Real Option Approach to Economic Analysis of European Sea Bass (*Dicetrarchus labrax*) Farming in Croatia

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Summary

The paper emphasizes the economic performance of the fresh European sea bass production and profitability of related processing to value-added fillets. Croatian annual farmed European sea bass and gilthead sea bream production in amount of 4,000 tones plays only about 1.7% of the World production with mediocre economic benefits for producers. However, product diversification, including processing measures as filleting, vacuuming and smoked processing can ensure additional product value providing long-term strategic orientation for fish-farmers. Seabass filleting, although at the initial phase, can be a modus of value-added production, which protects the producers of the price risk volatility targeting the population averse to the long lasting traditional fish mill preparation. Applied Real Option method can be helpful tool in the situation when the strategic project value includes not just the current economic features but also opportunities related to the basic model. Option approach indicates that seabass filleting triplicate the economic performance with respect to fresh seabass production.

Key words

economic analysis, European sea bass, real option

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Introduction

Aquaculture has a long history in the Mediterranean, with evidence of fish capture and fattening dating back more than 2,000 years (Report to the European Commission, 2004). The first commercial efforts to breed European sea bass (*Dicentrarchus labrax*) and gilthed sea bream (*Sparus aurata*) were made in the late 1970s and early 1980s in Eastern Mediterranean countries prior to Greece and Turkey. Production remained low until the mid 1980s, but then started to grow rapidly, expanding from 1,100 tones in 1985 to 8,400 tones in 1990 (FAO, 2005). One of the most important productions in European aquaculture has been the Mediterranean European sea bass industry, which in less than 15 years grew from a few thousand tones to 120,000 tones in 2008. Although Croatian European sea bass and gilthead sea bream production is only up to 1.7% of the World production, it offers strong growth potential considering favour agro climate conditions, increased fish consumption as a growing awareness of fish nutrition benefits and European sea bass processing option.

The objective of this paper is to outline the importance of Croatian aquaculture, with particular regard on European sea bass farming. Paper analyses economic and financial features of the fish farming based and the annual production of 100 tones of European sea bass.

Methods

In this paper, the economic performance of fresh European sea bass production has been analyzed with the standard investment analysis method, Net Present Value (NPV). NPV is difference between the present value of the project's cash inflows and the present value of the project's cash outflows. If it results with positive number, the project is acceptable.

Besides the standard economic analysis, where NPV is calculated, paper offers a modern analytic approach based on the valuation of the option that emerges from the initial investment.

Using so called Real option approach, paper stresses the European sea bass filleting results as the value-added production. Real option (RO) is the right, but not the obligation, to undertake some business decision, typically the option to make a capital investment (Brealey et al., 2006). This right will be exercised only in situation when it brings more benefits than costs of the additional resource consumption.

Options value has been determined with the most frequent RO method – Black-Scholes model (BS).

The first step of option valuation is determination of the next RO elements:

- Present value of the optional production (S)
- Present value of investment expenditure (X)
- Risk free rate (r)
- Option period expiry (t)
- Volatility of the optional production (v)

Risk free rate is represented by the expected rate of return for a riskless security, with the same maturity as the analysed project.

Option period expiry is established as the period of time in which investor has competitive advantage, which allows him deferring or expanding the project without risking its achievement by another firm.

Volatility of the optional production appears because of the errors associated with estimation of the financial cash flows and the value of underlying asset (Vintila, 2007). Monte Carlo simulation is used for variance assessing.

Black-Scholes model consists in a simple formula where a growth option value equals:

$$OP = SN(d_1) - X^{e-rt}N(d_2)$$

$$d_1 = \frac{\ln(\frac{S}{X}) + (r + \frac{v^2}{2})t}{v\sqrt{t}}$$

$$d_2 = d_1 - v\sqrt{t}$$

N(d) represents the cumulated probability of normal distribution

Calculations of European sea bass production were made according to the technological requirements of the European sea bass farm with capacity of 100 tonnes based on current inputs and outputs prices on Croatian and World markets.

Results

European sea bass production and processing

Actual world farmed European sea bass production is cca 120,000 tones with enormous growth within last twenty years (Kontali, 2009). According to Kontali Analyse AS (2009) the largest world European sea bass producer is Greece with 42.8% of the total world production followed by Turkey with 28.8% and Spain 9.9%. Croatia, with small share up to 1.7%, belongs to the group of small producers as Portugal, Cyprus, Israel, Malta, Egypt, Tunisia and Morocco.

The main cause of production growth is change of population nutrition habits that favour the "healthier protein sources" with regard on white meat and fish. With accordance with above mentioned, seafood consumption is showing a positive trend in most European countries. At the same time the quantity of caught fish is decreasing. Although the consumption of farmed European sea bass is concentrated in all Mediterranean countries and UK, the main selling market is Italy. In a context of wild fish shortage, as a result of both high demand and declining available fisheries resource, market circumstances look favourable for farmed fish. However, commercial achievement is depended to the ability of producers to be price competitive (compared to other, same-species producers, and compared to other farmed species) and to comply with buyers' specifications (Monfort, 2006).

Due to the Law of Supply, production expansion causes the unit price declined. Average European sea bass sale prices per kg over the 1988 to 2002 fell from €9.00/kg to €3.90/kg (Report to the European Commission, 2004). The substantial drop in prices of these species, however, leads to opening the new markets and expanding existing ones, although acceptable profit margins at

the production can only be sustained through further improvements in productivity and product diversification (FAO, 2005).

During last five years the fall of global European sea bass price has been restrained with a small increase to 5.3 €/kg (FIS, 2012). There is also some price variation due to the farmed fish size with different preferences in different countries. In Croatia, up to date trends are production of larger fish, which enable lower cost price, and, at the same time, higher selling price because of consumers' appeal to larger size fish.

Compared to many other species of farmed fish, such as salmon or trout, European sea bass has been so far mainly marketed whole and fresh, with only limited volumes undergoing any form of processing or value-addition (FISH INFO network Market Report, 2007). In any case, European sea bass processing has been very limited. One major reason is the conservatism of Mediterranean consumers, who are used to seeing the fish whole when sold retail, despite the fact that the fish certainly would have been better if they had been gutted at source (EUROFISH, 2003). The obstacles of filleted European sea bass production can also emerge from the fact that it should compete with other well-established fish filleted products produced at significantly lower cost.

Product diversification, including processing measures as filleting, vacuuming and smoked process, can be desirable in the long-term, as well as improvements in marketing and through the distribution chain.

Production of fillets at competitive prices is a challenge for the European sea bass industry (Monfort, 2006).

Croatian fish farming and processing industry

Marine fish farming in Croatia is gaining importance. As consumption is increasing, efforts are being put into increasing the production of cultivated fish, diversification of production and also in achieving the highest standards in environmental protection. The bulk of all Croatian farmed fish is exported (bluefin tuna to Japan, European sea bass and gilthead sea bream to continental Europe) and provides a stable source of income to islanders (CCOEA, 2007).

Due to the actual data, Croatian farmed European sea bass and gilthead sea bream production is 4000 tonnes (Ministry of Agriculture, Directorate of Fisheries, 2010). In general, the share of the Croatian production of these species is small, just about 1.7% of the World production (Kontali, 2009). Although Croatia has potential for increasing volumes, both European sea bass and gilthead sea bream production have been more or less stable and no huge development in terms of volumes has been made recently

The most important constrain of the Croatian European sea bass production increase is that Croatia is still not EU member what makes market shortness of the Croatian producers. It is possible to expect that after Croatia's EU accession, the production of European sea bass and gilthead sea bream may double (Shangina, 2007). Shangina (2007) mentioned that Croatia has enough capacity for that. At the moment Croatian producers utilize one half or even less of their licences and capacities for European sea bass and gilthead sea bream production. Furthermore the proximity to Italy combined with the EU membership will make Croatian products attractive to the Italia's market in terms of freshness and price. Proximity to Germany and Austria opens new perspectives for exports from Croatia. Fourthly, Croatian producers are planning production of value-added products based on European sea bass and gilthead sea bream. The products include fillets, smoked fish and pre-cooked meals.

Croatian aquaculture today is marked with two approaches: larger farms with an annual production of 200 to 700 tonnes, and fewer family type farms with capacities less than 50 tonnes, which are mostly financed by own capital, and only extremely by banking credits (Katavić and Vodopija, 2001).

Economic analysis of European see bass farming

In order to present the economic features of annual 100 tonnes of European sea bass production the both methods have been used, standard investment analysis as well as real option method. Using traditional methods, production of fresh unprocessed European sea bass has been tested, while real option approach calculated optional value of filleted fish production.

Fresh European sea bass production

The investment period is three years. During this period it is necessary to invest 962,550 EUR. Of this amount, 433,300 EUR is attributed to fixed assets and the rest for the procurement of current assets. Fixed assets consist of: platform, lattice, strings, barge, handle boat, refrigeration system, building capacity and other long term assets. Current assets include mostly the purchase of juvenile fish and fish feed. On the yearly basis projects requires annual costs in amount of 441,487 EUR. The largest indirect cost is a concession for the appliance of the marine, which requires 14,000 EUR.

Table 1. Total annual costs for European sea bass farming capacity of 100 tonnes (EUR)

1. DIRECTS COSTS	262,000
Provision of juvenile fish	75,000
Fish fodder	153,000
Fuel	7,000
Electricity	4,000
Medicines	4,000
Package	16,000
Inventory	3,000
2. INDIRECT COSTS	30,000
Vet services	3,000
Maintenance	6,000
Insurances	4,000
Administration	3,000
Concession	14,000
3. STUFF COSTS	96,000
Operate expenditure	388,000
4. DEPRECIATION	53,487
TOTAL COSTS 1+2+3+4	441,487

Source: Authors' calculation

The projection of income is made based on the production of 100,000 kilograms of fresh, unprocessed seabass. Projected selling price is 5.30 EUR/kg according to the available wholesale price on European market (FIS, 2012). According to presented results cash flow projection for the 15 years of business activity is showed in Table 3.

Table 2. Cash flow of unprocessed European sea bass production (annual production up to 100 tonnes), EUR

	Year				
	0	1	2	3	4-15
CASH INFLOW	0	0	0	530,000	6,360,000
Production (kg)				100,000	1,200,000
Income (pc=5.3 EUR/kg)		0	0	530,000	6,360,000
CASH OUTFLOW	433,300	201,600	327,650	405,703	4,868,430
Investment	433,300				
Production costs		201,600	327,650	388,000	4,656,000
Tax		0	0	17,703	212,430
NET CASH FLOW	-433,300	-201,600	-327,650	124,297	1,491,570
Discounted net cash flow	-433,300	-193,846	-302,931	110,500	1,001,632
NPV	182,054,94				

Source: Authors' calculation

Table 3. Cash flow – combined, fresh fish and fillets production (optionally), EUR

	Year				
	0	1	2	3	4-15
INFLOW				591,083	7,093,000
European sea bass for fillets (kg)				33,333	400,000
Fillets (kg)				15,000	180,000
Unprocessed eu. sea bass (kg)				66,667	800,000
Operative income (fillets)				237,750	2,853,000
Operative income (unprocessed fish)				353,333	4,240,000
OUTFLOW	433,300	201,600	327,650	458,575	5,140,606
Investment - farming capacities	433,300				0
Investment - processing equipment				35,000	0
Operative expenditures		201,600	327,650	395,070	4,740,844
Tax				28,505	399,761
NET CASH FLOW	-433,300	-201,600	-327,650	132,508	1,952,394
NPV	549,870,85				

Source: Authors' calculation

Considering attached cash flow projection and discount rate of 4% based on the relevant long-term loans rate of Croatian Bank for Reconstruction and Development, the fresh European sea bass production achieved Net Present Value in amount 182,055 EUR for the analysed 15 years period.

European sea bass processing production

As maintained before, seabass can be processed to the fillets. The share of fillet consumption is significantly unpretentious compared with the whole fish consumption. However, the modern dynamic life stile goes toward the increasing fillets consumption what gives the strong potential of processed seabass production. Therefore, option of filets production and placing should be evaluated. For that purpose the real option methodology (RO) can be used.

The first phase of RO analysis is finding the NPV of the optional project.

The results of optional model are based on the new production structure where 33 percent of the fish is aimed for the fillets production. The rest of the fish will be used in the unchangeable manner i.e. whole fish market placement. This structure is determined according to the projected consumer preferences in the future.

Income of fillets is calculated due to the next premises:

- Processing efficiency of 45 percent (1 kg of fresh fish results with 0.45 kg of fillets)
- Domestic market and export market trading relation is 70:30
- Domestic market price is 17.5 EUR/kg
- Export market price is 12.0 EUR/kg

Investment cost for the processing equipment is 35,000 EUR. Additional costs correspond to the additional employee, veterinary requirements and packaging.

After the all these five elements were determined, Black-Scholes (BS) model of option evaluation has been used.

BS model for pricing the Call option leads to conclusion that an option value of expanding the project from fresh fish to filleted fish selling is in amount of 180,623 EUR.

Table 4. Call option value evaluation

Present value of the optional production (S)	549,870.85 EUR
Present value of investment expenditure (X)	464,414.87 EUR
Risk free rate (r)	5.3%
Option period expiry (t)	2 years
Volatility (v)	37.8%
d1	0.780041974
d2	0.245469247
N (d1)	0.782316915
N (d2)	0.596953442
Call option value	180,622.55 EUR

This value can be added to NPV of unprocessed European sea bass production resulting with the strategic project value in amount of 362,678 EUR.

Conclusions

Croatian farmed European sea bass and gilthead sea bream production in amount of 4,000 tones yearly plays only about 1.7% of the Mediterranean production. However, Croatia has strong potential for increasing volumes in the nearest future. This affects favourable agroclimat conditions, expected EU membership, proximity of import markets and producers' orientation to production of value-added products based on European sea bass and gilthead sea bream.

Conducted economic analysis of farmed European sea bass production followed this remarks. Traditional and real option analyses of European sea bass farming give recommendation of accepting the project. The basic production of fresh, unprocessed European sea bass achieved the positive Net Present Value which indicates a good business performance. However, results can be even better when the growth to filleting option has been considered. Strategic value of the project is defined as the sum of the traditional NPV and real option value. In that case, European sea bass production value capacitated by annual production of 100 tones of fresh European sea bass can be increased from 182,055 EUR (unprocessed fish NPV) to 362,678 EUR (additional option value of filleting in amount of 180,623 EUR added).

Although now at the initial phase, filleting of European sea bass can be a reasonable measure of product diversification, which protects the producers of the price risk volatility targeting the population averse to the long lasting traditional fish mill preparation.

Paper showed that Real Option methods can be helpful in a situation when strategic project value includes not only the current economic project features but also opportunities related to the basic model as shown in the case of possible European sea bass processing procedure.

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