Funded by the European Union

Grant Agreement number: 635188

SUCCESS

Strategic Use of Competitiveness towards Consolidating the Economic Sustainability of the European Seafood sector

Start date of project: 01/04/2015 **Duration: 36 Months**

Deliverable: 5.2

Cost-benefit analysis of different policy options and discussion on socio-economic effects of different policies

Project co-funded by European Commission within the H2020 Programme		
Dissemination level of this deliverable		
PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including Commission Services)	
CO	Confidential, only for members of the consortium (including Commission Services)	

Document Status Sheet

Due date of deliverable	Month no. 32 (submission of draft version)
Actual submission date	
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Version	2.0
Document Status	Final

Change history of document

Version	Date	**Details** (additions, changes, reviews, performed by whom)
1.0	27 March 2017	Overall draft version (Note, major part in the draft of Deliverable 5.3 was moved to deliverable 5.2. Therefore, a draft on major part of the deliverable was first distributed on 22. October 2017)
2.0	30 March 2018	Final Version

CONTENTS

1 OBJECTIVES AND EXECUTIVE SUMMARY

1.1 OBJECTIVES

This report presents the different policy options analyzed in the project, not only with respect to their effects and technical effectiveness, but also with regards to their cost of implementation and benefits that result from them.

1.2 OVERVIEW OF DELIVERABLES IN WORK PACKAGE 5

The main objective of working package 5 is to synthesize, and build upon work from Work Packages 1 to 4.

Deliverable 5.1 contains an impact assessment of technological and regulatory innovations.

- Part I provides definitions and discussions regarding technological and regulatory innovations found in the SUCCESS project and how to measure the impacts.
- Part II lists the main technological and regulatory innovations reported in the SUCCESS project.
- Part III summarizes the main results and concludes.

Deliverable 5.2 contains a cost-benefit analysis of different policy options and discussion on socio-economic effects of different policies.

- Part I summarizes the main aim of EU fisheries and aquaculture policy
- Part II summarizes the main challenges found in the case studies and other deliverables.
- Part III Introduces possible policy options, based on those same case studies and deliverables, as well as on the challenges in part II.
- Part IV uses the tools developed in work package I to analyze different scenarios and compare them to the baseline scenarios developed in deliverable 1.4. Many of the scenarios are based on possible policy options, others are based on possible future scenarios

- Part V provides an overview SWOT analysis for case studies, based on their groupings in deliverable 5.1, as well as a short cost benefit analysis based on the scenarios in part IV.
- Part V concludes

Deliverable 5.3 provides a policy recommendation for the EU based on results from the SUCCESS project.

1.3 Executive summary

The SUCCESS project has identified the following challenges as the main ones faced by European fisheries and aquaculture.

Economic challenges:

- Low levels of profitability and sustainability.
- Restrained market access.
- Disadvantaged competitiveness of small-scale fisheries.
- Overcapitalization.
- Weak bargaining powers.
- Regulatory burdens, especially in aquaculture

Social and cultural challenges:

- Ill-informed consumers.
- Lack of demand.
- Rural flight.
- Loss of local cultures and identities.
- Lack of interest in working in seafood industries.

Environmental challenges:

- Overfishing.
- Un-environmental fishing practices.
- Excessive greenhouse gas emissions.

To tackle these challenges, the SUCCESS project has identified the following main policy options.

Regulatory policy options:

- Simplify and improve regulations, especially for aquaculture
- NTMs intra EU and competitive barriers in international trade.
- Designated areas for small-scale fishing.

- Discard ban.
- Labelling.
- Ban on fuel subsidies.
- Spatial management.

Economic policy options:

- User rights and incentive structures
- Opening of markets and free trade agreements
- Value chain and market/bargain power

Social and environmental policy options:

- Supporting environmental and social responsibility measures.
- Short supply chains.
- Procurement of regionally and sustainably sourced seafood.
- Training and information sharing to consumers.
- Empowering POs and cooperatives

Technical policy options:

- Support the 4th Industrial Revolution targets
- Fund research in technical efficiency
- Support the development of energy saving technologies

The matrix below shows how the main challenges and the policy options are brought together.

	Economic challenges	Low levels of profitability and sustainability	Restrained market access	Disadvantaged competitiveness of small-scale fisheries	Overcapitalization	Weak bargaining powers.	Regulatory burdens, especially in aquaculture	*Social and cultural challenges*	Ill informed consumers	Lack of demand	Rural flight	Loss of local cultures and identities	Lack of interest in working in seafood industries	*Environmental challenges*	Overfishing	Un-environmental fishing practices	Excessive greenhouse gas emissions
Regulatory policy options																	
Simplify and improve regulations		+		?			+										
NTMs intra EU and competitive barriers in international trade			+														
Designated areas for small-scale fishing				+							+						
Discard ban		+/-													+/-	+	
Labelling		+		+		+			+		+						
Ban on fuel subsidies		-			+												
Spatial management				+							+						
Economic policy options																	
User rights and incentive structures		+		+	+						+/-				+		
Opening of markets and free trade agreements		+/-	+														
Social policy options																	
Supporting environmental and social responsibility measures				+								+			+	+	+
Short supply chains		+		+							+	+					
Procurement of regionally and sustainably sourced seafood		+		+						+	+	+					
Training and information sharing to consumers		+							+	+		+				+	+
Empowering POs and cooperatives		+		+		+											
Support SME initiatives on training											+		+			+	-
Technical policy options																	
Support the 4th Industrial Revolution Targets		+			+				+				+			+	
Fund research in technical innovations		+															+
New products & product differentiation		+							+								

Some of the policy options are analyzed in part IV with the models developed in the toolbox in working package 1, along with some other interesting scenarios about the future. These scenarios are:

- Brexit
- Discard ban
- Labelling schemes
- Technological progress
- Ban or reduction of fuel subsidies
- Increased demand for fish in China
- Effect of fluctuations in fuel prices

The quantitative results from different models show that the effect of all these different policy options and their plausible effects differ widely between one fishery and another. In all cases, they demonstrate that the effects of different policy options are great, which in other words means that policies matter.

PART I - INTRODUCTION

The aim of the SUCCESS project is to find ways for policy makers to enhance competitiveness of the EU fisheries and aquaculture sectors. This report summarizes the main findings from the project in this regard.

The SUCCESS project has provided numerous and important insights into best practices when it comes to increasing the competitiveness of EU fisheries and aquaculture. The lessons learned come both from the case studies and other tools in the SUCCESS toolbox.

Below we discuss various issues related to challenges and policies. The SUCCESS project has accumulated vast amount of results and data, both from the different Work Packages as well as from the Case studies. In discussing them, we refer the reader to the main sources of work according to the Work Package (WP) number in parenthesis or Case Studies (CS). In many cases the challenges are addressed in more than one WP or CS in the project, so these references are not complete but still helpful.

The SUCCESS project is composed of the following nine Work Packages (WP):

- WP 1: Effect of global drivers, policies and regulation on growth, jobs and innovation in European fisheries and aquaculture sectors
- WP 2: Consumer preferences, market acceptance and social awareness towards seafood
- WP 3: Competitiveness and sustainability of European fisheries and aquaculture sectors
- WP 4: Trade and value chain
- WP 5: Economic viability and future outlook
- WP6: Management
- WP7: Dissemination
- WP8: Communication
- WP 9: Co-creation and Stakeholder platform

In addition the various Case studies form an integral part of the SUCCESS project (CS):

- Mussels
- White fish
- Seabass – seabream
- Salmonids
- Carp
- Flatfish
- Coastal fisheries

Furthermore, there were several videos specifically produced to highlight important issues related to the project. These can currently be found on the project website http://www.success-h2020.eu/

What is to follow is erected on these building blocks of the SUCCESS project.

2 AIM OF THE EU FISHERIES AND AQUACULTURE POLICY (CFP)

The CFP aims to ensure that fishing and aquaculture are environmentally, economically and socially sustainable and that they provide a source of healthy food for EU citizens. Its goal is to foster a dynamic fishing industry and ensure a fair standard of living for fishing communities.

The management of stocks (officially ‘conservation policy’) is the main objective of the CFP. Maximum Sustainable Yield is the management target since the last reform of the CFP in 2014. In 2020 all stocks shall be managed following MSY, which would, if properly implemented, maximize catches. There is no automatism that this also means a fishing sector that is economically and social sustainability but it’s for sure a very good condition to achieve it.

To this day, the impact of fishing on the fragile marine environment is not fully understood. For this reason, the CFP adopts a cautious approach, which recognizes the impact of human activity on all components of the ecosystem. It seeks to make fishing fleets more selective in what they catch, and to phase out the practice of discarding unwanted fish.

Grouping together the main aims of the CFP is the following:

1. Environmentally, socially sustainable fisheries and aquaculture
2. Source of healthy food for EU citizens.
3. Foster a dynamic fishing industry
4. Ensure a fair standard of living for fishing communities

For these aims to be met, the European fisheries and aquaculture industries have to be economically competitive. Looking for ways to improve the competitiveness of these industries in the EU is the core of the SUCCESS project.

Below, we present the main challenges to further improving the competitiveness of these industries in the EU and thereby help in achieving the aims of the CFP.

PART II – MAIN CHALLANGES

The SUCCESS project has identified the following as the main challenges that impede the competitiveness of EU fisheries and aquaculture. We have classified the challenges in three main groups, i.e. economic, social & environmental and technological. It should be kept in mind that some of these challenges overlap different categories. These challenges have been identified as being major in the SUCCESS project which does not rule out that there might be more challenges, so the list is not complete. No attempt has been made to rank the different challenges according to their importance.

Before moving on to the main challenges that fall into the three categories above, we will discuss an overarching challenge that has to do with data on European fisheries and aquaculture in general.

3 DATA AVAILABILITY

In many of the case studies as well as in the model analysis, reliable and comparable data on different levels of aggregation is missing.

There is a lack of accurate and reliable data at a more disaggregated level, especially with regards to economics, such as revenues, costs, capital, investments, employment and gender, to name but a few. There is also need for more precise environmental indicators, information on fish stocks for different fisheries at different levels of aggregation. The lack of data severly limits the possibilities of performing reliable studies and thereby analysis of the best practices with regards to policy options.

Also, as the policy objectives in the CFP are not only economic, but also social and environmental. Therefore, it is important to have reliable information on environmental indicators as well as social ones. Concerning data on social issues, employment rates and labor composition with regards to age and gender, can provide important information and help in understanding many of the important social issues.

Non-tariff measures (NTMs) are a complex matter, and the definitions of the various measures are not necessarily known. The discussion with the sector during the workshops organised in the SUCCESS project haven shown that a clear defining and classifying of measures would help to be able to talk about specific measures and the issues related to them. Promoting of the international classification of NTMs would be useful to encourage the discussion on NTMs and help identify and talk about the specific issues as well as solutions.

There are several different statistical sources with NTM information, (see Rau and Vogt forthcoming), and different databases that provide information about market access and trade-related issues. For example, the World Banks ”Doing business” indicators are readily available. Such indicators however only contain information for countries but not sector-specific information, which would have been of great help in the analysis of the European fish/seafood and aquaculture sectors in the SUCCESS project.

The global NTM database, NTM TRAINS, provides comprehensive and systematic information on regulations about a broad range of policy instruments that can influence international trade in goods. The information includes traditional trade policy instruments, such as quotas or price controls, as well as regulatory and technical measures that stem from important non-trade objectives related to health and environmental protection, such as Sanitary and Phytosanitary (SPS) measures and Technical Barriers to Trade (TBT). The objective of the database is to increase transparency and understanding about trade regulations and trade control measures.

The information about non-tariff measures is rather limited, and often anecdotes and opinions are presented. The NTM TRAINS database constitutes the most comprehensive database on NTMs and hence it has been used in the SUCCESS project. The fish/seafood sectors (according to HS codes of trade data) is included in TRAINS. NTM TRAINS is a regulatory inventory, and thus provides info if a regulation is part of the legal text of a country. Measures are usually reported to all countries and not specific to one country.

The limitations of the NTM TRAINS database can be summarised as follows:

- Limited number of countries.
- No information if the regulation is enforced and implemented.
- No information about if the measures matter to businesses and what the specific effects are.
- No information about *ad hoc* measures.
- No time series, i.e. changes of NTMs over time but only snapshot in the year of data collection.
- No information for the separate EU member states as the EU is covered as one entity.

Apart from what is available in NTM databases, sector experts could provide insights into the difficulties they face when supplying foreign and EU28 markets. The workshops organised within WP1 of the SUCCESS project have started a kind of dialogue about NTMs. Here, it is important to differentiate between measures, the implementation of measures and procedural obstacles related to the measures. During the workshops both experts on the NTM topic and sector experts were involved, and this combination of participants proved to be crucial to bringing the discussion beyond an opportunity for the sector to report complaints about perceived NTM issues. Given the experience in the workshops, collecting more information on NTMs much depends on the cooperation with the sector and that should be regarded as being prerequisite for further NTM work. In the SUCCESS project, the cooperation of the sector in the EU member states is much appreciated and made the discussion about NTMs possible.

4 ECONOMIC CHALLENGES

Turning from the more overarching question of data to more specific challenges, we start with those that we have classified as being economic. The following challenges are economic in the sense that they affect the finances of the different stakeholders in either fisheries and/or aquaculture in Europe.

- Low levels of profitability and sustainability.
- Restrained market access.
- Disadvantaged competitiveness of small-scale fisheries.
- Overcapitalization.
- Weak bargaining powers.
- Regulatory burdens, especially in aquaculture.

We will now discuss each in turn and in some cases, we refer the reader to the main sources of work according to the Work Package (WP) number in parenthesis or Case Studies (CS). In many cases the challenges are addressed in more than one WP or CS in the project.

Low levels of profitability and sustainability

As a whole, the EU fisheries sector shows low levels of profitability and sustainability (WP 3). This is the main reason why the SUCCESS project was initially launched. The SUCCESS project has clearly shown that there is huge heterogeneity between different fisheries regarding the profitability and sustainability, hence competitiveness. Therefore, it is important not to generalize the main findings of the SUCCESS project for all EU fisheries and aquaculture. The challenges and policy options analyzed in the project hold true for most fisheries and aquaculture activities in the EU, where competitiveness is lacking. Due to heterogeneities in EU fisheries and aquaculture, it is important to keep in mind that in many cases the policy measures recommended must be tailored to specific situations.

Restrained market access

Non-tariff measures, both within the EU and internationally, restrain the market access of some EU producers (WP1). This holds true both for capture fisheries and aquaculture.

Disadvantaged competitiveness of small-scale fisheries

Small-scale EU fisheries suffer the most from disadvantaged competitiveness, both with regards to larger industrialized producers both from the EU and elsewhere, as well as aquaculture imports (WP3). Small-scale fisheries are both economically important in many regions, but also have a cultural prominence that should not be overlooked and may interact with other economic and social activities such as tourism.

Overcapitalization

The member states of the EU are requested to provide a national report on the balance between fleet capacity and fishing opportunities (WP3). The aim is to identify overcapacity and overcapitalization in fleet segments. Scientifically there is no method to draw clear conclusions from the provided data but it is obvious that there are still segments ‘out of balance’.

Overcapitalization results in too much effort, which again means that too much fuel is used in the fishing activities. This has not only negative economic effects but excessive use of fuel also results in excessive greenhouse gas emissions. This is the case in many fisheries, but not all, as is evident in the scenario analysis in Part IV below.

Weak bargaining powers

Looking at the value chain, in some markets the producers have a weak bargaining power, resulting in less than favorable economic outcomes (WP4). Weak bargaining powers of producers means that wholesalers, or other agents further down the value-chain, can drive down the producer prices, resulting in less profitability for fishers and processors. Great care should be taken not to generalize, as in some cases this is a challenge to producers while in others it is not. The SUCCESS project has identified many of the drivers and bottlenecks that weaken or strengthen the bargaining powers of producers, wholesalers and other agents along the value chain.

Regulatory burdens, especially in aquaculture

According to the Blue Growth Strategy the EU aquaculture sector should aim to match the growing demand for seafood in the EU and improve the trade balance with other economic regions. However, the EU aquaculture sector is also facing some difficulties, due to, *inter alia*, lack of qualified workers, space constraints, low competitiveness, public awareness and disadvantageous regulatory measures (e.g. CS Salmonids, CS Mussels). According to many of the cases analyzed in SUCCESS, one of the chief regulatory burdens in aquaculture is due to environmental regulations that hinder growth in the industry, especially regarding the expansion of aquaculture sites.

5 SOCIAL AND CULTURAL CHALLENGES

There are numerous challenges that touch upon the social fabric of society and individuals alike. The project has identified the following social and cultural challenges that EU fisheries and aquaculture face:

- Ill-informed consumers.
- Lack of demand.
- Rural flight.
- Loss of local cultures and identities.
- Lack of interest in working in seafood industries.

We will now give a brief description of each in turn.

ILL-INFORMED CONSUMERS

Many consumers are ill informed about the seafood that they consume (WP2). They have difficulties in knowing the quality of the produce, its origins and how to prepare it. This reduces demand for fish and aquaculture products, not least for high quality goods.

LACK OF DEMAND

In some areas, the younger generations have grown unaccustomed to seafood (WP2). This is linked to the above-mentioned lack of information by the consumers, but is also due to cultural changes, especially with regards to the practice of preparing meals from raw materials. Some innovative initiatives to counteract this trend include educational videos on an internet channel showing how to filet plaice or mixing cooking courses with gastronomic experiences from chefs.

RURAL FLIGHT

Due to the economic hardships for many small-scale fisheries, regions in which they are the backbone of the economy are under threat of rural flight. This damages the social fabric in some rural societies, especially where other employment possibilities may be limited.

LOSS OF LOCAL CULTURES AND IDENTITIES

In many regions, small-scale fishing is not only an economic activity providing jobs and livelihoods but is also an important part of the local culture and identities (WP2). This may also have wider side effects on other industries and employment, such as tourism.

LACK OF INTEREST IN WORKING IN SEAFOOD INDUSTRIES

There is a limited interest among the younger generations, and especially women, to build careers in fishing and related industries (WP2). This is a long-term trend that has been observed in many parts of Europe and has proven difficult to tackle.

6 ENVIRONMENTAL CHALLENGES

There are numerous environmental challenges that European fisheries and aquaculture face. When considering competitiveness of EU fisheries and aquaculture not only financial short term results matter. Environmental damages result in less competitiveness in the long term. These costs are real, although they are often difficult to measure in monetary terms. The SUCCESS project has highlighted the following environmental challenges:

- Overfishing.
- Un-environmental fishing practices.
- Excessive greenhouse gas emissions.

We will now discuss each in turn.

OVERFISHING

Many EU fish stocks are still overfished, affecting both the species in question as well as the whole food chain in the ocean (WP3). Overfishing has been curbed by total allowable catch (TACs) limits for many species, but according to scientific information, overfishing is still an issue for some stocks. Overfishing often results from that the TACs are set too high, with respect to scientific recommendations. It is also common where there is not stringent enough control on catch levels (e.g. due to lack of surveillance and monitoring). Other reasons for overfishing can be the still relatively open access nature of some fisheries, where too many fishers are chasing too few fish which do not have the right incentives to adjust their fishing levels so that the long-term profits of the fisheries in questions are maximized.

UN-ENVIRONMENTAL FISHING PRACTICES

In some cases, fishing practices are not environmentally friendly, resulting in damaged or loss of habitat for marine species. In many instances the use of non-environmental fishing practices or technologies is not due to ill will, but rather due to ignorance about the harmful effects or the lack of economic incentives to adopt more environmentally friendly ways of fishing.

Discarding is defined as the practice of returning unwanted catches to the see, either dead or alive. In theory, this practice usually stems from the economic incentives faced by fishermen where the cost of landing it borne by the fishermen is higher than the benefit. Other reasons for discards such as lack of quota and legal requirements not to land certain catches, also play a major role in incentivizing fishers to discard fish.

EXCESSIVE GREENHOUSE GAS EMISSIONS

Some fishing fleets are energy intensive and therefore emit considerable amounts of greenhouse gases. While European countries have taken steps towards curbing greenhouse gas emissions, fuel subsidies in fisheries are common. A better alignment between these two policies, i.e. GHG emission curbing and fuel subsidies in fisheries is needed.

PART III – MAIN POLICY OPTIONS

There are numerous policy options available to alleviate the negative effects of the challenges identified for EU fisheries and aquaculture industries.

There are also many different ways in which the different policy options available can be classified. Besides, many different policy options can be classified as best practice to tackle different challenges. It is worth noting that policy options that aim to solve a specific challenge may have a counter-effect on other challenges. To give an example, strengthening Producer Organizations (Pos) can help producers by strenghtening their bargaining powers, but at the same time, this may result in adverse effects on consumers, e.g. as higher prices in the market.

In the SUCCESS project policy options are chiefly assessed at the case study level. Generic policies may be ineffective or even do more harm than good, especially in highly diversified industries.

7 CLASSIFICATION OF POLICY OPTIONS

We have chosen to classify the different policy issues in the following four categories;

1. Regulatory policies.
2. Economic policies.
3. Social policies.
4. Technical policies.

Most of the policy lessons learned from the SUCCESS project can be classified according to this categorization. For some policy issues it is not always evident in which category they belong to, but still such a classification can be useful.

Before discussing the different policy issues it is important to note an overarching issue which is directly aimed at the European Commission, and that is the need to improve data collection and dissemination on fisheries and aquaculture in the European Union. The data does not only need to exist, but also both flexible and accessable, and made easy to combine with other datasets.

8 DATA AVAILABILITY – POSSIBLE IMPROVEMENTS

In Part II we already discussed the numerous problems related to data issues regarding European fisheries and aquaculture. In what follows we discuss some areas in which policymakers can make positive contributions to improve the data collection and dissemination.

8.1 The EU Data Collection Framework

There is a large amount useful data available in accordance with the Data Collection Framework (DFC), which was used in many parts of the SUCCESS project. Still, data availability was often the limiting factor in the analyzes and in the models used.

8.2 Production data

To properly analyze the economic situation of the various fleets or industries, such data is needed, both on aggregate and unit level. It is important to be able to link economic outcomes to specific production units and processes to evaluate the competitiveness.

Both for the case studies and the modelling there is need for more disaggregated data, especially with regards to economic information, such as revenues, costs and profitability.

There is a data available since the year 2000 for fisheries. Time-series data publicly available is only available from the year 2008, covering almost all EU countries, yearly updated and focusing on economic performance of fleet segments (common and basic segmentation at EU level). Ensuring longer time-series would certainly be an improvement.

The data availability for aquaculture is more limited. Since 2008, the data on aquaculture has only been updated twice, 2014 and 2016. Much of the data is either missing or unreliable, depending on countries and segments. Yearly updates of the data and ensuring time-series data would be very helpful for research into the aquaculture sector.

8.3 MARKET CHAIN DATA

Similar things can be said about market chain data for fisheries and aquaculture. The data bases should allow researchers to collect data and match and combine the data for different aspects of fisheries, including economic, biological, environmental and social. This would e.g. enable better research into sustainability and competitiveness of producers. The following would greatly help researchers:

- Having indicators for the whole description of production systems, including on labor and capital/ownership structure.
- Market oriented and environmental indicators at producer level.
- More disaggregated data.
- Greater flexibility in choosing the a level of aggregation. This needs to hold across different datasets, so they can be efficiently combined.

Lower level of aggregation would allow researchers to answer questions related to specific fisheries or aquaculture groups, rather than to make general observations. It would also allow them to assess specialization or diversification of producers, and map out in greater detail the geographical variability of some production systems.

For the modeling work, especially, time series on biomass for specific stocks and fleets need to be more accessible at different levels of aggregation.

8.4 NTM DATA

The NTM data in TRAINS in general captures the EU28 as a whole. The reason is that the EU28 is regarded as a region with one harmonized policy and regulation system, i.e. all member states deal with a similar set of NTMs when importing or exporting within the EU. This may not always be the case, as further discussed below. Information about NTMs that affect intra-EU28 trade is not reported, though in practice different NTMs are in place.

For a better picture of the increasing role that NTMs play in trade between EU and third countries, as well as in trade between EU member states, NTM data collection needs to be extended over more countries. First, especially important countries that import EU fish/seafood exports are missing, as well as countries that supply the EU market.

It is recommended that the EC will support the extension of data collection towards more country detail, including the EU member states.

Second, the workshops that have been conducted in the EU member states have revealed differences in the interpretation and implementation of EU rules and regulation in the member states. As such, we would recommend a further discussion of the sector to further analyse the gaps in the level playing field across the different member states of the EU. This could be followed by a regulatory cooperation that would help to close the gaps and to bring coherence in the NTM interpretation and implementation issues. In addition, policies should lead to more transparency and dissemination of information about the NTMs, including creating possibilities for discussion and cooperation of the sector across the member states.

Third, NTM data usually miss the time dimension. Information about the point in time of implementation or withdrawal of measures would provide time series data and thus help to improve the quantitative analysis to go beyond cross section estimations. The time dimension is also relevant for *ad hoc* measures that countries may temporarily use to protect animal, plant and human health. For these measures the start and end date is crucial, but information particularly about the end date, e.g. the date of a ban being released and trade relations re-established, is not reported upon. Time series data would help to determine the impact of NTMs on trade business, because the situation before and after the introduction of NTMs (i.e. without and with NTMs) and the changes in the number of the NTMs can then be considered.

9 REGULATORY POLICY OPTIONS

There are numerous ways in which policy makers can change the regulatory framework to increase the competiveness of EU fisheries and aquaculture. The SUCCESS project has identified and analyzed the following:

- Simplify and improve regulations, especially for aquaculture.
- Remove NTMs intra EU and competitive barriers in international trade.
- Consider using designated areas for small-scale fishing.
- Discard ban.
- Labelling.
- Ban or reduce fuel subsidies.
- Consider spatial management.

We will now discuss each in turn.

9.1 Simplify and improve regulations, especially for aquaculture

There is a common theme throughout the case studies on aquaculture, and a clear message from stakeholders that the regulatory framework, especially for aquaculture, stunts growth in the sector (WP3, WP9, CS Mussels, CS Salmonids, CS Carp, CS Seabass/seabream). There seem to be ways in which environmental, hygienic and other aims can be reached while at the same time streamlining and speeding up processes, especially with regards to new installments and expansion of current fish farms. This is an overarching policy matter.

Simplifying and improving regulations should *ceteris paribus* cut costs and thereby increase profitability. It might also help new entry into the industry. How streamlining regulations affects different fleet segments, e.g. small-scale fisheries, is uncertain and depends on the specific implementation. The lifting of regulatory burden is especially important for EU aquaculture.

It is important to ensure coherence between different policies. A specific regulatory measure is perhaps needed, e.g. to ensure fair implementation of Marine Spatial Planning policies. There is also need to provide tools and methods to create conditions of social acceptability towards aquaculture development and implementation of new aquaculture technologies in general.

Integration of EU regulations that apply to fisheries and aquaculture into cross-policy sustainable food systems framework is also needed.

At the same time, it is important to look at the regulatory framework regarding the value-chain, including rules on vertical integration and cooperation along it. The SUCCESS project has underlined the heterogeneity of these issues between different countries and production processes.

9.1.1 Support the integration of market issues into the management of fisheries and aquaculture at the EU level

More care should be taken in integrating market issues into the management of fisheries and aquaculture, e.g. when deciding upon TACs in a multi-species/multi-fleet context (WP3, CS Flatfish). Drastic changes in quotas can have adverse effects on the market, shifting demand between species, changing prices, etc.

Improving market statistics and further developing tools to adjust the supply in aquaculture to market demand has proven to be one way of improving efficiency and competitiveness of fisheries, (CS Seabass - Seabream).

9.2 NTMs intra EU and competitive barriers in international trade

Non-tariff measures, even within the EU, often function as barriers to trade and thereby stifle trade and growth of the sectors (WP1). Reducing the negative effects of NTMs on trade could ease market access for many firms.

The recommendation is to identify and remove barriers to competition, both within the EU and internationally. This includes improving general knowledge regarding NTMs, especially to identify which markets are closed to EU products.

Implementation issues can create barriers although they are not formally NTMs but that need to be eliminate to improve the competitiveness of the industry. This can also mean that it can be advisable to implement barriers, in some cases, to level the playing field. This means increasing protection of EU producers that compete with countries which do not use the same social and environmental norms as in Europe (CS Seabass-seabream).

9.3 Designated areas for small-scale fishing

One of the chief concerns of EU fisheries policies is to strengthen and secure the sustainability of small-scale operators. One of the policy options available to achieve this aim is to designate specific areas for small-scale fishing (WP3). This seems to be a viable option in some cases. Such measures might also help in alleviating problems, both economic and social, related to rural flight.

9.4 Discard ban

A discard ban has been introduced in many fisheries, both within the EU and elsewhere. Discards are considered to be non-environmentally friendly but the effectiveness of such ban differs for different fisheries depending on costs, prices, monitoring possibilities and other factors. How a discard ban affects overfishing depends on how the fishing rights are defined and allocated. If properly implemented a discard ban may reduce overfishing, but if total allowable catches are increased to counter the loss in catches due to the discard ban, then the effect may be negative with regards to overfishing.

9.5 Ban on fuel subsidies

Fuel subsidies are common in many fisheries (WP5). While such subsidies increase the competitiveness of these fleets they run counter to other aims, such as energy savings and curbing of greenhouse gas emissions. European fishing fleets could be supported through other means, e.g. subsidizing labor, capital investments or other inputs. Bans on fuel subsidies will, other things equal, increase costs and thereby lower profitability. Market price transmission mechanisms determine to what degree the cost increase can be moved along the value chain. A ban on fuel subsidies should reduce overcapitalization. It should be kept in mind that a ban on fuel tax exemptions would probably have large distributional effects, especially as tax rates on fuel differ considerably between countries in Europe.

9.6 Spatial management

There are many ways in which spatial management measures can be used to better manage both fisheries and aquaculture in the EU. Disputes between different users, such as fishers and aquaculture firms, could be solved through well-designed policies that provide improved frameworks for how to utilize different areas for different users (CS Mussels, CS Salmonids). Also, designated area measures that allow only small-scale fishers to operate in the area, can strengthen their comparative competitiveness and counter rural flight from area reliant on small-scale fisheries (WP3).

10 ECONOMIC POLICY OPTIONS

How to improve the competitiveness of European fisheries and aquaculture depends, to a large degree, on economic efficiency (WP5). Economic efficiency can, in turn, be attributed to economic policies. Among the main policy options available are:

- User rights and incentive structures.
- Opening of markets and free trade agreements.
- Improving the value chain and market/bargain power.

USER RIGHTS AND INCENTIVE STRUCTURES

Much work has been done in fisheries economics on studying the relationship between different economic policies and economic outcomes. User rights and economic incentives have proven to be effective in increasing total profitability of the industry in many fisheries, but often with important social consequences. We will discuss social policies below.

A study conducted in the SUCCESS project has demonstrated how international trade in quotas can alleviate the negative impacts of landing obligations for mixed demersal fleets (CS Whitefish).[1]

The allocation of user rights will strengthen the competitiveness of those that receive such right, such as small-scale fishers. User rights have proven to be very efficient in reducing overcapitalization. Again, the allocation and tradability of user rights can have either negative or positive effects on localities depending on the fisheries, depending on the implementation, especially with regards to whether and how these rights are transferable. Here there is a clear trade-off between achieving efficiency goals and other social considerations.

OPENING OF MARKETS AND FREE TRADE AGREEMENTS

The EU single market is the biggest import market for seafood in the world. The same time exports are important to many fishing and aquaculture companies. Further opening of markets and free trade agreements will affect the competitive position of European fisheries and aquaculture. The effects may be either positive or negative, depending on many factors, including the implementation of the free trade agreements.

[1] See also Mardle, S. and S. Metz (2017).

The rising of China and other Asian countries in the world trade for seafood provides both threats and opportunities for European fisheries and aquaculture (WP1).

10.1.1 REMUNERATION OF MULTI-FUNCTIONALITY

Aquaculture production, especially traditional carp farming, has positive externalities, such as landscape preservation, provides ecosystem services, are an integral part of the cultural landscape and is an important part of tourist experiences in certain regions (CS Carp). These positive externalities are not remunerated in the market place to the full extent, and the question arises whether additional compensation to the farmers to sustain production can be an economically efficient way to preserve those positive externalities. Seen in this view it may be argued that carp farmers could be made eligible for CAP pillar 2 funding. The multi-functionality and role of carp farming in certain regions may also play a considerable role in territorial branding, can help in establishing structures to accompany other collective project in the regions and opens up possibilities of increased cooperation with other sectors, such as tourism.

11 SOCIAL AND ENVIRONMENTAL POLICY OPTIONS

Social policies can affect the competitive position of EU fisheries and aquaculture in many ways and help in achieving many of the goals of the EU Common Fisheries Policy. The main social and environmental policies analyzed in the SUCCESS project are:

1. Supporting environmental and social responsibility measures.
2. Short supply chains.
3. Procurement of regionally and sustainably sourced seafood.
4. Training and information sharing to consumers.
5. Empowering POs and cooperatives.

SUPPORTING ENVIRONMENTAL AND SOCIAL RESPONSIBILITY MEASURES

There are many stakeholders in Europe, both within and outside of the industries that have shown real concerns regarding environmental and social issues (WP2). Where such initiatives are aligned with the aims of the CFP, including increasing the competitiveness and sustainability, they can be further strengthened through financial and other support. Such support can be conditioned on specific fleets, e.g. small-scale, and can be very effective in protecting local cultures and identities. Also, such support can be used to help in the adoption of environmentally friendly fishing techniques, including the reduction of greenhouse gas emissions, to name one example.

SHORT SUPPLY CHAINS

New technological solutions, e.g. marketing and selling through Internet platforms, has made it feasible to shorten the supply chain between producers and consumers, while at the same time meeting increased demands for direct buying for consumers (CS Coastal fisheries). Shortening supply chains can have the positive effect on meeting local demand with local supply and thereby strengthen the local communities at both ends and the economic and social relationship between fishers and consumers in the localities. The SUCCESS project has highlighted some interesting cases where producers have taken advantage of such opportunities and at the same time strengthened their competitive position.

11.1 Labeling

Research carried out in the SUCCES project indicates that labeling schemes can be an effective way to profitability for the industry, while at the same time convey information about the products and production methods (WP2). Producers may receive higher prices for labeled products than otherwise. Labels may help small-scale fisheries with product differentiation and thereby increase their competitiveness with regards to other fleets and strengthen local fishing towns and regions (if the labels are e.g. geographically designated). At the same time, it may help in strengthening bargain power of those that are in possession of a label. In some markets, however, there are signs of label fatigue, which decrease the effectiveness of using labels to increase profits. Most of the labeling schemes already in use are private initiatives.

Consistency between European quality schemes and European organic labeling schemes could be improved, especially for shellfish farming and salmonids.

PROCUREMENT OF REGIONALLY AND SUSTAINABLY SOURCED SEAFOOD

Work done in the SUCCESS project has demonstrated that procurement of regionally and sustainably sourced seafood can achieve many goals, such as increasing awareness of local produce, help in promoting public health goals, while simultaneously increasing competitiveness of local producers (WP2).

These procurements could include universities, schools and other public buyers. This can also help in promoting knowledge about seafood products and be especially helpful in promoting lesser-known species.

A great care should nonetheless be taken to ensure that competition rules are not infringed.

TRAINING AND INFORMATION SHARING TO CONSUMERS

Educational and training programs can be effectively used to increase knowledge and raise awareness, both among producers, wholesalers, retailers, consumers and other stakeholders (WP2). Increased ocean literacy can sway consumer preferences toward both economically and environmentally friendly products while at the same time increasing consumers' satisfaction.

Special training programs for SMEs can also help in increasing competitiveness while at the same time reaching economic and environmental goals. Such program may e.g. help SMEs in adopting better fishing and harvesting techniques and reduce negative effects from their production such as greenhouse gas emissions.

EMPOWERING POs AND COOPERATIVES

Work done in the SUCCESS project has underlined the important role of producer organizations and cooperatives in strengthening the competitiveness of their members and their bargaining power (CS Mussels, CS Seabass-Seabream, CS Coastal fisheries). Examples include new ways of harvesting, introduction of new and improved products and important part played in labelling, product differentiation and marketing.

12 TECHNICAL POLICY OPTIONS

Competitiveness is directly influenced by adoptions of technological innovations. Public authorities can play a role with specific policies.

1. Support the 4th Industrial Revolution targets
2. Fund research in technical efficiency
3. Support the development of energy saving technologies
4. New products & product differentiation

SUPPORT THE 4TH INDUSTRIAL REVOLUTION TARGETS

Great strides have been made in recent years with regards to the use of information technology, data science and artificial intelligence. Such innovations provide opportunities all along the value chain for fisheries and aquaculture. They may decrease transaction cost, reduce overcapitalization, help with traceability and increase information flows in general.

Technologies that help with traceability and information dissemination along the market chain should be promoted. This can go hand-in-hand with training and educational programs for people working along the whole value-chain, from producers to consumers (WP4).

FUND RESEARCH IN TECHNICAL INNOVATIONS

There are various technical innovations that the SUCCESS project has analyzed that have the potential to increase the competitiveness of EU fisheries. These include new harvesting technologies, such as pulse fishing. These have nevertheless to be further analyzed as they may pose a threat to the environment.

SUPPORT THE DEVELOPMENT OF ENERGY SAVING TECHNOLOGIES

The SUCCESS project has pointed out to technological innovations in gear design which show the potential of drastically reducing energy consumption of the vessels and thereby simultaneously increase competitiveness of the fleet and reduce negative effects of fuel use such as pollution and greenhouse gas emissions. There is a specific video on the project´s website discussing the Sumwing trawl technology. It illustrates how technological improvements can greatly enhance energy use in fisheries.

NEW PRODUCTS & PRODUCT DIFFERENTIATION

The SUCCES project has also analysed technical innovations that increase shelf life of products (CS Mussels). Increased shelf life increases the value of the product, reduces waste and cuts costs.

PART IV – SCENARIO ANALYSIS

Scenario analysis are conducted in this Deliverable 5.2. Different scenarios or stories about plausible future development have resulted in different assumptions concerning changes in the future patterns of technology, economic and demographic development, consumer preferences and/or domestic and international policy measures. Models from the SUCCESS toolbox are used to quantify the impacts of the various scenarios in terms of comparing these with the outcomes of the baseline scenario developed in Deliverable 1.4. A further discussion about the scenario building framework can be found in D1.4.

The model outputs should not be considered to be forecasts, -neither the baseline scenario nor any of the alternative scenarios. They are comparisons between baseline cases and computed outcomes, given specific assumptions, which may in some cases be more realistic than in others.

Note that if more qualitative oriented scenarios cannot be analyzed by a model in the SUCCESS toolbox, then a qualitative analysis method is applied.

12.1REVIEW OF THE TOOLBOX MODELS

Deliverables 1.3 and 1.4 outline the three models of the SUCCESS toolbox that are used here for scenario analyses. The marginal cost model (MC model) is a static model based on microeconomic foundations, and can be applied on different scales and different level of aggregation. AGMEMOD and MAGNET are macro oriented equilibrium market models and can be used to simulate the dynamic evolution of competitiveness under a variety of conditions including those influenced by government and trade policies.

A full description of the models and the data can be found in Deliverables 1.3 and 1.4. What follows is a short summary description of each of them.

The marginal cost model (The MC model):

The MC model defines competitiveness as an profits divided by operational income.

The data used in the running of the model comes from *Annual Economic Reports* published by the European Commission. This data set covers:[2]

- 7 years (2008 - 2014)
- 23 countries
- 7 types of fishing gear
- 8 different levels of vessel length
- 3 fishing regions

The model is rather simple with only four control variables, i.e. operational cost, effort (proxied by energy consumption), quantity of catch (tons landed) and prices. All changes in other variables in the scenario analysis must therefore be morphed into changes in these four control variables. The model results are all expressed as a function of effort, meaning that the results are different for different level of effort. These functions, more specifically are; a *quantity* function, a *cost* function, an *income* function, a *profit* function and a *competitiveness* function.

MAGNET:

MAGNET is a general equilibrium model for global commodity markets. It reflects the complexity of interaction between the fishery and aquaculture sectors and the rest of the economy in the factor markets and in international trade with various world regions.

Its actors are countries and world regions, of which the EU may be defined as one. Because of its general equilibrium properties its level of aggregation over commodities is higher, i.e. the number of commodities lower, than AGMEMOD's, which is described below.

MAGNET can be used to project prices and quantities and simulate the impact of exogenous shocks such as policy measures. An important use of MAGNET in combination with AGMEMOD is that MAGNET can generate fish stocks projections that can serve as key driving factors for the fish supply markets in AGMEMOD.

AGEMOD:

AGMEMOD is a partial equilibrium model for EU commodity markets comprising a high number of products and therefore markets. Its level of aggregation is industries and countries, i.e. it considers the supply by industries and countries of the various commodities. It also includes the demand for the various products. The interaction between supply and demand determines equilibrium prices and quantities which in turn

[2] https://stecf.jrc.ec.europa.eu/data-reports

determine profitability. The model can be used for projections given the exogenous variables and simulating the impact of exogenous shocks and various policy tools such as trade and processing activities of fisheries and aquaculture groups in EU Member States.

12.2 SCENARIOS

The following table summarizes the type of scenario analysis applied, which originates from findings of the SUCCESS project. In order to utilize each model's strength, different aspects (i.e. regarding regional coverage, sector coverage, as well as social, economic or environmental challenges) of a scenario can be captured by using more than one model for a specific scenario. The models are complementary to each other.

Scenario	Exogenous shocks (MC Model)	MAGNET	AGMEMOD
Brexit	Price: ↑ 4%, 14,2%, 30% Landings: (not modelled, see below)	**Brexit_TFC:** TFC applied on trade in goods (excl. serv. & util.) between EU-UK, set on 8% **Brexit_fish:** Brexit_TFC + Loss of fishing access to UK part of EU-EEZ and vice versa **Brexit_NTM:** Brexit_fish + NTM measures on imports of all goods and services between UK-EU (compilation of sources) **Brexit_NTM_WTO:** Brexit_NTM + WTO Import tariffs for UK-EU trade set on MFN rates (from Yu et al. 2017)	
Discard ban	Both scenarios; Price : low case ↓10%; medium case ↓20%; high case ↓30% Scenario 1; Cost: low case: ↑16,4%; medium case: ↑20%, high case: ↑23,6% Scenario 2; Cost: low case: ↑ 10%; medium case: ↑15%, high case: ↑20%		5% increase in biomass for plaice since 2020. 5% increase in Biomass for pelagic marine fish from 2024. 15% increase in capital and labour cost, for pelagic and demersal marine fish from 2019 Plaice production would face a technical progress after 5 years from 2020 to 2024,
Labelling Scheme	Net price; low case: ↑4%, medium case: ↑24%, high case ↑44%		

Technological progress	Efficiency (CPUE); ↑ low case: 5%, medium case 10%, high case ↑ 20% AND Cost change; low case: ↓5%, medium case ↓10%, high case ↓20%		
Ban on fuel subsidies	Energy cost ↑ 21% (low case 5% - high case: 21% + 331 EUR/LTR)	a general increase in fuel tax across Europe of 20%	Increase of 7.5% in energy costs and an increase in 4.5% in feed costs, the latter only for aquaculture production
Increased demand from fish in China		Demand increases faster than was assumed in the baseline scenario	
Effect of fluctuations in fuel prices	Energy cost: ↑ 75% (-35% - 250%)		

We will now present the main results for the different scenarios from the different models in the SUCCESS toolbox.

13 AGMEMOD

13.1 Effect of discard ban

13.1.1 Baseline description

In the baseline case the AGMEMOD model includes, 8 fish categories, 29 countries, subsidies and operational costs, quotas for EU members states plus Norway and Iceland, prices for various prices, such as landing prices, and biomass for various species.

More details are in the following table:

8 fish categories: Cephalopods, Molluscs except Cephalopods, Crustaceans, Fresh water fish, Demersal marine fish, Pelagic marine fish, other marine fish, Plaice.
29 Countries: EUMS (except for Malta and Cyprus), Norway, Iceland , Turkey and Rest of the World (RoW)
Includes Support and Operational Costs
Includes Quota for EU MS, Norway and Iceland + Shadow Margin
Prices: Includes Landing Price, Incentive Price as Incentive Margin (production margin), and a shadow margin (with respect to the shadow price) in case of commodities with quotas.
Incentive Margin, as results from Landing Price + Support - Costs
Include discard ban as an increase in capital and labor cost since 2015 only for Plaice and for EU MS.
Include Biomass for Plaice and Pelagic fish, and Biomass growth in Production Equation.
Quota and Biomass per year (from 2011 and 2030,and not as % increase)
Quota increase since 2016 in 1% for all countries.

Biomass calculations according to historical data.

13.1.2 BACKGROUND AND CONTEXT

Worldwide by-catches are increasing, both as other fish than the target or as under sized target fish. This by-catch can be problematic for stock recovery. These unwanted catches are discarded to the sea, mostly dead or highly injured. This is not only a waste of natural resources but also a threat to the biomass and marine ecosystems.

Discard ban policies aim at stimulating innovations in more selective fishing methods. These measures can e.g. be focused on more selective gear, new types of vessels, that increase the selectivity of fishing, and thereby reduce by-catches. The EU discard ban is expected to influence costs and quota filling of capture fisheries. This policy is only applicable to EU Member states and species regulated by TACs. It has already been implemented since 2015 for sole and plaice species. For other quota species such as pelagic species; cod, hake and whiting (whitefish species) it will be implemented as of 2019.

1. **Problem and challenges of a discard ban**:

a. Increase in operational costs: New technologies to avoid discards could need some years and high levels of investment to be developed. Therefore, facing the discard ban policy, the implementation of technologies to gradually reduce discards involves an increase in operational costs, mainly labor and capital costs.

b. Quota filling: Discard ban measure is only applicable to TAC regulated species. Juvenile target fish fill the scarce quota and provoke higher prices. Non-target species should be allocated under the Quota system. Therefore, fishers may have to buy or interchange quota for unwanted species.

c. Increase in biomass: Reducing the catches of juveniles target species should promote the stock recovery, but is not clear in how many years and to what extent. Additionally, there is not clear if there are specific non-target species associated to the target species when they are caught. So, discard ban would promote the stock recovery of other additional species. Again, it is not clear which species, in what time terms and to what extent.

d. Improvement in technology: New technologies will initially require a high level of investment, and additional costs. However, it should represent a subsequent efficient use of operational resources, reducing at the end operational costs. However, is not clear in how many years would it be possible, and to what extent.

2. **Assumptions made in the model**:

a. As the discard ban policy is already applied since 2015, the scenario considers a stock recovery for plaice. This is represented by 5% increase in biomass for plaice since 2020.

b. The same situation is expected only for pelagic marine fish, but after 5 years from when the policy has been in force. This is represented by 5% increase in Biomass since 2024.
c. It is considered a 15% increase in operational costs, specifically capital and labor cost, for pelagic and demersal marine fish since 2019, as effect of the improvement in selectivity to reduce the discards.
d. Plaice production would face a technical progress after 5 years from 2020 to 2024, as result from intensive investigation to develop new technologies for reducing discards.

13.1.3 PLAICE

13.1.3.1 Production

The Netherlands, Denmark and United Kingdom have the biggest catches of plaice (measured in weight). Under the baseline, plaice production in the Netherlands is expected to increase 86% over the period, from 29.3 thousands tons in 2011 to 54.45 thousands of tons by 2030. This figure increases 3,2% under the discard ban policy (Scenario 1) with respect to the baseline, reaching 55.24 thousand tons by 2030. The same pattern is observed in Denmark, which production slightly increase 1,3% more by 2030 under the scenario 1 with respect to the baseline. The increase of production in both cases is motivated by the stock recovery of plaice, the increase in prices and the level of costs. Although the production increases, the margin in both countries is still positive. Additionally, the Netherlands have been working in developing new technologies for many years. These technologies increase the efficiency of production, promoting as well as an efficient use of resources which are reflected in a future reduction of costs. A different result is observed in the United Kingdom, where only a slight change is observed during the period. Plaice production in the United Kingdom increase 2,39% from 17.17 thousand tons in 2011 to 17.58 thousand tons in 2030 under the baseline. After applying the discard ban policy, the production slightly decreases, reaching 17.52 thousand tons by 2030. This result is explained by the fluctuating production margin that United Kingdom fisheries has to face, which decreases remarkably over the period. Germany represents a special case, although it only represents by 2030 3% of total plaice production in the world, it is the only country which plaice production diminishes over the period from 4.26 thousand tons in 2011 to 3.48 thousand tons by 2030 under the baseline. This situation intensifies under the baseline scenario, where production reduces 19,5% at the end of the period. This is mainly explained by the production of elasticity. Plaice production is highly elastic, more than in other countries. Therefore, it is highly affected by changes in prices. Additionally, the cost distribution plays a role. As well as United Kingdom, the major costs in plaice production are labor and capital costs, which are directly affected under Scenario 1. Furthermore, the production margin decreases considerably.

13.1.3.2 Effect on production margin

Production margin decreases in all country as result of the reduction of the prices over the period, and this would be intensified under the scenario 1 due to the increase in operational costs, i.e. labor and capital costs. The major decrease is presented in Spain. As the model does not include transferable quotas between countries, each country is limited by its assigned quota level. In the case of Spain, it produces exactly its quota level, which only increases in 1% per year. Therefore, Spain receives a shadow price for its plaice production decreasing the production margin over the period. This is followed by United Kingdom, which production margin decreases -71% under the baseline and -75% under the scenario 1. Germany is also deeply affected, but in less level than the United Kingdom. The production margin decreases by -59% under the baseline and -5% additional under the scenario 1. On the contrary, the Netherlands is one of the countries which showed less loss on production margin. It decreases -27% from 2011 to 2030 under the baseline. However, the application of the discard policy produced an additional loss of -40% in production margin in comparison with the baseline.

13.1.3.3 Demand

The effect of reduction on prices is less on the demand side than the production side. Rest of the World (RoW) represents 22% of total plaice consumption in the world in 2011. Due to its price and the fact that plaice demand in RoW is high elastic, total use increases 110% under the baseline over the period, and 112% under Scenario 1. The major plaice consumption country, Italy, represents 25% of total plaice consumption in the world in 2011. Contrary to RoW, Italy shows a smaller growth, 14% under the baseline and 15% under the Scenario 1. In the case of the Netherlands, Denmark and United Kingdom, there is almost no difference on the demand development under the baseline and scenario 1. The total demand in the Netherlands, Denmark and United Kingdom increases 29,6%, 24,2%, 27,6% respectively under the baseline and this barely change under the scenario 1 to 29,9%, 24,5%, 28%, respectively.

13.1.4 PELAGIC MARINE FISH

13.1.4.1 Production

RoW provides 87% of total plaice production in the world. This is followed by Norway (3,2%), Iceland (1,8%) and Spain (1,31%). RoW increase production moderately 12.2% under the baseline and there is almost no change under scenario 1 (12,3%). The major increase in production over the period is observed in France with 178% under the baseline. Pelagic marine fish production in France is considered high elastic, and therefore more sensible to the changes in prices than other countries. Prices for pelagic marine fish barely decrease under the scenario 1, this together with the increase in operational costs provoke a smaller increase of production of 171% over the period in comparison with the baseline. Norway and Iceland expect to increase their production over the period in 74% and 104% under the baseline. As Norway and Iceland are not affected by the discard ban policy, they do not present an additional increase in capital and labor cost. Therefore production increases more under scenario 1, 78% in Norway and 108% in Iceland over the period. Most of the countries show bigger increase over the period under scenario 1 than under baseline, despite the higher operational costs and reduction of prices. This is explained by the increase of the biomass in pelagic marine fish, which is positively correlated with production. Additionally, in this case, countries have not to adjust their production with a quota level, as the model does not include quota for pelagic species.

13.1.4.2 Production margin

The lack of quota restrictions and the increase on biomass that promote production produce an increase in production margin over the period in all countries. Since the operational costs increase under scenario 1, this reduces the profitability of pelagic production in all countries. As expected, the smaller changes under scenario 1 with respect to the baseline are observed in Norway, Iceland, and Turkey, countries where the policy is not applicable. Norway, Iceland and Turkey show an increase in profitability (production margin) of 11%, 13,3% and 9,5% respectively from 2011 to 2030 under the baseline. The decrease of prices under scenario 1 provokes a minimal reduction on profitability on those countries. Under scenario 1, profitability of Norway, Iceland and Turkey increases 10,6%, 12,8% and 9,1% respectively. Spain, as main pelagic fish producer within the EU MS, presents the highest increase in profitability among the countries. Under the baseline, the production margin increases 146% for the period 2011 to 2030, and this reduces to 133% under scenario 1. It is important to highlight that at the same time, Spain exhibits a smaller production margin than the average. Therefore, the increase of the biomass[3] and the lack of quota give it the opportunity to increase the production and in this way the profitability.

13.1.4.3 Demand

The higher levels of total demand of pelagic marine fish worldwide are observed in RoW (83%), Norway (3%), UK (1.7%), Turkey (1.7%) and Spain (1.3%). In general, total use of pelagic marine fish increases in all countries under both scenarios: baseline and scenario 1. There are minimal changes of demand increase over the period under baseline and scenario 1, most of them under 0.5% difference. As prices of pelagic slightly decrease under scenario 1 in comparison with the baseline, there is not a strong motivation to increase demand.

13.1.5 DEMERSAL MARINE FISH

13.1.5.1 Production

Production of demersal marine fish increases in all countries under both scenarios, i.e. baseline and scenario 1. Due to the increase in costs, the production increase over the period under scenario 1 is less than under baseline. However, this difference is almost insignificant. The only exception is Portugal, where its demersal marine fish production decrease over the period, as response of the high operational costs that it faces. Therefore, demersal marine production in Portugal migrates to other fish production with smaller operational costs and higher production share, as pelagic marine fish in this case. It should be noted that demersal marine fish production in the model is not linked to neither any quota restriction, technology improvement, nor biomass growth which have a big influence on the development of the production over the years. Under the scenario 1, demersal marine fish production is only affected by the increase in operational costs up to 2020.

13.1.5.2 Production margin

Demersal marine fish production provides the biggest increase in profitability over the period. Countries such as France, Spain and the Netherlands present high increases in production margin over the period under the baseline, 507%, 431% and 214% respectively. This is explained by the increase in prices, but mainly by the level of

[3] Spain is more sensible to changes in biomass of pelagic marine fish. The elasticity of production with respect to the stock growth is in Spain higher than in other countries.

operational costs for the production of demersal marine fish in these countries, which are smaller than the majority of the other categories. Therefore, as expected for all countries, the increase of operational costs due to the implementation of the discard ban reduces the margin, but slightly as it is applied up to 2020. The higher differences are observed in those countries, as they show the biggest growth rates but still the differences are small. Under scenario 1, France, Spain and the Netherlands present an increase in production margin over the period of 495%, 422%, 210%.

13.1.5.3 Demand

Again, as for pelagic marine fish, total use of demersal marine fish is expected to increase over the period, with almost no differences between baseline and scenario results. This is mainly explained by the minimal differences on the evolution of demersal marine fish prices under the baseline and scenario 1.

13.1.6 CONCLUSIONS

The scenario 1 presents the results of the implementation of a discard ban policy, which increase operational costs. This was applied for three different fish categories plaice, pelagic marine fish and demersal marine fish under three different situations. Plaice production is affected by the stock growth, quota restriction and a technical improvement. Additionally, the policy is applied before for this fish category than the other two. Pelagic marine fish production is affected only by a stock growth, while demersal marine production is not influenced by any of the previous exogenous variables. An increase in labor and capital costs are applied for three fish categories.

The integration of stock growth and quota restrictions reflect in a better way the effect of an increase in cost and changes in technologies. Since the quota restriction and the stock growth are directly linked with production, countries present a bigger impact on the production level, prices and consequently production margin. Therefore, some countries are reducing profitability and losing competitiveness after applying the policy. Results show that the only inclusion of stock growth as exogenous variable, without including the quota restriction, provokes a high impact on production, but small in production margin. However, these impacts are still smaller, than when both exogenous variables, quota and biomass growth, are included. The only increase of operational costs provokes minimal differences on the results in comparison with the baseline results.

The development of new technologies to reduce discards also leads to a more efficient use of resources. However, at the beginning it involves high levels of investment and additional costs to implement the technology and to train the crew. Given a quota restriction, this reduces the profitability of the fishing activity. Government should work together with the private sector and participate and share the investment costs for developing new technologies, which are more sustainable reducing discards, but at the same time more efficient reducing the use of resources as it provides public benefits.

The fact that the AGMEMOD model does not include transferable quotas reduces the profitability in some countries. As results, countries reduce production which negatively affects their profitability. In other cases, countries have to change to production of other fish categories, where quotas are not binding.

A discard ban policy is expected to increase in the future the stocks, and increase production. However, at the beginning it will lead to increases in costs due to the new technologies, the training and the quota filling of by-catches. The new technologies implemented should reduce the operational costs, however is not clear to what extend and in how many years. Therefore, without any governmental support, a discard ban policy reduces directly the profitability.

13.1.7 RECOMMENDATIONS FOR FURTHER RESEARCH

The inclusion of quotas for other species would reflect a better effect of policies, facing the production limits. Additionally, to include the transferable quota between countries, to see the real effect on profitability. Biomass growth should be incorporated as well for the other fish categories.

13.2 HIGHER OIL PRICES

13.2.1 BACKGROUND AND CONTEXT

Oil price projections are quite uncertain and vary a lot between sources. Historical data shows a deep fall during the period 2014 -2016 as result of an oversupply of oil. However, several research institutions/ organizations such as IHS Global Insight, the International Energy Agency and the OECD/FAO are expecting a slow recovery in oil prices in the next years followed by an increase. The increase rate exposed for oil prices differs among institution, but all of them agree that they will stay under the levels of 2011.

13.2.2 Problem and challenge:

Changes in oil prices affect directly the Seafood market, as it increases the fuel costs affecting both capture and aquaculture fishing. A higher increase or an unexpected increase in oil prices is a threat for the seafood sector as it reduces profitability of fish business and affects the competitiveness of the seafood market among the countries.

It is difficult to determine which type of costs will be affected the most with the increase of oil prices. At the same time, it is not clear if the increase in oil prices would produce a trade-off between the different types of operational costs: energy, feed, capital and labour. Additionally, as it affects both capture and aquaculture fishery, it is not clear which fish categories could be the most affected, and if it provokes a trade-off between fish categories of capture and aquaculture sources.

13.2.3 Assumptions made:

The Scenario considers an increase in oil prices which produce an increase in energy costs and feed costs for all fish categories and all countries. It is applied to different rates: an increase of 7.5% in energy costs and an increase in 4.5% in feed costs, the latter only for aquaculture production. The increase in energy and feed costs is applicable since 2017.

13.2.4 Model results:

13.2.4.1 Capture production

Production

Although operational costs increase as effect of a higher oil price, the impact in worldwide production differs among categories. A reduction of production over the period has been expected under the scenario 2 (increase of oil prices) in all categories. However, this is the case only in cephalopods, plaice, and pelagic marine fish production. In the case of demersal marine fish and other marine fish, there is almost no difference between results under baseline and under scenario 2. On the contrary, the production of freshwater fish, molluscs and crustaceans over the period is under the scenario 2 higher than under the baseline. This is explained by the increase in prices over the period, which is much higher under the scenario 1 than under the baseline and as consequence the increase in production margin.

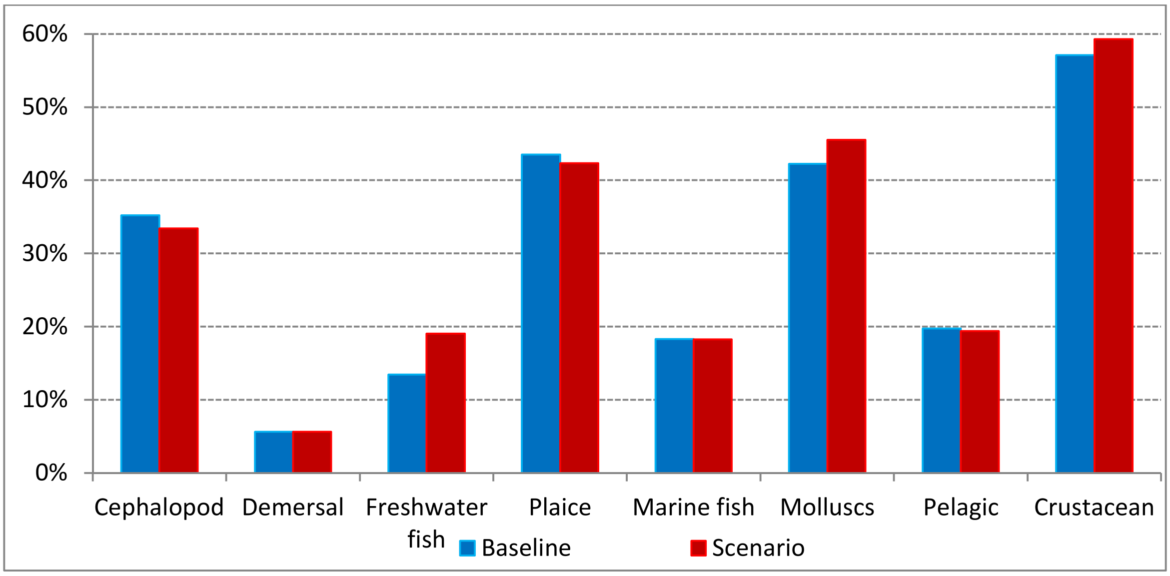


Figure 1 Worldwide changes in capture production over the period 2011 – 2030 by fish categories under baseline and scenario 2

Source: Own results

The picture is different when capture production on the EU MS is evaluated. It is observed a decrease in pelagic marine fish, crustaceans, plaice and demersal marine fish production. Cephalopods, other marine fish and molluscs present a small increase under scenario 2 with respect to the baseline. However, this increase stays under 1%, while the production of freshwater fish under scenario 2 surpasses the one under baseline in 2.5%.

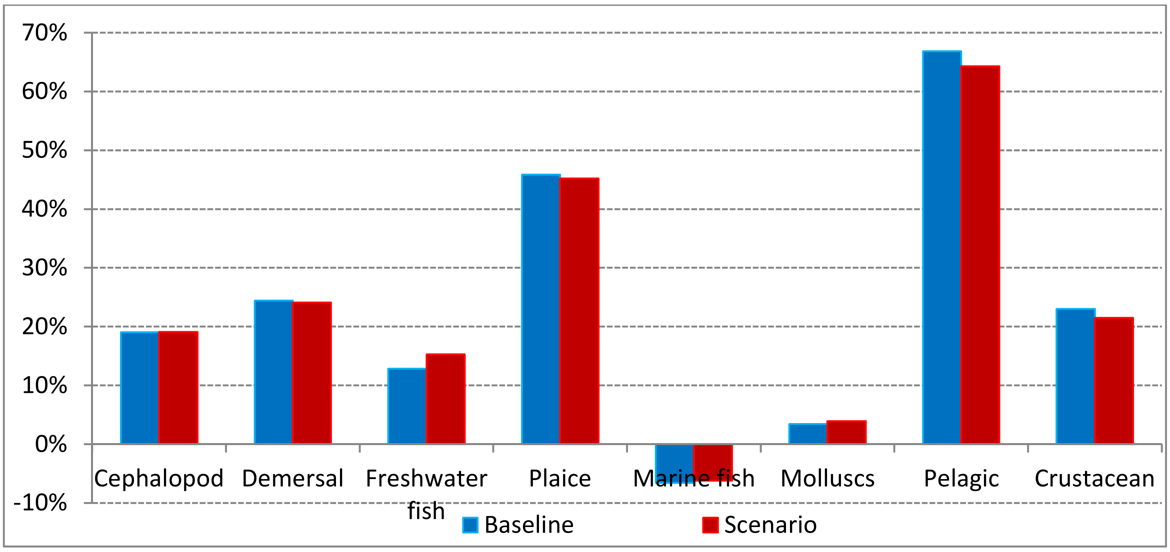


Figure 2 Comparison of changes in capture production within the EU MS over the period 2011 – 2030 by fish categories under baseline and scenario 2

Source: Own results

Production margin

World prices develop positive over the period 2011-2030 for all fish categories and increase more under scenario 2 than under the baseline. Although this could motivate to increase production, it has been limited by the development of the production margin. The increase in costs has reduced the profitability in some fish sector such as plaice and pelagic marine fish sector within the EU. On the contrary, the profitability of other sectors within the EU such as freshwater fish, cephalopods, and other molluscs increases more under the scenario 2, despite the cost growth. Most of freshwater fish producers within the EU MS show a high improvement on the production margin under the scenario 2. Despite the increase in costs, this promotes the production growth.

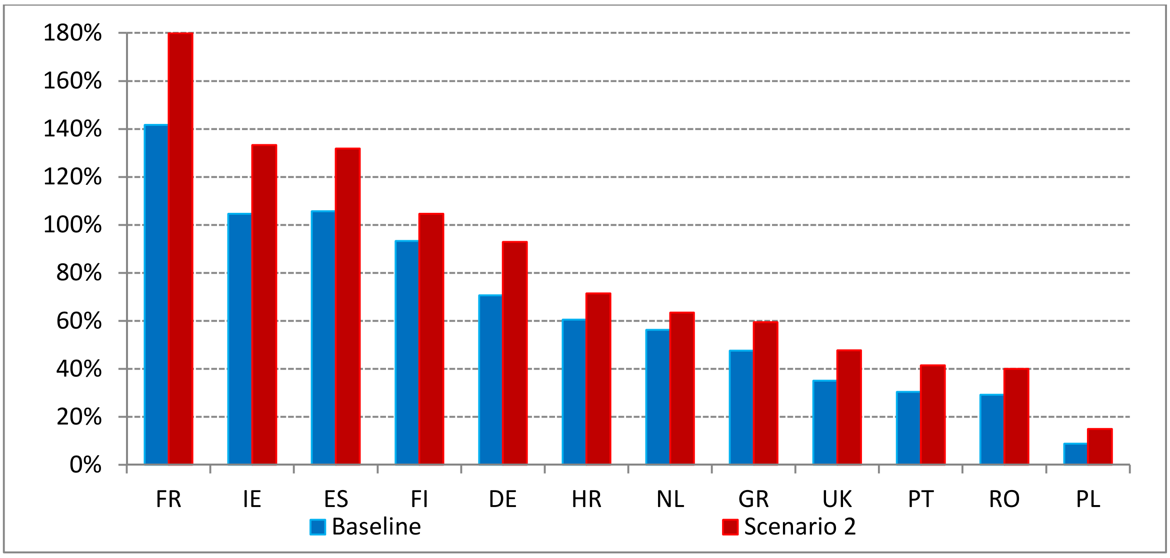


Figure 3 Comparison of changes in production margin over the period 2011-2030 for freshwater fish production under baseline and scenario 2

Source: Own Results

The same is observed in the production of other molluscs, where the main producers among the EU MS: United Kingdom (UK), France (FR), Denmark (DK), Italy (IT) and Spain (ES), present a higher increase in profitability after the increase of oil prices.

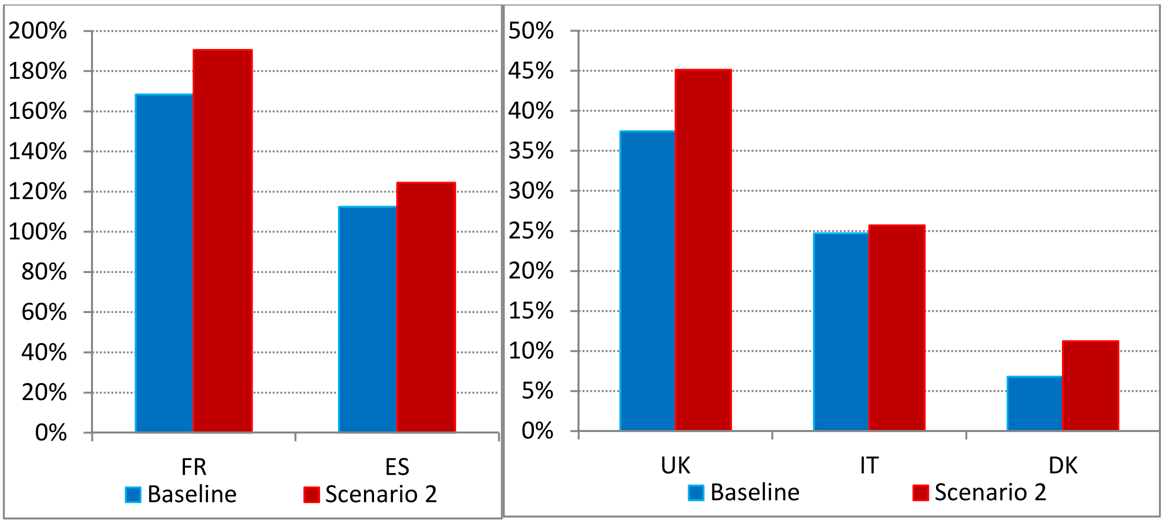


Figure 4 Comparison of changes in production margin over the period 2011-2030 for other molluscs production under baseline and scenario 2

Source: Own Results

Pelagic marine fish is the main fish category produce among the EU MS with respect to the amount of tonne produced. However, it presents, after plaice, the lowest market price. Therefore, any additional increase in costs may have a bigger impact on profitability than in the production of other fish categories. The main pelagic marine fish producer countries among the EU MS: Spain (ES), United Kingdom (UK), Denmark (DK), the Netherlands (NL), France (FR) and Plaice (PL), loses profitability after the increase in oil prices over the period 2011-2030.

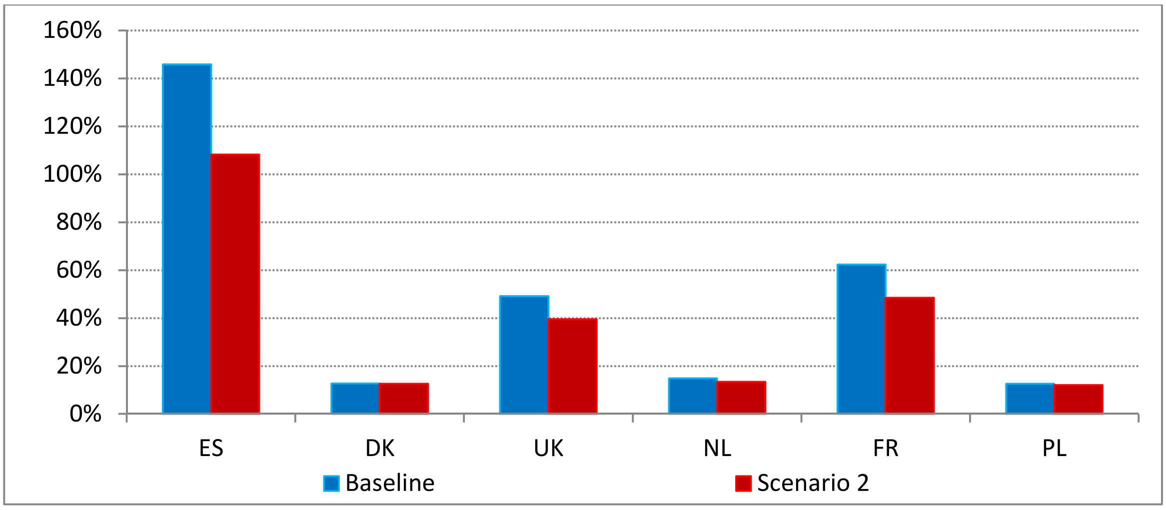


Figure 5 Loss of profitability under Scenario 2 with respect to baseline in main producer countries of pelagic marine fish over the period 2011-2030

Source: Own Results

13.2.4.2 Aquaculture production

Production

Worldwide aquaculture production is mainly focus on three fish categories: Freshwater fish (63%), other molluscs (24%), and crustaceans (10%) that in together represent 97% of total aquaculture production. Therefore, the impact on these fish categories will affect the whole aquaculture sector. The increase of oil prices produces a reduction of aquaculture production levels in all fish categories. The main fish categories affected are: other marine fish, although it only represents 1% of worldwide aquaculture production, crustacean and freshwater fish production.

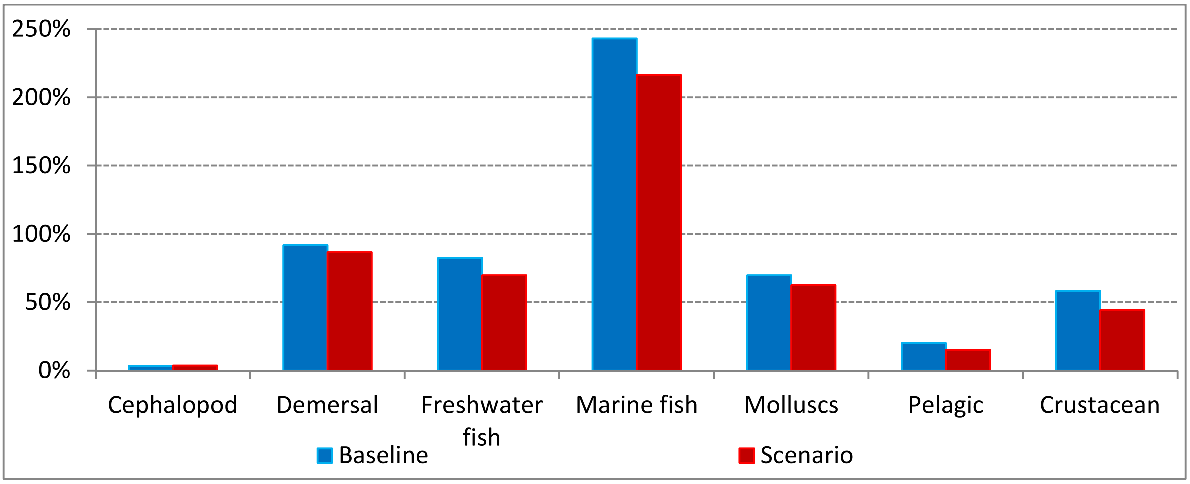


Figure 6 Worldwide changes in aquaculture production over the period 2011 – 2030 by fish categories under baseline and scenario 2

Source: Own Results

The EU MS represent only 1% of total aquaculture production, while Norway solely represents 3%. The effect of an increase in oil prices is similar in both Norway and the EU MS but in different scope. Freshwater fish and other molluscs production unlike the other categories, present in Norway and EU MS a higher production level despite the increase in oil prices. Still bigger effects are observed in Norway.

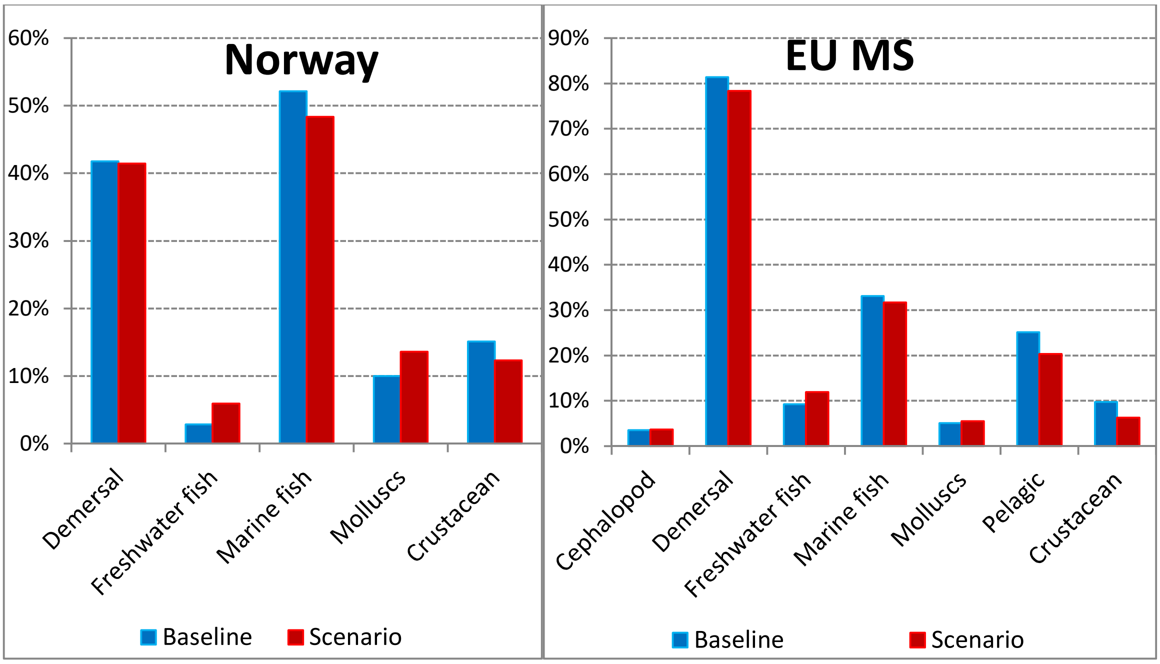


Figure 7 Comparison of changes in aquaculture production in Norway and the EU MS over the period 2011 – 2030 by fish categories under baseline and scenario 2

Source: Own Results

Results show an increase in aquaculture production of freshwater fish in all countries especially in the main producer countries: Norway (NO), United Kingdom (UK), Turkey (TR), France (FR), Italy (IT), Denmark (DK) and Poland (PL) under scenario 2. Even Poland that under baseline shows a decrease in aquaculture production of freshwater fish, it recovers the production level which still decrease over the period from 2011-2030 but in lesser intensity.

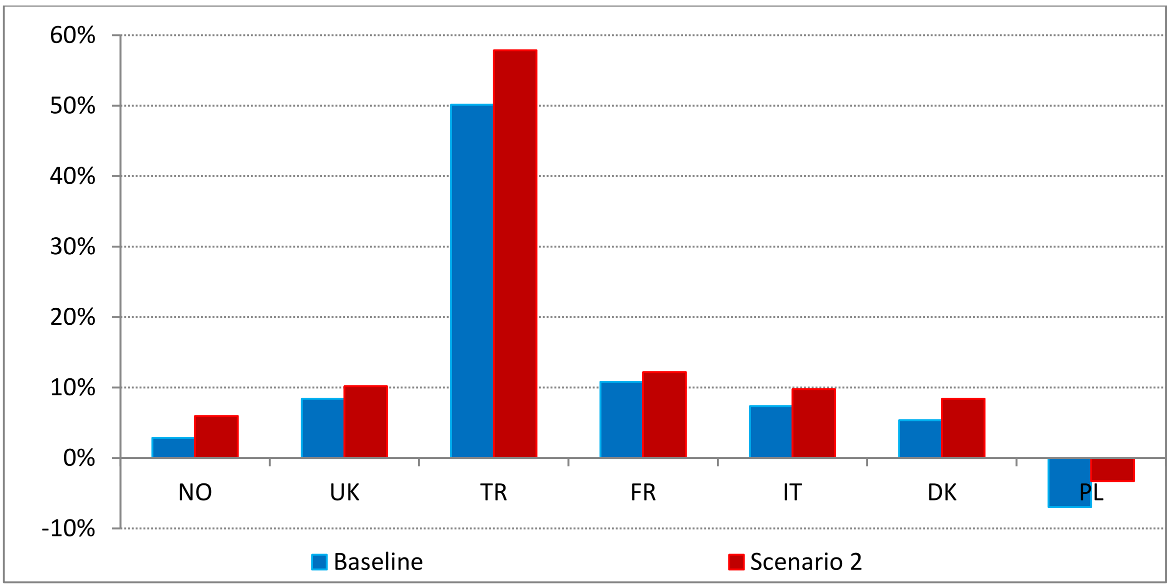


Figure 8 Comparison of changes in production margin over the period 2011-2030 for freshwater fish production under baseline and scenario 2

Source: Own Results

Production margin

Development of production margin after the increase in oil prices shows an improvement among the EU MS and Norway only for freshwater fish, cephalopods and other molluscs in aquaculture production. Although the costs of energy use and feed consumption in aquaculture production, production margin increases due to two main reasons: first, in most of the countries, with the exception of RoW, the share of energy and feed costs of total operational costs is less than 50%. Second, although costs increase domestic prices increase more resulting in higher incentive margin over the period in most of the countries. In Norway, for example, the share of energy and feed costs over the total operational cost for freshwater fish exceeds the 55%. However, as the domestic prices increases more under the scenario 2 than the increase in costs, production margin is still bigger. The production margin in France grows more than in the case of Norway, as the share of feed and energy costs stays under the 50% of total operational costs.

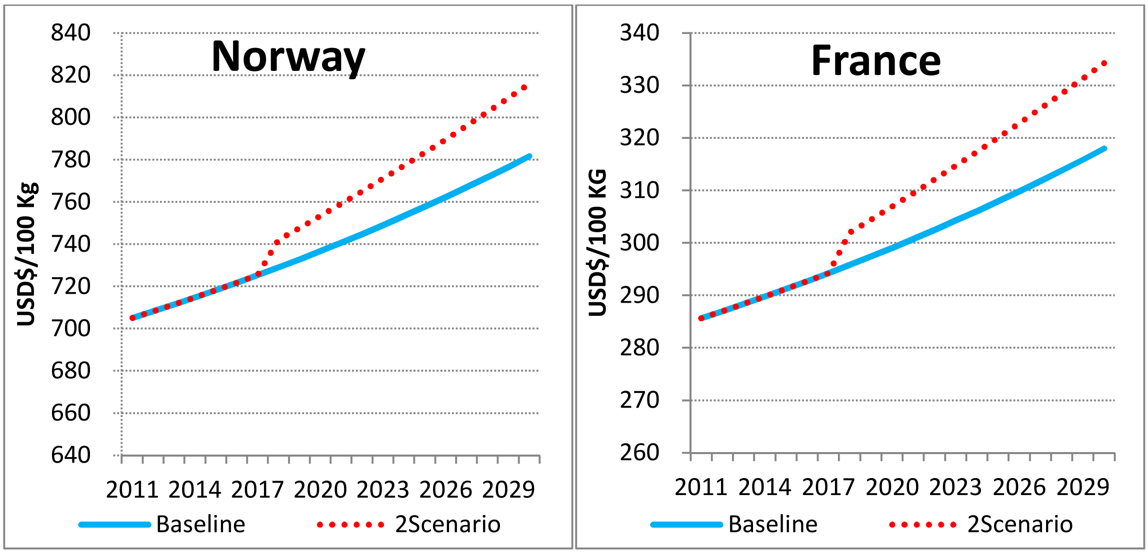


Figure 9 Evolution of production margin for aquaculture production of freshwater fish in Norway and France over the period 2011-2030 in USD$/100 Kg

Source: Own Results

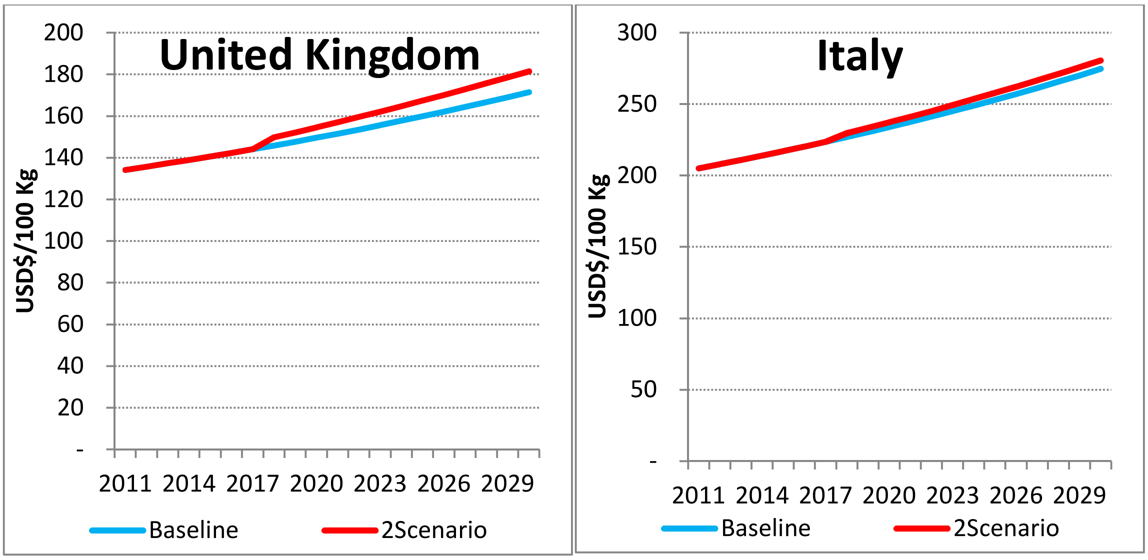


Figure 10 Evolution of production margin for aquaculture production of freshwater fish in United Kingdom and Italy over the period 2011-2030 in USD$/100 Kg

Source: Own Results

In the case of United Kingdom and Italy, for example, they still present a higher production margin under the scenario 2 with respect to the baseline. However, in both cases the difference is smaller than in other countries, as France and United Kingdom. Since the share of energy and feed costs in United Kingdom and Italy surpass the 65% of the total operational costs, the increase in oil prices reduce the margin in those countries.

13.2.5 CONCLUSIONS

The scenario 2 shows the impact of an increase of energy and feed costs in fish production as result of an increase in oil prices. This affect all countries and fish categories, and for both production systems aquaculture and capture production in the case of energy costs, and only aquaculture production in the case of feed costs. The increase in costs is applied since 2017 with the objective of evaluating future development of the production and production margin.

Results of worldwide capture production over the period 2011-2030 show a different effect among the fish categories. Most of the fish categories will reduce production as consequence of the increase in costs, but not in freshwater fish, crustaceans and other molluscs production. RoW produces 98%, 96% and 93% of world freshwater, crustaceans and other molluscs from capture production. These three fish categories in RoW present high production elasticity with respect to the prices. Since prices increases more under scenario 2, RoW increases its production, marking the difference among the other fish categories. On the contrary, global aquaculture production decreases in all fish categories as response of the increase in energy and feed costs. Despite also the increase in prices, the effect of the increase in both feed and energy costs is bigger in the RoW. The share of both over total operation costs in RoW is near 80%.

Similar effects are observed within the EU MS in both capture and aquaculture production of fish categories, especially on the production of freshwater fish categories. The development of the production under scenario 2 is motivated by the evolution in prices and the evolution of production margin, despite the increase in costs.

At first impression an increase in production costs will results in a reduction in production. However results show that there are some other variables that have to be analysed on each fish category production and country. First, the production elasticity with respect to the price plays an important role. Over the period, prices for fish categories increase. The production of a determine fish category in a country will have a bigger impact, if it present a higher elasticity. Besides, is important to observe the profitability of each activity in each country. The increase in costs could reduce the profitability despite the growth in prices, and therefore the production. Furthermore, it is important as well to define the share of the independent costs over the total operational costs. As results show, although the increase in cost is focus on energy and feed use, in some countries the share of both together in total production costs in smaller than 45%. Therefore, the increase in costs still produces a positive increasing production margin.

13.2.6 RECOMMENDATIONS FOR FURTHER RESEARCH

The inclusion of a factor that reflects the trade-off among types of operational costs will provide a better analysis of the effect of an increase in oil prices. Since the increase of costs is focus in energy and feed, producers might change technologies to reduce the use of those resources and substitute by the use of the other, capital and labor.

14 MAGNET

14.1 EFFECTS OF BREXIT SCENARIOS

An unprecedented an unexpected outcome of the British referendum on Brexit is one of the most discussed topics in the media nowadays. The economic consequences are not yet exactly known but most of the existing studies agree on negative impacts for the UK. According to Paul Krugman, Brexit could cost UK about 2% GDP. Recently, warnings appear that not only UK, but also the EU member states will be negatively affected. For instance, the Guardian (19.1.2018) alerts that "*Europe must wake up to the drastic consequences of a hard Brexit*". A study done by the Dutch economic institute CPB claims that "*a hard Brexit could make every Dutch person poorer by an average of €1,000*".

Most of the existing studies concentrate on the general impact of Brexit on the economy. However, some specific industries such as fisheries and agriculture may be affected by Brexit significantly more than the rest of the economy. As for the agri-food sector, it is well known that despite the efforts of the GATT rounds in the past 60 years, large part of trade in agricultural commodities remains protected by high tariffs. Leaving the EU, for Britain, thus (in theory) means leaving the common market and adapting these high agricultural tariffs (and the same for the EU). Although the "hard Brexit" option does not seem very likely at this moment, it is still open for discussion and remains a sensitive issue not only for the EU-UK but also for the third WTO parties who feel rightly offended in case a preferential regime is adopted for the trade between UK and EU.

The focus of our analysis is however the fisheries sector. The political importance of fisheries in the Brexit context is already advocated by the study of New Economics Foundation (2016). This is because leaving the Economic Union also suggests closing marine borders around the UK. This may affect several EU countries, which fish frequently in UK waters. For instance, around 40% of all Belgium and Dutch landings come from the UK. In turn, the importance of the EU waters for the landings of wild fish in the UK is much more limited. Therefore, there seems to be an opportunity for the UK to cash in on if closing marine borders becomes part of the hard Brexit conditions. On the other hand, the tight trade relations between UK and the EU, particularly in the connecting fish processing industry make UK vulnerable to trade protectionism. The available study on the impact of Brexit on the fisheries sector (New Economics Foundation, 2016) poses a relevant question "whether the Brexit really is a sea of opportunity for UK or rather a sea of risk".

In our study, we are going to respond to this question by looking at the impact of hard Brexit on UK and EU fisheries sector in the context of the whole economy, which entails not only wild fisheries, but also aquaculture, fish processing, and the other sectors of the economy. Moreover, we also consider the tight trade relations between the EU countries which turns out to be very relevant for the consumer markets, where at present, various international fish sources are used to produce the final fish product consumed by households.

The methodology used in this study employs a CGE model MAGNET, which is particularly suitable to analyze the impact of Brexit. The most attractive features of MAGNET in this respect are that it is a global model that traces bilateral international trade flows and enables to carry out simulations concerning protectionism measures such as import tariffs or NTMs. Second, MAGNET has been recently extended to model detailed fish markets, with explicit distinction between wild fish sector, aquaculture and fish processing. On the endowment side, next to the standard labour, capital and other inputs, fish stock natural resources are newly modelled in MAGNET. This enables to carry out simulations concerning fish access. Third, MAGNET is a dynamic model which provides baseline projections into the future. With MAGNET, we bring in the Brexit simulation into the already changing world and capture all important interactions in the economy – e.g. in the factor markets, interconnection of wild fish sector to other industries and the international trade linkages.

Finally, it is important to note that the results of this study should be understood as supportive evidence for the ongoing negotiations. By the hard Brexit simulation, we can highlight the feasibility of the measures and their potential impact if they are put in force. It may be argued that closing marine borders as we simulate in our exercise overwrites the history given that before the UK accessed the EU, no such a strict marine closure existed. However, it is important to understand that if this happened at present, what are the consequences of such a strict measure.

14.1.1 DESCRIPTION OF SCENARIOS

In this section, we present the overview of the scenarios that aim to quantify the impact of UK leaving EU on the competitiveness of the EU fisheries sector and the economy. We focus on capturing three main channels of how Brexit can affect the economy: i) access to fish landings, ii) internal EU-UK tariffs and iii) non tarrif measures (NTM) and trade facilitation costs (TFC). In order to understand the impacts of all these channels, we introduce them step-by-step. This enables to isolate the effect of each and to assess which of the three channels prevail in their impact. The detailed description of the scenarios and modelling assumptions is given below.

14.1.1.1 Brexit_TFC scenario

Immediately after leaving the European Union, Great Britain will have to comply with the administrative matters valid for other non-EU countries, which include proof of origin, export licences etc. Details about concrete TFC measures can be found for instance in the KPMG study (2018) and a recent study prepared by Berkum et al. (2017). Therefore, the first Brexit scenario simulates increased trade facilitation costs (TFC). A TFC mark-up of 8% is chosen as the upper limit of the average transaction costs, as mentioned in Donner Abreau (2013, cit. in Berkum et al, 2017). We apply this 8 % trade costs increase homogenously across all trade in goods. Regarding trade in services, this additional administrative burden can be omitted due to higher share of electronic transactions when crossing the border. This is also in line with Yu et al. (2017) who do not report Rules of origin costs for services sectors.

14.1.1.2 Brexit fish (access) scenario

The second channel that we consider is the change in fish access where we take the most restrictive alternative, that is, we simulate an exclusive access to the North Sea territory around British waters solely by the UK (and vice-versa loss of access of UK boats to the EU fishing zone). For the UK, this would mean an increase of access to landings of about 60% and for certain EU member states a decrease of about 40%. The procedure we used to quantify the shocks of fish access for UK and EU countries is described below.

14.1.1.3 Calculating shocks to fish species

We make use of NAFC Marine Center report (Napier, 2016) that provides quantities and shares of fish landings acquired in British waters by 8 key EU-member states where fish landings from UK represent about 60% of all landings (see Appendix 1). The information is provided per species type which is very useful for our analysis. Table 1 shows the proportions of landings in quantity of landed fish as a percentage of countries' landings.

Table 1: Share of countries' landings from UK-EEZ by EU boats

	DEM	PELA	TOTAL	OTHER
LANDINGS FROM UK BY EU BOATS (T)				
BEL	46%	27%	45%	40%
DEU	5%	47%	31%	15%
DNK	4%	67%	34%	0%
ESP	2%	0%	1%	2%
FRA	31%	13%	17%	5%
IRL	21%	46%	35%	29%
NLD	23%	45%	39%	50%
SWE	0%	19%	15%	2%

Source: NAFC Marine Center Report (2016)

Note: there is some discrepancy in the reported values. The total landings per country are in line with our data obtained from the FAOSTAT but the split between pelagic and demersal doesn't correspond. We keep the shares as provided from the report but the corresponding landing quantities then slightly differ in the report to those calculated based on the shares from our dataset.

The report also provides information on the landings of UK boats that proceed from EU territory. Expressed as a share of total landings by UK boats, the UK boats landed about 18% of fish from the EU Economic zone. It is apparent that UK waters are much more important to EU fisherman than the EU waters to the UK boats.

Table 2: Share of landings in EU-EEZ by UK boats

	DEM	PELA	TOTAL	OTHER
LANDINGS IN TONS				
NORTH SEA	13,000	0	15,000	2,000
WEST SCOTLAND	1,000	19,000	22,000	2,000
SOUTH&WEST UK	10,000	34,000	50,000	6,000
TOTAL	**24,000**	**53,000**	**87,000**	**10,000**
LANDINGS AS A % OF TOTAL UK LANDINGS				
NORTH SEA	14%	0%	5%	5%
WEST SCOTLAND	6%	17%	14%	7%

SOUTH&WEST UK	37%	69%	39%	11%
TOTAL	**18%**	**16%**	**15%**	**8%**

Source: NAFC Marine Center Report (2016)

The reduction of landings in the respective EU countries is then translated into the MAGNET shocks. For countries that are included individually in the MAGNET database, we shock (reduce) fish landings directly by the percentage given in Table 1. Given that Germany, Sweden and Denmark are included under the Western and Northern Europe groupings, we calculate corresponding percentage change reduction for the whole group. Furthermore, the reduction of landings by UK boats in the EEZ are proportionally distributed over the key EU member countries that fish in UK waters. Finally, we calculate the shocks for UK by adding the landings of EU countries that will be prohibited by Brexit and reducing the UK landings in EEZ by Brexit.

As pelagic fish are high migratory, the expected increase of fish stocks of 134% is not realistic as the fish will moves freely across the border. The study of the New Economics Foundation estimates that closing the marine border would lead to an overcrowding of pelagic fish by about 40% in the UK. We use this assumption in our scenario as well and we limit the increase of the pelagic fish stocks in UK by 40% as well.

The final shocks entering MAGNET are provided in Table 3. There will be a considerable increase of fish landings for UK boats due to the reduced competition of the EU countries (70% more resources). By limiting the shocks to pelagic fish, access to demersal fish is affected more. The EU countries that are mostly hit by the reduced fish access are Belgium, Ireland and Netherlands.

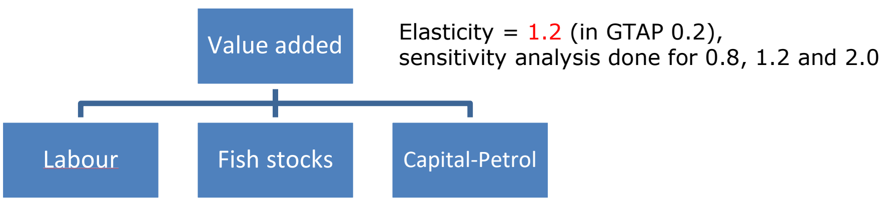
Table 3: Final reductions of fish landings in Brexit scenario

	TOTAL	**DEMERSAL**	**PELAGIC**	**OTHER**
BEL	-43%	-44%	-7%	-37%
DEU	-30%	-3%	-13%	-13%
DNK	-10%	-2%	-19%	2%
ESP	1%	0%	1%	0%
FRA	-15%	-29%	-3%	-2%
IRL	-33%	-19%	-13%	-27%
NLD	-38%	-21%	-13%	-48%
SWE	-14%	2%	-5%	0%

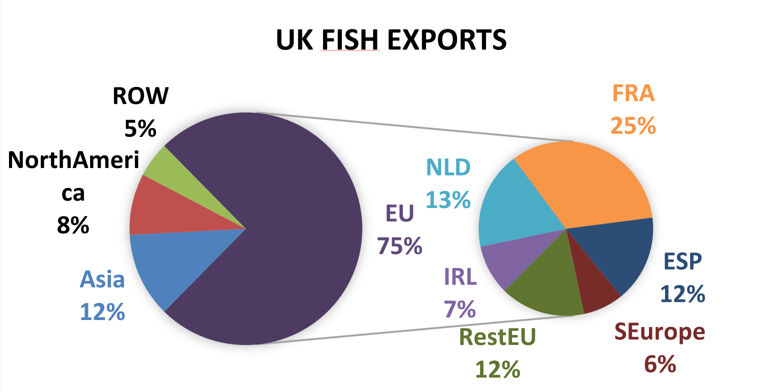
GBR	70%	58%	41%	21%
WEUROPE	-3%	0%	-2%	-1%
NEUROPE	-3%	0%	-5%	0%

It is important to explain how these fish access shocks are transmitted into the final production of fish. Figure 1 shows, that value added in the fish sector is created by employing a set of inputs, such as labour, capital, petrol and fish stocks. By allowing a larger substitution between fish stocks and the rest of inputs, the radical decline of fish stocks can be compensated by an increased effort (use of other inputs). If the substitution would be less than one (as is in the standard GTAP model), a decline of fish stocks would result in a decline of fishing (factors are complements). In reality, we do not expect that fish production would contract totally, but rather that it would cost more resources to reach the fish. Substitution elasticity is therefore an important instrument to avoid a drastic impact on fish sector and induced price spikes. To reflect this, we employ a sensitivity analysis on the substitution possibility between natural resources and fishing effort such as fuel, labour and capital. We opt for a “middle of the road” version that we use in all scenarios but we also present the bounds for the fisheries sector with the different elasticity values.

Figure 1: Production structure in the fisheries sector



Another important consideration to take into account is the role of trade in fish. Although an increased access of fish stocks clearly favours UK over the EU, there is a large dependence of EU as a major trading partner for the UK. Figure 2 shows that the proportion of fish traded with the EU is fundamental, where about 75% of exports of UK fish go to EU and about 60% imports come from EU. At the same time, for the whole EU, exports and imports from UK represent only 7% of the total. It will be therefore interesting to see which of the two aspects – fish access vs fish trade will dominate the final Brexit impact.



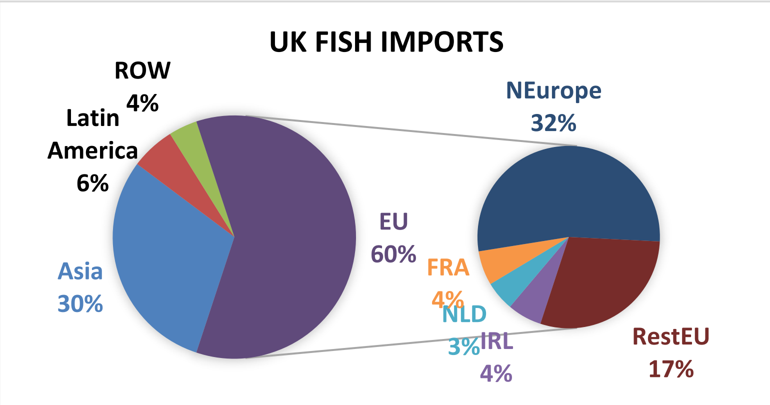


Figure 11 Share of EU in UK's fish exports and imports

14.1.1.4 Brexit NTM scenario

When simulating a hard Brexit, it is relevant to consider the imposition of non-tariff trade measures (NTMs). NTMs raise costs associated with regulatory differences across countries such as labelling requirements, health standards, control procedures, etc. The NTMs are probably the most significant economic measures of hard Brexit, because they affect trade in all sectors of the economy with potentially quite damaging impact. There are various studies that model the impact of NTMs, such as Egger et al. (2015), Yu et al. (2017), Francois et al. (2013) or Rojas-Romagosa (2016). Based on these sources, we introduce sector-specific NTM trade costs, where food processing has the highest trade increase (40%), followed by primary agriculture, chemical and petrochemical sector (20%). The lowest burden is registered for primary energy, services and utilities (5% – 10%).

SECTOR	NTM	NTM + TFC
AGRICULTURE, FISHERIES AND AQUACULTURE	20	28
FOOD PROCESSING	40	48
FORESTRY, COAL, GAS	5	13
CHEMICAL AND PETROCHEMICAL	20	28
OTHER INDUSTRY	10	18

SERVICES	10	10

Note: The values represent expected trade costs increase

We also considered a sub-scenario in which we imposed additional NTMs for the imports of fish from Netherlands to the UK due to the aversion against pulse fishing. However, this scenario provided no additional impact and therefore we removed it from the analysis.

14.1.1.5 Brexit TMS scenario

The last channel that we bring into our simulation is the possibility of a no trade deal between EU and UK which results in a WTO regime for both countries. Although EU is a custom union, in the MAGNET database, the import tariffs applied by each member state on the imports from NAM are not identical, due to the commodity aggregation (there are 41 aggregated commodities in MAGNET and the import tariffs are thus trade-weighted averages of individual tariffs). For our Brexit scenario, it is more transparent that we apply a common tariff table for all EU countries. We can apply a trade-weighted average of import tariffs that are imposed on the trade between the EU countries and North America. In the study by Yu et al. (2017), the authors weight the individual tarrif lines by the corresponding value of EU's import from all its MFN partners, providing a more precise WTO tariff aggregation. Figure 3 shows the comparison USA tariffs and weighted average of all MFN countries tariffs. In both cases, the highest tariffs are applied on the agri-food commodities, including the fishery products, whereas trade in manufacturing goods is mostly free of tariffs. It is apparent though that for some commodities such as sugar, using USA tariffs as a reference could lead to a bias where in fact the WTO regime is much stricter. For this reason, for the agri-food commodities, we borrow from Yu et al. (2017) to align to the MNF tariffs.

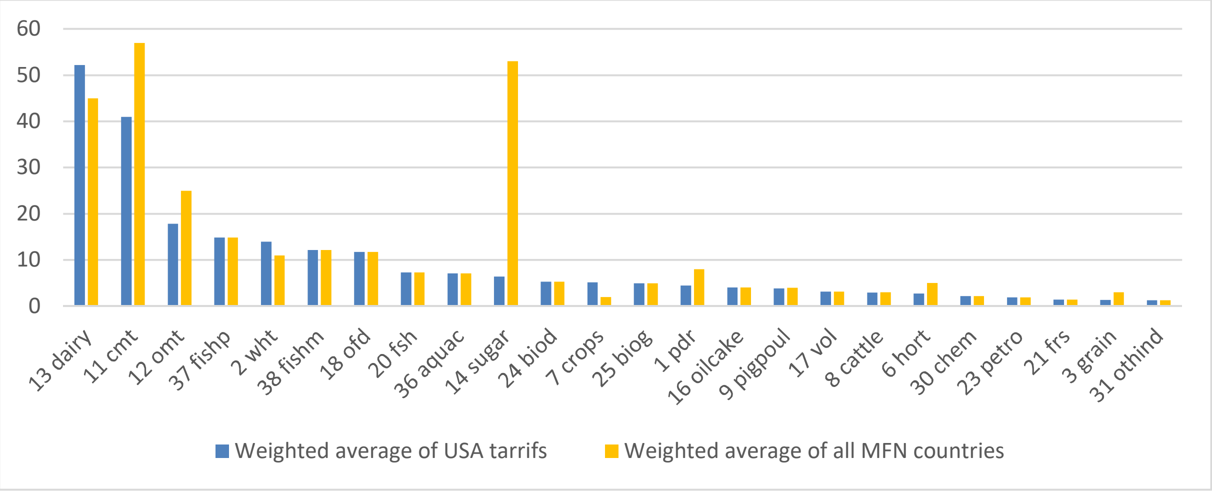


Figure 12 Weighted import tariff in Brexit scenario (weighted average of MFN tariffs applied

Source: own calculation and Yu et al. (2017)

Finally, the overview of all scenarios is presented in Table 4.

Table 4: Overview of Brexit scenarios

Scenario name	Description	Assumptions
Baseline	Baseline	SSP 2, tech change in aquaculture, oil price shock, no (eq. to soft) Brexit
Hard Brexit components	Brexit_TFC	TFC applied on trade in goods (excl. serv & util) between EU-UK, set on 8%
	Brexit_fish	Brexit_TFC + Loss of fishing access to UK part of EU-EEZ and vice versa
	Brexit_NTM	Brexit_fish + NTM measures on imports of all goods and services between UK-EU (compilation of sources)
	Brexit_NTM_WTO	Brexit_NTM + WTO Import tariffs for UK-EU trade set on MFN rates (from Yu et al. 2017)

14.1.2 Results

Since this study is focused on the competitiveness of the EU fisheries sector, we will first focus on analysing the impacts of Brexit on the production, consumption and trade of fish commodities. We will then look at the impact of Brexit on the other sectors of the economy. Finally, we will quantify the macroeconomic effects looking at GDP and welfare.

14.1.2.1 Impact on the fisheries sector

14.1.2.2 Fish production and producer prices

At first, the impact on the global fish production is analysed. Figure 4 displays the percentage growth of fish production (capture) in baseline and the Brexit_NTM_WTO scenario, which includes all considered channels of Brexit impact. Given that the Brexit scenarios affect mostly the EU-UK relations, it is no surprise that **the world-wide impact of Brexit on fish production is negligible**. World production of fish is expected to grow by 10% compared to 2015 and the growth will be mainly driven by Africa, due to dynamic population and economic growth. Concerning the EU, the Brexit will have a negative impact on the EU countries, whereas the UK would see a benefit in increased fish production.

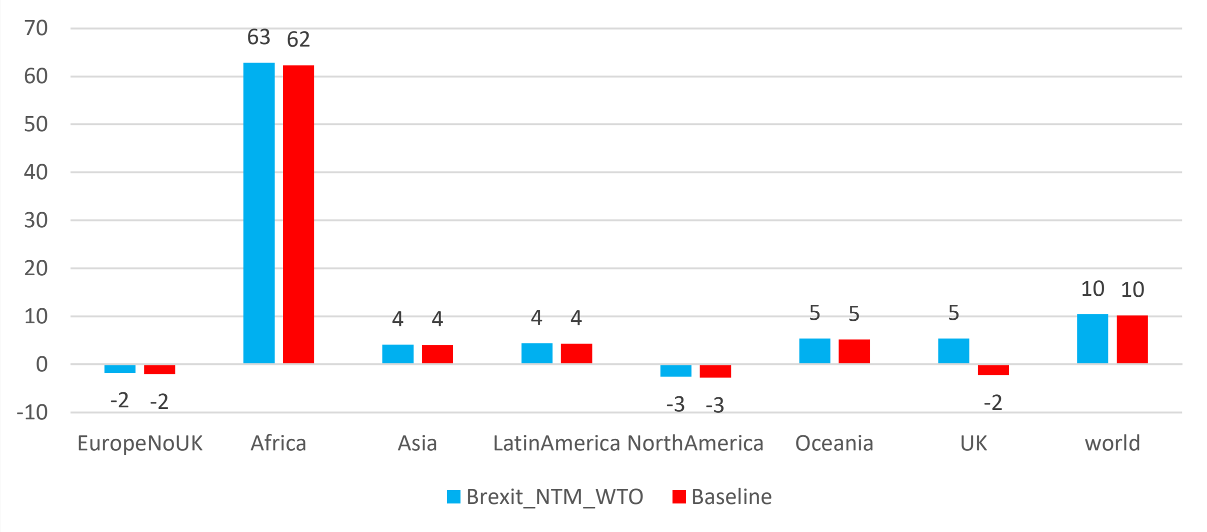


Figure 13 Growth of fish production (capture) between 2015 - 2030

Given the little impact of Brexit on the global level, it is most interesting to concentrate now on the individual EU countries. Figure 5 zooms into the key EU countries that will be most heavily affected by Brexit. The impacts are analysed on the immediate horizon, after the policies are implemented (2020-2025). It is apparent, that Great Britain gains importantly from Brexit, as the **fish production would revert the trend from decline to an increase**. The advantage slightly fades over time but still, at the end of 2030, fish production would be 5% higher than in 2015, compared to a 2% decline in the baseline. On the other hand, **Ireland would be hit the most**, where fish production would go down by more than 5% instead of growing by 1%. Similarly, in Belgium, a moderate growth of fish production would turn out to a decline of almost 6%. The other hit EU country would be Netherlands, where the fish production would grow by 3% instead of 6%. Smaller impact is recorded for France and a little advantage is noted in North Europe, that takes over the trade in EU markets, as seen in the following charts. A region that clearly gains is Spain where the growth of wild fish production goes to positive numbers. On the European level in total, the impacts are negligible and we can see that the fish production is expected to slightly decline by 2030 with, or without Brexit.

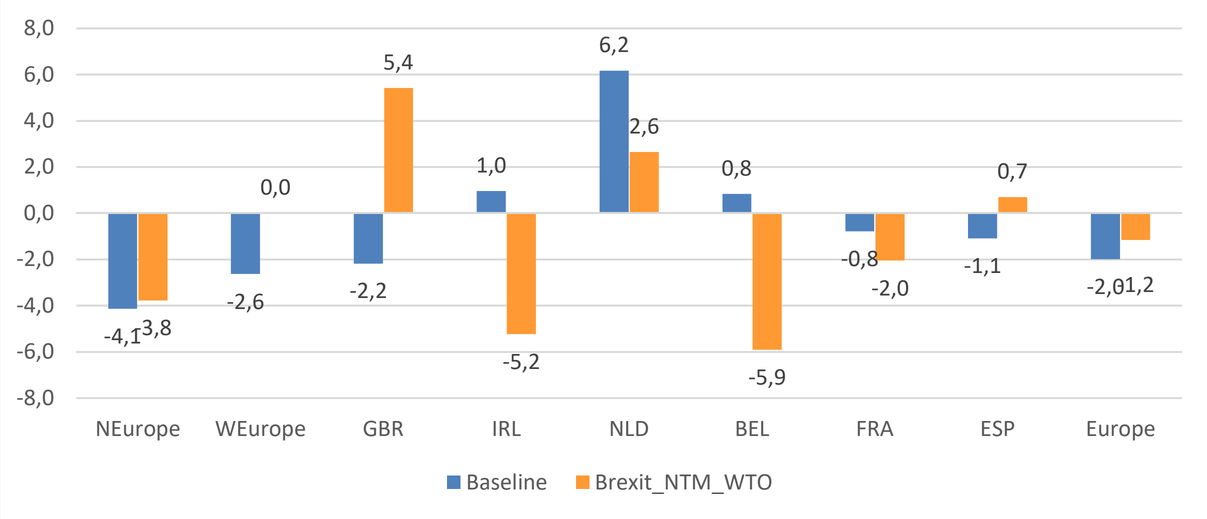


Figure 14 Growth of wild fish production (% change 2020 -2030)

When decomposing the impact of different channels of Brexit (Figure 6), it is apparent that the **access issue dominates the results**, whereas the additional trade measures affect the fish production rather moderately. Looking at Great Britain, **the enforced border would lead to an increase of fish production by about 15%** compared to baseline. However, the advantage would be notably weakened in the presence of **import NTMs and tariffs that could reduce the gain** by about one third, due to a **high importance of EU markets as export territory for the UK**. As for the EU countries, the fish production would contract in range of 2% for France to 8% to Belgium, driven predominantly by fish access. The import tariffs play a minor role, as the UK is not such an important export territory, except for North Europe and Ireland (about 10% share of fish exports to the UK). An interesting situation occurs in North Europe, which benefits from the closure of marine borders as one of the few EU countries (next to Spain). However, with the additional NTM burden between UK and EU, the wild fish production declines as well, compared to the baseline. Looking at the cumulated impact on Europe, the impact of Brexit on wild fish sector depends on the measures that would be agreed. Gains of 400 mln USD could be expected if UK gains back its fishing territories and there are no trade protectionism measures. However, under NTMs and MFN tariffs, which is the more likely scenario, most of these gains are faded away and there is a zero sum.

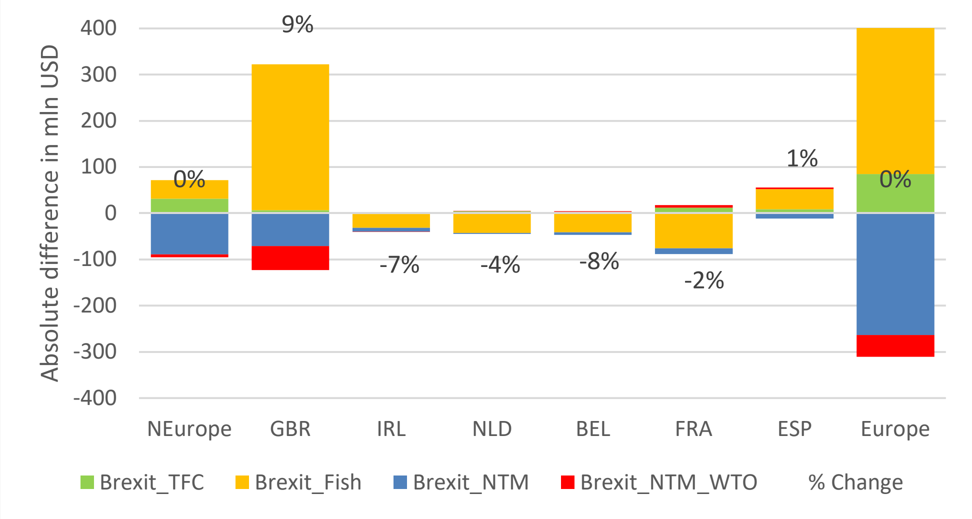


Figure 15 The decomposition of impact of Brexit on wild fish production (difference from Baseline

It is interesting now to turn the attention to the other fisheries sectors, which are aquaculture, processed fish and fish meal, that are lined to wild fish in the supply chain. Figure 7 shows a schematic representation of how the three new sectors have been implemented and how they interact with each other. Both fisheries and aquaculture provide part of raw fish to the processing industry, and the second part is directly consumed by consumers in their final demand. Fish meal is produced as a by-product of fish processing, and is used as feed in aquaculture and cattle sectors, capturing thus the competition between aquaculture and cattle sectors for available feed.

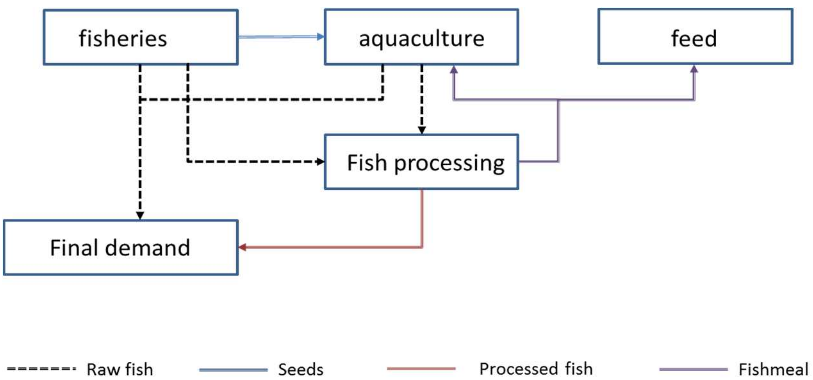


Figure 16 Relations between fish sectors in MAGNET

Table 5 shows the fish processing industry and fish meal sectors would be negatively affected by Brexit in the EU countries, driven by the decline of wild capture. Concerning aquaculture, it is the most dynamically developing sector and on the Europe and as a whole, it will not be impacted much by Brexit. On the individual EU countries level, aquaculture sectors would gain in countries where there is a negative impact on wild fisheries sector (except for Ireland which depends partly on exports of aquaculture fish to Great Britain). On the other hand, in Great Britain, the gain in wild fisheries would be accompanied by a large negative effect on aquaculture. This is because **Brexit creates a comparative advantage for the wild fish sector** in the UK and aquaculture becomes less competitive on the internal UK market and abroad.

Table 5: Impact of Brexit on production volume (% change from Baseline in 2025, Brexi_NTM_WTO scenario)

	FISHPRODUCTS	FSH	AQUAC	FISHP	FISHM
NEUROPE	-0.1	-0.3	1.0	-0.9	-0.9
GBR	-1.1	9.4	-13.9	-1.9	-1.9
IRL	-8.9	-7.3	-5.6	-15.8	-15.8
NLD	-7.4	-4.3	-0.1	-12.7	-12.7
BEL	-9.6	-8.4	3.9	-16.0	-16.0
FRA	-1.5	-2.3	3.1	-3.1	-3.1
ESP	1.3	1.2	2.2	0.7	0.7
EUROPE	-0.6	0.3	-0.5	-1.8	-1.8

It is also important to look at the producer prices that drive the supply of fish products (Table 6). The increase of wild fish prices in the selected EU countries reflects the scarcity of the natural resources and the resulting increase of production costs. In the UK, in turn, prices of wild fish would go down benefiting from higher fish access. Prices of fish processing follow the same direction, only the impact is more moderate, as it reflects the use of other inputs. For the whole Europe, the impact of Brexit leads to a general increase of prices of fish products in the range of 0.5%.

Table 5: Impact of Brexit on the Producer prices of fish products (% change from Baseline in 2025, Brexi_WTO_NTM scenario)

	FISHPRODUCTS	FSH	AQUAC	FISHP	FISHM
NEUROPE	0.3	0.8	0.1	-0.3	2.1
GBR	-3.7	-12.5	3.5	-0.1	4.2
IRL	3.9	4.9	4.2	1.1	8.5
NLD	3.3	3.5	0.7	3.3	4.4
BEL	6.9	7.5	1.3	3.9	2.8
FRA	2.1	3.7	0.6	1.4	2.9
ESP	-0.3	-0.2	-0.5	-0.6	0.4

EUROPE	0.1	-0.1	0.4	0.1	2.0

The analysis so far points to four countries, that are hit the most by Brexit, which is the UK, Ireland Belgium and Netherlands. We decompose the effect of each Brexit measures on fish markets separately for UK, NL and IRL (Figure 7). Netherlands is interesting not only because of large share of fish landings coming from the UK EEZ but also because it is a very open economy. It is apparent that fish access is the key driving factor for a positive effect of Brexit in UK and negative impact in the other two EU countries, as long as the wild fish market is considered. In the UK, the volume of fish production (aggregated), measured in constant prices, would go up by 420 million USD, from which 350 million would come from wild capture and 90 million from fish processing. However, if import tariffs and NTMs are in place, almost 500 million USD would be lost as a consequence of reduced exports to the EU countries. Particularly for aquaculture, this is the main channel of Brexit impact, pointing on the dependence of EU territories for the export of this commodity (about 85% of aquaculture exports is destined for EU members). EU markets are also equally important for the exports of wild fish, but the drop of fish prices due to increased access would keep the export competitiveness. Overall, the advantage of an increased fish access is completely overweighed by the costs of protectionism resulting in a moderate decline of fish industry in the UK.

Concerning the other two countries, it is apparent that the loss of fish access would harm wild fish production, but the additional NTM and WTO tariffs would cause even more damage, particularly for the fish processing sector due to high import tariffs. This is also because there are not much exports of wild fish between EU and UK - only 3 % of Dutch wild fish exports end up in the Great Britain. Unlike Ireland, there is no impact of Brexit on the aquaculture sector in Netherlands as The Netherlands does not depend on the UK for aquaculture exports.

Figure 17 Decomposition of impact of Brexit on fish production for UK, Ireland and Netherlands

14.1.2.3 Impact on trade in fish products

Table 6 depicts the impact of full Brexit on the volume of exports of fish products in the key EU countries. The exports of wild fish would decline between 10% - 14% for the most affected EU countries including UK. Notable decline of exports would however occur in case of fish processing – up to 60% in the UK. The loss of UK exports of aggregated fish products would amount to 30%, which is considerably more than in Belgium or Ireland (12%). These figures show how drastic impact Brexit could have if trade protectionism measures would be in place. For the processed fish sector, the NTM trade costs are expected to increase by 28% in total and in the WTO regime, import prices would further increase by 15% tariff. Thus, the industry would face almost 45% increase in trade costs, resulting thus in a sharp decline of competitiveness. Although the trade measures are symmetric for the EU, the lower dependence of EU on UK market smoothens the total impact on exports.

Table 6: Impact of Brexit on exports of fish products (% Change from Baseline in 2025, Brexit_WTO_NTM scenario)

	FISHPRODUCTS	FSH	AQUAC	FISHP	FISHM
NEUROPE	0.0	0.6	4.4	-3.1	-11.2
WEUROPE	0.4	4.5	9.3	-5.1	-3.1
GBR	-30.6	-13.5	-40.0	-61.0	-55.5
IRL	-12.4	-7.1	-2.6	-23.7	-44.4
NLD	-8.7	-4.3	2.4	-18.1	-22.7
BEL	-12.4	-10.3	10.1	-20.1	-16.3
FRA	-6.1	-5.5	3.5	-10.5	-17.1
ESP	3.1	3.9	6.1	-1.7	-3.2
EUROPE	1.2	2.0	0.1	1.2	-2.3
EUROPENOUK	-8.6	-5.2	-2.4	-12.0	-21.8

Figure 8 shows the impact of full Brexit on net trade in all fish products. Great Britain's net exports would decline by 400 mln USD in constant prices of 2011. It is interesting to note that exports volume would decline even in the wild fish sector, which benefits from increased access. The reason behind is that in the presence of the high NTMs and tariffs, the consumption of wild fish in the UK would be sourced from domestic production, and exporting less abroad. It is also apparent that North Europe and Spain would gain from Brexit with positive trade balance in fish products. After closing marine border, Spain is one of the few countries that would benefit with increased access to landings, due to reduced competition from UK boats.

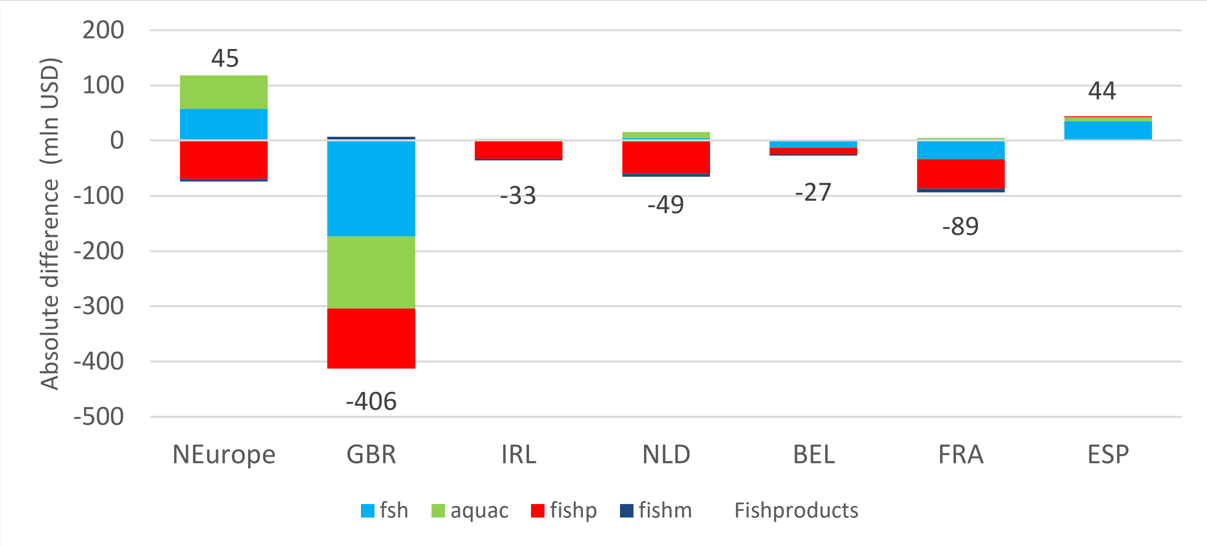


Figure 18 Net trade in fish products with world (diff. from Baseline in 2025, Brexi_WTO_NTM scenario)

It is also interesting to see the changes in territorial structure of trade in fish (Figure 9). It is apparent that Great Britain would be forced to find new export markets in Asia and Africa, however, they would not compensate for the loss of the EU markets (at least not in the short term). On the other hand, North Europe and Spain would take over the EU markets and would benefit from this new situation.

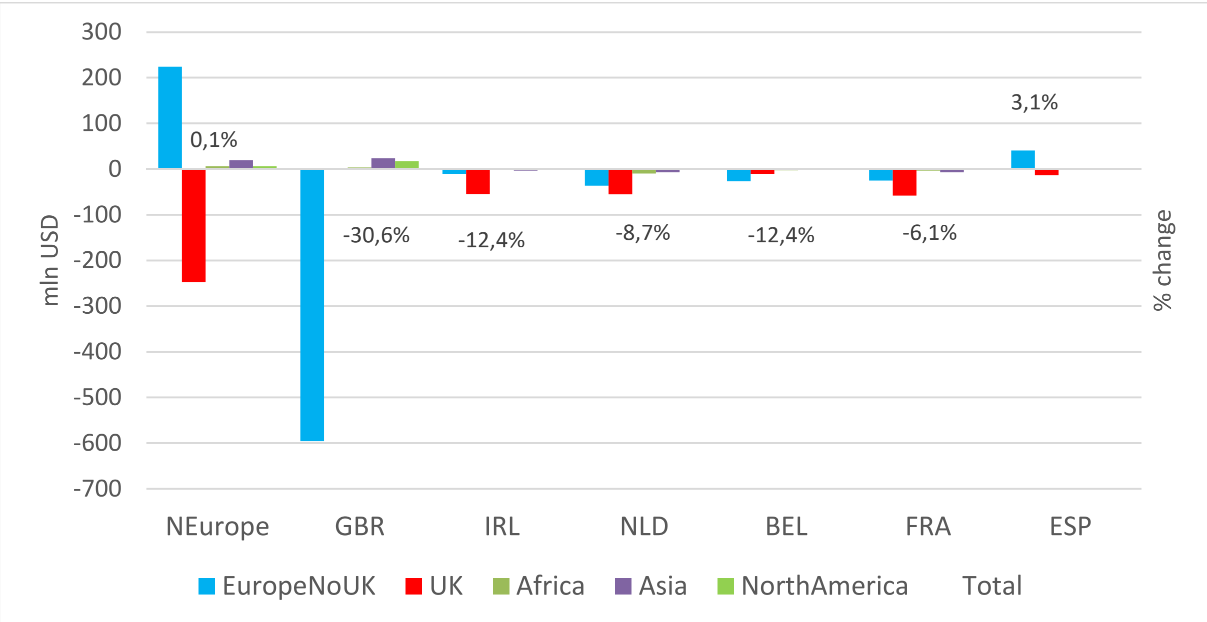


Figure 19: Impact of Brexit on exports of fish products (diff. from Baseline in 2025, Brexit_WTO_NTM)

14.1.2.4 Impact on consumption of fish

The impact of hard Brexit on the consumption of fish products and consumer prices is shown in Figure 10. It is clear that Brexit would negatively affect consumption of fish products in all selected EU regions including the UK, with drop of consumed quantity in range of 1% - 4%. The most visible impact of Brexit on fish consumption would be expected in Ireland (more than 4% decline), followed by UK. The change in consumption is directly linked to the changes in consumer prices. On the world level, Brexit has no impact on consumed quantity of fish and negligible impact on consumer prices. Within the EU, prices of fish products would grow between 1% - 9%. The strongest increase of fish prices occurs in Ireland, where consumer prices of fish products would grow by more than 9%. The reason for such a high price reaction is the large dependence on trade in the fish processing sector. In Ireland, about 80% of consumption is sourced by imports out of which 70% comes from Europe, leading to a high sensitivity of consumer prices on trade changes. In Netherlands, there is a high dependency of aquaculture consumption on imports (almost 90% aquaculture products are imported), with 85 % of it coming from Europe.

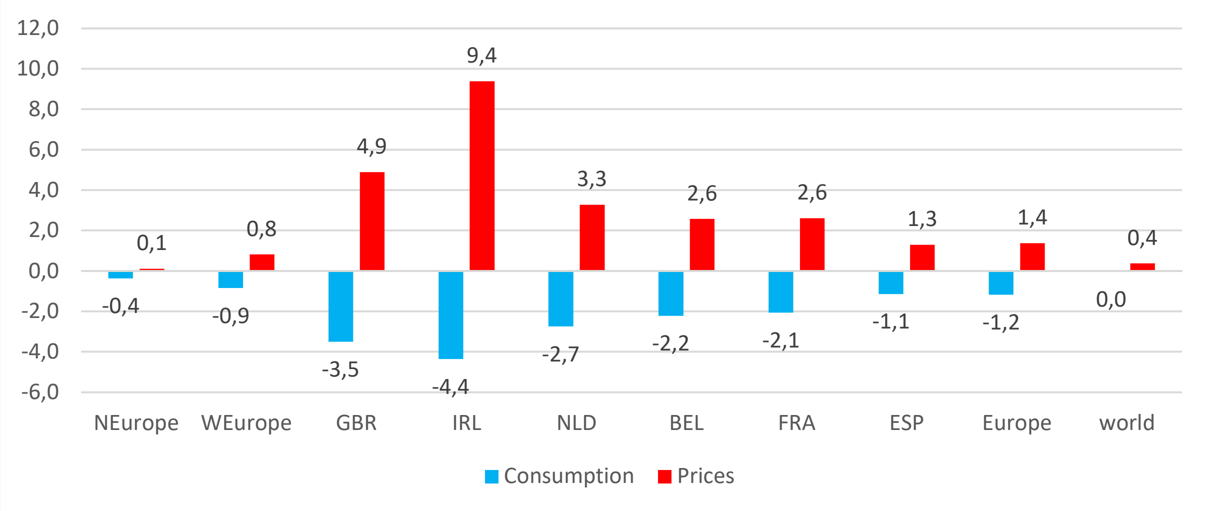


Figure 20 Impact of Brexit on the volume of consumption and consumer prices (% diff. from Baseline in 2025, Brexit_WTO_NTM)

The source of consumption in Great Britain changes quite a bit as figure 11 shows. Domestic products become far more important for consumption. The domestic consumption share of wild fish for example increase to nearly 80% after the Brexit. In total 70% of fish products consumed in Britain are from domestic sources after the brexit, before the brexit this was about 60%. The source of imports also changes quite a bit. While over 50% of all fish imports came from Europe, after the brexit only 36% of all fish imports come from Europe. After the brexit, Great Britain will start importing far more from Asia and far less from especially Northern Europe.

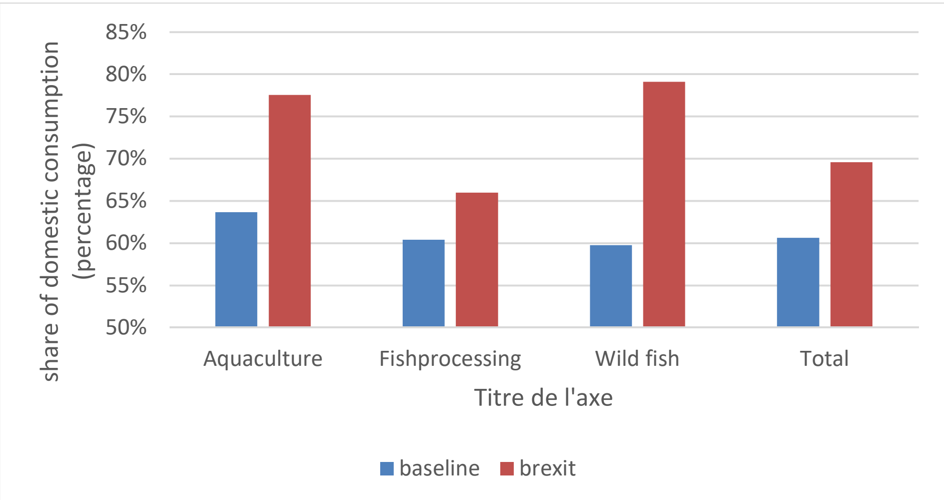


Figure 21 Impact on source of consumption fishproducts

14.1.3 IMPACT OF BREXIT ON OTHER INDUSTRIES

In this section, the impact of Brexit outside of fisheries sector is analysed. Figure 12 shows absolute differences of Brexit impact and Table 7 % change from Baseline. It is noted that the impacts on fisheries sector are very marginal compared to the changes observed in other sectors of the economy such as services and industry. Interestingly, large gains are observed for the agricultural sector in Great Britain after Brexit. The reason for this is increased protectionism, where the imposed tariffs and NTMs on the agricultural and food commodities increase the competitiveness of the domestic agri-food sector that benefits from this. In Ireland, on the other hand, the agri-food sector contracts by 30%, which is a major decline. It is important to note here that the hard Brexit imposes large tariffs on dairy and meat products which are very export oriented commodities in Ireland (dairy exports and cattle meat exports from 68% to 80% of domestic production resp.). Next to that, the share of exports to UK in total Irish exports ranges for these commodities from 38% for cattle meat to 92% to sugar. As a consequence of hard Brexit, the exports of the key food processing commodities from the UK decline by 80% - basically there is no trade with UK anymore. Such a drastic shock on food processing then also brings down the primary agriculture. With respect to industry and services, the impact is negative in the UK but in some EU countries such as France and Spain, positive impacts are noted.

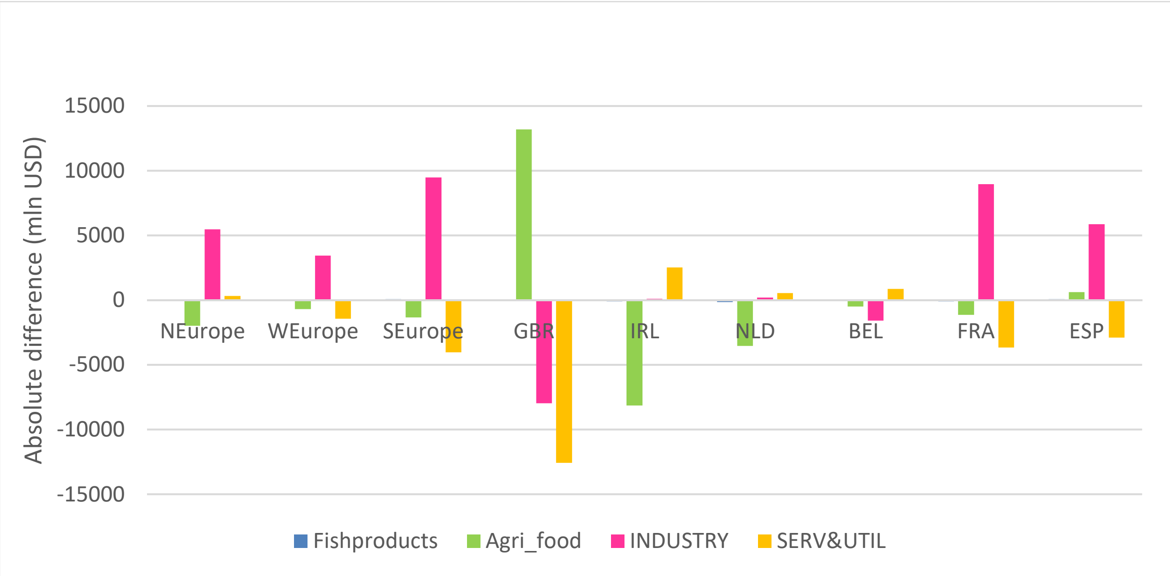


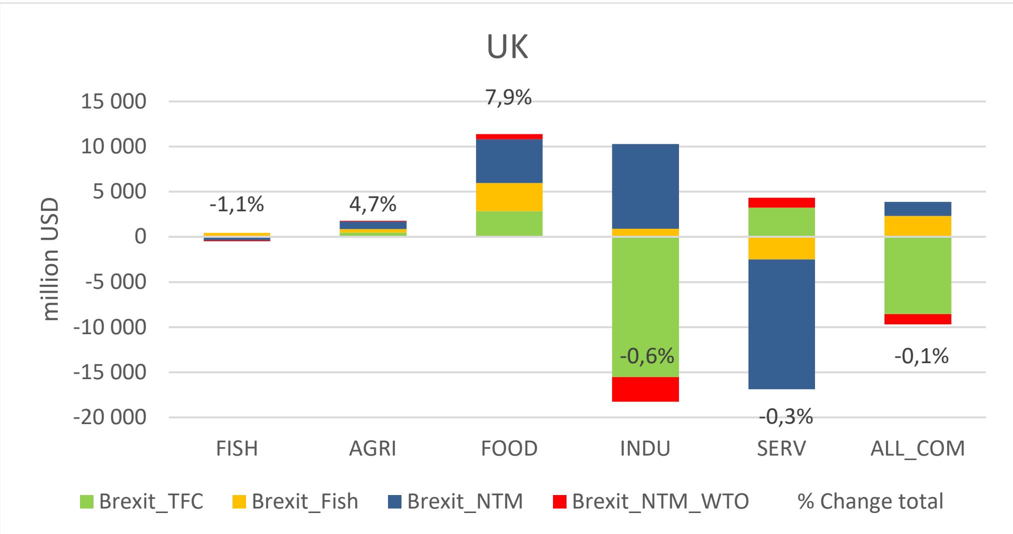
Figure 22 Changes of production volume due to Brexit in 2025 (change from Baseline, Brexit_fish_WTO_NTM)

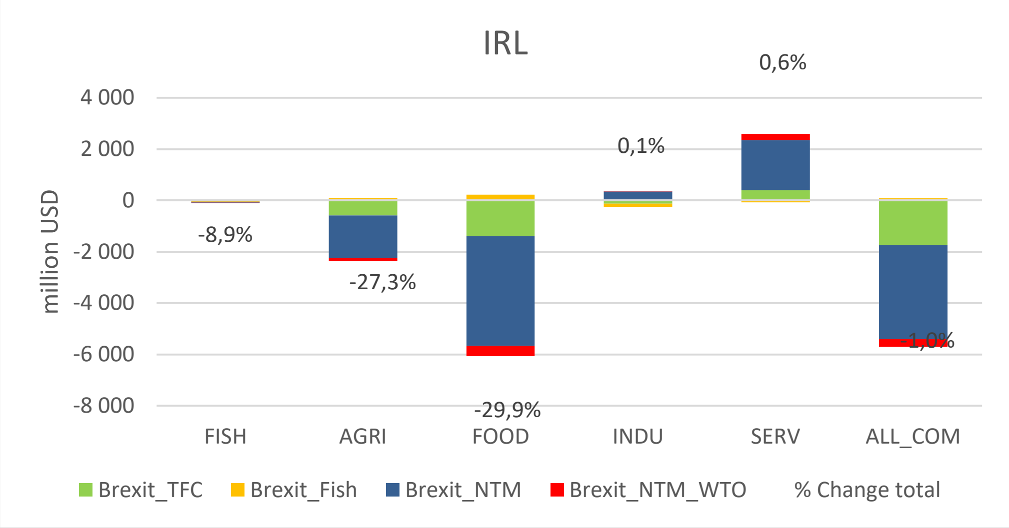
Table 7: Changes of production volume due to Brexit in 2025 (% change from Baseline, Brexit_fish_WTO_NTM)

	FISH PRODUCTS	AGRI_PRIM	AGRI_PROC	OTHER_PRIM	INDUSTRY	SERV&UTIL	ALL_COM
NEUROPE	-0.1	-0.9	-1.3	-0.5	0.5	0.0	0.1
GBR	-1.1	4.7	7.9	2.7	-0.6	-0.3	-0.1
IRL	-8.9	-27.3	-29.9	-4.4	0.1	0.6	-1.0

NLD	-7.4	-2.0	-2.9	-0.9	0.0	0.0	-0.2
BEL	-9.6	0.2	-0.9	0.8	-0.3	0.1	-0.1
FRA	-1.5	0.1	-0.5	0.7	0.6	-0.1	0.1
ESP	1.3	0.0	0.3	0.9	0.7	-0.1	0.1
EUROPE	-0.6	-0.2	-0.1	0.3	0.2	-0.1	0.0
EUROPENOUK	-0.5	-0.6	-0.9	-0.2	0.3	0.0	0.0
WORLD	0.1	0.1	0.2	0.2	0.1	-0.1	0.0

It interesting to zoom into the impact of the individual Brexit measures on the key sectors of the economy (Figure 13). It is clear that the TFC and NTM measures are the most dominant drivers of the impact for industry and services. In the UK, the imposition of TFC creates a comparative advantage to services which do not face trade facilitation costs. However, in case additional NTM measures are imposed, the competitive advantage is reversed back to industry. In total, the industrial sector is affected more than services and that drives the overall decline of production volume in Great Britain in Brexit. In Ireland, the NTMs and TFCs are also the key drivers of Brexit impact, across all sectors. The overall decline of production is driven by the agri-food sector, whereas industry and services in fact benefit a bit from Brexit. The Dutch agri-food sector and the rest of the economy, compared to Ireland, is more resilient to Brexit. Interestingly, the impacts of fish access are transmitted positively to the Dutch agri-food sector. The decline of fish production and increased price of fish has a small positive impact on agricultural food demand and thus production. However, the NTM impact is stronger so the agri-food sector declines after Brexit, but the impact is small as is in the rest of the economy.





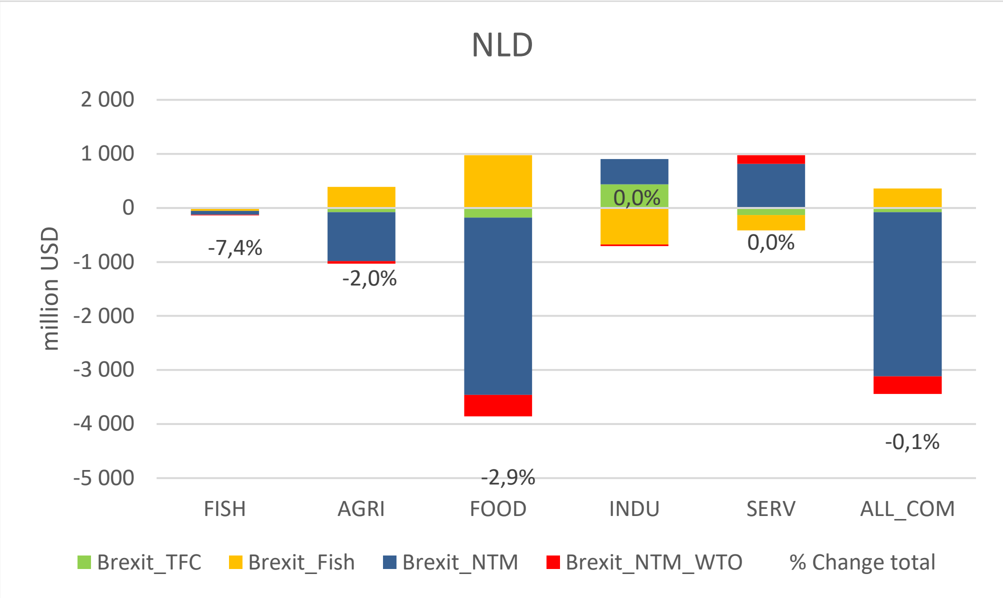


Figure 23 Decomposition of Brexit impact on production volume in the economy (difference from Baseline in 2025)

14.1.4 MACROECONOMIC IMPACT

Finally, the macroeconomic impact of Brexit scenarios is analysed. Figure 14 plots the percentage difference of GDP in hard Brexit compared to Baseline in 2025 and 2030, showing both immediate effect and longer-term effect. It is apparent that the GDP effects are lasting in time, moreover, the gap between the GDP without and with Brexit becomes wider over time. For instance, in Great Britain, GDP in 2025 declines by almost 3%, and by 2030, it is almost 4% lower than if Britain remains an EU member in the same period. Similar effects are noted for Ireland. The impacts for Netherlands are interestingly much lower. As already mentioned, t**he Dutch economy is more resilient to Brexit than Ireland.**

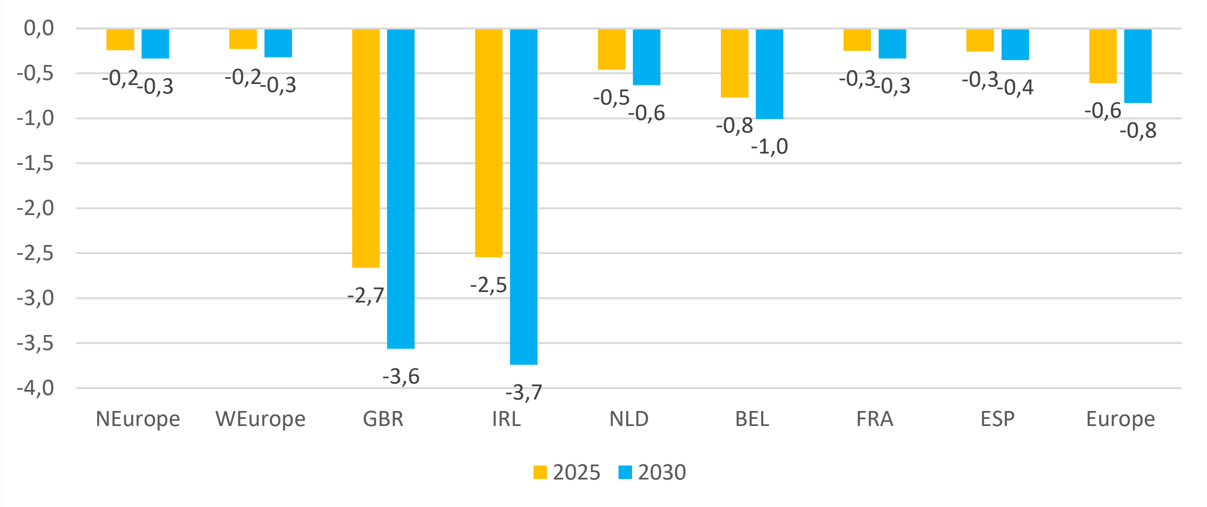


Figure 24 Impact of Brexit on GDP (% Difference from baseline, Brexit_fish_WTO_NTM scenario)

Again it is interesting to decompose the impact of the different Brexit measures on GDP volume (Table 8). Given that all scenarios concern EU-UK relations, the impact on world (and non-European regions) is limited. This holds particularly for the fish access scenario, which only simulates changes in the fisheries sector. The major impact on GDP is driven by the NTM measures. For instance, in the UK, the imposition of trade facilitation costs reduce GDP by 1% compared to Baseline and the additional NTM causes it to further decline to 2.6%. Given that import tariffs are charged on trade of mostly agri-food and fisheries products, the impacts on GDP range around -0.01%, which is negligible, even for Ireland. About 0.6% loss of GDP could be expected for the whole Europe and in Great Britain and Ireland, these impacts exceed 2%.

Table 8: Impact of Brexit on GDP volume (% difference from Baseline, 2025)

	BREXIT_TFC	BREXIT_FISH	BREXIT_NTM	BREXIT_NTM_WTO
NEUROPE	-0.1	-0.1	-0.2	-0.2
WEUROPE	-0.1	-0.1	-0.2	-0.2
GBR	-1.0	-1.0	-2.6	-2.7
IRL	-0.7	-0.8	-2.5	-2.5
NLD	-0.1	-0.2	-0.5	-0.5
BEL	-0.3	-0.4	-0.8	-0.8
FRA	-0.1	-0.1	-0.2	-0.3
ESP	-0.1	-0.1	-0.3	-0.3
EUROPE	-0.2	-0.3	-0.6	-0.6
AFRICA	0.01	-0.06	0.02	0.02
ASIA	0.01	-0.14	0.02	0.02

WORLD	-0.04	-0.14	-0.11	-0.11

GDP is often reported in country comparisons as a welfare measure and as indication for compensation payments. Kohli (2004), however, demonstrates that when one country experiences some terms of trade improvements this welfare indicator may be in fact misleading as it underestimates the increase of real domestic income and welfare. Real GDP is unable to capture the beneficial effect for an economy of an improvement in its terms of trade (say an increase in export or decrease of import prices) as it focuses only on production possibilities. As impacts of Brexit are driven by changes in trade and trade barriers, the welfare impacts are better measured by the equivalent variation which is the change in wealth, at current prices, that would have the same effect on consumer welfare as would the change in prices, with income unchanged. We use an adjusted for the MAGNET model version of the welfare decomposition method developed by Huff and Hertel (2001). As both GDP and equivalent variation are used as indicators for compensation we present both variables and use the equivalent variation as a method to decompose the overall welfare effect in their main components.

Welfare of Great Britain is negatively impacted as figure 15 shows. The biggest welfare loss is due to worsening terms of trade. Especially the NTM's have a significant negative impact on welfare. The welfare gain from extra fishing stock access in no way comparable with loss due to tariffs and NTM's. The higher tariffs and trade barriers also worsen the welfare due to an allocation impact. This measures how much welfare is lost due to a change in consumption as a reaction to higher prices for goods and services. The NTM's have an higher impact then the tariffs on the overall welfare.

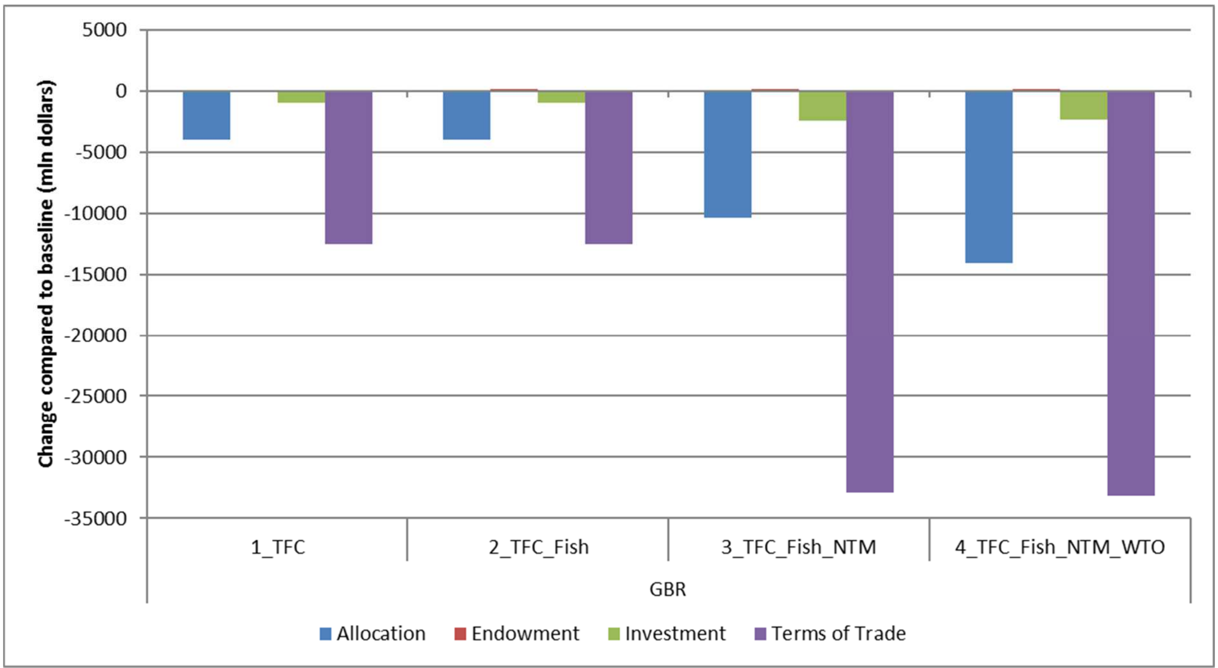


Figure 25 Welfare change Great Britain (absolute difference from baseline in mln dollars)

Welfare of Europe is also negatively impacted by the Brexit. Europe welfare will worsen due to deteriorating terms of trade and a negative allocation effect as figure 16 shows. This welfare loss is especially high for western European countries. Other regions in the world will benefit from the Brexit as figure 16 shows. Especially Asia and North America will increase trade with Europe and the UK and therefore benefit on their terms of trade.

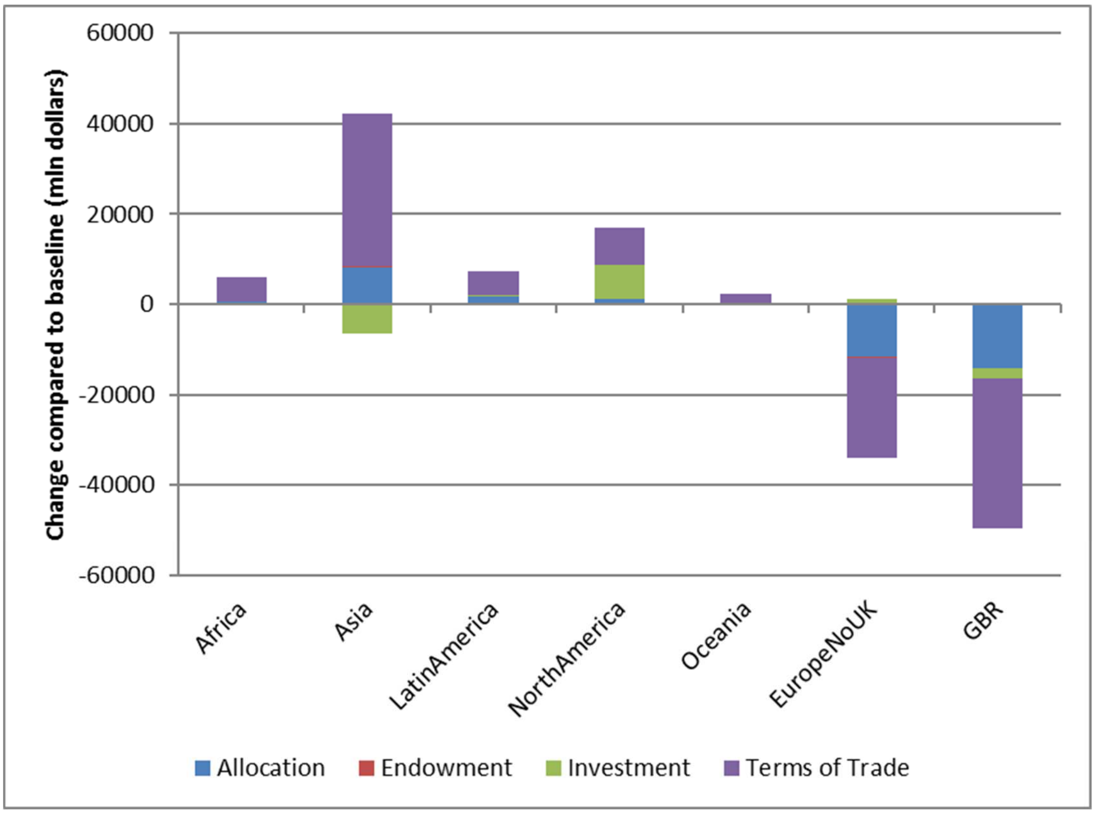


Figure 26 Welfare change world (absolute difference from baseline in mln dollars, Brexit_fish_WTO_NTM scenario)

14.1.5 SENSITIVITY ANALYSIS

The crucial assumptions that determine the magnitude of impact of Brexit on the fisheries sector is the substitution elasticity between fish stocks and other production factors. For this reason, the sensitivity analysis was performed to test the assumptions. Table 9 shows the impact of Brexit fish scenario on the fisheries sector in the key EU countries (the impacts outside of fisheries are negligible, therefore we omit them from the analysis). This scenario simulates an increased (or reduced) access to fish stocks in the respective countries. The substitution elasticity of 2.0 assumes that fish stocks and the other production factors are substitutes, whereas 0.8 assumes they are complements. The elasticity of 1.2 allows a moderate level of substitution. As Table 9 shows, these assumptions are very important for the magnitude of reaction both for production volume and prices, but they do not change the direction. For instance, if we believe that under higher abundance of fish, fisherman can reduce their effort in the UK and vice versa, with a reduced access to UK fishing zones, the fishermen in the EU can increase their effort, the impacts on production volume and prices are more moderate. On the other hand, if we believe that an increased access to fish will lead to even higher effort to catch the fish and parallel, in the EU countries, a reduced acces to fish will also require less effort, the impacts are more dramatic. In the UK, this could mean an increase of production volume by up to 16.5% and a reduction of prices by 9.5%. In value terms, UK fisherman would gain in all cases, but if the factors behave as complements, gains are quite higher than if they are substitutes (1.9% increase of value vs 5.4%). These assumptions are then key for the reaction on the labour markets where they not only influence the magnitude, but also the direction of the fish access impact of Brexit. In case of high substitution, labour costs could be saved by 11% in the wild fish sector in the UK, but for instance in Netherlands, this would on the other hand require almost 10% increase of labour input, to compensate for the decline of fish stocks. Under the assumption of complementarity, labour costs may go up in the UK by 2% and decline by the same rate in Netherlands.

For our analysis, we opted for the medium value of 1.2, where assume that with an increased access to fish stocks, the fisherman are able, to a certain extent, reduce their effort and save the total fishing costs.

Table 9: Sensitivity analysis of Brexit_fish scenario in wild fish sector (% Change in 2020-2025)

	Elasticity = 2	Elasticity = 1.2	Elasticity = 0.8
Production volume			
GBR	9.6	13.3	16.5
IRL	-5.4	-7.2	-8.8
NLD	-0.9	-2.9	-4.7
Price production (market prices)			
GBR	-7.1	-8.1	-9.5
IRL	4.0	4.5	5.7
NLD	3.5	1.1	2.6
Production value, market prices			
GBR	1.9	4.1	5.4
IRL	-1.6	-3.0	-3.5
NLD	2.6	-1.8	-2.2
Labour costs			
GBR	-11.3	-4.4	2.1
IRL	6.0	-0.4	-3.2
NLD	9.4	0.5	-2.1

14.1.6 CONCLUSION

This study analysed the impact of hard Brexit on the fisheries sector and the rest of the economy. Regarding fisheries, if UK would completely close its marine areas, Ireland, Netherlands and Belgium would be affected the most. The reduction of fish access for these countries, and in turn, an increase of fish access in UK, would cause an important trend reversion. From expected decline by 2025, UK would see a boost in wild fish production and vice-versa for the EU countries. The impacts on wild fish production range in 10-15% interval (positive for the UK and negative for the EU). However, if the other measures are accounted for, such as the imposition of the NTMs and the import tariffs, the gain for UK is lost because of a largely negative impact on aquaculture. In the affected EU member states, the loss would be mostly driven by fish processing which would face a significant increase in trading costs. In aggregate, both EU and UK fish sectors would lose, except for Spain which can moderately benefit from reduced competition of UK boats in its marine waters. The Brexit trade measures have further negative repercussions on the consumer markets across all Europe. It is therefore not in the interest of consumers that the protectionist measures would be put in place.

With respect to the impact on other industries, the increased protectionism in agriculture favours the position of domestic producers and the agri-food sector in the UK would benefit from higher domestic prices. On the other hand, food processing industry, particularly dairy and meat in Ireland would be hit extremely hard, if UK does not trade with Ireland in the free trade zone anymore. The effects on industry and services are variable across the EU countries and depend on the type of measures. It has been shown that the UK industrial sector is rather vulnerable to the trade measures, whereas for instance Netherlands is much more resilient to the Brexit impact. The total GDP effects in for the Dutch economy are thus rather moderate and are below the estimates obtained by other studies (less than 1% in our study compared to CPB). On the other hand, Brexit could cost UK and Ireland about 2.5% GDP in the short-term horizon, but more than 3.5% in the longer horizon. This is more than the usual estimate of 2% from other studies.

With the results presented above we can argue that the employed MAGNET model proved to be useful in analysing the impact of Brexit. Not only that we were able to decompose the impact of each of the hard Brexit measures on the economy, but we could also capture the interlinkages between different fisheries sectors and the impact of Brexit on their relative competitiveness. Given that most of the Brexit measures impose comparably higher burden on the primary and secondary sectors of the economy such as fisheries, agriculture and food processing, alternative CGE models and methods that do not consider this sectoral detail may obtain more biased impacts of their Brexit analyses.

It is also important to note that some assumptions are very important for assessing the impact of Brexit on the fisheries sector, which is the substitution possibility between the production factors employed in the wild fish sector. More expert assessment about the possible repercussion of an increased (or reduced) fish access on the employment of other factor such as labour is needed. This would however not influence the aggregated impact on the rest of the economy.

Finally, it can be concluded that if hard Brexit was adopted as it is simulated in this analysis, a lose-lose situation to all affected parties and notable welfare losses could be expected due to increased protectionism and misallocation of resources.

14.2 EFFECTS OF AN INCREASED DEMAND FOR FISH IN CHINA

China is both the biggest producer and the biggest consumer of fish products. The baseline showed that in 2015 china consumed about 34% of the total world fish production. While total consumption is assumed to go up in the period 2015-2030, the share China has in total world fish consumption will decline from 34% to 29%. Fish consumption in other parts of Asia will increase faster than in China as figure 1 shows.

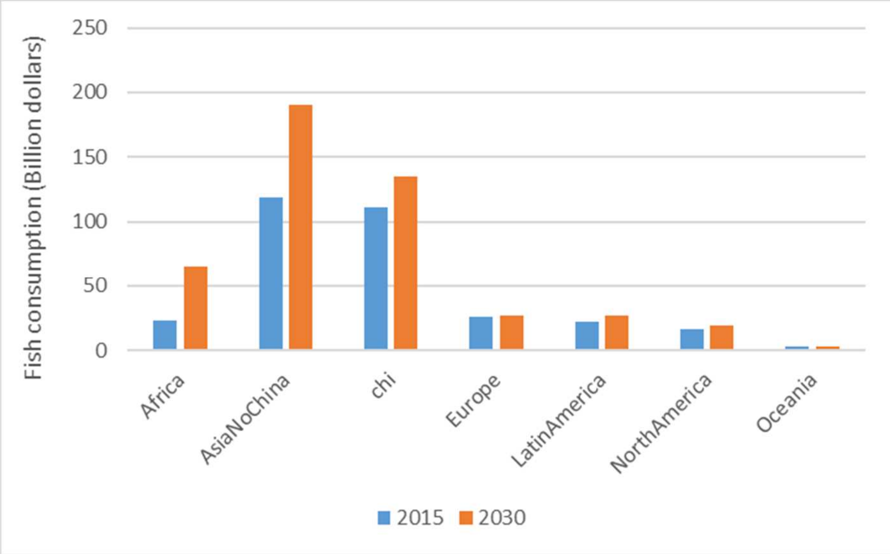


Figure 27 World fish consumption 2015-2030 baseline results (billion dollars)

However these results from the baseline are based on the assumption that current consumer preferences will hardly change. Consumer preference shift are difficult to predict. The Rabobank (2018) published a report showing that consumers preferences for fish are shifting and that it can be expected that consumer demand for fish in China will significantly increase in the next decade. Figures from OECD-FAO statistics (2017) also suggest that Chinese food consumption has seen an remarkable increase in the last decade. It will be more than likely that China will not be able to produce these amounts of fish themselves and will become more dependent on world trade to meet the demand for fish consumption.

To analyse the impact of a consumer demand shift in China, we used MAGNET to simulate how the world market of fish would change if the demand for fish consumption growth significantly in China. In the next paragraphs, we show what kind of impacts can be expected for China and the world. And whether increased trade in fish products offers any opportunities for the European fish producers.

14.2.1 Description of an increased demand from China scenario

In this section, we analyse the impact that fish consumption in China can have on the world fish consumption and production. China is by far the biggest consumer and producer of fish. In this scenario, we analyse what will happen if fish consumption per capita increases faster than expected. Figure 28 shows the assumed increase in consumption of fish per capita. In total fish consumption per capita will double in China, especially due to the increase consumption of aquaculture and processed fish. As wild fish production has only limited possibilities of expansion we assume only a modest increase in the consumption of wild fish.

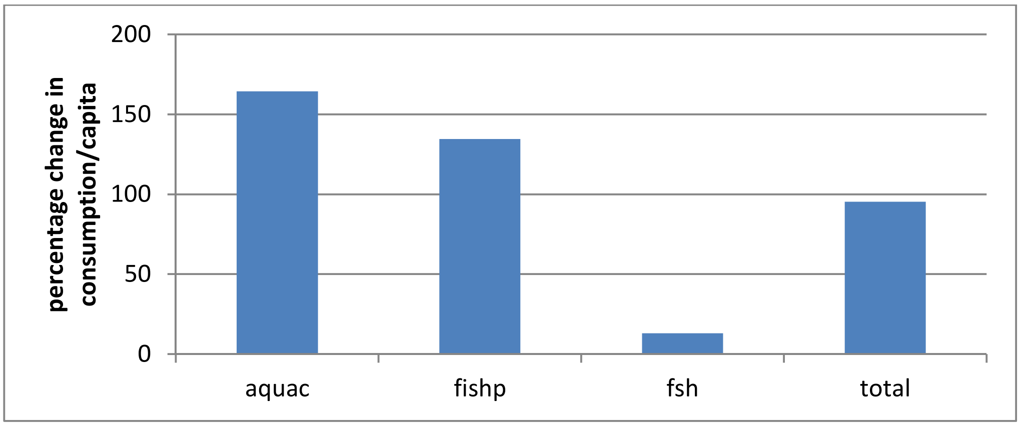


Figure 28 Assumption about percentage change of fish consumption per capita

14.2.2 RESULTS

The results show that most of the increased demand for fish in China is met by increased domestic production. China increases its aquaculture production by 140% to meet the higher demand for fish. The processed fish sector will also increase by 120%. As wild fish production is limited by available stocks, the production of wild fish can hardly increase as Figure 29 shows. However not all of the higher demand can be filled by domestic production. Extra fish will also need to be traded. Therefore, the increase demand for fish in China has an impact on the production of fish in other regions of the world. All regions will see a modest increase of fish production to trade with China (between 1 and 10%). Especially Oceania increases its fish production for trade. In Oceania, aquaculture production is expected to increase by 10%.

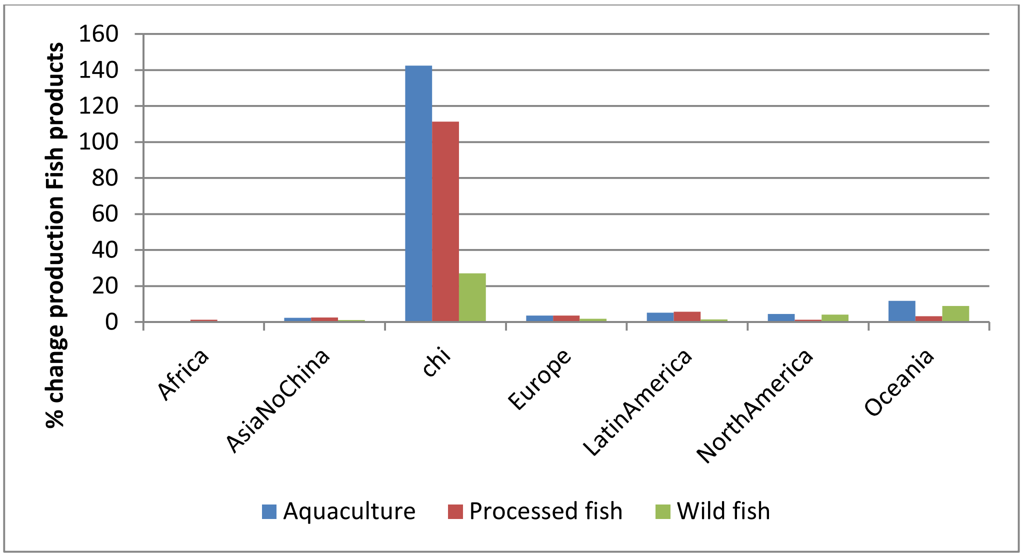


Figure 29 percentage change of world fish production

The increase demand for fish in China firstly has a high impact on fish prices in China as Figure 29 shows. Fish prices increase between 2% (aquaculture) and 16% (wild fish) in China. Overall the price of fish products in China will increase by nearly 6%. The world market price of fish also increases but more modest. We see an increase of the world market price of fish of about 2%. Again, aquaculture fish prices increase is more modest (1%) than wild fish price (4%).

The impact on fish prices in the rest of the world is modest. In most regions fish prices will increase between 0.5 and 1%. Only in Oceania fish prices increase in total by 2%.

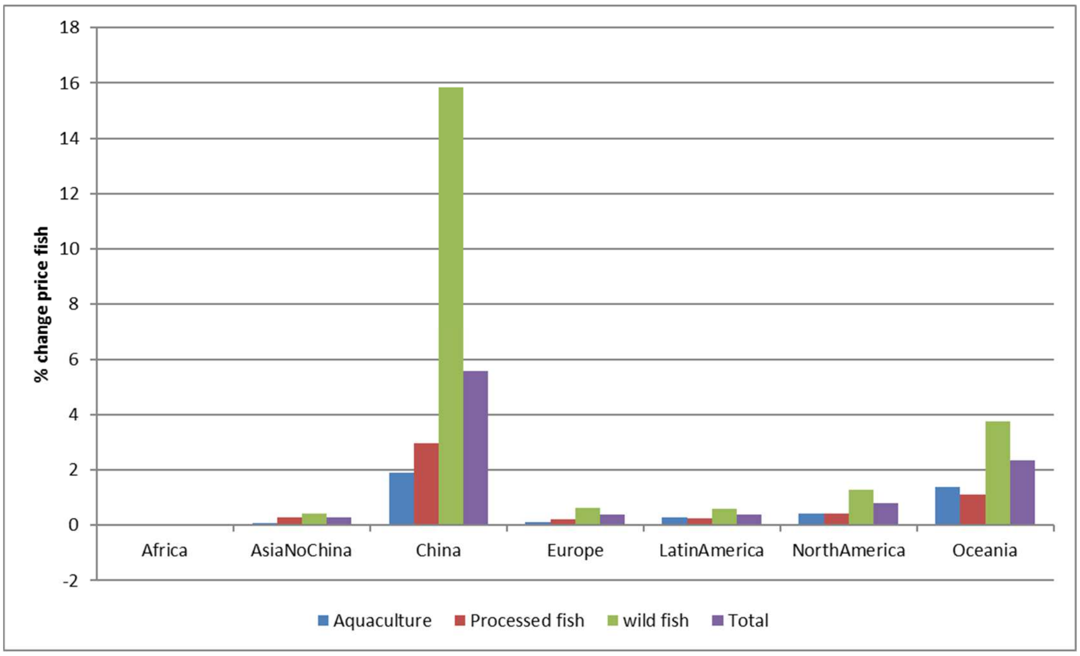


Figure 30 Percentage change in price fish

The higher fish prices will impact world-wide consumption of fish. All countries will consume less fish per capita due to the increased prices for fish. Oceania especially starts exporting more wild fish to China, which leaves less fish for domestic consumption. The consumption of wild fish in Oceania declines by 3%.

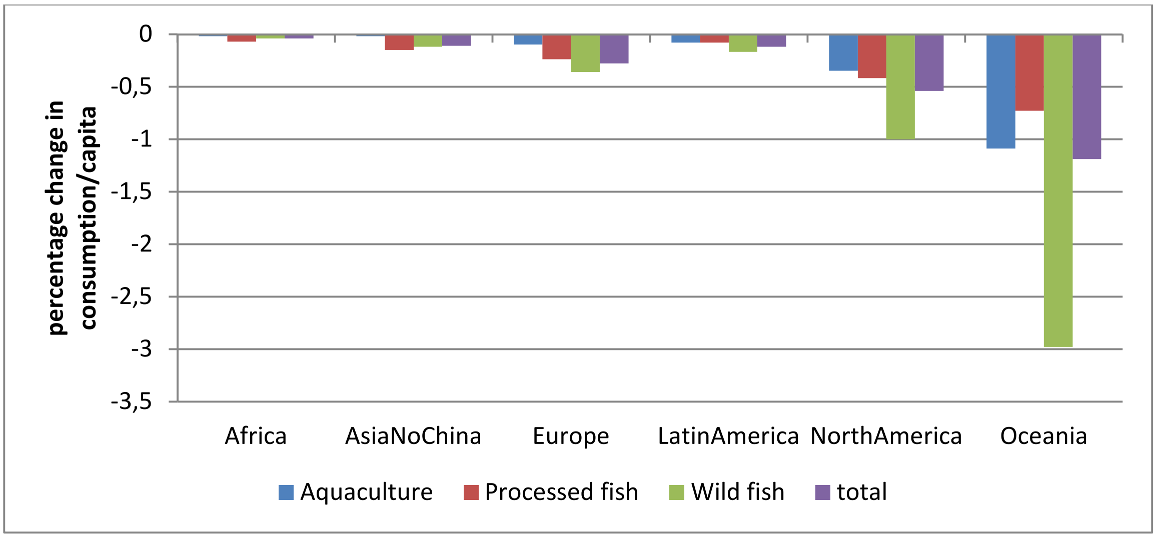


Figure 31 Percentage in fish consumption per capita

The increased demand will lead to make China a net importer instead of a net exporter. All regions trade more with China but most of the extra trade flows come from the rest of Asia as Figure 32 shows. Results show that China will start importing far more processed fish and wild capture fish. Imports of fishmeal will also increase substantially due meet the increased demand for fishmeal by the growing aquaculture sector in China.

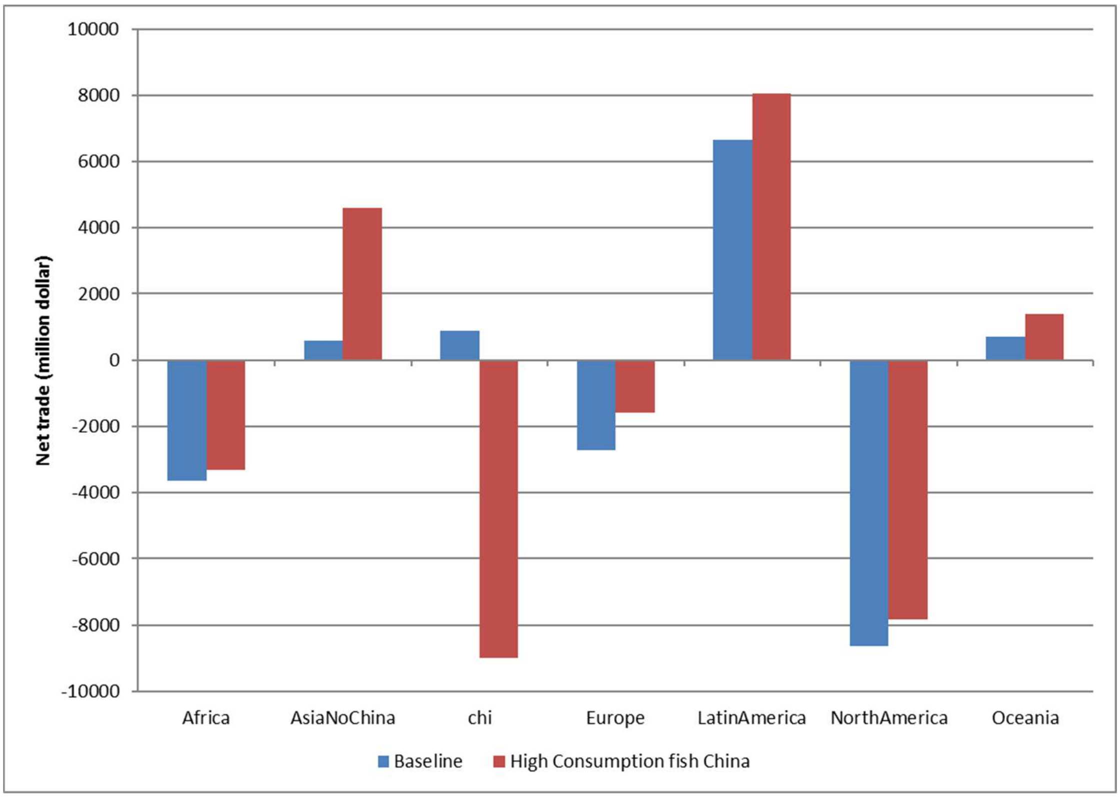


Figure 32 Net trade world regions (million dollars)

Figure 33 zooms in on the trade flows of the different fish products exported to China. Results show that especially the rest of Asia and Latin America start exporting far more processed fish to China. North America and Oceania mainly increase the exports of wild fish to China.

Only Northern Europe is expected to increase the exports to China due to the increase in demand for fish products in China. They mainly increase the exports of processed fish. It is notable that the other regions in Europe do not seem to benefit from the increased demand for fish products from China.

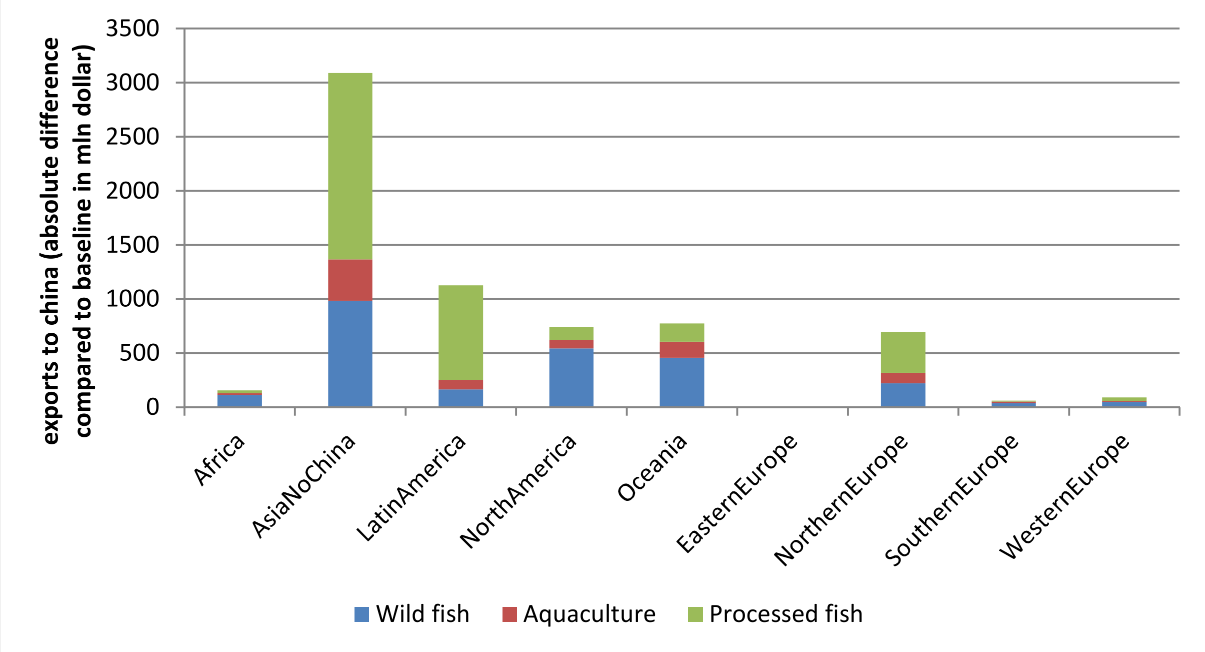


Figure 33 Exports of fish products to china from the rest of the world (in million dollars)

However as Figure 34 shows the trade flows from Europe countries do change. As Northern Europe starts concentrating more on export to China and other Asian countries, they are expected to trade less with the other European countries. This provides opportunities for both southern and western Europe. They will start trading more with Europe. Trade from Europe to Africa also increases more. This is because China exported fish products to Africa, which it does not longer due to the increased domestic demand for fish. This leaves Europe with some extra opportunities for exporting to Africa.

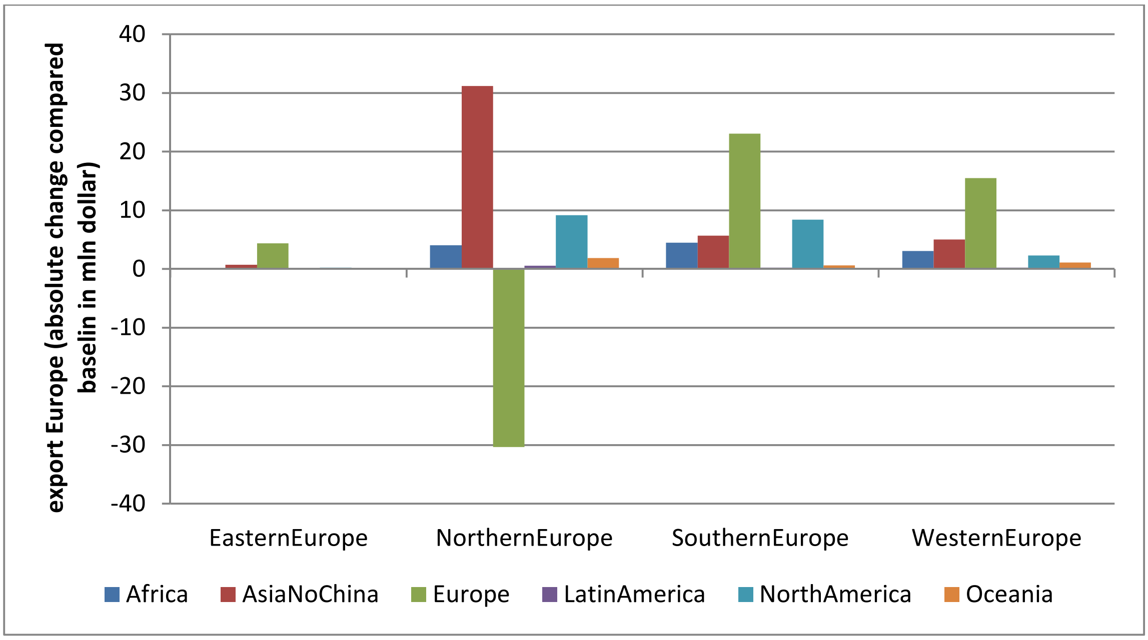


Figure 34 Export Europe (absolute change compared to baseline, in million dollars)

14.2.3 CONCLUSIONS

If the consumers preferences for fish products in China shift and China starts consuming more fish per capita, then this will have a significant impact on the world market for fish. An analysis run with MAGNET shows that while most of the increased demand for fish can be produced domestically by China itself, trade in fish products will still increase significantly.

Fish production in all regions in the world can be expected to increase. Especially fish processing sectors around the world will benefit from the higher demand in China. The demand and imports for fishmeal will also increase significantly due to the increase of aquaculture production in China.

The world market price for fish products can be expected to increase by 2% and less fish will be available for consumption in the rest of the world. Which will leave consumers in all regions apart from China worse off.

Only Northern European countries will increase export to Asia. While the rest of Europe is not expected to benefit from increased trade in fish products to China, western European and Southern European countries will benefit from increased intra-European trade.

14.3 FUEL COST ANALYSIS

Fishing is a fuel intensive activity. Economic performance of the fishing fleets depends quite a bit on fuel costs. On average about 27% of total costs go to fuel cost for fisheries (STECF, 2015). For some fishing techniques, like for example beam trawling, the share of fuel costs may even rise to 40 to 50%.

In this scenario analysis we will test how sensitive the results are to fuel cost changes. We introduce two scenarios: 1) removal of fuel cost subsidies; 2) technological change which reduces fuel dependency

Scenario: Removal of fuel subsidies:

Fisheries fuel prices are often lower then public prices. Countries for example apply tax exemptions or direct fuel subsidies for fisheries sectors. Lower fuel prices or tax exemptions are often used to increase competitiveness of the national fisheries sector. However, lower fuel prices may also lead to more pollution and greenhouse gas emissions and higher fishing effort or capacity than is socially acceptable. The OECD (Martini, 2012) estimated fisheries fuel subsidies or tax exemptions to be about 2 billion for 9.3 billion litres in 2008. However a full overview of all fuel subsidies applied by each European Member state is not available (Guillen et al, 2016). Since a full overview is difficult, for this scenario we assume a general increase in fuel tax across Europe of 20%.

Scenario: Technological change which reduces fuel dependency

Fisheries can reduce fuel cost dependency with new technologies like pulse fishing but also other measures like fishing slower, using a smaller motor, or using lighter fishing gear. In this scenario we analyse how much the competitiveness of the sector can improve by reducing the fuel dependency of the sector. We assume a general technological improvement in the fishing sectors in the EU which reduces the use of fuel by 20%.

14.3.1 Results

Figure 35 shows the impact fuel cost changes will have on the production of wild fish but also aquaculture and fish processing. Especially less fuel use will have an impact of wild fish production. Northern, Western and Southern European countries will increase fisheries production quite a bit. The higher production of wild fish has a negative impact on the production of the aquaculture sector. Overall the price of wild fish declines and thus the demand for the relatively expensive aquaculture fish. This leads to a decline in the aquaculture sectors in Europe. Fish processing benefits from lower fuel dependency in the fisheries sector. As this sector uses wild fish as an input they benefit from the lower fish prices and can increase production.

Removing the fuel subsidies has a negative impact on the fisheries sector. The fisheries sector declines in all European countries. Overall the price of fish increases. This will slightly benefit the aquaculture sector in Europe. Most regions slightly increase their production of aquaculture fish. However overall fish is more expensive in Europe and this will negatively impact the fish processing sectors in Europe.

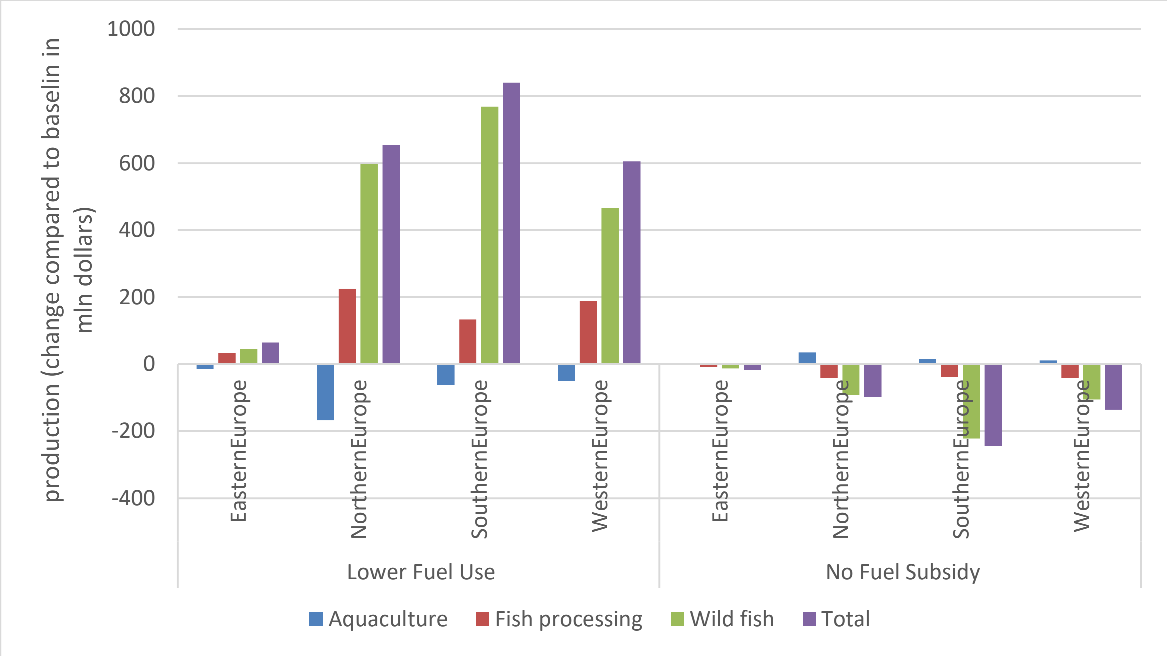


Figure 35 Production fish products 2030 (Change compared to baseline in million dollars)

Consumers benefit from a lower fuel dependency in the fisheries sector. The price of fish declines and therefore they can consume more fish. The opposite is true for a removal of the fuel subsidies. In this case fish becomes more expensive and therefor the consumption of fish declines as Figure 36 shows.

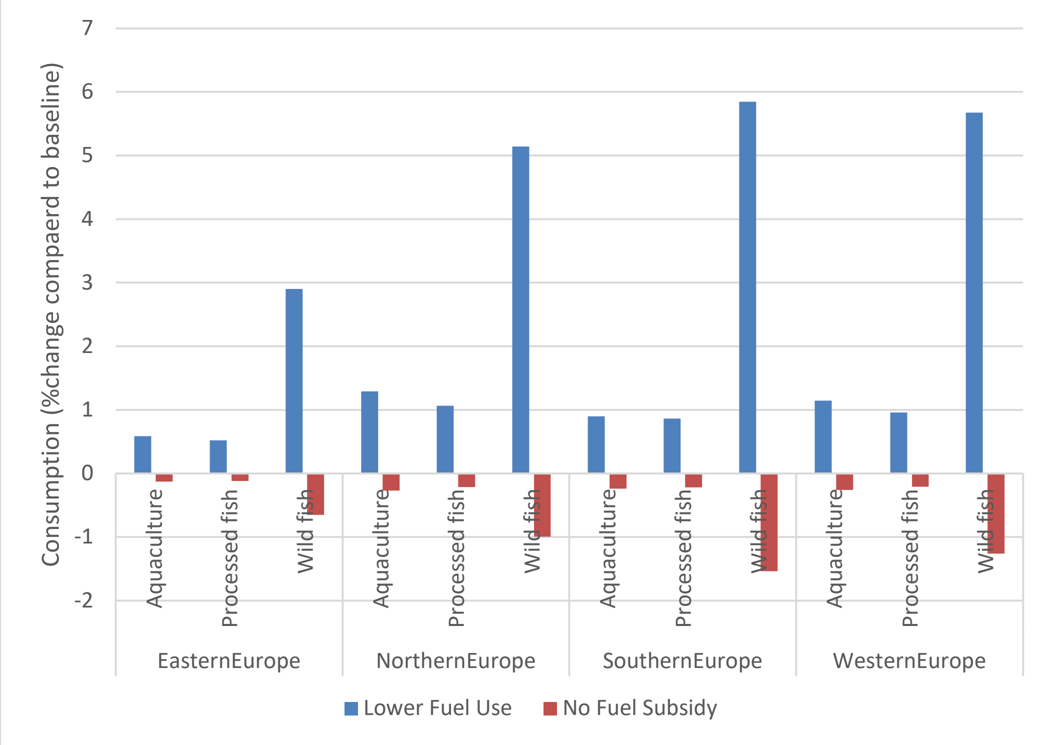


Figure 36 Consumption in 2030 (percentage change compared to baseline)

Figure 37 shows the welfare impact of the different scenarios. Decreasing the fuel dependency of the fisheries sector has a small positive impact on GDP. GDP will increase by 38 million dollars (eastern Europe) to 715 million dollar (Southern Europe). Decreasing the fuel subsidies has a very small negative impact on GDP.

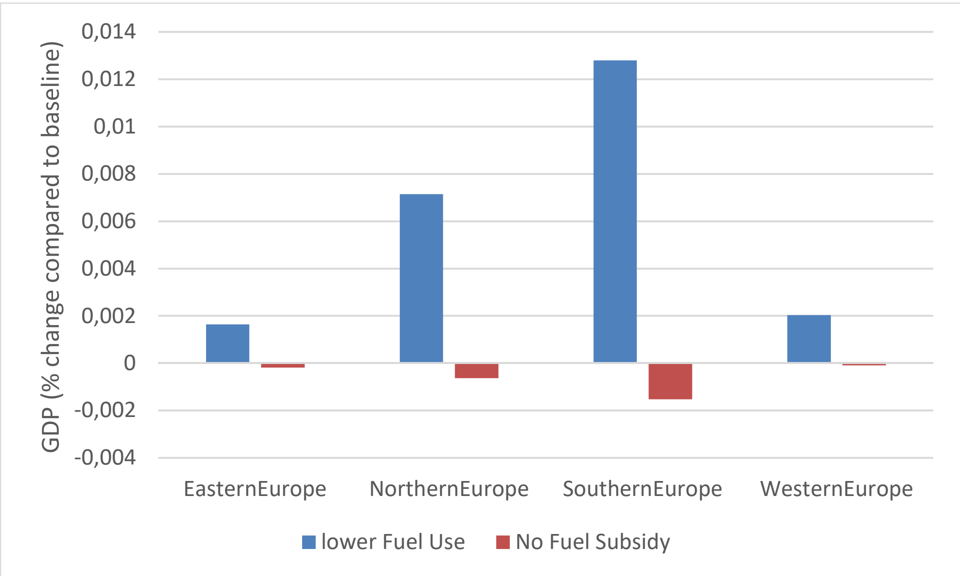


Figure 37 GDP in 2030 (percentage change compared to baseline)

Reducing fuel dependency and removing fuel subsidies both reduce emissions produced by fisheries as Figure 38 shows. The reduction of the fuel dependency has a slightly bigger impact on emissions than the removal of fuel subsidies.

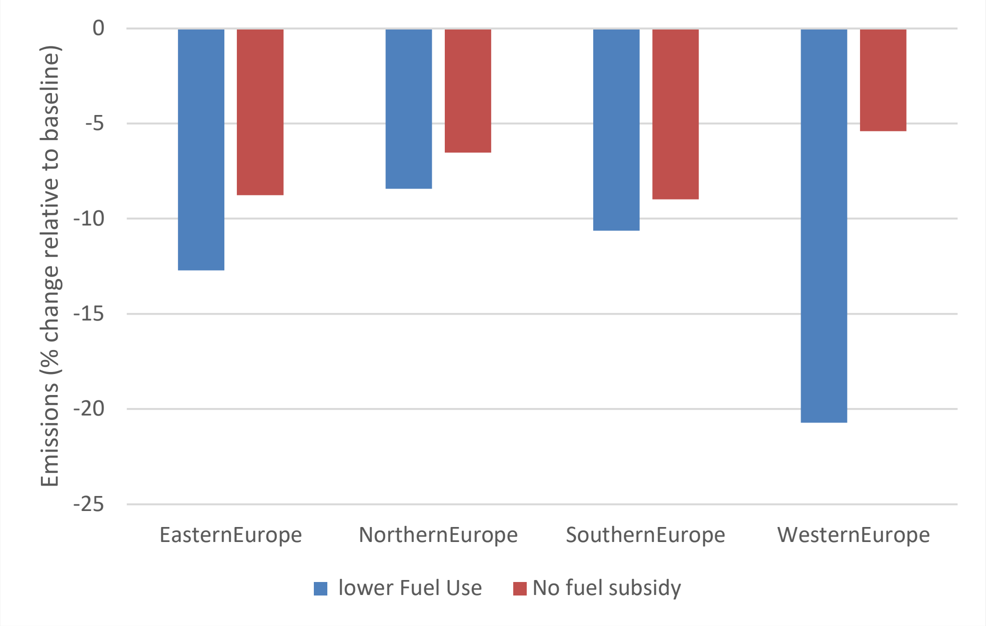


Figure 38 Emissions fisheries 2030 (percentage change compared to baseline)

Removing fuel subsidies has a negative impact on the competiveness of the European fisheries sector. Figure 39 shows that the net trade effect of the measure is negative. All European countries export less fish products. The small increase of aquaculture production does not lessen the negative trade impact. All extra production of the aquaculture sector is consumed domestically. Reducing the fuel dependency increases the competiveness of the sector. Both wild fish and processed fish is traded more as Figure 39 shows.

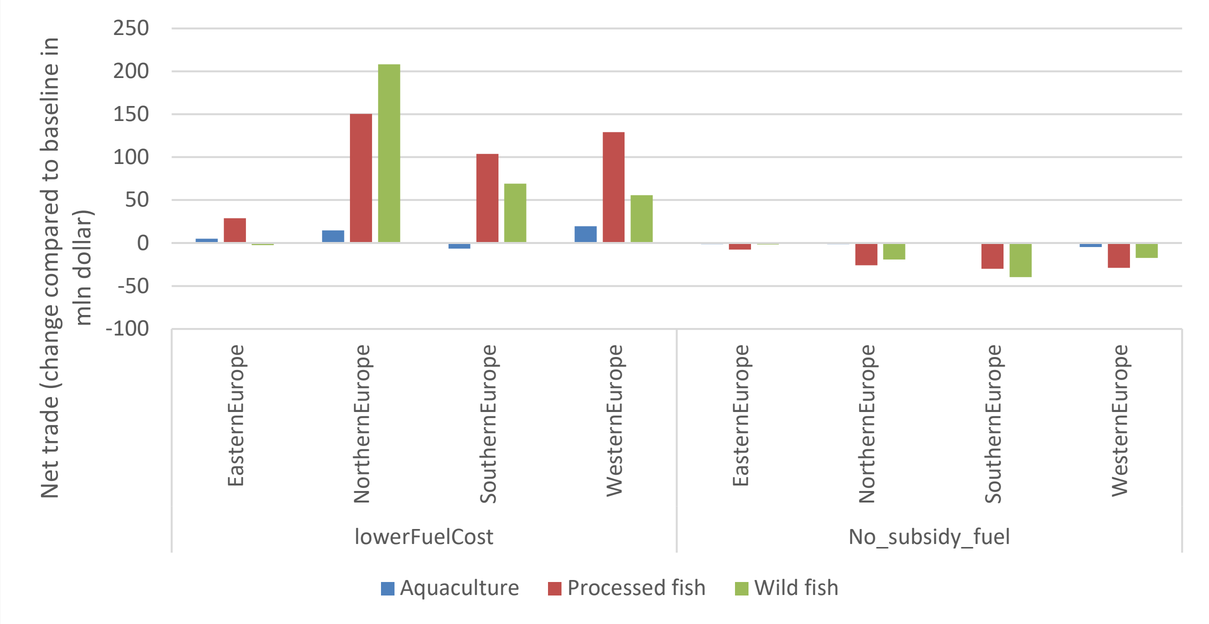


Figure 39 Terms of trade in 2030 (change compared to baseline in million dollars)

While the overall trade impact is similar for all European regions, the trading partners for these European regions is different. Due to a reduction in fuel dependency, Northern Europe is expected to trade significantly more with Asia and increase intra-European trade. For the other regions, we mostly see an increase in intra-European trade (Figure 40).

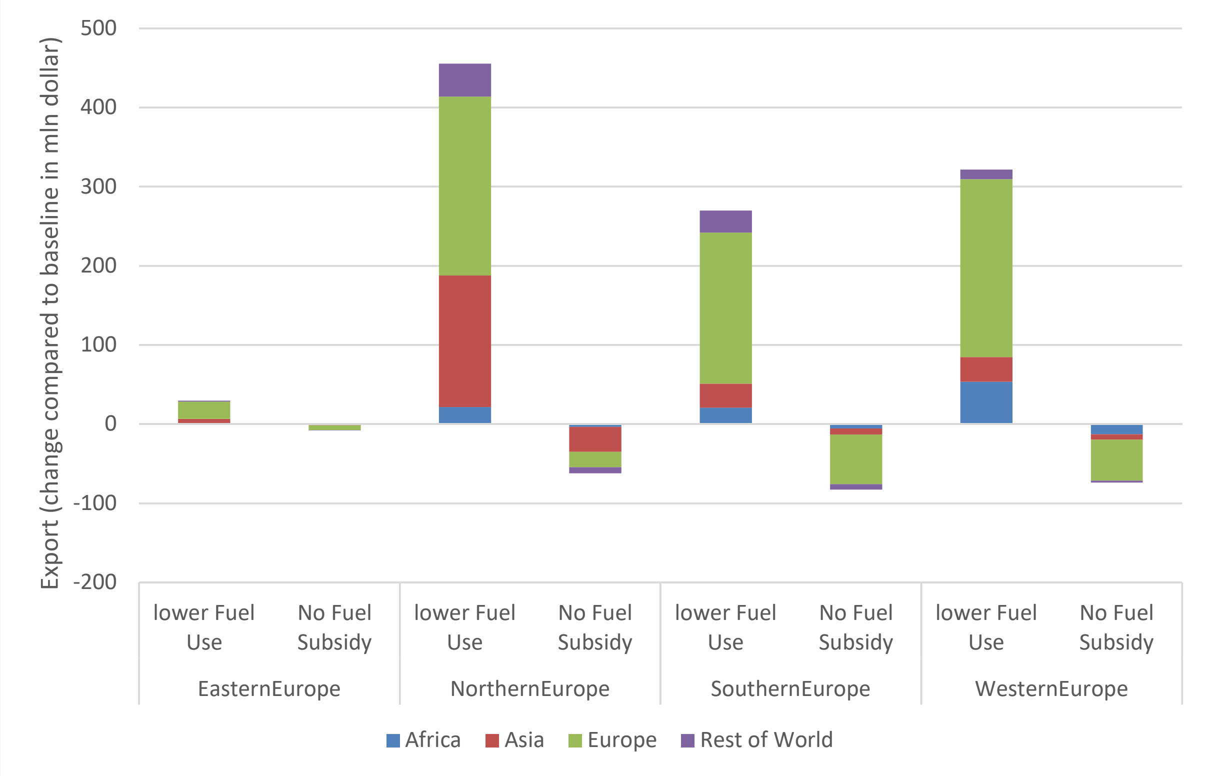


Figure 40 Export in 2030 (change compared to baseline in million dollars)

14.3.2 CONCLUSIONS

In these scenarios the impacts of changes in fuel dependency or fuel subsidies were analysed. Reducing fuel dependency has a positive impact on the competitiveness of the fisheries sector. The lower fish prices due to a reduction in fuel cost increase fish consumption and also have a positive impact on the production of the fish processing sector. Increased competition of the fisheries sector has a negative impact on the aquaculture sectors. They will not be able to compete with wild fish and therefore production of aquaculture fish declines because of the innovations in the fisheries sector.

Reducing fuel subsidies on the other hand has a negative impact on the competitiveness of the sector. Production of wild fish will decline, fish prices go up and less fish is consumed. While aquaculture production benefit from the removal of fuel subsidies, overall production of fish products decreases. The trade competitiveness of both wild fish and fish processing declines and the terms of trade worsens because European countries will export less fish and import more cheap foreign fish products.

15 MARGINAL COST MODEL

The Marginal Cost (MC) model has been described in Deliverable 1.2 and Deliverable 1.4. Here we report on the effect of different policy options and technological innovations, run through the model.

The impacts of different policy options are investigated for chosen cases. As discussed in Deliverable 1.4 then in some cases the signs of the estimated parameters were not in accordance with economic theory. This can be due to factors such as coincidence, low statistical power, or that subsidies were not accounted for in the model. Therefore, such cases were not selected for analysis. Great care was given to incorporate as wide a selection of cases to analyze as possible.

For all scenario we compare three alternative scenarios to the baseline scenarios developed in Deliverable 1.4. These three scenarios, a low, medium and high case scenario, are derived from different magnitudes in the assumptions made, and reflect inherent uncertainty in the models.

Note that in the following calculations, fishing effort is measured in millions of liters of fuel, as fuel use correlates very well with other more complicated measures of effort.

Below we discuss each different policy option scenario in the MC-model. We start by a short description of the scenario, including the assumptions made, and then we present the model results and discuss the findings.

The following policy options analyzed are:

- Ban on fuel subsidies.
- Technological improvements.
- Discard ban.
- Brexit.
- Labeling schemes.

16 BAN ON FUEL SUBSIDIES

Fuel subsidies, mostly in the form of tax exemptions are quite common, not only in European fisheries but also in other fisheries around the world. Fuel intensity varies greatly between different fisheries and fishing technologies.

The dependence on oil varies greatly between fisheries. The graph below shows the distribution of the share of fuel cost of total cost for different gear used for the underlying data.

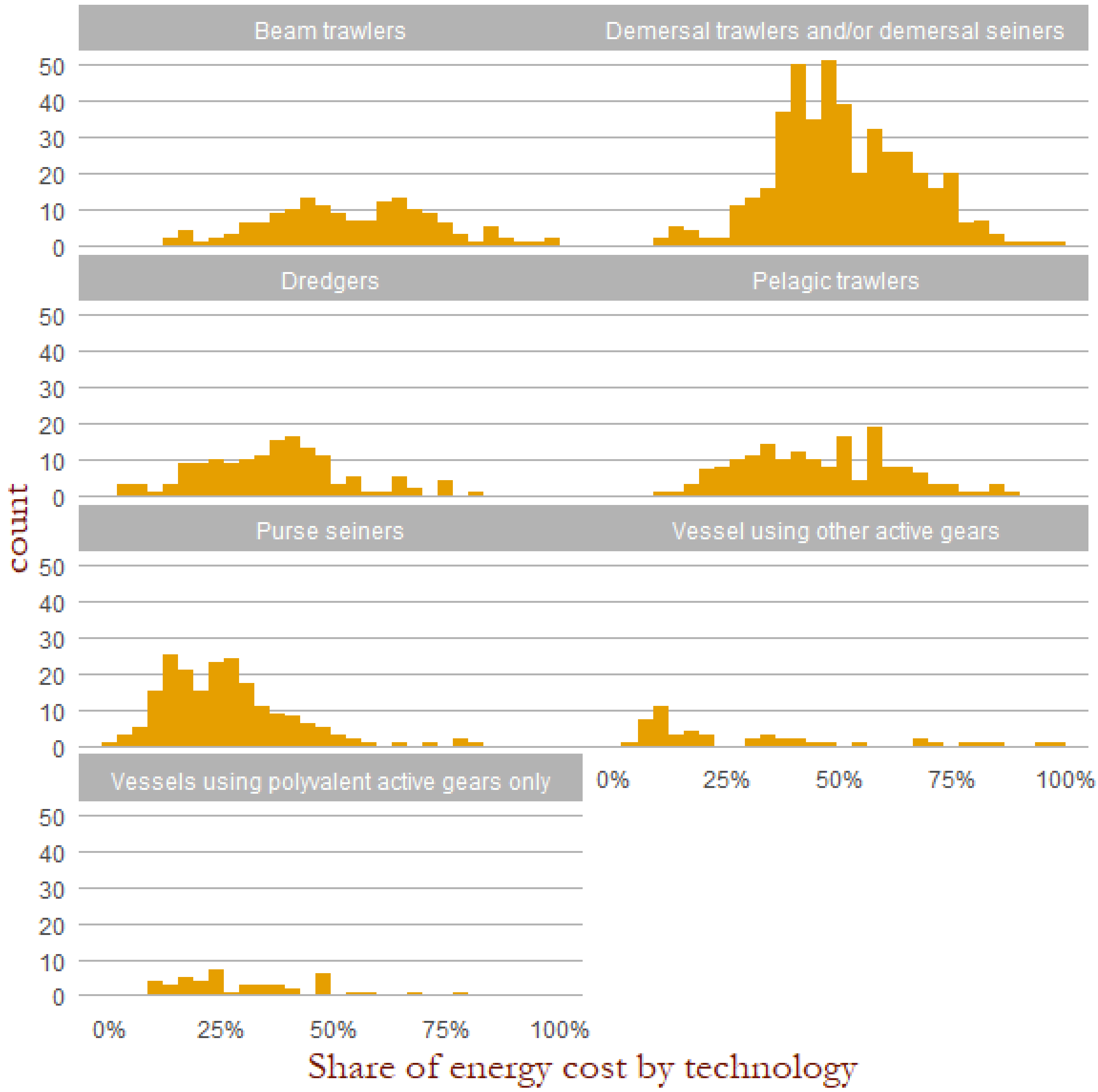


Figure 41 Fuel consumption in different fisheries

The clearly shows the great dispersion of energy share of total cost, both for fisheries with different technologies and within the same technology group. This implies that the effect of a ban on fuel subsidies may differ much between fisheries.

Here we examine possible effects of a ban on fuel subsidies on two distinct fisheries. One is a demersal trawler/seiner fleet in Spain, and the other one is a beam trawler fleet in Italy.

Both in Italy and in Spain, fuel subsidies are exempt from a 21% VAT.[4] Additionally, both fleets are exempt from gas oil tax. Thus, in the alternative case, we assume that this tax is imposed on the fuel, and that the fuel cost will increases accordingly. Because it is not clear, how much VAT reduction these fisheries receive, we have put a 5% increase in fuel cost as a low case scenario.

According to numbers from 2013, the usual oil tax in Spain was 331 euros per 1.000 litres, but a reduced rate, e.g. for agriculture vehicles, was 78,21 euros per 1.000 litres. No instances were found for a reduced rate for Italy, but here use 78,21 euros for both cases as a plausible scenario. In the high tax scenario, we assume that this tax oil tax will be imposed in addition to a full 21% VAT tax rate.

The following table provides a summary of main descriptive statistics for both cases.

	Spanish fleet (case 1)	*Italian fleet (case 2)*
year	2011	2013
country	ESP	ITA
description	Demersal trawlers and/or demersal seiners	Beam trawlers
vessel_length	VL2440	VL2440
effort	100.5	1.5
oil_share	36.3%	35.7%

As can be seen from the table above these two cases operate on a different scale with regards to their size (measured in effort).

16.1 MODEL RESULTS

16.1.1 REMOVAL OF FUEL SUBSIDIES FOR THIS SPANISH FLEET – CASE 1

Running the MC models for this specific Spanish demersal trawlers and/or demersal seiners (see details in table above) yielded the results shown below. Note that effort is measured as fuel use, measured in millions of litres.

[4] http://www.europarl.europa.eu/RegData/etudes/note/join/2013/513963/IPOL-PECH_NT(2013)513963_EN.pdf

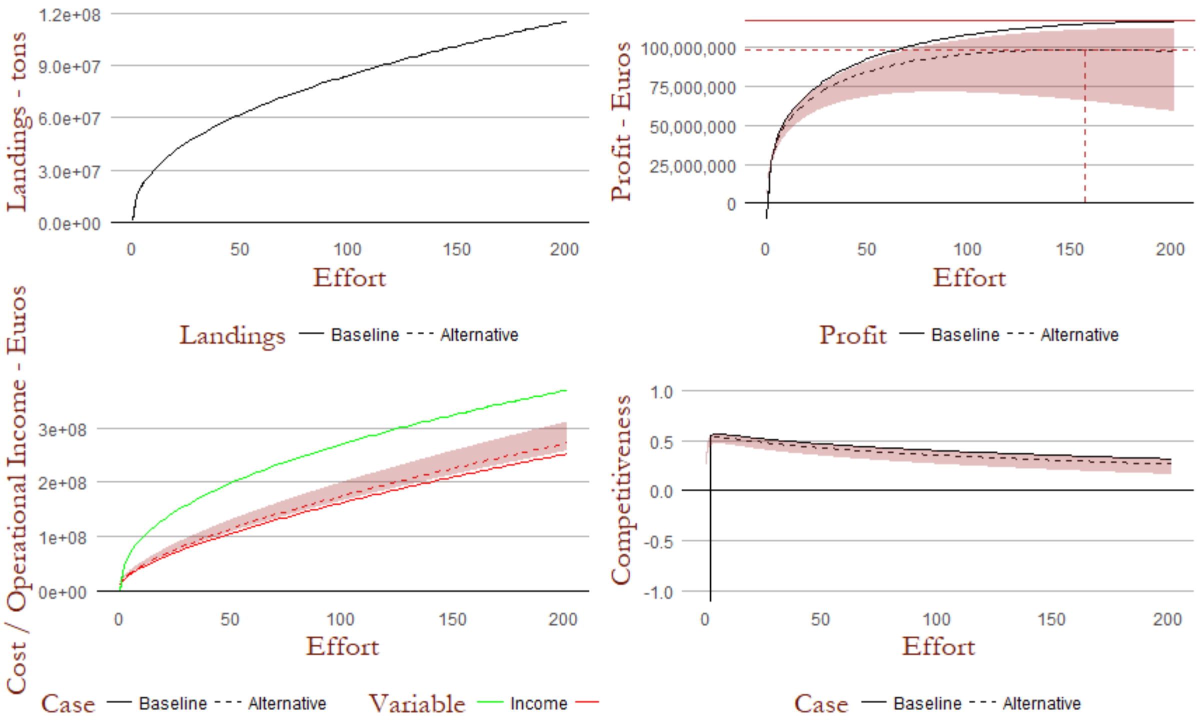


Figure 42 Removal of fuel subsidies in this Spanish fleet - Case 1

These result show that not only does the removal of fuel subsidies reduce the profit for any given level of effort, but furthermore, the optimal level of effort decreases considerably.

The table below shows a comparison between the baseline case (actual situation) with the low, medium and high alternative scenarios.

Table 1 Removal of fuel subsidies – Attainable profits - Case 1

[1] "baseline max profit is 116,795,199.61 Euros, reached at the effort level of 218.60"
[1] case max profit is: 98,474,579.90 Euros, reached at the effort level of 156.67"
[1] "medium case max profit is: 112,070,355.70 Euros, reached at the effort level of 201.48"
[1] "high case max profit is: 71,167,204.13 Euros, reached at the effort level of 85.88"

In the case of this Spanish fishery, the level of effort is below that which optimizes profits, not taking into account the possible depletion of the fish stocks. However, if the fuel subsidies are removed, the level of effort is above the profit maximizing level.

According to the model, competitiveness, measured as profit as a share of income, would improve with less effort following a fuel price increase, *ceteris paribus*.

16.1.2 REMOVAL OF FUEL SUBSIDIES FOR THIS ITALIAN FLEET – CASE 2

Below are the model results regarding the Italian beam trawl fishery. These are on a much smaller scale than the Spanish fishery above.

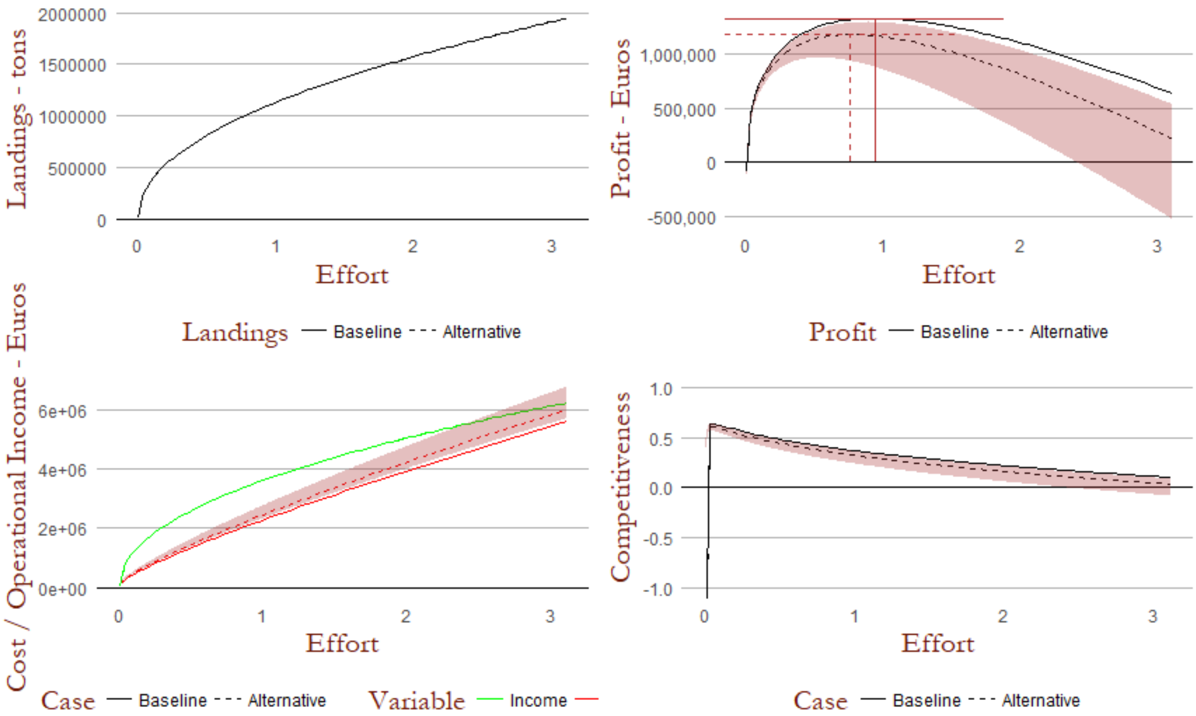


Figure 43 Removal of fuel subsidiies - Case 2

As is mentioned above, the level of effort was about 1.5 (measured in millions of litres). Interestingly, this is above the effort level which maximizes profit at 0.94, even with the existence of fuel subsidies.

Table 2 Removal of fuel subsidies for this Italian fleet - Attainable profits - Case 2

[1] "baseline max profit is 1,332,304.08 Euros, reached at the effort level of 0.94"
[1] "low case max profit is: 1,181,775.27 Euros, reached at the effort level of 0.76"
[1] "medium case max profit is: 1,294,188.65 Euros, reached at the effort level of 0.89"

```
[1] "high case max profit is:  965,708.46  Euros, reached at the effort level of  0.54"
```

With the removal of fuel subsidies, the level of effort which maximizes the profit is reduced still further, to 0,54 (million litres), a mere third of the actual level of effort. Reducing effort further would also increase the competitiveness of the industry. In this case, the calculations imply that a ban on fuel subsidies might increase the profitability of this fishery, if the fishers are able to adjust to a higher fuel price.

16.1.3 PRICE UNCERTAINTY

According the new Word Energy Outlook 2017 by the International Energy Agency (IEA), the price of oil may increase by around 75% by 2020. These estimates depend on several different plausible scenarios in the world economic outlook. There is tremendous difference by the base case and the alternative cases (high and low cases), ranging from about 35% price drop to about 250% price increase.[5] The cases differ both in terms of their assumptions on supply and demand of oil, which further depends on economic growth, especially in the non-OECD countries.

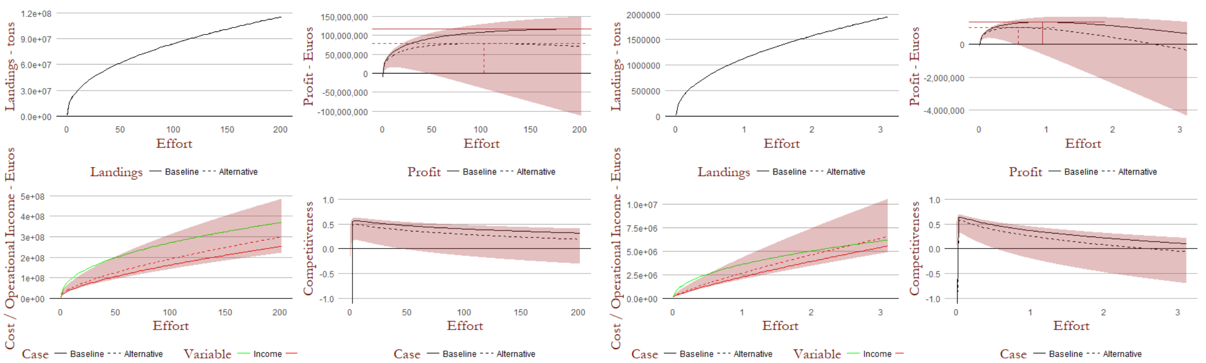


Figure 44 Effects of price uncertainty – Case 1, Spanish fleet (left) and Case 2 Italian fleet (right)

These projections display fuel price uncertainty, which is vastly greater than the one we use in the calculations above. Therefore, we have estimated the effect of greater uncertainty in fuel prices on the two cases. The figures below show the effect of a

[5] http://www.worldenergyoutlook.org/publications/weo-2016/

decrease in the fuel price by 35% and an increase up to 250%, in accordance with the estimations provided by the IEA.

These figures show that the possible effects of natural swings in fuel prices can easily outweigh the effects of removing the fuel subsidies for those fisheries.

17 TECHNOLOGICAL IMPROVEMENTS

Technological progress can either manifest itself in a lower production cost or in a higher catch per unit of effort (CPUI). There are many possible technological improvements possible and in the SUCCESS project we have analysed some, including methods to improve shelf life of seafood products (mussels in Greece) as well as an improvement in gear efficiency, i.e. the Sumwing trawl design, which greatly decreases fuel use.

In order to model the effect of technical improvements we take the case of a German demersal trawler and/or demersal seiners fleet and estimate, firstly the effect of a cost reducing technology, and secondly the effects of increased efficiency, measured as an increase in CPUE.

The following table provides summary statistics on the fleets analysed.

year	**2011**
country	DEU
description	Demersal trawlers and/or demersal seiners
vessel_length	VL1824
effort	3.575164

17.1 MODEL RESULTS

TECHNOLOGICAL INNOVATION THAT REDUCES COSTS FOR THIS GERMAN FLEET - CASE 1

The graphs below show the results of technological improvements that reduce costs of production, for this specific fleet. We used 5% decrease in cost as a low case, 10% decrease as a medium case, and a 20% as a high case alternative scenario.

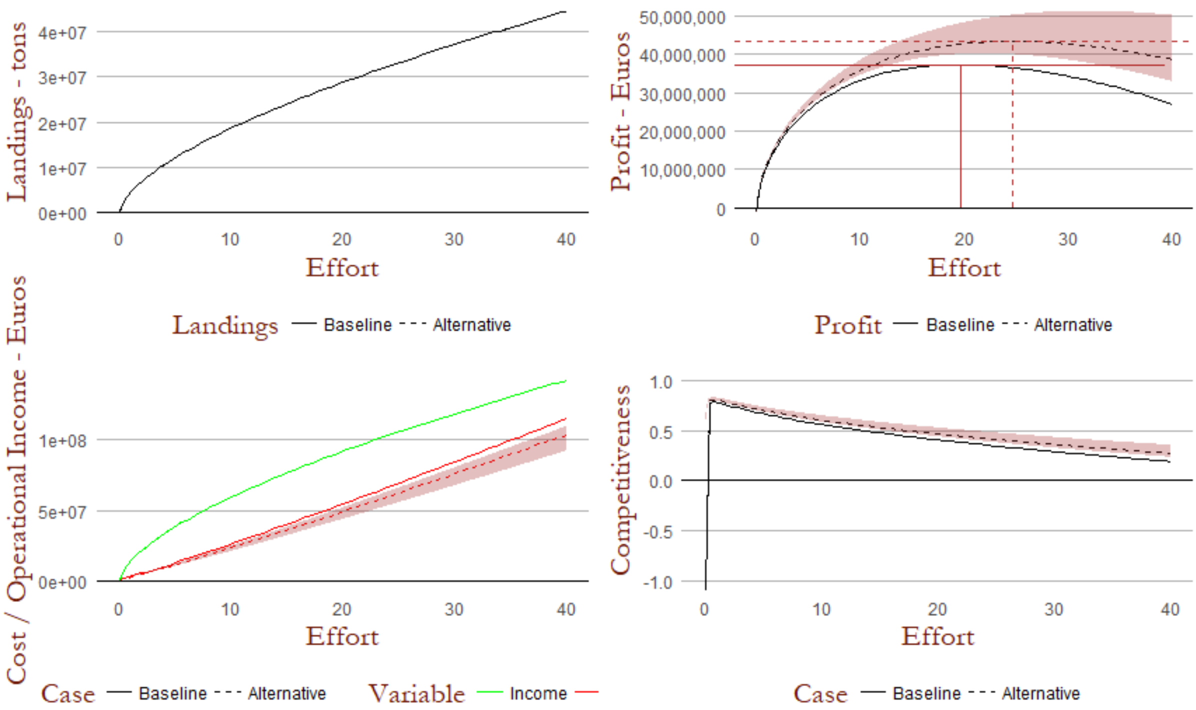


Figure 45 Reduced costs for this German fleet - Case 1

In this instance, a 10% decrease in cost due to technical improvements would increase the maximum profit by approximately 16%. The optimal level of effort, for which the highest profit is reached, is increased by 25%. This implies that increased technological level, i.e. lower cost per unit of effort, leads to an increase in the optimal level of effort.

17.1.1 Case 2 – Technological innovation that increases catch per unit of effort (CPUE).

Technological improvement can also be viewed as something that increases efficiency, i.e. higher CPUE. The graphs below show the effects of an increase in CPUE for this specific fishery.

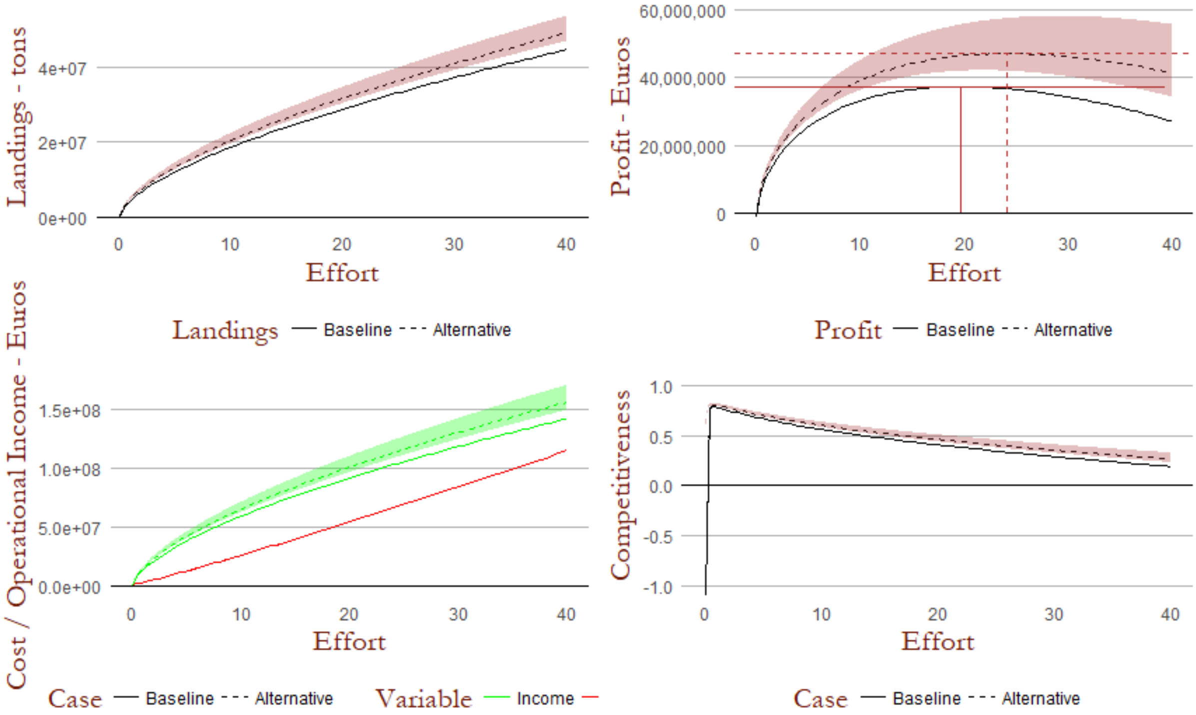


Figure 46 Increased CPUE for this German fleet - Case 2

Interestingly, the effects of increased efficiency on profitability and competitiveness, is very similar to the effects of reduced cost, albeit a little bit stronger.

Table 3 Technological innovations - Attainable profits for this German fleet - Cases 1 & 2

Case 1 – Cost reducing technologies	Case 2 – Increased efficiency (higher CPUE)
[1] "baseline max profit is 37,362,627.84 Euros, reached at the effort level of 19.62"	[1] "baseline max profit is 37,362,627.84 Euros, reached at the effort level of 19.62"
[1] "low case max profit is: 43,412,818.15 Euros, reached at the effort level of 24.65"	[1] "low case max profit is: 47,078,351.77 Euros, reached at the effort level of 24.12"
[1] "medium case max profit is: 40,202,603.03 Euros, reached at the effort level of 21.92"	[1] "medium case max profit is: 42,062,463.06 Euros, reached at the effort level of 21.81"
[1] "high case max profit is: 51,260,760.05 Euros, reached at the effort level of 31.82"	[1] "high case max profit is: 58,079,884.29 Euros, reached at the effort level of 29.12"

The current level of effort in this specific fishery is much lower than the effort level that achieves the maximum profit, according to the model. It should be kept in mind that the model is static, i.e. does not consider bio-economic dynamics, i.e. the effect of effort on sustainable biomass levels, and therefore on future profits. This is a small-scale fishery, as is evident from the vessel length of the fleet and increasing effort can be troublesome, without adding additional vessels into the fishery. This could be investigated further with a more detailed data on the fleet and its economy.

18 DISCARD BAN

Discarding is defined as the practice of returning unwanted catches to the see, either dead or alive. This practice usually stems from the economic incentives faced by fishermen where the cost of landing it borne by the fishermen is higher than the benefit or due to lack of quotas for species caught, among other reasons.[6] Designing and implementing efficient ways to counteract discarding in fisheries is complicated and difficult.[7]

The discard ratio, i.e. the weight of discarded fish measured as a ratio of the total fish both discarded and landed, can by substantial. It does, however, differ greatly between species, fishing gear and fishery management systems. In a research from 2005 the discard in the North Sea were estimated to be upwards to a one third of total catches.[8] For certain fisheries, the discard ratio can be higher or lower. In a recent Dutch research the discard ratio was estimated to be around 50% for pulse trawls and 60% for beam trawls (Buisman and Turenhout 2016).

The extra cost incurred by the discard ban depends on the fisheries management system. If there is a quota (e.g. a ITQ) on landing, a discard ban results in a smaller average fish because smaller fish is often less valuable and thus thrown out. This can result in a lower price or, if the fish is processed on-board, a higher labor cost or both. The effect can also depend on the market structure. For instance, if there is an increased need for processing that requires increased labor or increased capital, the ban will affect the cost if the processing happens before the fish is sold, but affects the price if it occurs afterwards, i.e. if the companies have a higher degree of vertical integration. For simplicity, the net change in profit will all be considered as an increased cost.

In other cases, such as when there is no upper limit on TAC (total allowable catch), the otherwise discarded fish would be a net addition to the market. That would lead to increased income which would partially offset the increased cost (if the offset would be complete there would be no discarding in the first place).

[6] http://www.fao.org/docrep/W6602E/w6602E04.htm

[7] Sarda, F., M. Coll, J.J. Heymans, K. I. Stergiou (2013). Overlooked impacts and challenges of the new European discard ban. *Fish and Fisheries*, Vol, 16, Issue 1.

[8] Catchpole, T.L., C.L.J. Frid and T.S. Gray (2005). Discards in North Sea fisheries: causes, consequences and solution. *Marine Policy*, Volume 29, Issue 5.

In their 2016 paper, Busiman and Turenhout consider the economic impact of discard ban on beam trawls and pulse trawls, based on various plausible assumptions. They expect the cost to increase by 16.4% - 23.6% for beam trawls and 8.5% - 18.9% for pulse trawls. Instead of estimating the price for the otherwise discarded fish, we assume that the price will decrease considerably, keeping in mind that a large share of the previously discarded fish is not fit for human consumption and that the share of discarded fish of the total catch can be quite high in this case. Here we assume that the average price may be between 10 – 30% lower.

In the MC-model we consider the effect of a discard ban on two specific fisheries, specifically a Dutch beam trawler fleet (Case 1) and a Belgian Demersal trawler and/or demersal seiners (Case 2).

The following table provides summary statistics on the fleets analysed.

year	**2008**	**2008**
country	NLD	BEL
description	Beam trawlers	Demersal trawlers and/or demersal seiners
vessel_length	VL1218	VL1824
effort	1.438.468	4.357.692

18.1 Model results

Effects of discard ban on this Dutch fleet- Case 1

Unlike the other cases, a discard ban would affect both the price and the cost of given fisheries. In the case of small sized beam trawlers in Netherlands, the income will always be higher than the cost, when some threshold level of effort has been reached. This means that there is no maximum level of profit to be reached. More effort would always lead to higher profits. This would still be the case if discarding were to be banned.

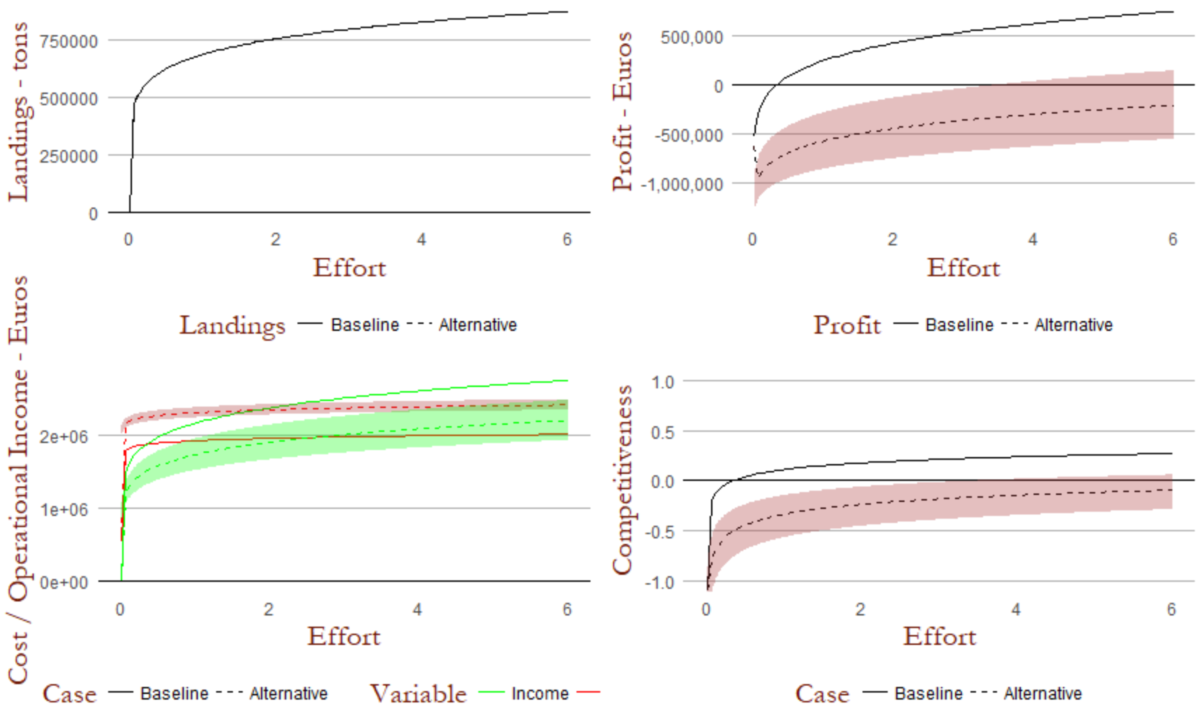
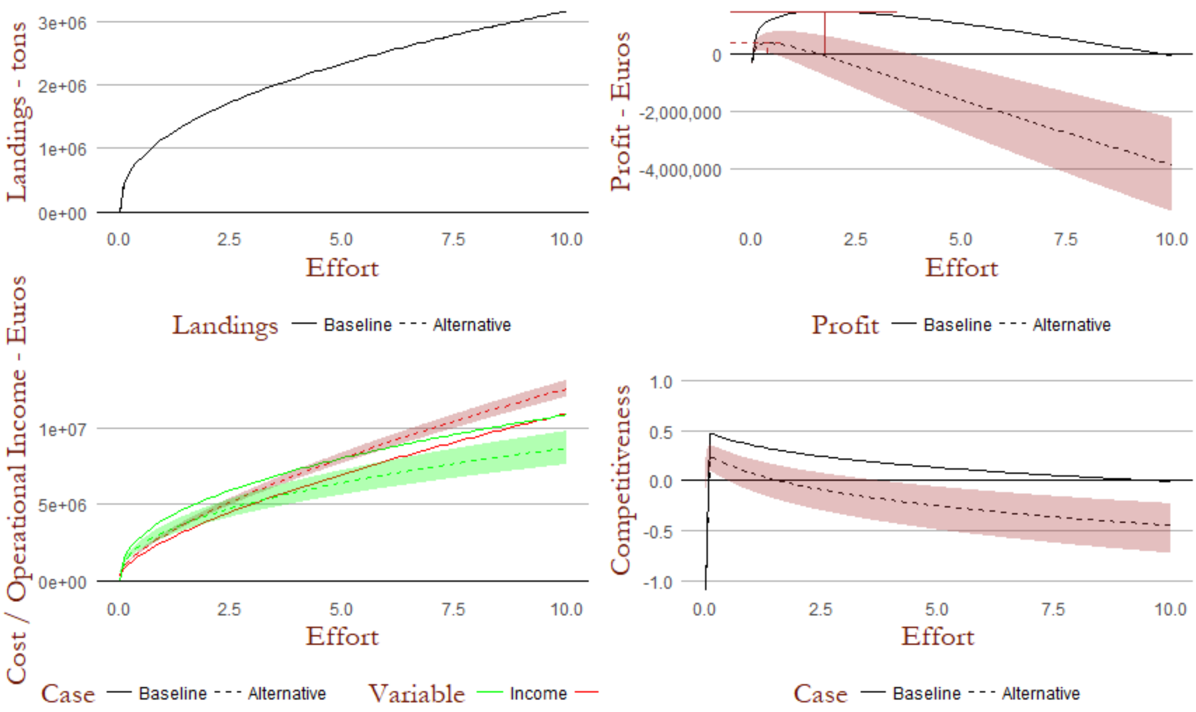


Figure 47 Discard ban - Case 1

Since there is no profit maximizing level of effort, we do not present a table with such statistics. It is however clear, that a much higher level of effort would be needed to break even. Specifically, the effort level would need to at least double from it´s current level to be economically profitable.

EFFECTS OF DISCARD BAN FOR THIS BELGIAN FLEET – CASE 2

According to the MC model, the maximum profit would be reached, in these specific Belgian fisheries, at an effort level around 1.7 (millions of liters) which is somewhat lower than the current level of effort. The effects of discard ban in this Belgian fleet would be quite different from the other case studied.



In this case, the maximum profit, as well as the optimal level of effort, would decrease, still further away from current level of effort, if discarding were to be banned.

Table 4 Discard ban - Attainable profits for this Belgian fleet Case 2

`[1] "baseline max profit is  1,479,900.74  Euros, reached at the effort level of  1.73"`
`[1] "medium case max profit is:  386,017.42  Euros, reached at the effort level of  0.36"`
`[1] "low case max profit is:  776,678.23  Euros, reached at the effort level of  0.73"`
`[1] "high case max profit is:  105,052.68  Euros, reached at the effort level of  0.17"`

The estimated effects are quite large, which is understandable, in the light of the fact that a discard ban can affect both prices and costs, as discussed above.

Notice that the effects off discard ban may be elevated, or even fully eliminated, if it affects most or all fisheries, because then the producers could potentially increase price to accommodate higher cost.

19 BREXIT

Great Britain plays an important role in European fisheries. According to Eurostat, around 702 thousand tons of fish were caught in the UK region in 2015, which accounted for almost 14% of the total EU catch.[9] According to the UK Fisheries Statistics, only 59% was caught be the home fishing fleet, indicating that over 40% was caught by the fleet of other EU countries.[10] A recent research from the NAFC Marine Centre suggest that this underestimates the importance of British waters. They estimate that the EU fishing boats landed about 58% of the fish and shellfish from the UK EEZ (Exclusive Economic Zone) in 2016.[11] Furthermore, that implies that almost one quarter (23%, by weight) of the fish and shellfish landed by EU fishing boats from the North-East Atlantic in 2016 was caught in the UK EEZ. Meanwhile, only a fraction (12%) of the landings by the UK fleet was caught outside the UK EEZ.

As of this writing, the terms of Brexit are still being negotiated, and there are limited predictions available on possible agreements. What can be assumed is that any agreement will lie between two different extremes. One extreme is the possibility that nothing will change with regards to fisheries and aquaculture, i.e. that trade of goods, labor and capital will remain completely unrestricted. The other extreme is the so-called hard Brexit. Europe would lose access to the British fisheries and the GB would lose access to the European fisheries. Furthermore, tariffs on trade of goods could be set by both parties (i.e. the UK and the EU).

To complicate matters further, a “hard Brexit” might result in disagreements regarding the quota, which might lead to higher quotas being set for both parties.

In a stakeholders meeting held by SUCCESS partners on non-tariff measures, the following issues related to Brexit were raised:

- Most products exported from UK are fresh and various issues can influence the import into EU after BREXIT. For example, UK may have a risky situation if the location of the custom clearance will be a small port in France with one person in charge. This may imply delay at the border and as a result the products (e.g. fresh lobster) will lose quality and value.

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[9] Eurostat.

[10] https://www.gov.uk/government/statistics/uk-sea-fisheries-annual-statistics-report-2015

[11] http://www.nafc.uhi.ac.uk/t4-media/one-web/nafc/research/document/eez-reports/eez-report-10-2017-10-02.pdf

- Also, SPS can be interpreted differently and some member states may put on a special restriction on UK export/import. This will cause changes in the dynamics of trade and as a consequence UK could be seen as a low-cost producer.

19.1.1 MODEL RESULTS

Brexit does not affect every segment of EU proportionately, irrespective of country, but instead, one country will be left out. Thus, it would be misinformed to only adjust the harvest for the representative fishery in the MC model. However, Brexit will have some effect on the remaining fisheries in Europe. Namely, Brexit could either result in reduced supply to the market or in tariffs.

Standard economic theory would predict similar effects from tariffs and collapse in imports. In fact, if tariffs are increased sufficiently they become in effect an import ban. Standard economic theory would predict that tariffs would result in higher prices and increased producer surplus (i.e. higher profit for EU fisheries), but which would be more than offset by reduced consumer surplus. Additionally, those exporting to the EU (i.e UK fisheries) would suffer reduced profit.

It is not clear which level of tariff, if any, is to be expected. EU tariffs on seafood differs between products and fishing areas. Even if one can determine a reasonable assumption on the tariffs, the relationship between tariffs and prices depend on many factors. If the both the EU and the UK are price takers one would expect the new price to be simply the old price plus the tariff. Tariffs on seafood is seldom lower than 4%. Thus, assuming the same price elasticity as before, a lower bound on the effects of Brexit on prices will be put as 4,1% increase.

Additionally, part of the EU fisheries would go the UK. This will decrease the scale of the EU fisheries but will not affect the models in any other way.

UK will have more fishstocks available; EU fishing in UK EEZ has less fishstocks available

We make use of a report from UK that provides quantities and shares of fish landings acquired in British waters by key 8 EU-member states where fish landings from UK represent about 60% of all landings. The information is provided per species type which is very useful for our analysis. Table 1 shows the proportions of landings in quantity of landed fish as a percentage of countries' landings.

To get an estimate for the effects on the price we use estimates on food elasticities from Tiffen et al (2011) with long term own price elasticity of -1.016. The upper bound will be chosen to stem from 14% reduction of supply, i.e. assuming that none of the fish in the UK EEZ will come to the EU market. That would translate into 14.2% increase in price.

The effect of Brexit was estimated for two very different fleets in different regions of Europe. Case 1 is a Spanish demersal trawler and/or demersal seiner fleet, which is comparatively large. The other fishery (Case 2) is a Slovenian purse seiner fleet, which is comparatively small, with regards to most other European fleets.

Summary statistics for the two fleets is provided in the table below.

year	**2009**
country	ESP
description	Demersal trawlers and/or demersal seiners
vessel_length	VL2440
effort	27.004.859

19.2 MODEL RESULTS

19.2.1 BREXIT – EFFETS FOR THIS SPANISH FLEET

For this fleet, a Brexit scenario, results in increased profits, due to higher prices of catch. At the same time, the effects of competitiveness are relatively mild. This is most likely due to the high cost of fishing.

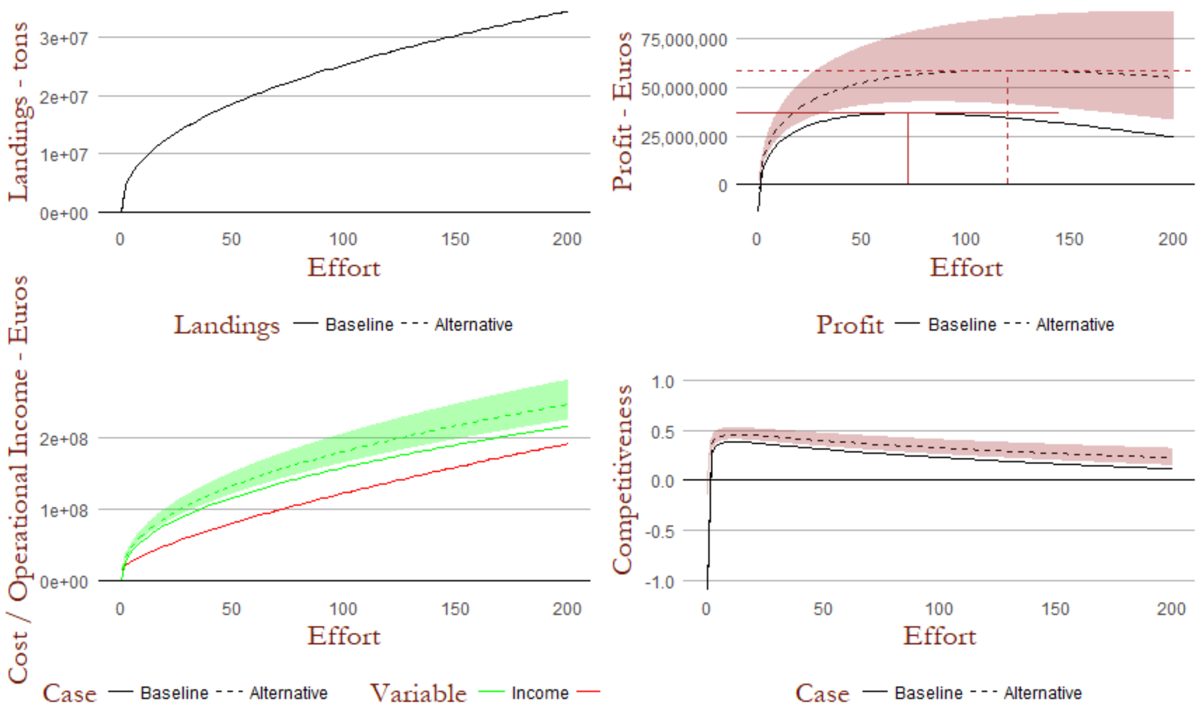

Figure 48 Brexit – Effects for this Spanish fleet - Case 1

Comparing the baseline case with the medium case shows that profits would likely increase by around 60%, while the optimal effort level would increase by 67%. The current level of effort is much lower than the optimal level under different scenarios.

Table 5 Brexit - Attainable profits for this Spanis fleet - Case 1

[1] "baseline max profit is 36,982,540.82 Euros, reached at the effort level of 72.23"
[1] "low case max profit is: 58,908,778.21 Euros, reached at the effort level of 119.70"
[1] "medium case max profit is: 42,663,418.31 Euros, reached at the effort level of 83.85"
[1] "high case max profit is: 89,385,471.70 Euros, reached at the effort level of 195.95"

20 LABELING SCHEMES

In most economic models, there is an underlying assumption that both producers and consumers have perfect information about the good in question.

Due to this high level of market segregation, various labeling schemes can help in informing the consumer, while at the same time create a premium for the producers. In the case of Mussels, 31% - 41% of consumer are willing to pay higher price. There is however no mention on how much higher they are willing to pay (See D5.1).

Rohem, Asche and Santos (2011) estimate the premium for a sustainability label in the UK to be about 14.2% for Alaska pollock. Ankamah-Yeboah et al. (2016) find about 44% price premium for organic salmon in the Danish market.

Other studies in agriculture indicate that effects of labelling on prices can be around from 4% - 24% (Oya, Schaefer, Skalidou, McCosker, & Langer, 2017)

To estimate the effect of labeling on industrial fisheries, we ran the model for two fisheries of comparable sizes, considering effort levels. Both are demersal trawlers and/or seiner fleets of the same vessel size category (18-24 meters vessel length).

The table below shows summary statistics for these two fleets.

year	**2013**
country	BEL
description	Demersal trawlers and/or demersal seiners
vessel_length	VL1824
effort	4.277.286

20.1MODEL RESULTS

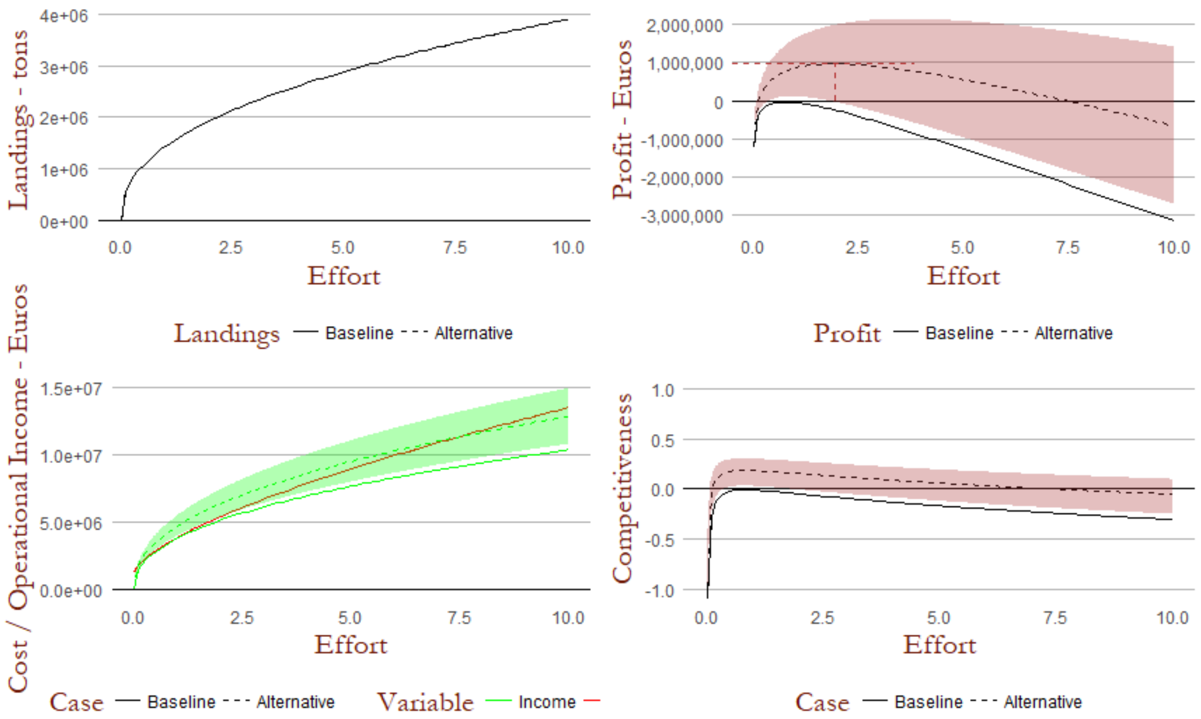

Figure 49 Effects of abeling scheme for this Belgian fleet- Case 2

It is interesting to note, that although the Belgian fleet (Case 2) is quite similar to the German one (Case 1) according to the summary statistics on vessel size, technology and effort level, the estimated effects of the introduction of a labeling scheme are the same with regards to the signs of the effects, but not to the degree of these same effects.

For this Belgian fleet, according to the model the maximum baseline profit is negative as is the case for this period. The introduction of a labeling scheme would improve the economic outcome of this fishery, but at much lower optimal level of effort for the different scenarios, compared to the German fleet (Case 1).

Table 6 Effect of labeling scheme - Attainable profits for this Belgian fleet - Case 2

```
[1] "baseline max profit is  -36,087.55  Euros, reached at the effort level of  0.76"
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[1] "low case max profit is:  969,751.01  Euros, reached at the effort level of  1.92"
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[1] "medium case max profit is:  104,336.29  Euros, reached at the effort level of  0.90"
```

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[1] "high case max profit is:  2,138,497.93  Euros, reached at the effort level of  3.64"
```

These model outcomes indicate that although you can have similar fleets of similar sizes, the effect of different policy options can be dramatically different with regards to optimal effort levels. This indicates that in some cases there are stronger forces at work, than can be directly attributed to policy measures.

20.2 General comments on the MC-model

The MC-model, like most economics models, has drawbacks and strengths. Above we present many interesting results for different fisheries concerning the effects of different policy options.

The results should be interpreted in the light of the strengths and weaknesses of the underlying model.

It has already been pointed out that the MC-model is not dynamic and does not take into consideration bio-economic effects, such as stress on stocks following changes in effort levels. Level of fish stocks affect the efficiency and hence the profitability and economic situation of fishing industries in general. Further research should focus on how to incorporate bio-economic relationship into the model. To mitigate possible bias due to the negligence of explicit bio-economic effects in the MC-model we used panel data methods and dummy variables to account for any unobserved or missing variables, such as biomass. Further details are to be found in Deliverable 1.4.

The data is from a public database, i.e. Annual Economic Reports published by the European Commission. It is aggregated to a fishery level and there are relatively few data for each and every fishery, i.e. data for seven years. This leads to some parameter instability in estimation and low statistical power. This means that the estimated relationships can show considerable deviation from the actual underlying relationships. In fact, the estimated relationship in some for some of the cases does not conform to economic theory. There were also cases where the estimated functions did not compare to reality of these fisheries. In order to draw stronger conclusions regarding the effectiveness of different policy options, the data used would preferably be at vessel rather than fisheries level.

The MC-model also has important strengths. It is based on sound economic principles and is focused on the main issue at hand, i.e. profits and competitiveness of different fisheries. It can easily be adapted to different kinds of data and datasets, and different scales, without a great investment in time and money. In that way it is both compact and flexible. The data being used in these estimations allowed for the estimation of a wide range of different policy options, due to the fact that it contained information on costs related to different inputs, such as labor, capital, fixed costs, etc. The policy options analyzed is only a small example of what is possible.

The model is still a work in progress, but the results presented above shows that there may be a great potential in a model like this, given how it has performed with a data that was in fact quite limited compared to the number of estimated parametrs.

All those considerations should be kept in mind when evaluating the numerical results presented above.

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PART V COSTS-BENEFIT ANALYSIS

SWOT & C-B ANALYSIS

21 SWOT ANALYSIS

Here we will present a summary of strengths, weaknesses, opportunities and threats of the fisheries and the aquaculture sites that have been identified or analysed in the SUCCESS project. These four types of attributes form the basis of a so-called SWOT (Strength, Weaknesses, Opportunities, Threats) analysis. They can be split into two dimensions depending on weather they are harmful or helpful, and weather their origin is internal or external, as is shown in the matrix below.

	Helpful	**Harmful**
Internal	Strengths	Weaknesses
External	Opportunities	Threats

This is not an all-inclusive analysis, but rather a systematic overview of the main findings on the case studies in the SUCCESS project. The analysis will be performed on each group of the case studies, as identified in Deliverable 5.1. Even though the case studies differ from each other, most case studies within each group have similar findings. To recap, these groups are;

1. Technological innovations (Chapter 4 in D5.1)
2. Regulatory systems (Chapter 5 in D5.1)
3. Marketing, labelling, branding and consumer preferences (Chapter 6 in D5.1)
4. Market structure and the value chain management (Chapter 7 in D5.1).

The following analysis complements the table in part III in deliverable 5.1.

21.1 TECHNOLOGICAL INNOVATION

There are mainly two cases that cover technological innovation directly. These are the flatfish case study in the Netherlands, the Mussels in Greece and the spatial management system.

Technological innovations

	Helpful	Harmful
Internal	Fuel efficient gear (SumWing, Netherlands) Fuel efficient fishing technology (Pulse fishing, Netherlands) Recirculating methods in Aquaculture (Greek) Innovative products (Greek, Costal fisheries in Trapini) Increased Shelf life (Greek) Alternative Spatial management (Greek)	Environmental effects (Netherlands)
External		Environmental regulations (Netherlands and Greek) High fuel costs (Netherlands) Low consumer demand (Greek) Low production density (Greek) Fuel subsidies

Both cases show examples of promising innovations to increase technical efficiencies, but in a very different setting. In the Netherlands, SumWing is promising, but it's economic efficiency has yet to be determined. Pulse fishing has a clear financial benefit, as it cuts down the cost of fishing, but faces question about its adverse effect on the fish. The research on the aquaculture in Greece also looks to provide increased technical efficiency and allow higher density of production. But a further experience is needed before making a final judgement.

21.2 REGULATORY SYSTEMS

Regulatory systems are a highly complex topic. A policy that has positive effect on one producer may have adverse effects on others. Furthermore, there may be a high degree of trade-off between different desired goals when designing a policy. A regulation that may benefit local communities may have adverse effects on the competitiveness of the industry as a whole or have a negative environmental impact.

That being said, in the table below are the main regulatory issues faced in the cases studied in SUCCESS.

Regulatory Systems

	Helpful	**Harmful**
Internal	PO's have stabilized price and reduced overfishing (Smooth clam, Italy) Increased quality (Seabass aquaculture in Greece)	Wasteful practises (UK cod and haddock) High production cost (German trout farming) Low profitability (Icelandic char)
External	Territorial User Rights (Smooth clam, Italy) Protected Designation of Origin (PDO)(Italian mussel farming) The regislative framework has evolved appropriately (Seabass aquaculture in Greece) Internationally traded quotas can elevate cost of discard ban (Whitefish, UK)	Low price (Smooth clam, Italy) Discard ban landing (UK cod and haddock) Low market power (German trout farming) Consumer perception (German trout farming) Scarcity of water and suitable locations (German trout farming) High compliance cost (German trout farming) High regulatory and administrative burden (Italian seabass / seabream; Icelandic char) Non-tariff measures

In many cases covered in the SUCCESS case studies, there where evidence of either the regulatory framework posing a cost or other burden on producers or helping them face challenges. It is evident that facilitating PO's or consortiums can help producers gain market power and increase their value. The same goes with territorial user rights and PDO's which both help to differentiate and decrease direct competition. Finally, internationally traded quotas can help to alleviate the cost of discarding, as it allows fishers to get quota for accidentally fished fish, easier and cheaper. In other cases, especially in aquaculture, there is high cost associated with regulatory framework.

21.3 MARKETING – LABELLING, BRANDING AND CONSUMER PREFERENCES

One of the things common themes throughout most of the case studies was that many consumers are willing to pay some premium for higher quality. To utilize the opportunity which that brings, many producers have started using labelling, certification or other means of diversification to get higher prices. Another function of labels and certification is to respond to limited trust of the industry by the consumer.

Consumers, as well as many of the firms in the supply chain, seem to lack knowledge of the products. Not only on the origin of the product, but also on the best ways to prepare it or cook it. There are many ways possible to tackle that, e.g. with innovative packaging and preparation.