Statistics Faroe Islands

A 50,382,937.48 USD* question

Abstract
This paper looks at the negative value-added amount of U$50 million as generated by the Faroese fish-farming industry in 2003. It describes the main theoretical points regarding productivity applications and relates it to the sample of 30 Faroese enterprises involved in fish-farming. It then suggests possible causes of the situation as well as considers eventual management improvements.

Zvonko Mrdalo

* ER on 24/09/2004

To,
For,
And because,
of those that harvest at sea

PREFACE

This is an independent study, which was written mainly in response to the current Faroe fish-farming situation. Since this work is not commissioned by any particular group or body, it is felt that its content is objective and fair. Any reader, however, expecting an answer to the fifty million dollar question will be disappointed as this question has intentionally been left unanswered. Nevertheless, I hope that the given indications of this very complex matter are sufficient enough to help the reader follow the historical developments within the industry and derive conclusions on his/her own.

Circumstances have provided an opportunity to see this issue from another aspect. Working in the Faroese fish industry for more than ten years has given me a useful insight and hopefully this experience can be complemented with my newly acquired academic knowledge for the future. For this reason I can only express my outmost respect for all participants involved in the Faroese fish-farming and I dedicate this paper to them.

However, it is also necessary to see the things beyond a personal level, that is to say, we need to see into the simple and very often cold facts. It is often here that most of the objectivity and professionalism of the individual is tested and where *argumentum ad hominem* must be avoided. It is for the reader to judge the paper's findings but as far as the author of these lines is concerned, the objectivity was the most important tool used for obvious reasons.

This study has also benefited from others and I am indebted to Andrias Reinert, Hans Jakúp Mikkelsen, Hermann Oskarson, John Jacobsen, Johnny í Grótinum and Mourits Joensen for their numerous helpful comments and suggestions, as well as to my family who put up with my late evening studies in order to complete this paper.

With all the help received from those above, the reader should not have any doubt in their mind that only I will be responsible for any mistakes that are present.

1. Introduction

"We have always known that heedless self-interest was bad morals. We now know it's bad economics. And bad for society"
Franklin Roosevelt, second inaugural address, 1937

Value-added of the Faroese fish-farming industry has dramatically declined from the peak of U$70 millions in 2000, to a negative value of around U$50 millions in 2003. This paper tries to see if such a sharp drop can be explained from the available data. It must be said from the outset that it is not our intention, nor capability, to cross the boundaries between marine biology, industrial technology, environmental studies and other non-economic disciplines that are certainly involved and affected by this outcome. However, a general reference to possible environmental stress will be made in order to present additional dimension of fish-farming activity.

In reference to the management of the renewable natural resources, the sustainable development concept will be presented. We particularly address a "tragedy of commons" issue with reference to the institutional requirements along the producers co-operative behaviour. Further on, the main variables of fishing industry in Denmark and EU-15 are noted, in order to indicate main trends within the industry at that level. In what follows, the main productivity indicators incorporated within the growth accounting theoretical framework will be presented in order to inform us about its importance in nation's wealth creation process.

Before moving on to analyse our data sample and derive the main conclusions, the general trends within the Faroese fish-farming industry are analysed. Going from general to specific analysis includes closer look at the 30 enterprises (large and small), and their behaviour. In all cases, only data observations are used to derive either a general or more specific conclusion. In most of the instances we base our conclusion on the economic theory or empirical research, as we do not posses a great association with the industry that is fighting for its survival at the moment. Needless to say, no individual firm is mentioned for obvious reasons and we have based our observations on only index-based movements at the aggregate levels.

Finally, we will try to give some plausible explanations about what went wrong using the economic theory of the firm. Understanding the level of investments in the Faroese fish-farming industry over the last decade or so cannot be complete without looking at the capital providers, mainly financial organisations and external capital in form of Foreign Direct Investment (FDI). Sadly, to the best of our knowledge, no reliable sets of data records exist that would bring our qualitative analysis up front, and for this reason we can only express our regrets and imply some normative questioning of the matter in hand.

Not withstanding, we have given ourselves a great task and it would be wrong to pretend that we would be capable to find the right answers. It is clear to us from the outset of this paper that we cannot identify a single "culprit" factor that could be blamed for the present Faroese fish-farming situation of near collapse. However, we are of opinion that industry did not have the last word as far as its contribution to the total output is concerned, and it is our hope and intention with this study to contribute along the discussion route, to a perhaps "healthier development" of such a industry in times to come.

2. Sustainable Development – reference to fishery

"Development is sustainable if the rules of the game are transparent and the game is inclusive." -World Development Report 2003

Traditionally, open access to many natural resources has reflected the view regarding such resources as being infinitely renewable. From this point of view, it was not needed to assign any managing control to interested parties, especially at the lower level of the human development.

However, as economic activity becomes more intensive due to technological improvements, it becomes obvious that the pressure on natural resources increases too, which in most instances causes a scarcity issue. The natural reaction under such non-desirable circumstances was and still is, in majority of cases, a new race to grab the assets and property rights. However, what is needed is the realisation that these problems must be solved through the co-ordination at all levels, putting correct policies and institutions to work that will perform desirable market functions. "For people to thrive, assets must thrive"[1]

According to the same principle of prudent management of assets it is worth considering the role of such policies and institutions. Briefly, the key function of the institutional environment is to take good care of a fellow human being. That is to say, it must learn to listen and analyse the signals received from various parties, weight and negotiate different interests involved, reflecting its long-run implications and most importantly, be able to bring the credibility issue up-front by executing and delivering its promises and agreements. Needless to say, the institutions have very demanding and complex tasks to perform, but on the another hand, fruitful results in form of *win-win: preservation of natural resources and continuos growth* might emerge.

From the preceding discussion one might conclude that we ignored the importance of the market and its role, especially as far as competition and price incentives were concerned. On the contrary, we strongly support free entry to the markets and see it as the only way that will lead to an efficient allocation of all available resources (human, natural, etc.) in the country. Furthermore, our opinion is to leave the markets on their own the most of the time.

Overuse or under-provision of assets

Our concern, however, primarily lies in the context of market failures – reflected by *overuse* or *underprovision* of the assets due to the ill defined property rights (fishery, air) or public goods' externalities (education, health provision). Leaving the latter for another study, we would like to focus ourselves on the renewable assets – fishery. From the perspective of society, due to the not well-defined property rights in the fishery – "tragedy of commons" take place. "The fish biomass of several important fisheries is now a mere tenth of its pre-exploitation level – 90 percent of initial stocks have been destroyed."[2]

In relation to institutions, fisheries present a very challenging environment. A typical story within fishery exploitation takes a place when a new fish stock is discovered (farmed). Due to extraordinary profits and open access, a fisherman (fish-farmer) makes good money to start with. However, as time progress and efforts (catch, farmed fish) increases, the value added per hour of effort decreases which usually bring collapse of the industry. Government involvement in the form of various subsidies usually makes things worse – and prolongs inevitable bankruptcies.

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[1] The World Bank, "World Development Report 2003", World Bank & Oxford University press, Washington, D.C., USA, 2003, p.1

[2] Heal Geoffrey M., "Nature and the Market place: Capturing the Value of Ecosystem services", Washington, D.C. Island Press, USA, 2000

Exit

Contrasting such a gloomy outcome with a happy one, where a co-operative fisherman (fish-farmer) manages resources well by adopting a level of effort that will maximise the present value of the natural resource at all times. In order to materialise such a happy idea we would need to present some *big ifs.*

The biggest challenge is then to get fishermen (fish-farmers) to realise that *if* they cooperate, *if* they are able to control their actions, *if restrain* and commitment to above goal is ultimate point in the long-run, *if* protective institutions are put in place, then and only then, will their harvesting efforts bring major benefits. *Any other action* would lead to loss of credibility and ultimately loss of livelihoods.

On the point of the protective institutions, there is evidence from both developed and less developed countries that greater information availability leads to better outcomes at all levels. It is therefore imperative for a social planer to acquire and seek "right" information upon which balancing interests and alternatives can take place. Due to specific market failures in the fishery case, the institutional framework can be seen as a key to prevent such failures, which will further encourage and co-ordinate (but not dominate) sustainable and more productive management of renewable resources.

Getting the most or the least from the fisheries – what the data is telling us

In what follows, we will present the main body of the fishing industry level analysis looking at the productivity growth in Denmark and EU-15. The data set used is from the National Institute for Economic and Social Research and the Groningen Growth and Development Centre, where the construction was financially supported by the European Commission, DG Enterprise. The data sets are indexed expressed (1998=100) and we have focused ourselves mainly on the input factor (labour) and deflated value-added variable, as well as labour productivity / per person & per hour of effort.


Denmark - fishing industry index (1998=100)
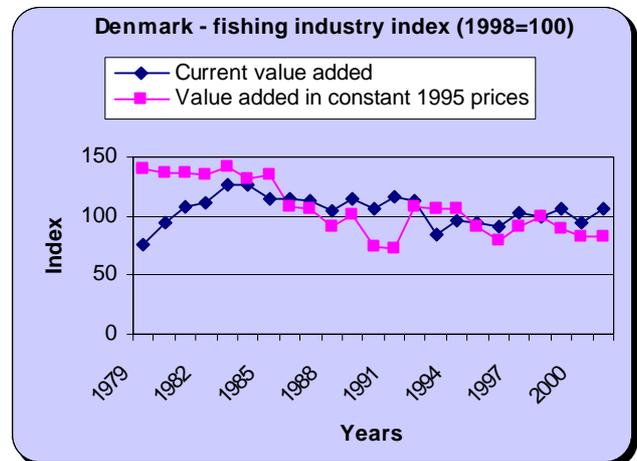
It seems that both value-added variables and labour inputs (person&hours) have declined over time in Denmark, perhaps reflecting the technological improvements within the industry.

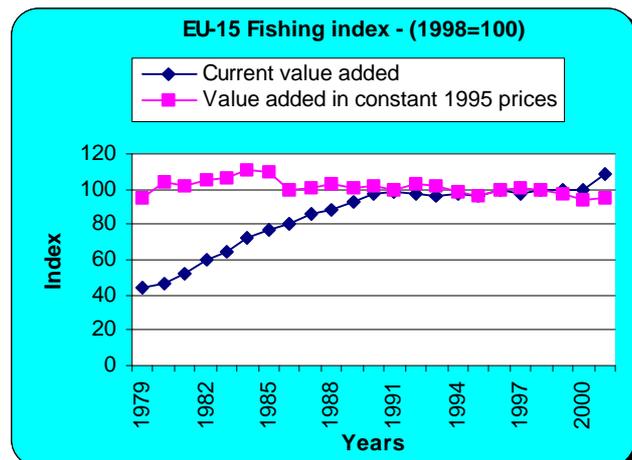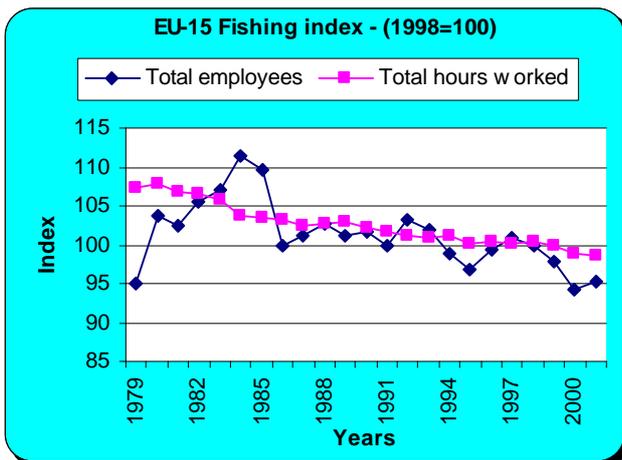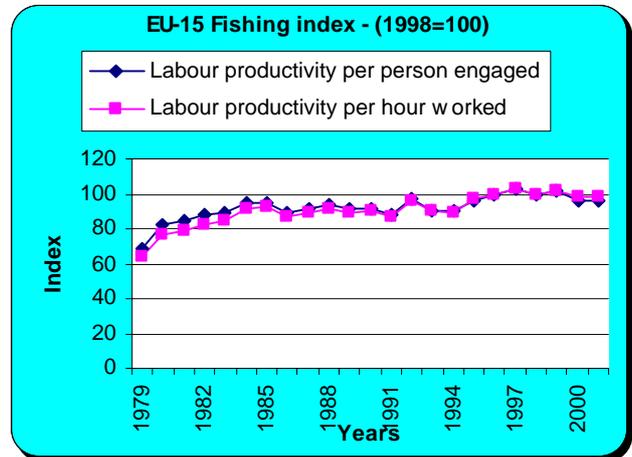Denmark - fishing industry index (1998=100)
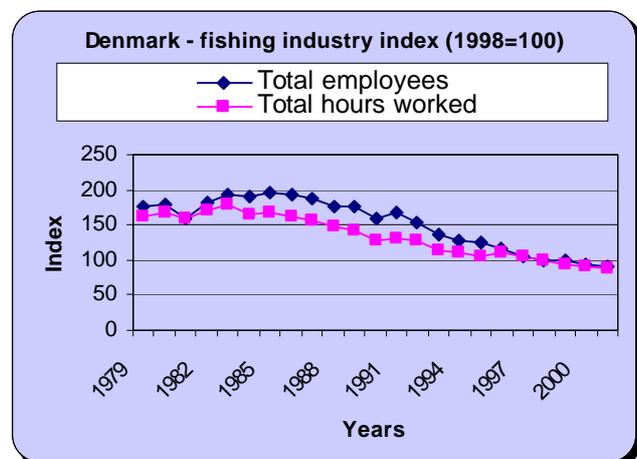
At the same time, the labour productivity index has followed downward trend until the beginning of 1990, just to pick up at two occasions later on. Overall, both labour productivity indexes show very high correlation and hardly moved beyond the 1998 base level[3].

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[3] We are aware that choice of base year in case of structural changes might give misleading picture, but for consistency reasons we have chosen 1998 base year throughout text, unless specified otherwise.

Denmark - fishing industry index (1998=100)
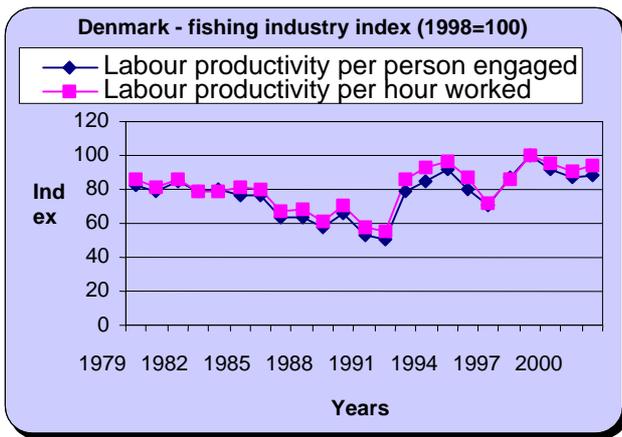
Almost identically as in Denmark, both the total working force and hours worked in the fishing industry at the EU-15 level declined reflecting perhaps similar tendencies in all countries and availability of the same technologically advanced physical capital.

EU-15 Fishing index - (1998=100)

However, both productivity indicators show a gradual increase over the time and very little sudden fall or rapid rise is present. Overall, when analysing the Danish and EU-15 fishing industry sectors, we can say that certain trend of no over excited value-added regions are present, followed by the

decrease in factor inputs (labour) and the steady increase of productivity. Before taking a look at similar data regarding the Faroese fish farming it would be appropriate to introduce and highlight the main aspects of the productivity growth.

EU-15 Fishing index - (1998=100)

EU-15 Fishing index - (1998=100)

3. Productivity measures – theoretical considerations

The real income improvements are closely related to productivity growth. Slow productivity growth puts a boundary on the rate at which the real income and welfare of the people can increase, and consequently increases the probability of uneven and conflicting requirements regarding the distribution of income.

The focus of this study is on so-called non-parametric values of productivity methods as opposed to the econometric methods that are usually used in more advanced academic studies. Needless to say, one can find many different measures of productivity growth but the common characteristics to all of them is found in relation of output to input variables.

More specifically, one relates gross and value-added output measures to labour, capital, and capital&labour input variables to construct single or multi-factor (MFP) productivity measures. This criteria enables us to construct productivity measures; Labour productivity, Capital Productivity, and Capital – Labour MFP measures, each based on gross output or value-added.

Gross output and value added

Relating the productivity measure to a producing unit (a firm, an industry or an economy) assumes that such a unit will produce the goods and services, which will become available to the outside usage. It is intuitively desirable that such gross output rises faster than the rate of inputs used in production process.

In contrast, value added based productivity measure is constructed by taking ratios of value added divided by primary inputs of labour and capital.

The closed economy productivity growth measure based on both approaches won't differ much at the aggregate level, while an open economy due to imports will produce different results. Further on, we can recognise two types of differences in productivity: between-industry and within-industry differences. Due to various reasons; technology, efficiency, economies of scale as well as real cost savings, non-homogenous labour and not at least, exogenous shocks different productivity growth will be found at the different levels.

More formally, the economic theory of production as embedded within the growth-accounting approach can be presented following Solow (1957), or Varian (1992) theoretical framework. It is assumed that the outputs inputs relation is captured by a production function of the form;

$$Y = F(L, K, M)$$

where none of the inputs are homogenous. At the aggregate levels primary inputs of labour (L), capital (K) as well as intermediate inputs (M) like fish feed, energy, etc., are related to the gross output (Y)

$$L = f(l_1, l_2 ... l_n)$$
$$K = f(k_1, k_2, ... k_m)$$
$$M = f(m_1, m_2 ... m_r)$$

Adding a Hicks-neutral productivity change condition (A) to our first equation will shift production function outward where;

$$Y = AF(L, K, M)$$

Assume further that the firm behaves as a cost-minimising firm subject to a given technology. Both the labour and intermediate inputs are purchased at the market rates (w, pm) while the user cost of capital (μ) is the price for providing capital that includes efficiency loss or deterioration. In general form, finding cost-minimising path to produce a required output can be written as

$$\min_{x} wx$$

s.t.

$$f(x) = y$$

or, as in our case of a standard optimisation problem

$$MinC = \sum_{i=1}^{N} w_i L_i + \sum_{i=1}^{M} m_i K_i + \sum_{i=1}^{R} p_{m_1} M_i$$

s.t.

$$Y = AF(L, K, M)$$

Applying the method of Langrange multiplier to this constrained minimisation problem, yields the first order conditions under which the firms employ factor inputs to the point where their marginal revenue equal their price.

$$w_i - I \frac{\partial f(x^*)}{\partial x_i} = 0$$

$$f(x^*) = y$$

It implies that due to the heterogeneity of factor inputs different marginal productivity will take place and thus should be accommodated by the appropriate weights expressed as its share in total output.

$$wL = \sum_{i=1}^{n} w_i L_i$$

$$mK = \sum_{i=1}^{M} m_i K_i$$

$$p_M M = \sum_{i=1}^{R} p_{M_i} M_i$$

However, one has to be aware that the above-presented accounting is perhaps not the only formulation that helps explain economic growth. Our reasoning would be seriously flawed unless we also identified the relative importance of other factors such as institutions, openness to trade, rule of law and so on. It is however, the principal aim of this paper to use growth accounting and productivity measures as the main proximate sources of economic growth.

4. From general...

The experience of the Faroese fish-farming industry will be developed in this chapter mainly by looking at the more general indices of the industry performance; volumes and prices. This industry has overall contributed lately to a further economic growth and a considerable amount of investment and creation of working places took place in the last decade or so. Therefore, it is even more important that one tries and looks into this segment of total Faroese fishing industry to explain the levels of its maturity and its long run consequences for growth. The latest development (near total collapse of the industry) is mildly said, very worrying not at least for the people involved daily in this industry, but also for the Faroese policy makers and all the community.

Starting from a very basic index (1998=100) of quantity and related values, it can be seen that this has steadily increased since the mid 1990's, perhaps as a natural reaction to relaxation of the external constraint.

Exported quantiy & value index (1998=100)
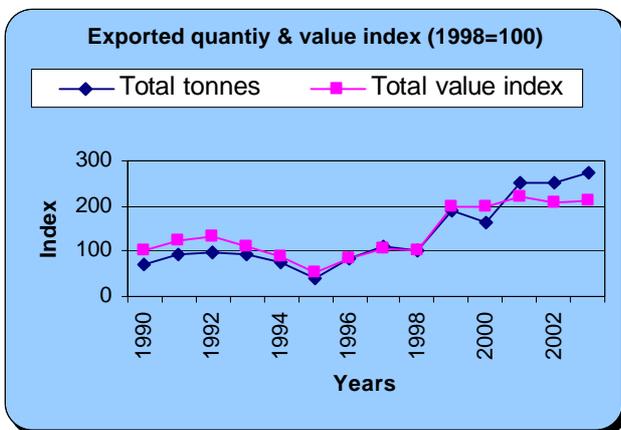
On the contrary, as can be seen from the price chart below, both the salmon and trout price index had a steady decline over the same period of the time. However, a sudden but short-lived rise, happened in 2000 for both variables.

**Export quantity & value index (1998=100)**
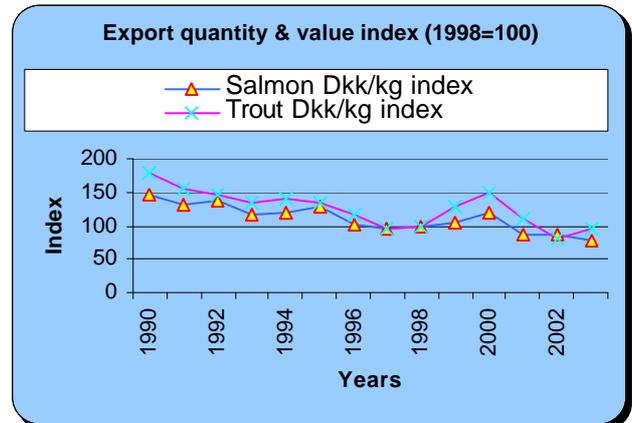
Relating the value index to the quantity one would be the next natural step in our analysis. As can be seen, the 1995 export was valued at just above the DKr 200 mill. which corresponds to around 7000 tonnes. The last year of available data, 2003, marks large increases both in values, almost DKr 1 bn, and in quantities around 47000 tonnes. Such a rapid increase of production has certainly contributed to an environmental stress and addressing such an issue is beyond the scope of our study[4].

**Total Values vs Quantities exported**
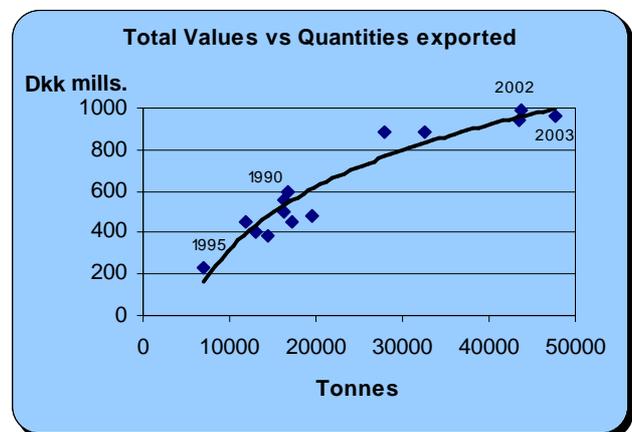
In relation to our next chart, the economic theory of demand and supply can be recalled. It seems that at the within 1990 salmon price of around DKr 40 per/kg, fish farmers were able to make money and certain production expanding incentives took place. However, the expanded

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[4] However, on this point see "Konjukturfrárgreiðing 2004" p.5, "Alitíðindi" No1.,2004, p.13 and "Strategy for Environmental Control and Marine fish Farms in Faroe Islands", 2002

production was followed by the gradual decline of this price. This situation reflects the global industry today where the break-even price is not very clear at the moment.

Salmon - Dkk/kg vs Tonnes
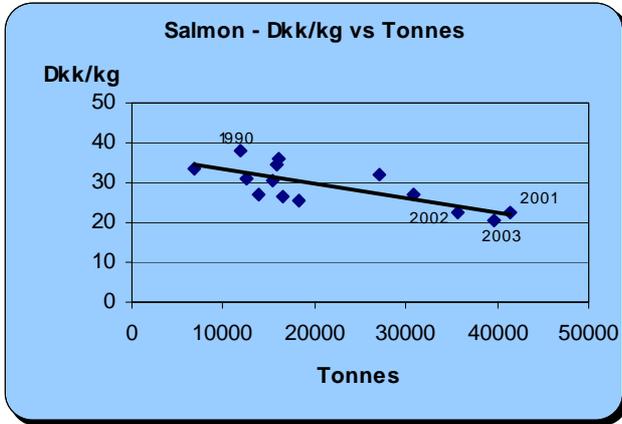
A similar pattern has followed the trout price development, however, at different levels. The trout production in 1990 at around DKr 40 per/kg was under 50 tonnes, a figure not even remotely mirrored 13 years later, around 8000 tonnes and price halved down to DKr 20 per/kg.

Trout - Dkk/kg vs Tonnes
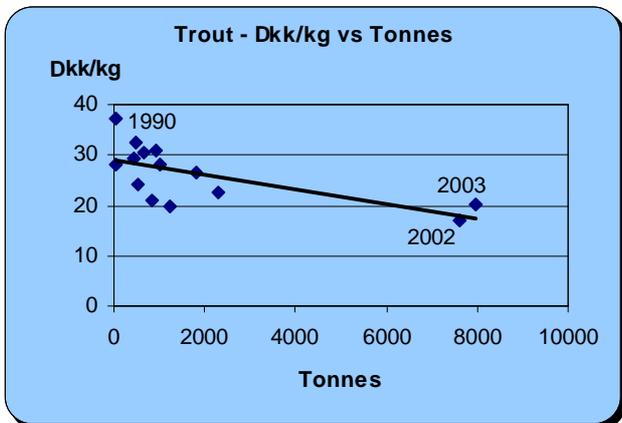
Although the Faroese fish farming passed through a rapid growth phase, its maturity as an established segment of the Faroese fishing industry is yet to be established. Our present analysis, however does not the possess the power to get into deeper framework of such an industry and perhaps elaborate on previously mentioned issues of defined property rights, licences, territorial use rights and other institutional matters, even where that would be desirable on various grounds, not the least regarding the long-run vision and place of this industry within the Faroese economy. However, it can be seen from the undergone – "touch the surface only" - analysis that one can legitimately question the successful sustainable management within the Faroese fish-farming industry given the present status of such an activity.

5. ... to specific

According to a previous discussion, the Faroese fish-farming industry expanded considerably over time, especially in the last decade or so. Our next chapter tries to analyse productivity growth of the industry, in order to analyse different patterns or management practices. The experience of the industry, rapid growth and sudden fall, may perhaps be the norm and not a one-off experience. If this is true, both people involved in the industry and policy makers should be very worried (speculative capital excluded), and would perhaps like to eliminate such a trend if it exists. This chapter will tentatively suggest that the proper management fused with proper institutional work might turn the corner – provided those involved in the industry as well as social planners use the same discount rate, mainly the industry vision regarding the long-term existence (+20 yr.).

Utilising the latest compiled data set by the Faroese National Statistical Agency – Hagstova Føroya, we were able to identify a sample of 30 fish-farming enterprises. Arbitrary chosen, the number of employees was taken in order to separate large from small enterprises and perhaps reflect the economies of scale or the availability of the financial funds and we find it not surprising that the variables in question are highly correlated in almost all cases.

## Value-added at the national level – fish-farming share

Prior to looking at our sample, a word or two about the value-added index. Consider the fish-farming industry where whole fresh fish is sold at the market price, if we deduct all the purchased-in goods and services from such a price we will be left with the value-added by that product alone. Any company that fails to increase its value-added cannot increase competitiveness through its productivity. Consequently, *lower productivity* lowers a nation's standard of living and per capita income, eliminating the source of competitive

advantage and long-term economic prosperity.

Value added = sales minus all bought-in goods and services

Wealth creating enterprises that increase their value-added will be able to distribute it to the next parties; i) employees, ii) government, iii) capital providers, and iv) the company itself. Under the conditions of lower added-value all four parties will be affected and activities such as - employees pay increase, re-investment without borrowing, handing over dividends, and offering a better product to a customer – will not be optimised. Therefore, serious consideration should also be given to all these cornerstones of value-added creation activity.

Looking at the 55 Faroese economic groups' value-added indexes, one cannot escape noticing among more or less compact bulk of lines (due to scaling), a line that showed somehow a worrying trend. After a more than average increase of value-added index in the period 1998-2000 a sudden, but sharp fall to the actual negative value-added index occurred. The line, of course, belongs to the Faroese fish-farming industry. Needless to repeat again, this is a very sad outcome for the once very promising industry.[5]

Value added in current prices
- index (1998=100)

Fish-farming value added index (195)

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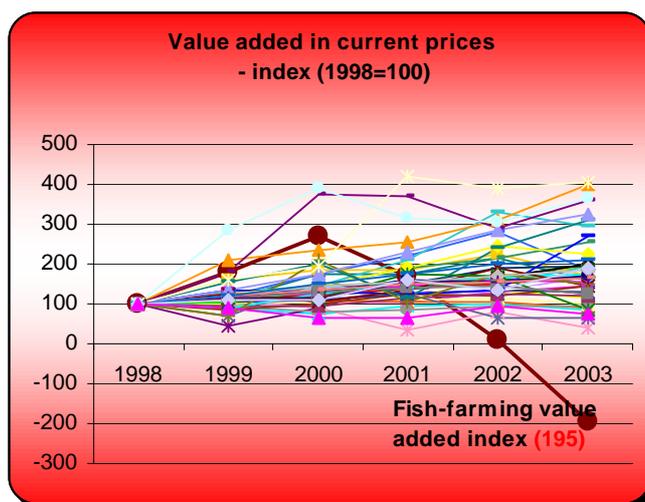
[5] Author's note; It is our hope and modest intention with this study to highlight some important issues within the fish-farming industry and contribute to perhaps a "healthier development" in times to come.

Similarly, in perhaps a more visual manner, the chart below presents value-added contributions (notice the sharp triangle) as a percentage of total value-added in the Faroese economy for the period 1998-2003. The arrow again points to a negative % expressed as part of total value-added leaving all other sectors with the positive values.

Value added in current prices - all categories %
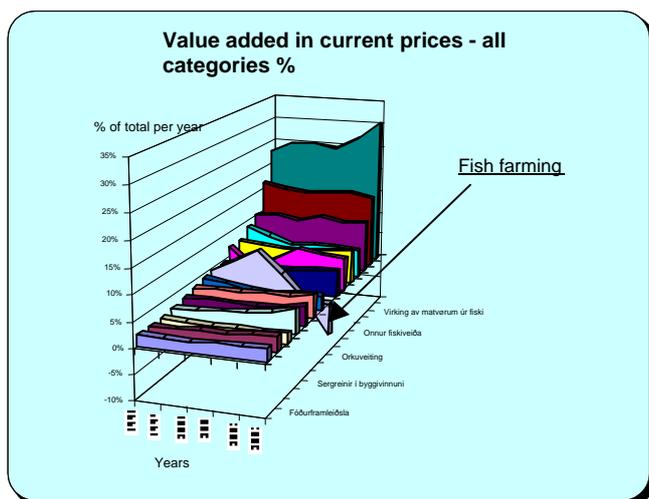
Given the focus of the previous two charts we will try to analyse such a large drop of value-added on our sample of 30 firms (see the sample's distribution in the Appendix I). It is perhaps fair to express a word of warning regarding our data sample and data quality. We have to the best of our knowledge, accepted recorded annual accounts recording as well as calculation incorporated within National Accounts as given, and we do not express any doubt in their quality. However, due to, perhaps, our not great association with the industry, our conclusions (right or wrong) based on data sets, will be exactly that – data sets derived conclusions.[6]

The sample's analysis

Starting from the total sales index, the large enterprise sales increased almost 6 times over the seven years, leaving the small enterprises with the lower increase, but nevertheless considerable increase. It is perhaps interesting to find out the reasons

[6] Author's note: Since the industry has enough problems of its own, it was decided not ask for any interviews with the producers, however, it may be taken up at the later date.

behind the earlier decline of sales for small enterprises as compared to the large one (possible vertical difference). At present we can only guess that perhaps large enterprises benefited from the economies of scale factors at the extended stage rather than the small ones.
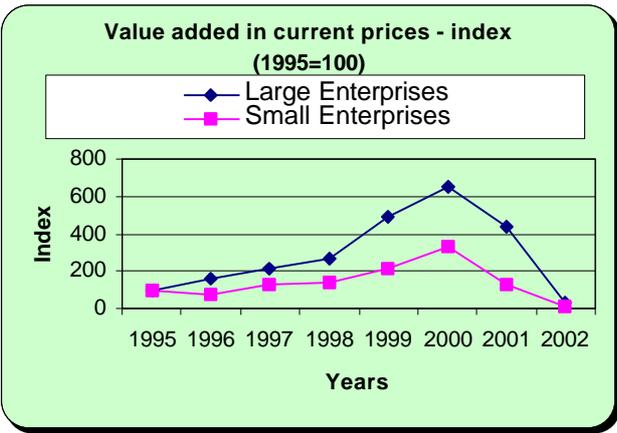

Total sales - index (1995=100)
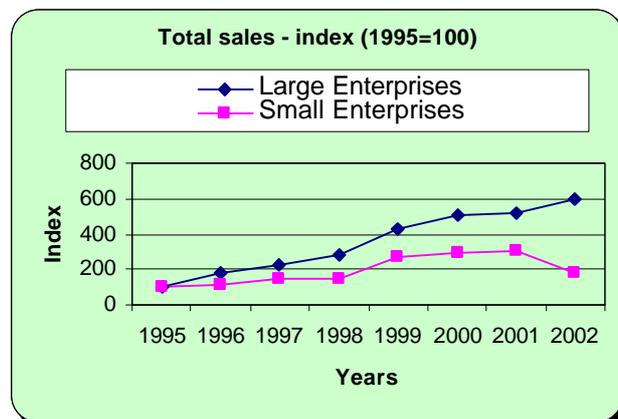
As already mentioned, the Faroese fish-farming industry has employed a considerable amount of the working force and this growing trend can be seen from the chart below. The closure of the indexes for both the small and large enterprises reflects maybe the fact of minimum threshold of human capital for certain fish-farming operation disregarding the size of the enterprises.
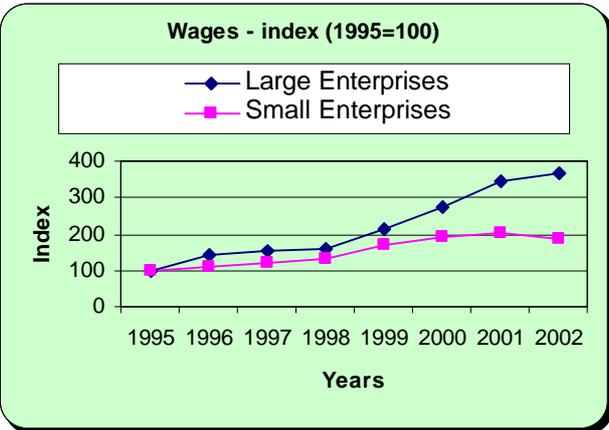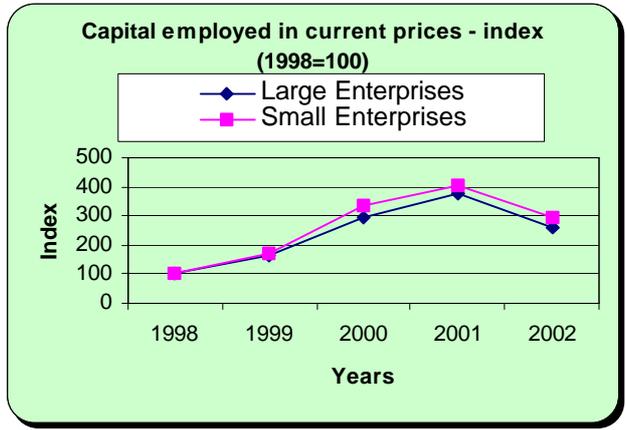

Number of employees - index (1995=100)
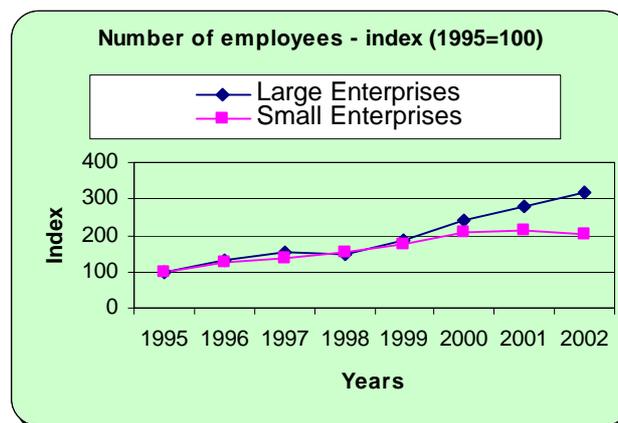
Continuing with the plain sail throughout our data analysis brings us to more qualitative data sets, starting with the value-added indicators in current prices. Needless to say again, it is our main index of performance measure and as such exhibits a very sharp rise followed with a dramatic drop. Both sub-groups followed

the same worrying trend (upwards and downwards) reflecting the identical situation within the industry only at the different levels. It is our normative based statement, even after accounting for 2000 price rise that such a dramatic drop was inevitable following too sharp and fast a rise. However, a more positive statement can be deduced upon more complex analysis of data to which we do not have access at this present time.

Value added in current prices - index (1995=100)

In comparison to the above chart on the number of employees' index, wages index differs considerably in a lower degree of correlation, which is manifested at their final levels. It seems that larger enterprise were able to increase their factor input compensations by a larger amount than the smaller enterprises. Again, as previously seen, the economies of scale perhaps could have been involved but given the theoretical postulates of costs minimisation we might look for another explanations such as; unionisation, shortage of labour supply or even labour loyalty issues (bond labour).

Wages - index (1995=100)

While the wages index showed dissimilarities among the two sub-groups, the capital employed index exhibits a very strong correlation (0,98) and we are tempted to conclude that the nature of the fish-farming industry is presented with the same technological threshold disregarding the economies of scale. That is to say, certain daily operations are only to be performed using proportionally the same amount of capital. On the positive side, one might express the opinion that at least all the enterprises have equal access to the technology and/or externalities are present which is a very plausible explanation in so small fish-farming society, not to mention the total population of the Faroese nation (around 48000) as a further contributing factor.

Capital employed in current prices - index (1998=100)

Box 1. Overview of main productivity measures

The properties of production function as mentioned above reflect the economic theory of production and we can use such properties to identify empirical measures that provide a satisfactory approximation to the unknown variable. We present only two of five most widely used productivity concepts mainly; Labour and Capital productivity, based on the value added.

Labour productivity = Quantity index of value added/ Quantity index of labour input

Capital productivity = Quantity index of value added/ Quantity index of capital input

How are we to explain such a labour productivity? Certainly not in isolation as this would be very flawed. Since, our labour productivity index is based on value-added as opposed to the gross output, interpretation of such an index need not be the same. Labour productivity simply shows at which extent is labour productively used, which consequently implies that the availability of labour units won't necessarily generate value-added unless other factors like capital stock, intermediate goods (fish feed), technology, "know-how" and "know-why" are allowed to be used efficiently too, not to mention economies of scale and role of institutions. For the more practical grounds, labour productivity calculated utilising value-added terms can be used in wage bargaining, but we strongly suspect this took place on the Faroe Islands due to very rigid labour market conditions and very high (international standards) minimum wages levels.

To continue, the capital productivity based on the value added, similarly to a labour productivity, cannot be analysed in isolation. On the contrary, it reflects only partial productivity and is influenced by a host of other factors, including the appropriate applications of the human capital. It is usual practice to distinguish capital productivity from the rate of return (ROR, IRR) on capital.

However, the question arises as to which data formulation will be sufficient for empirical purposes. Generally, the productivity hypothesis can be tested only by using the deflated values. That is to say, value-added (deflated), labour inputs (total hours), capital inputs (gross capital stock) and intermediate inputs (deflated expenditure) should be provided as an independent representation of productivity measure.

A numerical example of the Faroese fish-farming productivity measures would than in theory help us to present combined influences of factor inputs on the final outcome. Details regarding such calculations are not available to us at the moment, but for the more practical grounds, we have constructed two Key Performance Indicators (KPI I, KPI II) based on value-added & capital input in current prices related to the number of employees as presented in annual accounts. For illustrative purposes only, we believe that this two indicators present "the second best" choice as far as productivity indicators are concerned even where such are seriously flawed to their current values as opposed to the deflated ones. Nevertheless, we strongly believe that both KPIs trends mirror value-added, which in turns reflects the price behaviour, which in turn very much reflects the natural resources organisational (mis)management situation upon which we will elaborate at a later stage in our study.

Conceptually, adoption of such measures as KPI's amounts to only presenting the trend without making more specific conclusions. In deed, the KPI(I) trend reflects other finding. In contrast to other charts, the KPI (II) for small enterprises lies above the large enterprises, which presents a challenging observation. This outcome might be contributed to the sample quality, as well as that the smaller enterprises were capable due to their different production applications to utilise more on their available capital. In any case, the difference is significant and this cannot be fully explained without referring to individual sample characteristics over time, which is beyond the remit of this study[7].

KPI (I) - index (1995=100)

KPI (II) - index (1998=100)
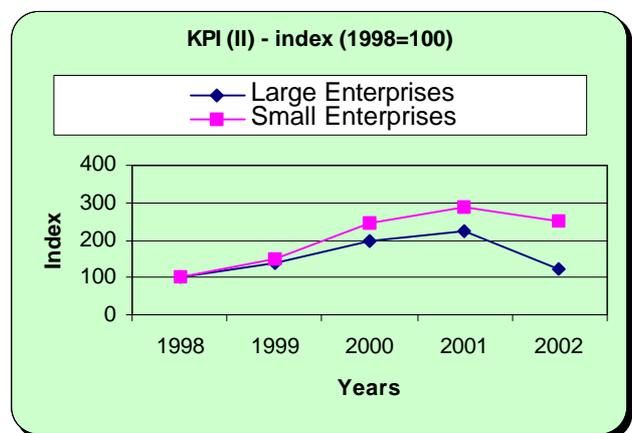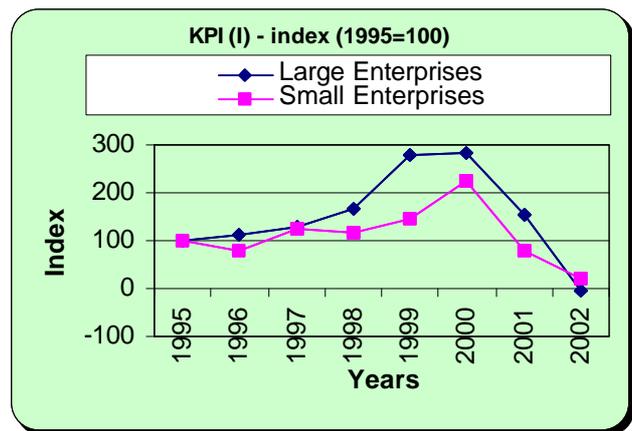
Finally, wages per value-added index was constructed in order to see the share of the factor input (labour) to the total value-added. It is not surprising that this declined over time given the movements of both wages and value-added. However, surprisingly enough, we had an outlier where the negative value was observed and this was excluded. Under normal circumstances and *if this outcome was observed*, the management of this firm should have been extremely worried about their prospects of survival. However, that does not mean that such an enterprise would not be able to respond and turn their luck, but the probability is that the financial market might have not responded favourably to their requests, unless further restructuring took place.

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[7] Both KPI I&II for illustrative purposes only. Both capital and labour productivity calculations would require quality data as explained in Box 1.

Wages per value added (cp)- index
(1995=100)
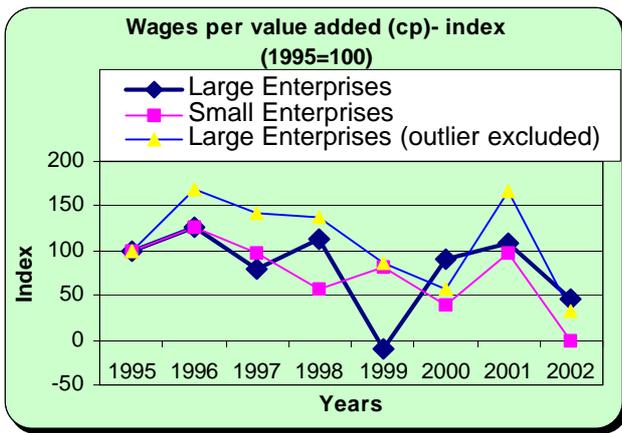
To conclude, almost all indexes in our sample show the downward trend followed with sporadic, but short-lived increases. Given such facts, it is our intention to partially call to economic theory in order to enhance our understanding of the matter from above.

6. Firm-level analysis of investment and uncertainty – theoretical model and hypothesis

Traditional economic analysis at the aggregate level refers to the representative agent while analysing savings and investment trends. As far as the investment is concerned, the representative agent is the firm who tries to maximises its output Y, net of factor inputs (K, L, M) at the given wage (w) and discount rate r. Capital stock adjustment does not happen instantaneously and installation cost function g(I) for the particular level of investment is introduced. More formally,

$$\max \sum_{t=0}^{\infty} \left\{ F(K_t, L_t M_t) - w_t L_t - g(I) \right\} (1+r)^{-t}$$

s.t. $\quad \dot{K}_t = I_t - d K_t$

where second equation nets off depreciation out of the capital accumulation process.

The optimal conditions are found as;

$$\frac{\partial Y_t}{\partial L_t} = w_t$$

$$h'(I_t) = q_t$$

where q is the unit cost of investment installation at the optimum point. Generally speaking, due to a stochastic future return function, increased risks depress level of investments, which leave a firm with the below optimum net present value (NPV).

The argument from above is very well developed by Dixit and Pindyck (1994), who elaborate on the existence of three phenomena – uncertainty, irreversibility of investment and freedom to decide on timing of investment. In their own words, under the situation of a downward shift of industry demand, all competitive firms are as badly affected due to irreversibility of investment. However, the large or monopolistic firm may posses the option value to postpone or wait to execute its investment plan without worrying about losing a market share.

Additionally, each firm receives an inflow of cash that is expressed as the difference between its value of output net of labour payments, intermediate goods and new capital goods

$$NCF_t = f(Y_t, L_t, M_t, I_t)$$

Where NCF stands for net-cash flow of the firm. Assuming that the firm has an infinite life span, a perfect capital market and a certain future cash flow, we can write an expression for the net present value (NPV) of the firm obtained by using discounted rate r, the rate at which firm can borrow or lend.

$$NPV = \sum_{t=0}^{\infty} \frac{(P_t y_t - W_t L_t - p_t M_t - p_t I_t)}{(1+r)^t}$$

It is obvious from the above equation that NPV will depend on the total revenue and costs of factor inputs. Deciding on capital investment is related to how much the firm wishes to produce given the availability of labour. However, when the green light is given to a capital formation and this was executed, due to irreversibility condition, a capital good cannot be easily converted into the consumption good, unless it is sold. This state of affairs is significant for the industry that actually can regard their product (farmed-fish), as fixed capital formation. Consequently, a farmed-fish will most probably require in the short-run (1-2yrs) a fixed amount of labour&capital to feed it until the same reach the marketable size. In meantime, many things can happen, and usually they do.

## Applications to the Faroese fish-farming industry

Is there anything from the above presented theory of the firm that can be applicable to the Faroese fish-farming? To start with, we cannot assume that the fishing industry even remotely mirrors a certain cash flows and infinite life span, but such a concept can help us enhance our understanding about the real life phenomena. One interesting point can be made on an important impulse to invest, given our index indices from the charts. It seems that capital formation took place based on two impulses – price and future expectations. In both cases, uncertainty threshold seems did not play any verification role in order to consider "a real option" to postpone an investment decision.

However, once such capital formation was implemented due to irreversibility condition the industry was at the mercy of the law of demand and supply, and it seems that such a sharp increase of activity also caused environmental stress. The latter issue has, to the best of our knowledge, contributed to the earlier than intended cash-flow realisation (lower in value than expected, too), and due to environmentally forced premature sale of the final product (fresh salmon). To conclude, we believe that greater than average expectations contributed to the speedy capital formation that allowed markets to lower prices and eventually lead to lower revenues and profits. However, we are aware that the Faroese fish-farming producers are price takers at the world market, but one is tempted to conclude that if similar behaviour took place around the globe, and this is true, then this has considerably increased the world supply of salmon.[8]
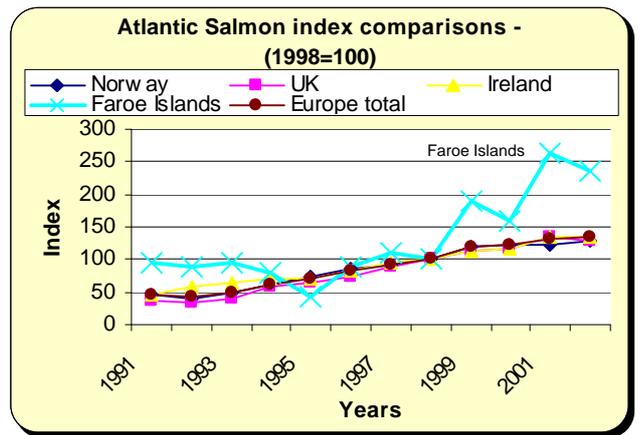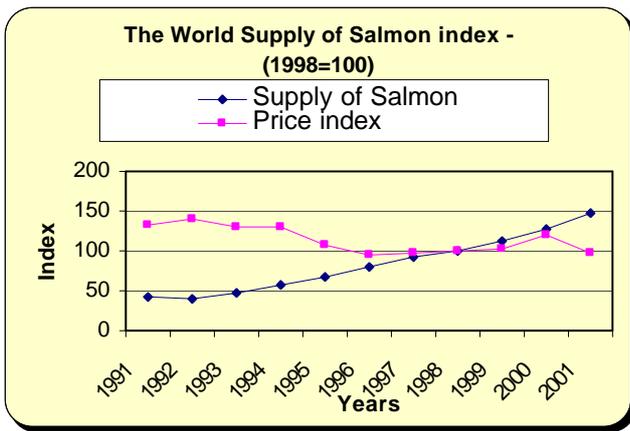
The Faroese farmed-salmon – global comparisons

In keeping with the last point we would like to relate the Faroese farmed-salmon industry production levels to global trends. The salmon farming industry is a big global business and we differentiate between two types; Atlantic vs. Pacific salmon (leaving wild salmon aside), utilising the geographical breakdown. It seems that, the production profile of the Atlantic salmon as shown below took off in early 1990's and never looked back for all 4 countries.
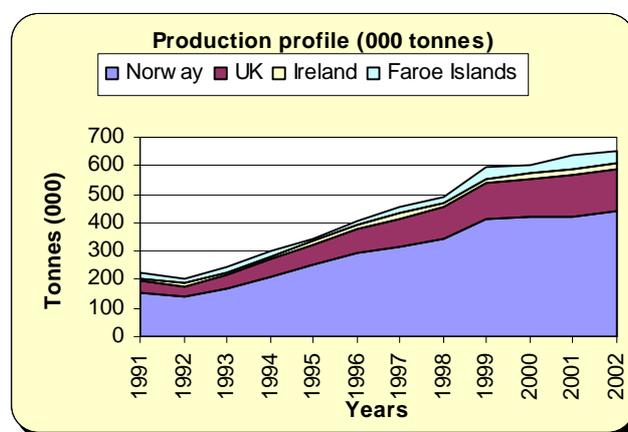

In relation to our next chart, it is visible that production index showed the steady upward trend while price index showed a gradual downward trend with the short-lived increase in year 2000. As it should be obvious by now, year 2000, as shown throughout our analysis reflects a one-off increase of the price. The common understanding of such an occurring relies on relatively lower supply through this period, as well as Norwegian's industry constraint on growth, in form of a feeding quotas starting from 1997.[9]

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[8] The Faroe Fish Farming Association, (H.J. Mikkelsen), "Injury Submission", Vinnuhúsið, House of industry, Tórshavn, Faroe Islands, 2003, p.22

The World Supply of Salmon index - (1998=100)

Atlantic Salmon index comparisons - (1998=100)

The two final charts [10] of our analysis visualise the Faroese farmed-salmon production index in relation to; i) Atlantic salmon producing countries and ii) geographical areas. In both cases non-Faroese time series exhibit steady increase, while same cannot be observed for the Faroese data set.

Aggregate index comparisons - (1998=100)

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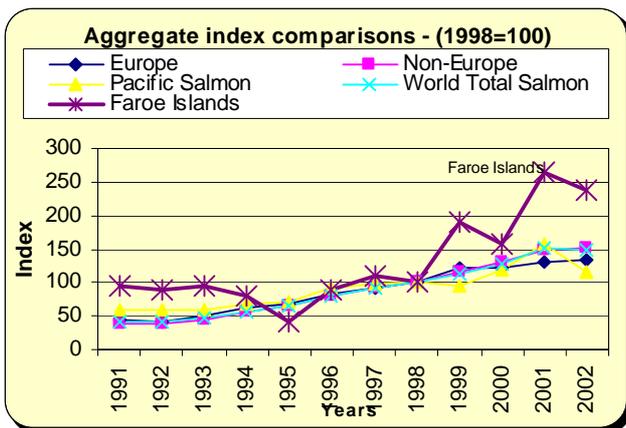
[10] For illustrative purposes only.

In addition to our value-added grouping analysis from above, we are tempted to state that the Faroese fish-farming did not follow average tendencies at both national and global levels. Indeed, more formal analysis of the global data shows in almost all instances that the lowest degree of correlation is persistent if we ignore Iceland's case, (low absolute values). The second table clearly adds to our global observations, where we have correlated some Faroese fish-industry associated groups to each other.

Correlation Table global	Faroe Islands (FI)	Norway (NO)	UK	Ireland (IR)	Island (IS)	Europe total (E)	Atlantic Salmon Total (AST)	Pacific Salmon Total (PST)	World Salmon Total (WST)
FI	1								
NO	0,7773	1							
UK	0,8131	0,9892	1						
IR	0,8656	0,9677	0,9825	1					
IS	0,8321	0,6381	0,7022	0,7549	1				
E	0,8205	0,9967	0,9956	0,9818	0,6854	1			
AST	0,8603	0,9788	0,9887	0,9925	0,7634	0,9901	1		
PST	0,8300	0,8836	0,9279	0,9289	0,8629	0,9080	0,9334	1	
WST	0,8625	0,9753	0,9886	0,9921	0,7777	0,9879	0,9994	0,9454	1

Correlation Table (Faroese grouping)	Fish-farming	Fishery (fresh fish)	Ship's yards	Fishery (other)	Food processing	Fish processing	Fish feed processing
Fish-farming	1						
Fishery (fresh fish)	-0,2368	1					
Ship's yards	-0,1373	0,3242	1				
Fishery (other)	-0,3588	0,8656	0,3995	1			
Food processing	-0,7850	0,4792	-0,2852	0,4607	1		
Fish processing	-0,3167	0,9233	0,1569	0,8149	0,6504	1	
Fish feed processing	-0,6954	0,8129	0,1882	0,7774	0,8475	0,9016	1

7. Finance and the cost to the provider of capital

Analysis from above would not be complete without mentioning the financial sector as well as Foreign Direct Investment (FDI) that provided a financial capital. It is perhaps there where one should look for specific solutions before one makes institutional changes. It is inevitable fact of globalisation that the stock markets activities gave unseen access to the financial capital. At the same time, it would be impossible for such economic activity not to reach the large global companies including farmed-fish producers. Consequently, the various global players become exactly that – global players and one can legitimately question effects of their policies at the local levels. Similarly, at the same level we do not propose to stop such tendencies, but care must be taken where and if the global players are capable disturbing sustainable balances on the local levels.

Further on, it is very important from the capital provider's view to assure healthy rate of returns on the assets provided. In light of such a development, the financial institution's expertise as a provider of not only financial capital but also financial management is perhaps even more helpful and should not be overlooked. To the extent that adequate financial management was overlooked, it is at least questionable if such activity can be offered prior to providing such resources. It is not in our domain to question such an occurrence, but it is obvious that not all proper mechanisms required for smooth and healthy management were available to all parties involved.

8. Conclusion

"*A man is likely to be a better economist if he trusts to his common sense, and practical instincts, than if he professes to study of the theory of value and is resolved to find it easy.*"[11]

A negative value-added of around U$50 mill. as generated by the Faroese fish-farming industry is partly a *men-made*[12]. For this reason we are of opinion that the same *men* can make it to a positive value again, but what is needed to be considered this time is how **to sustain** such positive value-added term. Given all our findings from above it is obvious that industry needs major rethinking of its practices. However, industry must not be left in isolation as this will be a grave mistake and history might repeat itself. On the contrary, the social planer should play a significant, but not the dominant role, which we tried to highlight throughout our paper. Overall, and as far as medium and long-term periods are concerned, the Faroese fish-farming industry would have benefited most from the "steady as she goes" sutsainable approach, in comparison to any other management strategy.

It should be emphasised that the intention of this study was not to derive a sustainable model for the Faroese fish-farming industry (however, see Appendix II for possible "rotten apple" cases). Its scope was more limited based on available historical data, where we attempted to reach some relevant (right or wrong) conclusions by recalling the economic theory. It is up to the reader to judge our success, but we feel that our main task as far as motivating discussion of the matter is completed, and the ball is now in your court. At the end, we hope that no more than common sense will prevail and achieve what economists usually call sustainable economic activity[13].

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[11] Marshall Alfred, "Principles of Economics", Prometheus Books, New York, USA, 1997, p.184
[12] Exogenous factors excluded. However, a question remains if some exogenous factors were endogenised by management practices.
[13] For similar point see "Seyðabrævið" and "Laksebrev" discussion by Andrias Reinert, "Havbrug på Færøerne", 1990, p.9

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Appendix 1: Value-added index distributions

Value Added index_1999

Value Added index_2000

Value Added index_2001

Value added index_2002

Value added index_2003

Value added index_1995-2003
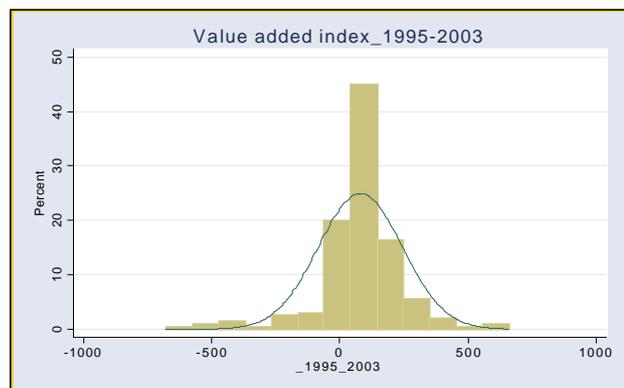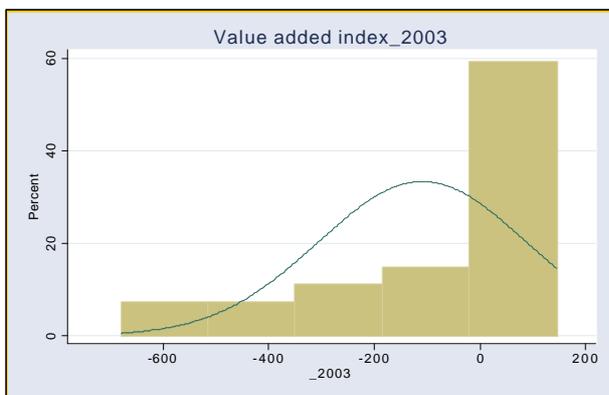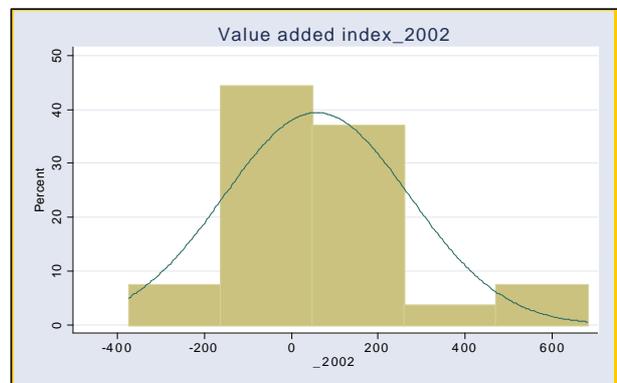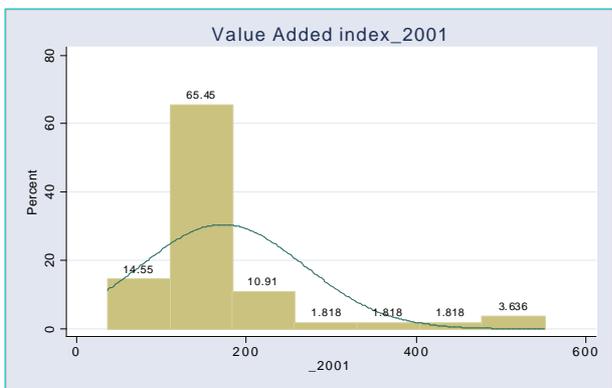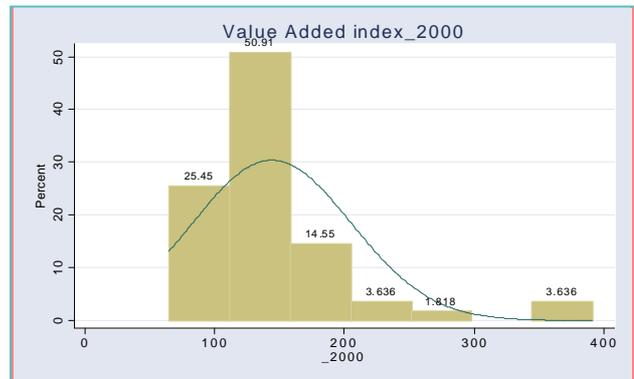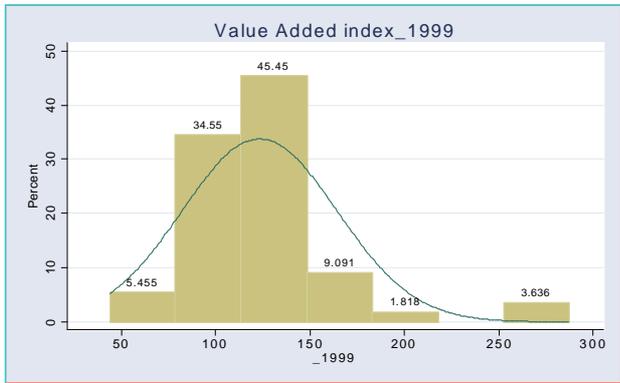
Appendix II: Fish-farming sustainable concept – simplified cases

Participants	Tools	Activity	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6*
Industry itself → Management practices		Sustainable				(+)	(+)	(+)
		Unsustainable	(-)	(-)	(-)			
Social planner → Institutions		Regulated		(+)	(+)		(+)	(+)
		Unregulated	(-)			(-)		
Capital provider → Financial management		Healthy		(-)	(+)			(+)
		Unhealthy	(-)			(-)	(-)	

NB. For illustrative purposes only, cases not exhausted. We define activitites as;

i) sustainable as one not causing environmental stress,

ii) regulated as one that will correct market failures but not dominate the outcome, and

iii) healthy - provides financial management along the provision of financial capital

* Stable case per definition, we assume that no party involved would be motivated to departure from this point, all other cases

including those not presented above contain at least one "rotten apple"