**5.7**
Cyprus	1,517	23.1	5,039	76.9	**6,556**	**4.0**
France	2,200	61.1	1,400	38.9	**3,600**	**2.2**
Greece	42,557	46.3	49,265	53.7	**91,822**	**55.6**
Italy	6,800	47.2	7,600	52.8	**14,400**	**8.7**
Malta	39	1.7	2,221	98.3	**2,260**	**1.4**
Portugal	403	25.8	1,162	74.2	**1,566**	**0.9**
Slovenia	70	100.0	0	0.0	**70**	**0.0**
Spain	22,956	64.9	12,396	35.1	**35,353**	**21.4**
Total	**81,852**	**49.6**	**83,185**	**50.4**	**165,037**	**100.0**

Source: EUMOFA using EUROSTAT data.

In the last decade, European producers of cultured sea bass and sea bream in the Mediterranean Sea have had to compete strongly among them as well as with Turkish producers to be competitive. One important factor of economic competitiveness is to be productive or technical efficient. Efficiency studies on aquaculture are relatively few compared with other industries and they are focused mainly on no European countries. Further, the identification of the factors that determine aquaculture firms' productivity is also an important issue to propose managerial decisions in the sector. Therefore, the purpose of this work, which is part of the MedAID project funded by the European Commission (H2020, GA727315), is twofold: first, we have evaluated the technical efficiency of the European sea bass and sea bream producers in the Mediterranean Sea using the stochastic production frontier (SPF) approach and, second, we have analyzed the effect of some specific-firm factors such as location, production type (organic), years of experience, and size on firms' productivity.

To estimate technical efficiency, we have adopted the Battese and Coelli's (1993) SPF model using *Translog* and *Cobb-Douglas* production functions for panel data in which the inefficiency effect (u_{it}) has a truncated normal distribution. An unbalanced panel composed of a representative sample of 30 firms producing sea bass and sea bream in the Mediterranean Sea from 7 European countries (see Table 2) was employed to estimate the production functions. The period of time analyzed ranges from 2005 to 2014 (10 years). Economic data for this analysis was obtained from the AMADEUS and EUMOFA databases. Maximum likelihood (ML) estimates of the parameters of the stochastic frontier and the inefficiency effects model were obtained simultaneously using the FRONTIER 4.1 computer program.

Table 2. Range of technical efficiency by country (period 2005-2014)

Country	Statistical values		
	Mean	*Min.*	*Max.*
Croatia	0.6797	0.5108	0.8437
Cyprus	0.8962	0.8868	0.9057
France	0.8196	0.7424	0.8968
Greece	0.9221	0.8986	0.9456
Italy	0.7236	0.5361	0.9087
Slovenia	0.7108	0.7108	0.7108
Spain	0.7952	0.7176	0.8795
All countries	**0.7911**	**0.5108**	**0.9456**

The results show that the technical efficiency of those firms is positively related with their location (better environmental conditions), age (more experience), size (larger returns of production), and production system (organic).