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The effect of fuel price scenarios on Belgian fishing fleet dynamics.

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Abstract

Since there is no doubt about the huge impact high fuel prices currently have on the performance of European fleets, researches start to wonder about the future. This paper contributes to this recently emerging discussion. It evaluates the effect of three fuel price scenarios on Belgian fleet dynamics. These scenarios are tested using a microeconomic microworld.

The obtained results prove on the one hand that rising fuel prices do have a negative impact on the future size and performance of the Belgian fleet. However, these rising fuel prices do not affect every vesseltype as much. Additionally, in the long run, these negative impacts are weakened and counteracted by the introduction of adaptive strategies on vessel and fleet level which cope with the rise in fuel price. Therefore, it is important to realize that the rise in fishing costs caused by the increase in fuel cost will generally be considerably smaller than the initial impact suggests.

Key words: Fuel prices, fleet dynamics, microworld, system dynamics.

1. Introduction

The financial performance and viability of many fishing fleets in Europe have been directly affected by current high fuel prices (Salz 2006; Rossiter 2006; Van Balsfoort and Grandidier 2006; Beare and McKenzie 2006). There can be no doubt that “the fishing industry has been severely hit by the recent and rapid rises in the cost of fuel. Some sectors of the fleets are no longer profitable and with little hope for a reduction in fuel costs it is very difficult to see how these businesses will continue beyond the short term.” (Rossiter 2006: 51) This is especially true for beam trawler fleets. In a recent study, Van Balsfoort and Grandidier (2006) examined the financial situation of the French and Dutch trawler fleets and stated: “with the actual fuel prices the traditional beam trawl fishery has a very limited economic perspective as a viable fisheries.”(Van Balsfoort and Grandidier 2006: 47)

Since almost the entire Belgian fleet consists of beam trawlers (110 beam trawlers on a total of 118 vessels), the current high fuel prices affect the Belgian fishing industry by far the most of the European fleets. Over 25% of the revenues made by the Belgian fleet go to fuel, resulting in severely declining gross operating profits (GOP) if fuel prices are increasing (figure 1). Today, many trips at sea result in a financial loss for the owners of Belgian beam trawlers and it is clear that this fleet is on the edge of not being profitable (Polet et al. 2006).

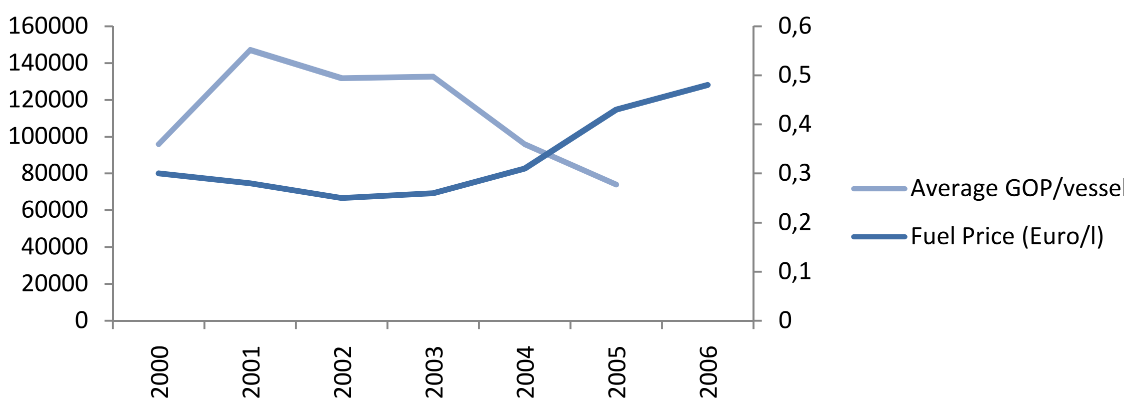

Figure 1: The relation between Gross Operating Profit (GOP) of an average Belgian vessel and the fuel price for the years 2000 till 2006 (Data source: Belgian Sea Fishery Service).

2. Objective

This paper evaluates the effect of three future fuel price scenarios on the performance and the dynamics of the Belgian fishing fleet. These scenarios are tested by means of a micro-economical microworld. In this way, it contributes to the recently emerging discussion about the actual impact of future fuel prices on the performance and viability of fishing fleets in Europe.

3. Methodology

A preliminary microworld (for further information on this microworld: see annex 1) is used to evaluate the performance (measured in gross operating profit) and dynamics of the Belgian fleet under three future fuel price scenarios. This study opts for a dynamic simulation model based on a microeconomic approach of fleet dynamics (Helu, Anderson, and Sampson 1999) using system dynamics as a modelling technique (operational base: Vensim®DSS) (Moxnes 1998; Moxnes 1999; Moxnes 2003; Dudley 2003; Dudley 2003). A microeconomic approach means that the behaviour and decision making of individual boat owners determine the general dynamics of the fleet. Furthermore, this approach enables evaluating the performance of individual companies and vessels that follows from the impact of policies or externalities on their individual management decisions (tactical and investment decisions).

In this study, fuel prices scenarios are the externalities causing the impact on individual management decisions. Since most fuel analysts expect the present price trend to continue on its current course for the foreseeable future (Rossiter 2006), the three fuel price scenarios are based on stable or increasing fuel prices. Figure 2 visualizes the different fuel price scenarios (dotted lines) used to run the microworld. Scenario one keeps fuel prices constant at the level of 2005 (0,43 euro/litre). Scenario two increases the fuel prices linearly, with the slope as a proxy of the slope between 1995 and 2005 (starting from 0,43 euro/litre in 2005 to 0,63 euro/litre in 2015). This scenario is perhaps the best proxy of the future fuel prices. Scenario three is one of exponential increase in fuel prices (starting from 0,43 euro/litre in 2005 and reaching 0,89 euro/litre in 2015: growth rate: 0,14% per week, since the microworld has a DT of a week). This scenario is perhaps the worst case scenario. However, if market dynamics in natural resources exploitation are taken in consideration, an exponential increase in fuel prices may be the future fisheries will have to deal with.

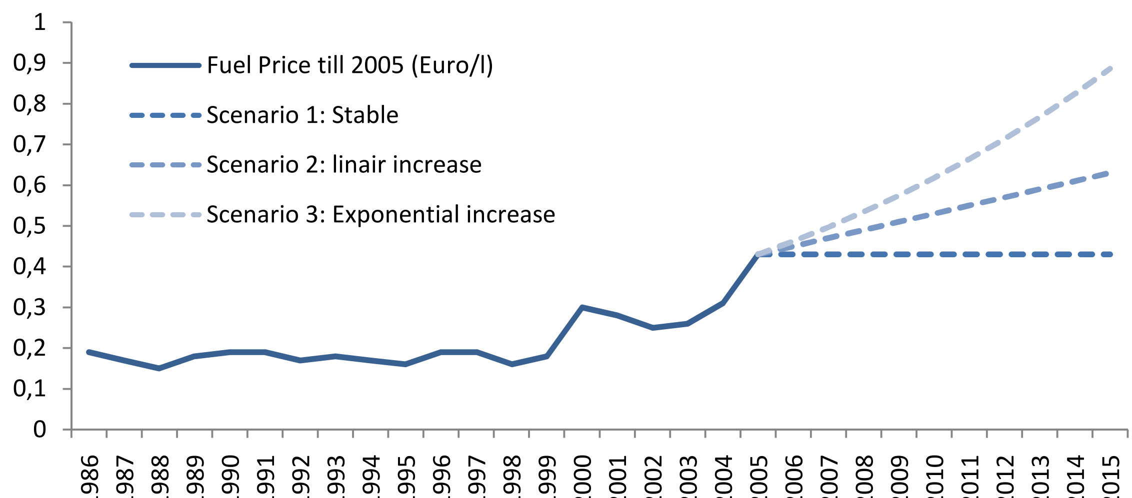

Figure 2: The fuel price scenarios derived from historical data (Data source: Belgian Sea Fishery Service).

To perform this study, data was collected from individual vessels on catch composition, effort allocation and financial situation for the years 2000 till 2006. These data were compiled from two institutes. Firstly, there is a very useful database (still under construction) called 'Belsamp' hosted at the Institute for Agriculture and Fisheries Research holding detailed data per individual vessel on catch composition and effort allocation. For financial data on individual vessel level, the Belgian Sea Fishery Service of the Flemish government was addressed. They collect financial data of the Belgian sea fisheries fleet by survey (on a voluntary yearly basis, sample of approximately 65 vessels).

4. Results

This study chooses to use the data of the year 2005 as the initial values to run the microworld (for a full overview see: annex 2). In 2005, the Belgian fleet consisted out of 100 vessels: 30 eurocutters, 52 large beam trawlers, 15 shrimp trawlers and three set netter. Each vesseltype consumes different amounts of fuel per year resulting in a different share of the revenues spent on fuel costs (figure 3). Different future fuel price scenarios will alter these shares resulting in changing gross operating profits per vessel. Consequently, changing gross operating profits will lead to fleet dynamics since some vessels will exit the fisheries while others will remain profitable enabling them to build up savings for future investements. These remaining vessels are also left with more quota since the quota in Belgium are a "common pool".

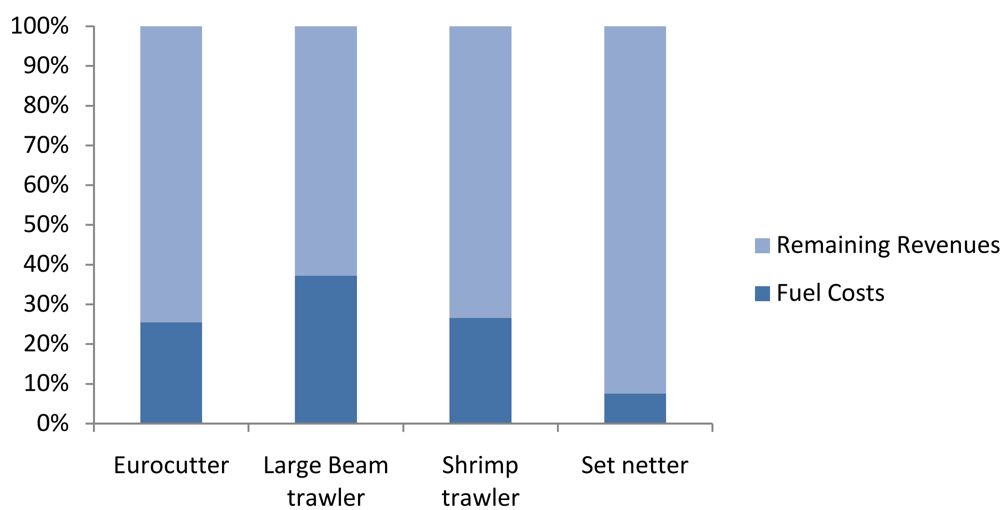

Figure 3: Proportion of the revenues which goes to fuel (year 2005)

Scenario 1: Stable fuel prices at the level of the year 2005 (Baseline)

Figure 4 illustrates the effect of a stable fuel price from 2005 onwards (0,43 euro/litre) on the fleet size and the average gross operating profit per vessel. This scenario serves as the baseline for further comparison between the scenarios. The figure consists of two parts. Part one, till 2005, plots the historical data on fleet size and the average gross operating profit per vessel. The second part, from 2005 till 2015, visualizes the estimated future behaviour of both variables generated by the microworld.

This figure tells us that although fuel price remains constant, the fleet size will decline due to vessels going bankrupt. This seems conflicting with the raising gross operating profits for an average vessel between 2006 and 2009. However, it is perfectly possible that although gross operating profits increase, vessels become bankrupt. Gross operating profit does not take into account the effect of depreciations and in 2005 many vessels in the Belgian fleet where coping with major net financial losses. Secondly, bankrupt vessels exit the fleet resulting in a smaller fleet which is left with the same amount of quota. Consequently, there is more quota (fish) for less vessels leading to a higher opportunity for vessels to increase their GOP due to increasing revenues. His explanation is backed by the (opposite) behaviour observed in the graphs after 2013 where an increase in fleet size results in a decrease of average GOP per vessel. However, this explanation only contains any explanatory value given a constant fuel price combined with the "ceteris paribus"-clause.

A last and crucial conclusion from this scenario is the increase in fleet size after 2012. This proves that although the fuel prices in 2005 are undermining the viability of the Belgian fleet, a stable high fuel price allows the fleet to adapt itself to his new environment, resulting in a recovery in fleet size. However, this new fleet structure in terms of vesseltypes differs from the initial fleet structure. There is a shift in fleet structure towards smaller vessels using passive fishing techniques.

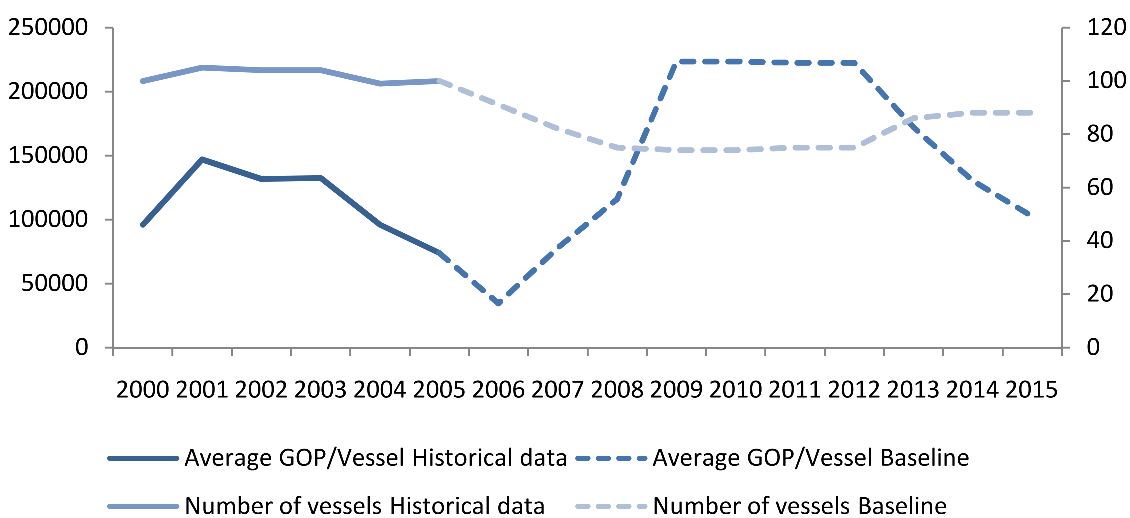

Figure 4: The effect of a stable fuel price since 2005 (0,43 euro/litre) on the fleet size and the average gross operating profit per vessel.

Scenario 2: Linearly increasing fuel prices

In scenario 2, the fuel price increases linearly from 0,43 euro/litre in 2005 to 0,63 euro/litre in 2015. Figure 5 illustrates approximately the same behaviour (although extrapolated) for both average GOP per vessel and fleet size as figure 4. Consequently, the same general conclusions made in scenario one also apply to this scenario. As in scenario one, special attention needs to be drawn to the last part of the graph (year 2012 till 2015) which illustrates the adaptive capability of the fleet to the linearly increasing fuel price resulting in a partial recovery of the loss in fleet size during 2005 till 2012.

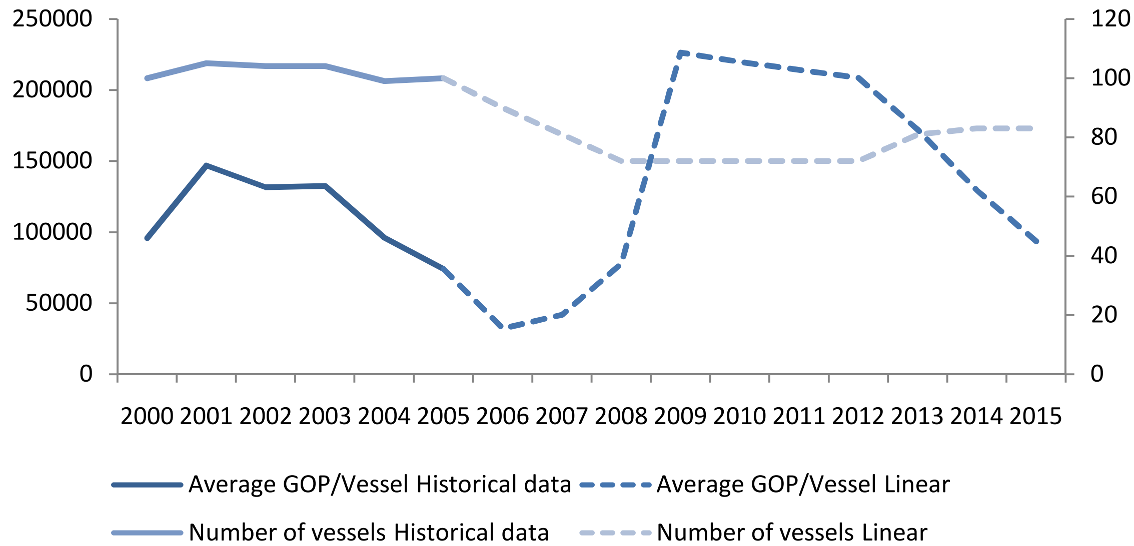

Figure 5: The effect of a linearly increasing fuel price after 2005 (from 0,43 euro/litre in 2005 to 0,63 euro/litre in 2015) on the fleet size and the average gross operating profit per vessel.

Scenario 3: Exponential growth in fuel prices

If the fuel price increases exponentially starting from 0,43 euro/litre in 2005 to reach 0,89 euro/litre in 2015 (growth rate: 0,14% per week, since the microworld has a DT of a week), average GOP per vessel and fleet size behave as presented in figure 6. This figure shows approximately the same behaviour (although extrapolated) for average GOP per vessel as the previous figures. However, the number of vessels in the fleet is now continuously declining. Consequently, this exponential growth in fuel price does not allow any recovery, meaning that there is of course a limitation to the adaptive capability of the fleet.

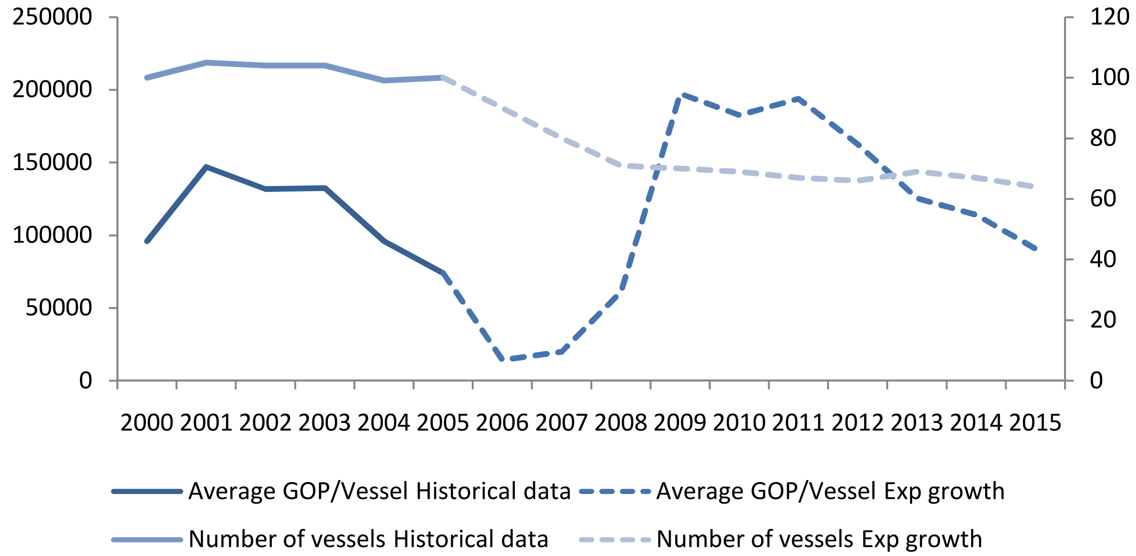

Figure 6: The effect of an exponentially increasing fuel price after 2005 (starting in 2005 from 0,43 euro/litre, growth rate: 0,14%/week) on the fleet size and the average gross operating profit per vessel.

5. Discussion

This paper contributes to the recently emerging discussion about the impact of future fuel prices on the performance and viability of fishing fleets in Europe. Since there is no doubt about the huge impact current high fuel prices had on the performance of European fleets (Salz 2006; Rossiter 2006; Van Balsfoort and Grandidier 2006; Beare and McKenzie 2006; Van Hoof 2006), researches start to wonder about the future. Many of them believe that in the short run some sub fleets (e.g. traditional beam trawling) will no longer be profitable (Van Balsfoort and Grandidier 2006; Polet et al. 2006). Our results do not contradict these findings, but shed a more nuanced light on the impact of future fuel prices.

Our results prove on the one hand that rising fuel prices do have a negative impact on the future size (figure 7) and performance (expressed in figure 8 as GOP/vessel) of the Belgian fleet. However, this impact needs to be nuanced since it is not equal for all vesseltypes. Further inquiry into the results from the microworld confirms clearly that large beam trawlers suffer more from rising fuel prices than set netters do. This finding is backed by the recent work of Beare and McKenzie who state: “boats with mobile gears appear to be potentially more vulnerable to increasing fuel costs” (Beare and McKenzie 2006: 14). Van Hoof (2006) also confirms this finding: “considering the fuel prices, the current economic situation in fisheries especially the fleet segments using active (towed) gears has been serious. The segments using passive gears will be less touched by the high fuel prices. If this situation remains unchanged many enterprises could face bankruptcy next to a substantial decrease of the crew share”.

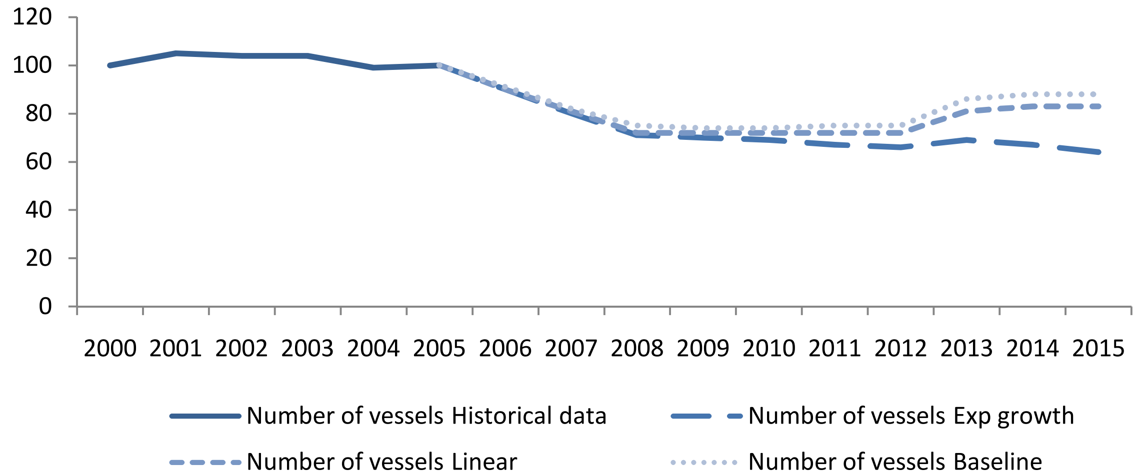

Figure 7: The effect of the fuel price scenarios on the Belgian fleet size

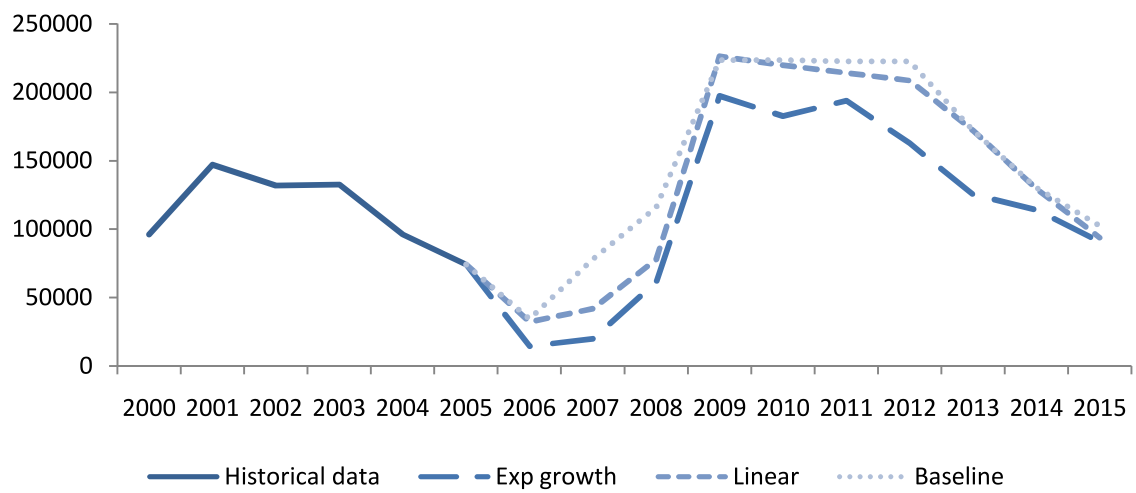

Figure 8: The effect of the fuel price scenarios on the average gross operating profit per vessel.

A final point for discussion is the financial recovery in gross operating profit of the Belgian fleet between 2006 and 2009, which is common for each scenario, combined with the subsequent behaviour in fleet size (an increase in scenario one and two and a decrease in scenario three). A potential explanation for this phenomenon can be found in the recent work of Rossiter (2006) and Arnason (2007), respectively on adaptation strategies of the UK fleet to the current high fuel prices and the economics of rising fuel costs on European fisheries.

In his work, Rossiter (2006) enumerates possible adaptation strategies of the UK fleet to the current high fuel prices ranging from short term fishing tactics (e.g. reducing towing and steaming speeds, visiting closer fishing grounds) to long term fishing strategies (e.g. changing landing port, re-engining, changing fishing methods, modifying gear, improved maintenance and cease fishing). Further inquiry in the results generated by the microworld indicates a shift away from large beam trawlers (exiting the fleet) towards smaller shrimp trawlers and more passive fishing techniques (entering the fleet). As a result, this more diverse fleet can cope better with the rising fuel prices leaving opportunities for further growth in fleet size. Therefore, the increase in fleet size between 2012 and 2015 can be explained by the adaptive capability of the fleet. However, our present microworld deals currently only with a limited number of long term fishing strategies. In our future research other interesting adaptation strategies will be included in the microworld. Nevertheless, this discussion already confirms how crucial adaptive strategies are if fishermen want to survive the future changes in fuel prices. Nonetheless, as scenario three indicates, there are limits to these adaptive capabilities. If fuel prices increase too fast, the fleet size keeps on declining.

In line with these findings, we agree with Arnason's (2007) theory of the impact and economics of rising fuel on European fisheries. Arnason (2007) distinguishes the effect of rising fuel prices on the future performance of the fishing industry into three phases: 1) initial impact, 2) short term, and 3) long term. When fuel prices rise, it creates an initial impact. "The initial impact of fuel price increases on the fishing industry is to make it less profitable. This, however, is just the initial impact and it will soon be counteracted" (Arnason 2007: 27). This counteraction is a result of the effect of the adaptive strategies enumerated by Rossiter (2006). These adaptations will lead in the short term towards uncertainty in fleet performance and size, but in the long run it can cope with the future rise in fuel prices making fleet size recovery possible.

Therefore, we agree with Arnason's (2007: 27) conclusion: "it is important to realize that the rise in fishing costs caused by the fuel cost increase will generally be considerably smaller than the initial impact suggests. Thus, the method of estimating the cost impact of a fuel price rise by the initial fuel expense multiplied by the increase in fuel price almost certainly overestimates the actual increase in costs".

6. Conclusions

This paper contributes to the discussion about the impact of future fuel prices on the performance and viability of fishing fleets in Europe by stressing the importance to realize that the rise in fishing costs caused by the fuel cost increase will generally be considerably smaller than the initial impact suggests due to adaptation strategies from the fishing industry.

The results from our simulation work indicate that the Belgian fleet can cope with future rises in fuel prices by using adaptive strategies on vessel and fleet level. However, as our result point out, there is often a serious time delay between the implementation of a certain adaptive strategy and gaining their benefits. Therefore, it is crucial to begin this transition phase as soon as possible so the "zero-profit fisheries" (Salz 2006) will not become bankrupt due to future increasing fuel prices. As a result, this study can only agree with Salz'(2006: 6) conclusion: "The short term problem of the increased fuel costs only highlights the structural economic weaknesses of the [many] fishing fleets".

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Annexes

Annex 1: The preliminary microworld

The microworld has a time horizon of 10 years with a time step (DT) of 1week. It can be graphically summarized as illustrated in figure 9.

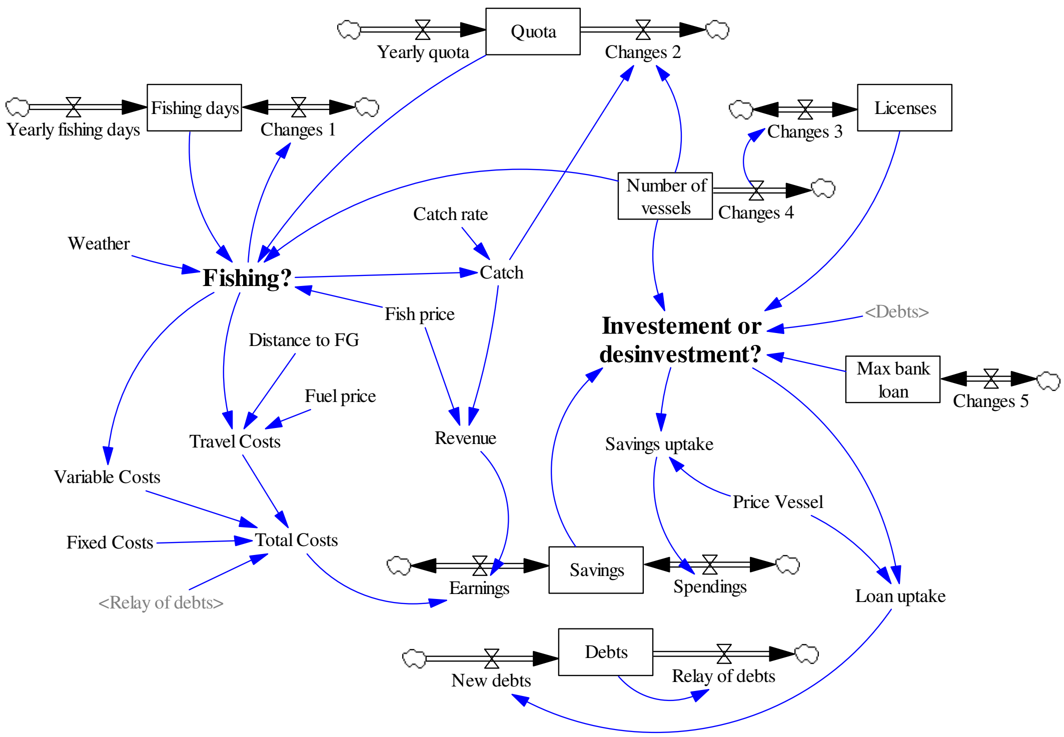

Figure 9: A simplified representation of the used system dynamics microworld (whereby: □ = stock, ○ = converter, => =in- or outflow, and the bold words = decision algorithms)

Annex 2: Data used for running the preliminary microworld

(VT = Vessel type, FG = Fishing ground and TS = Target Species)

Variable			Initial Value	Unit of measurement	Real or Proxy	Data source*
Quota	FG IVbc		10'287'000	Kg	Real	SF
	FG IIVde		2'913'000	Kg	Real	SF
	FG IIVfg		1'096'000	Kg	Real	SF
Max Fishing days	Eurocutter		200	Day	Proxy	ILVO
	Large Beam trawler		250	Day	Proxy	ILVO
	Set netter		140	Day	Proxy	ILVO
	Shrimp Trawler		200	Day	Proxy	ILVO
Licenses			120	License	Proxy	Fictive
Number of vessel per company	Company 1	Eurocutters	**30	Vessel	Real	ILVO
		Large Beam trawlers	0	Vessel	Real	ILVO
		Set netter	0	Vessel	Real	ILVO
		Shrimp Trawlers	0	Vessel	Real	ILVO
	Company 2	Eurocutters	0	Vessel	Real	ILVO
		Large Beam trawlers	***52	Vessel	Real	ILVO
		Set netter	0	Vessel	Real	ILVO
		Shrimp Trawlers	0	Vessel	Real	ILVO
	Company 3	Eurocutters	0	Vessel	Real	ILVO
		Large Beam trawlers	0	Vessel	Real	ILVO
		Set netters	****3	Vessel	Real	ILVO
		Shrimp Trawlers	0	Vessel	Real	ILVO
	Company 4	Eurocutters	0	Vessel	Real	ILVO
		Large Beam trawlers	0	Vessel	Real	ILVO
		Set netter	0	Vessel	Real	ILVO
		Shrimp Trawlers	*****15	Vessel	Real	ILVO
Productivity rate	Eurocutters	FG IVbc	4'152	Kg/week	Real	ILVO
		FG IIVde	4'393	Kg/week	Real	ILVO
		FG IIVfg	2'463	Kg/week	Real	ILVO
	Large beam trawlers	FG IVbc	9'901	Kg/week	Real	ILVO
		FG IIVde	8'269	Kg/week	Real	ILVO
		FG IIVfg	2'720	Kg/week	Real	ILVO
	Set netters	FG IVbc	1'322	Kg/week	Real	ILVO
		FG IIVde	1'320	Kg/week	Real	ILVO
		FG IIVfg	0	Kg/week	Real	ILVO
	Shrimp trawler	FG IVbc	1'635	Kg/week	Real	ILVO
		FG IIVde	1'085	Kg/week	Real	ILVO
		FG IIVfg	0	Kg/week	Real	ILVO
Fish price	Average TS		4	Euro/kg	Proxy	SF
Distance to FG	FG IVbc		150	Km	Proxy	ILVO
	FG IIVde		350	Km	Proxy	ILVO
	FG IIVfg		700	Km	Proxy	ILVO
Fuel price			0,43	Euro/litre	Real	SF
Variable	Company 1	Eurocutter	8'720	Euro/week at sea	Real	SF

costs		Large beam trawler	15’760	Euro/week at sea	Real	SF
		Set netter	5’679	Euro/week at sea	Real	SF
		Shrimp Trawler	2’803	Euro/week at sea	Real	SF
	Company 2	Eurocutter	8’720	Euro/week at sea	Real	SF
		Large beam trawler	15’760	Euro/week at sea	Real	SF
		Set netter	5’679	Euro/week at sea	Real	SF
		Shrimp Trawler	2’803	Euro/week at sea	Real	SF
	Company 3	Eurocutter	8’720	Euro/week at sea	Real	SF
		Large beam trawler	15’760	Euro/week at sea	Real	SF
		Set netter	5’679	Euro/week at sea	Real	SF
		Shrimp Trawler	2’803	Euro/week at sea	Real	SF
	Company 4	Eurocutter	8’720	Euro/week at sea	Real	SF
		Large beam trawler	15’760	Euro/week at sea	Real	SF
		Set netter	5’679	Euro/week at sea	Real	SF
		Shrimp Trawler	2’803	Euro/week at sea	Real	SF
Fixed costs	Company 1	Eurocutter	1’113	Euro/week	Real	SF
		Large beam trawler	2’592	Euro/week	Real	SF
		Set netter	506	Euro/week	Real	SF
		Shrimp Trawler	495	Euro/week	Real	SF
	Company 2	Eurocutter	1’113	Euro/week	Real	SF
		Large beam trawler	2’592	Euro/week	Real	SF
		Set netter	506	Euro/week	Real	SF
		Shrimp Trawler	495	Euro/week	Real	SF
	Company 3	Eurocutter	1’113	Euro/week	Real	SF
		Large beam trawler	2’592	Euro/week	Real	SF
		Set netter	506	Euro/week	Real	SF
		Shrimp Trawler	495	Euro/week	Real	SF
	Company 4	Eurocutter	1’113	Euro/week	Real	SF
		Large beam trawler	2’592	Euro/week	Real	SF
		Set netter	506	Euro/week	Real	SF
		Shrimp Trawler	495	Euro/week	Real	SF
Debts	Company 1		50’635’602	Euro	Proxy	Fictive
	Company 2		241’350’002	Euro	Proxy	Fictive
	Company 3		4’965’060	Euro	Proxy	Fictive
	Company 4		3’886’131	Euro	Proxy	Fictive
Price for a vessel	Eurocutter	Buying	2’100’000	Euro	Proxy	ILVO
		Selling	500’000	Euro	Proxy	ILVO
	Large beam trawler	Buying	5’000’000	Euro	Proxy	ILVO
		Selling	1’100’000	Euro	Proxy	ILVO
	Set netter	Buying	1’500’000	Euro	Proxy	Fictive
		Selling	300’000	Euro	Proxy	Fictive
	Shrimp Trawler	Buying	2’100’000	Euro	Proxy	Fictive
		Selling	500’000	Euro	Proxy	Fictive

*Data source: (1) Belgian Sea Fisheries Service = ‘SF’, (2) Internal data Institute for Agriculture and Fisheries Research = ‘ILVO’ (3) Fictive data = ‘fictive’.
** Number of eurocutters in 2005
*** Number of Large beam trawlers in 2005
**** Number of Set netters in 2005
***** Number of Shrimp trawlers in 2005