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Deliverable 2.4

Report on "boom and bust" cycles for selected European fisheries and farmed species

February 2017

Executive Summary

The seafood production and trade system is exposed to a variety of disruptions including fishery collapses, natural disasters, policy changes and price spikes. Especially the shocks caused by the latter are particularly negative for fisheries and aquaculture operations because they limit the ability to generalize or predict and, consequently, to adequatevely response to the market's shocks. The overall objective of PrimeFish is to enhance the economic sustainability of European fisheries and aquaculture sectors to inform operators and help them to identify potential risks and opportunities to build resilience in the global food system. As part of WP2 "Economic performance and prices" in PrimeFish, this deliverable is devoted to provide a detection of the component of time series of prices and an analysis of the occurrence for "boom and bust" cycles for the selected species studied in PrimeFish.

This study simply investigated patterns in the price – without trying to explain it beyond time components i.e. year - trends, seasonality – months and potentially other cyclical patterns.

The critical factors which are responsible for the principal prices' turbulences and drops and spikes in the prices of agricultural commodities in world markets has been explored through literature obtained from the principal databanks such as Web of Science for the last 10 years. Next, a similar literature review for price volatility of both fisheries and aquaculture markets has been realized. The sequence of price shocks presented in the metaanalysis is further empirically compared with the price series analyses executed using the method of Kalman's filters.

Comparing the B&B identified for our case studies and the literature review, after year 2009 the numbers of occurrence of B&B, as defined in the Report, increased meanwhile in international market volatility also increased, showing an increasing degree of commodities/products interconnection which leads to a rapid propagation of shocks. No recent manuscripts (e.g. peer-review papers, reports, etc.) have shown results about price volatility in the fish sector.

An example of how macroeconomic factors, such as household income, market prices, production volume, tariff and non-tariff barriers and exchange rates, can affect the occurrence and development of boom-and-bust cycles has been described in the case of Pangasius.

Price co-integration analysis has been carried out to implement the analysis of price transmission and market integration between species along their value chains. This is suggesting that the retailers are "cooling" the spikes in the first sale market and keep an average price at relatively constant level even if the first sale price is moving well above the average. In other words, retailers seem to alternate months of losses and gains. It is remarkable to observe that recent months are likely to have been economically negative for retailers, which have absorbed most of the spread difference in the prices.

In WP5, our efforts will be devoted to analyse more in depth the differences between aquaculture and fisheries case studies.

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Contents

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Introduction

As part of WP2 "Economic performance and prices" in PrimeFish, this report is devoted to provide an analysis of the occurrence and critical factors for "boom and bust" cycles for the selected species studied in PrimeFish. The latter will among others be investigated through comparative studies of agricultural commodities sectors and aquaculture cases.

An example of how macroeconomic factors, such as household income, market prices, production volume, tariff and non-tariff barriers and exchange rates, can affect the occurrence and development of boom-and-bust cycles has been described in the case of Pangasius.

Price co-integration analysis has been employed to implement the analysis of price transmission and market integration between species along their value chains.

The report has not the intention to go deeply into many different aspects concerning "boom and bust" (B&B) but rather to provide an insight for major component of the behaviour of fisheries and aquaculture products price, to allow the detection of B&B cycles and to make predictions on price fluctuations, protecting against such future cycles.

The analysis and report is divided into six parts providing i) introduction on sources publically available for fish prices, ii) a literature review on price volatility in world agricultural markets and a specific focus on the fisheries and aquaculture sectors, iii) detection of "boom and bust" cycles and making predictions of price, iv) how macroeconomic factors affect B&B occurrence, v) analysis of price transmission and vi) discussion and conclusion.

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Literature survey

In the following chapter we firstly present the critical factors which are responsible for the principal prices' turbulences and drops and spikes in the prices of agricultural commodities in world markets. To this end, we have consulted literature obtained from the principal databanks such as Web of Science. Next, we will conduct a similar literature review for price volatility of both fisheries and aquaculture markets. The sequence of price shocks presented in the metaanalysis is further empirically compared with the price series analyses executed using the method of Kalmann's filters.

The vast literature on price volatility shows that the price trend of the XXth century has stopped and that actual prices since 2000 have increased more than 100%. Thus, a greater proportion of food is being traded internationally between more countries that ever before, and this increases the potential for shocks to local food systems to propagate into global crises.

Generally speaking, there are many causes for this price trend reversal. In primis, supply growth is "per se" limited due to limited resources such as land and water. Furthermore, energy is becoming more expensive, productivity grow is declining, global warming is constraining production and there is a growing resource competition between food and non-food crops (biofuels, copper, rubber, flowers and ornamentals). Additionally von Witzke (2014) explains that from the demand side population and per capita consumption growth are posing a constraint on price stability.

All said, looking at price trends from the 1970s until nowadays, most scholars have reached the following conclusions on price volatility:

- In general terms, price volatility has not increased (von Witzke, 2014; Sartori & Schiavo, 2015) due to the fact that periods of extreme volatility in agricultural markets are seldom. Specifically, Prakash and Gilbert (2011) distinguish the '73-'74 episode as a "crisis" with extreme high price levels and volatility on commodity markets, whereas the recent 2006-2007 is not comparable in size and effects (i.e., taking into account the five million malnutrition related deaths) to the former. To similar results comes also Huchet-Bourdon (2011) who finds that volatility is higher in the last decade than in the 1990s but not higher than that of the 1970s. On the same vein, Gilbert and Morgan (2010) find that recent volatility is higher than in the 1970s, only for cereals.
- Regarding speculation in general terms the scientific community agrees on the necessary role for markets to serve as an insurance against price risk. Speculation tends to reduce price volatility. However, in specific categories of commodity, speculation has been shown to favour spikes. For instance, McPhail et al. (2012) show that in the corn market speculation causes spikes in corn price. However, in the long run, other factors, such as energy and increasing global demand are the causes of spikes in corn price.
- Finally, keeping our focus in general terms, it is important to distinguish among general price volatility and perceived price volatility. Whereas, as we mentioned before, the diachronic perspective confirms different price spikes but not an upwards trend of price volatility, on the EU level perceived price volatility has changed. In fact, due to the more liberal CAP, EU consumers tend to perceive price volatility in world agricultural markets as higher respect to the past.

In order to deep our analysis on price volatility for specific commodities, in the following we deep our analysis on three episodes, namely the grain crisis with price spikes in the wheat, soybean and rice prices (the rice bubble).

During the 2008 grain crisis, grain prices spiked due to increased demand for biofuels, higher oil prices, decreasing grain stocks, and the weakened US dollar (Headey, 2011). Rising wheat prices led India, the second largest rice producer, to ban exports of non-Basmati rice which subsequently led other rice exporting countries, including China, Vietnam and Egypt to introduce export bans. Some major importers, including the Philippines, responded by purchasing additional rice at increasing prices. This led to driving up of the global price of rice. By the end of the crisis, the World Bank reported over 130 million people were driven into poverty and the FAO estimated that an additional 75 million people became malnourished (Headey, 2011).

Furthermore, the analyses of price trend of wheat prices from January 2007 to July 2008 conducted by von Witzke (2014, available at: www.agriskmanagementforum.org/content/international-seminar-food-price-volatility-looking-viable-policy-approaches) using simply partial equilibrium model, shows that 78% of the price increase of wheat can be attributed to the following factors: freight rates (29.6), oil prices (29.3) , production reduction due to bad weather in southern eastern EU and Australia (hereby with a negative effect of -10.7!), exchange rates (7.6), export restrictions (6.1), population growth (2.3), income growth (2.0) and bioenergy production (0.1).

On the other side, the application of the same method to the soybeans price trend in the same time period shows the following factors as the major causes of the 111% price spike of soybeans: freight rates (28.9), oil prices (21.9) , production (11), exchange rates (7.6), export restrictions (4.3), bioenergy production (3.9), population growth (2.3) and, finally, income growth (2.0).

All these examples, explained in table 1, illustrate the potential for multiple stressors (e.g., increasing biofuel demand and oil prices, changes in commodities stock policies and financial crises) to cause shocks which propagate on large spatial scales. Interestingly, recent studies on price volatility show a weakened impact of the oil price on agricultural prices, thereby showing a declining trend of oil-intensity in production of agricultural commodities (Alam & Gilbert, 2017). More specifically, Siami-Namini and Hudson (2017) show that volatility of international agricultural commodities prices do not significantly react to the volatility of crude oil price in the short run for the time period 1986-2005. However, they discover that, in the long run, the volatility of crude oil prices does affect the US dollar exchange rate volatility for the time period 2006-2015, which, in turn, affects the volatility of the international agricultural commodities returns through changes in prices. Similar effects have been detected also in the energy sector. For instance, using a dataset from March 2005 to March 2011, Du and McPhail (2012) showed that the shocks in the ethanol market have the largest impact on the corn price. Focusing on the same cereal, Regmi and Featherstone (2017) demonstrated that biofuel production related policies within the U.S. impacts the world price of corn (time period: 1982-2016) and its effect may last for a longer period of time.

As a consequence, particularly in the food systems, price volatility has gathered momentum in the last ten years and a plethora of studies (Canuto, 2014; Cashin et al. 2002; Carter et al., 2011; Kornher & Kalkuhl, 2013; Tomek & Kaiser, 2014) analyse the nature and frequency of disruptions, or shocks, to food systems on a regular basis to better understand the factors that contribute to global food security.

Finally, thanks to the great availability of studies, some general conclusions have been reached. For instance, to reduce price volatility in the agricultural commodities markets Semerari (2011) envisages three principal actions at the marketplace: 1) the monitoring and controlling of markets' trends in order to forecast in advance commodities shocks and turbulences 2) decreasing of import and export measures because of their distorting effects on the market and, finally, 3) Policies of market management such as public purchase, constraining stock of commercial retailers, or (which is still controversial) the creation of world-wide stocks to be used in case of market tensions. Table 1 provides an overview of the most important shocks in commodities markets that we have discussed so far.

Table 1: Overview of the most important shocks in world agricultural markets as reported in the literature (time period: 1970s – 2010)

Year(s) of shock	**Cause of unexpected price increase/spike (unless other specified)**	**Consequence**	**Reported by**
1973-74	Causes: low grain stocks, increasing oil prices and inputs, spike in grain demand of former USSR	Grain crisis in general	Prakash, 2011 pag. 260
1990s	Deterioration of the global supply/demand situation during period of sharp liberalization process	General crisis of agricultural products	Prakash, 2011 pag. 260
1990s	Poor monsoon season in South Asia Brief export ban on oilseeds by the USA Increase in import demand for rice	Sharp increase of price of rice	Prakash, 2011 pag. 260
2004-2008	Export surge Spike in oil prices	Sharp increase of price of maize	Headey, 2011
2007-2008	Causes, from highest to lowest magnitude: Freight rates, Oil prices Production Exchange rates Export restrictions, Bioenergy production Population growth Income growth	Sharp increase of price of soybeans (111% price increase)	Headey, 2011 Harald von Witzke (2014), Ulysses Project (http://www.agriskmanagementforum.org/content/international-seminar-food-price-volatility-looking-viable-policy-approaches) available at: https://www.youtube.com/watch?v=1pHX1hEXBnI
2007-2008	Causes, from highest to lowest magnitude: Freight rates, Oil prices Production (NOTICE: has a negative effect on wheat prices) Bad weather (southern eastern EU and Australia), Exchange rates Export restrictions, Population growth Income growth Bioenergy production	Sharp increase of price of wheat (78% price increase)	Harald von Witzke (2014), Ulysses Project (http://www.agriskmanagementforum.org/content/international-seminar-food-price-volatility-looking-viable-policy-approaches)

Year(s) of shock	Cause of unexpected price increase/spike (unless other specified)	Consequence	Reported by
2007-2008	Multiple causes to explain the rice bubble: Two step mechanism consisting of both external and internal factors: (external) increasing oil prices since 2004 Weak US dollar Increase in biofuel Increasing price of maize Increasing price of soybeans Decline of wheat-production due to bad weather Increase in wheat price (internal factor) Decision of key rice trading countries to ban rice export (India, Viet Nam) Increase of rice price	Grain crisis: rice bubble	Headey, 2011 and Prakash (2011)
2008-2010	Use of grains and oil crops as biofuel Population growth Increase in the trend of purchasing future contracts by non-commercial agents Bad weather and export bans of grains in some grain key exporting countries	Sharp increase of price of grains and oilseeds Propagation of the crisis to livestock and dairy products	Prakash, 2011 pag. 260

Unfortunately, in the fisheries and aquaculture markets the situation is different. Although these markets are as well exposed to a variety of disruptions, price spikes, overfishing and disease outbreaks, the patterns and trends of these shocks are poorly characterized (Delgado et al., 2003) and underreported due to the fact that temporal analyses have focused more on long-term trends rather than sudden drops and their resulting impacts (Gephart et al. 2017 and 2016). As a consequence, in the following, we present an overview of shocks as reported on the scarce literature in the field, derived essentially by scientific papers and news reports of international institutions such as FAO and IFPRI (see Table 2).

Table 2. Literature review of price volatility in the fisheries and aquaculture markets

Title	**Author**	**Year**	**Study topic**	Methodology	Main results	Data collection
Shock to fish production: identification, trends and consequences	Gephart et al.	2017	Analyse patterns and trade of fish shocks	Statistical shock detection approach 1976-2011 + a case study	The largest magnitude shocks focused on Asia, Europe and Africa. In response countries tend to increase imports and experience decreases in supply- Aquaculture systems are more likely to be interested by shocks than capture systems. Shocks have not grown along the time nor in frequency nor in magnitude.	United Nations' Comtrade and Fao Fishstat
Economic shocks in the fisheries sector and maritime piracy	Flueckiger and Ludwig	2015	Correlation of shocks in the marine sector and piracy	Panel of 109 coastal countries	Negative economic shocks, measured by drops of phytoplankton, in the fisheries sector are associated with an increase in maritime piracy. Ergo: the economic conditions in the fisheries sector have an important impact on modern-day piracy	Decrease of amount of phytoplankton as a proxies for decrease of fish catch
Vulnerability to shocks in the global seafood trade network	Gephart et al.	2016	Shocks' simulation to assess the food-security outcomes. Comparison of changes in national fish supplies with indices of each country's nutritional fish dependency	Development of a shock-propagation model to quantify how trade flows are redistributed under a range of shock scenarios.	High degree of countries' interconnection in the seafood and aquaculture sector. The most vulnerable countries to shocks are those with a high reliance on seafood and that are all large importers relative to their exports. Countries can reduce their overall vulnerability to shocks by reducing reliance on imports and diversifying food sources	United Nations' Comtrade and Fao Fishstat
Economic incentives and overfishing: a bioeconomic vulnerability index	Cheung and Sumaila	2015	Creation of a vulnerability index	Creation of an index that evaluates the level of vulnerability by comparing discount rates and fish growth rate	Particular vulnerable countries: Canada, Pacific Coast of Mexico, Peruvian coast, southern and south-eastern coast of Africa and the Antarctic	Mix of different sources among which FAO database

Disaster response and risk management in the fisheries sector	Westlund et al. (FAO Fisheries technical paper, n. 479)	2007	Compilation of both natural and human-induced disaster	Qualitative recollection of cases	Guidelines and recommendations are provided to governments to rapidly solve situations of emergence due to disasters in the fisheries and aquaculture sectors	FAO database and literature

Using data of United Nations' Comtrade and Fao Fishstat, Gephart et al. (2016) demonstrate that also the seafood and aquaculture sector is characterized by an increasing degree of countries' interconnection which leads to a rapid propagation of shocks on a spatial scale according to a mechanism of increasing imports and decreasing supply (Gephart et al., 2017). Although shocks have not grown along time nor in frequency nor in magnitude (Gephart et al. 2017), their monitoring is important since seafood is among the most highly traded food commodities. Furthermore, according to Gephart et al. (2016), in the last years, above all those countries that were net importers of seafood, and that depended on seafood for nutrition, tended to be the most vulnerable to shocks to the system. In particular Central and Western Africa stood out as being highly vulnerable. Especially shocks initiated in Northern Europe or Eastern Asia resulted in major supply decreases in West Africa. However, Eastern Asia and Southern and Western Europe were also vulnerable to external shocks, in particular those originating in Southeast Asia. Among the more vulnerable countries, Cheung and Sumaila (2015) count also Canada, Mexico, Peru and the Antarctic. As a consequence, countries can reduce their overall vulnerability to shocks by reducing reliance on imports and diversifying food sources. An interesting perspective on the turbulences that characterized the seafood sector is provided by the work of Flueckiger and Ludwig (2015). These authors illustrate the importance of monitoring the economic conditions in the fisheries' sector, since negative economic shocks are associated with an increase in maritime piracy. Table 3 provides an overview of the most important shocks which are caused by both natural and human-induced disasters (Westlund et al., 2007).

Two main conclusions can be drawn on the work so far:

Firstly we can make a parallel between the seafood sector and the agriculture sector. In the same way as no increase can be found in the number of shocks in agricultural systems in the past 25 years (Sartori & Schiavo, 2015), increases in shocks with time or in frequency or in magnitude in the capture and aquaculture markets cannot be found either (Gephart et al. 2017).

Secondly, in the last 20 years, aquaculture systems were more likely to be affected by shocks than capture systems (Gephart et al., 2017).

Table 3: Overview of the most important shocks in the fisheries and aquaculture markets as reported in the literature (time period: 1990s – 2009)

Year of shock	**Cause**	**Consequence**	**Reported by**
1985-1997	Rapid growth of aquaculture production	Decline of export unit values for **salmon**	Delgado et al., 2003
1987-1988	Overfishing	Dispute between France and Canada	Gephart et al., 2017
1989	Oil spills in Southern and Central Alaska	Drop in sell of **salmon, harbour seals, herring, crabs** and **clams** (around 240000 tons of fish) with food security problems for the population	Westlund et al., 2007
1990	Farm production fish diseases in 15 Asian Countries	Loss in freshwater **finfish** pond culture and marine cage culture of **finfish**	Westlund et al., 2007
1991-2002	War in Sierra Leone	Sharp decline in fish supplies with loss in food security	Westlund et al., 2007
1992 onwards	Political: dismantling of URSS,	Drop in seafood catch combined with increased export from Estonian governments Not recovered until 2011	Gephart et al., 2017
1993	**Cod** commercial near extinction, collapse and closure of the **cod** fishery	Food security problems for population of islands Saint Pierre and Miquelons (French territories)	Gephart et al., 2017
During the 1980s and mid-1990s, with eventually drop in catch in 2000	Decline of both **pelagic fish** and **demersal species** in Ghana	Food security problems for Ghana's population	Gephart et al., 2017
2000	Floods in Viet Nam	Destruction of fishing vessels and drop in fishing trade infrastructure	Westlund et al., 2007
2002	Cyclones in Mozambique	Destruction of fishing vessels and drop in fishing trade infrastructure	Westlund et al., 2007
2002	Typhoon in the Philippines	Loss of 3000 metric tons of fish production	Westlund et al., 2007
2002/2003	Ice drifts in Canada and USA (Maine)	Killing of large numbers of farm fish	Westlund et al., 2007
2004	Long series of hurricanes in the Caribbean	Destruction of fishing vessels and drop in fishing trade infrastructure	Gephart et al., 2016
2004	Tsunami	Substantial drop in per capita seafood supply at the shock point and food security for Sri Lanka (and Asian Countries)	Gephart et al., 2017
2004-2009	Negative economic shocks, caused by drop of phytoplankton's quantities	Decrease of fish catch and increase of maritime piracy	Flueckiger and Ludwig, 2014

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Materials and Methods

Data sources

The report is largely based on EUMOFA (The European Market Observatory for Fisheries and Aquaculture) tool, which is the most complete dataset for price series analysis of both fisheries and aquaculture markets, chosen after having analysed the others sources publically available, namely 1) UNData, The United Nations Commodity Trade Statistic Data Base, 2) FAOSTAT FishStatPlus, 3) FAO FISH PRICE INDEX 4) UN Comtrade, International Trade Statistics Database, 5) Eurostat, 6) Tradestat.

UNData (www.data.un.org) is managed by the United Nations Statistics Division. It contains over one million entries on the commercial exchange of the various Commodity Codes dating back to 1962. Data is available in English. Each year, more than 140 UN Member States provide statistical data to calculate the figures of international trade. Data is updated at regular intervals. This can determine a retrospective update of data, especially for the last provided year.

FAOSTAT (www.fao.org) is part of FAO's mission to improve statistical data collection and dissemination in order to foster development and fight global hunger and malnutrition. Member States and regional areas have been involved in gathering and sharing data since 1961. The FAO Fisheries and Aquaculture Department compiles fisheries and aquaculture statistical data using FishStat Plus as a part of FAOSTAT. FishStat Plus statistical data have been used to present an overview of the mentioned typologies of fish trend market at global level, specifically Global production, Aquaculture production and Capture production (in tons). It does not use Commodity Codes. The dataset is available in six languages (Arabian, Chinese, English, French, Russian and Spanish).

FAO FISH PRICE INDEX (www.fao.org/in-action/globefish/fishery-information/resource-detail/en/c/338601) The FAO Fish Price Index (FPI) is regularly published in GLOBEFISH publications and in the FAO Food Outlook. Starting from 2011 for the first time, fish and fishery product are included in the annual OECD-FAO Agricultural Outlook publication. Currently, the index includes seafood imports to three markets (EU, Japan and USA) and six major species groupings (salmon, whitefish, other fish, crustaceans, small pelagic and tuna).

The **UN Comtrade (**https://comtrade.un.org/data/**)** is the database provided by the United Nations Commodity Trade Statistics Database and concerns the major global importing and exporting countries in value (USD) and quantity for the years 1996-2016. This database contains self-reported annual import and export bilateral trade flows (in US dollars) and is available in English.

EUROSTAT (http://ec.europa.eu/eurostat) belongs to the European Commission and is available in English, German, and French. It provides statistical details on the European Member States and candidate countries, through various statistical publications and data. The latter is collected using internationally agreed concepts and definitions developed by the Coordinating Working Party on Fishery Statistics, comprising Eurostat and several other international organizations with responsibilities in fishery statistics. The domain "Fisheries" contains data on 1) catches by fishing region, 2) aquaculture production and on total production, 3) landings in EEA ports, trade in fishery products, 4) on the EEA fishing fleet by age, length and gross tonnage as well as 5) fishing fleet by type of gear and engine power.

Trade Map (www.trademap.org) belongs to International Trade Centre (ITC). It is available in English, French, and Spanish. It is an interactive online database on international trade statistics that presents indicators on export performance, international demand, alternative markets and the role of competitors from both the product and country perspective. Trade Map covers the annual trade flows of over 220 countries and territories (direct and mirror data) and 5,300 products defined at the 2, 4 or 6-digit level of the Harmonized System with different trade indicators (values, quantities, trends, market share and unit values) and times series since 2001 displayed in graphic, map or tabular format. Trade data are also available at tariff line level for more than 100 countries and on a monthly or quarterly basis for more than 50 countries. Monthly data for most OECD countries are updated on a constant basis with a three months-delay. The monthly, quarterly and yearly trade flows are available from the most aggregated level to the tariff line level. It is financially supported by ITC's Global Trust Fund and the World Bank. Users in developing countries and territories can register at www.intracen.org/marketanalysis to access ITC's market analysis tools free of charge. Users in developed countries and territories can register to get a one-week free trial access or subscribe for a longer access.

Finally, the **EUMOFA** database (www.eumofa.eu/it) is an initiative of EU commission. Under the supervision of DG MARE, EUMOFA is managed by the following companies: AND (France), EUROFISH (Denmark), KONTALI ANALYSE (Norway) and Business Integration Policy (Italy). It is available in the 24 languages of the EU countries. It is fed with data from different sources, at European Union level and from different countries. The core part of the database relies on official statistics, complemented with data from private providers regarding prices for selected species and places (weekly), volume and values for all species and places (monthly) as well as EUROSTAT's data of volume and values for all species. Data is harmonised in 97 commercial species and 12 commodity groups. Specifically, EUMOFA permits following prices along the supply chain at different stages of the chain. At the first sale level, it provides average annual prices for fish landed in EU ports as well as weekly and monthly prices, allowing to analyse intra-annual fluctuations. Also average annual prices for imported products are provided. On the contrary, ex-farm prices of aquaculture products are not systematically monitored, nevertheless, EUMOFA provides average annual prices for some farmed fish. Furthermore, concerning wholesale prices, the dataset provides them for some products and Member States. Ex-factory prices can be inferred from PRODCOM annual surveys, in particular apparent average annual prices. It also provides price of imported processed products in competition with EU products (COMEXT). Finally, regarding prices at consumer level, EUMOFA provides available retail price data from panels. Time-series provided by the dataset help answering different questions concerning structural elements influencing price structure and/or short/term factors responsible for price volatility. EUMOFA provides average annual prices at the following levels: production, import, export, wholesale, ex-factory and retail. Besides, weekly data at first sale (landing) and quarterly data are available as well. However, at intermediate stage of the chains (wholesaling, processing) only annual average prices are available. Price structure analyses are therefore only possible on a yearly basis. Finally, annual average prices are given also for substitutes and supply-demand balances.

Because of the heterogeneity of the over mentioned databanks direct comparison of data is difficult to achieve. For this reason, Primefish aims at aggregate data and harmonize them and become, in this way, a benchmark tool that serves effectively to fisheries and aquaculture operators. Specifically, we concentrate on the economic performance of the following selected species: Atlantic herrings, cod, pangasius, salmon, seabass, seabream and trout. As in WP1, because of the higher availability of data, the databank EUMOFA is employed (Sørdahl et al., 2015). However, to compensate data missing in some categories, specific surveys and interview with processing companies are employed to obtain reliable information on the missing categories.

Methods

The Methods used for the Report vary according to the parts. The report start with a literature review on price volatility in world agricultural markets with specific focus on the fisheries and aquaculture sectors as described in the specific chapters.

The detection of "boom and bust" cycles, making predictions of price was conducted implementing the Kalman Filters in MATLAB, macroeconomic factors affect B&B occurrence with regression analysis and the analysis of price transmission was conducted using cointegration models. For each part of the Report the methodology has been fully explained.

Detection of "boom and bust" cycles and making predictions of price

The goal of task 2.3.1 of WP2 is to analyse historically the behaviour of seafood prices and to detect the presence of boom and bust cycles in these time series.

The investigation will focus on the European fisheries/aquaculture sectors and other relevant international players and it is conducted through the analysis of aggregate data of primary production units (capture fisheries and aquaculture) obtained from available public sources as well as detailed data from individual companies. The use of a statistical methodology, implemented in MATLAB software, allows the detection of boom and bust cycles in time series and potentially, predictions on price fluctuations, protecting against such future cycles.

The scientific literature has various methods for the analysis of time series and each method is particularly efficient but only on certain data types. In order to choose the best method for data related to the fisheries sector, we had to test different algorithms through many simulations and compare the results. This preliminary analysis showed that the best method for the analysis of time series of prices and the identification of the boom and bust cycles are the Kalman filter, also known as linear quadratic estimation (LQE) (doi:10.1115/1.3662552). The Kalman filter is an efficient recursive filter that estimates the state of a dynamic system from a series of subject to noise measurements. For its inherent characteristics, it is a great filter for noise and disturbances. The Kalman filter has a large number of applications in technology. It is typically known for applications in guidance, navigation, control of vehicles, particularly aircraft and spacecraft and robotic motion. Furthermore, and not less important, the Kalman filter is a widely applied method in time series analysis used in fields such as statistics, signal processing and econometrics.

In particular, the application of the Kalman filter to the data in the fisheries is based on its main feature: the decomposition of time series. More in detail, this method decomposes the time series into elementary parts such as trend, cycle, seasonality and irregular component. What are trend, cycle, seasonality and irregular component in the statistical language? Trend is defined as any long term tendency. By extension, in this case, the trend is the fundamental tendency (towards the increasing, the reduction or even to price stability) that the activities of the fisheries sector in periods of varying length (but always groups of years), apart from accidental variations (irregularities or outliers), seasonal and cyclical. The cycle (or cyclical component) is defined as alternation of different sign fluctuations around the trend. Seasonal component consists of changes that occur with similar intensity in the same periods every year, but with different intensity in the course of a year (for example, production is falling every year in the summer following the holiday closure of many companies, but it increases every year as Christmas approaches to and greater consumption). The irregular component represents unforeseeable and accidental variations related to all the most varied types of events. This component in some cases, may include extreme values or outliers. The Kalman filter as well as break down the price trend in building blocks may be allocated to each member of the characteristics of stochasticity and determination. The classification of a component as a stochastic or deterministic is of particular importance since it allows to understand more in detail what inside on the price trend analysis can be considered as "fixed" or "probabilistic". The Kalman filter also allows to determine if the individual components are stochastic or deterministic. The classification of a component as a stochastic or deterministic is of particular relevance since more are the deterministic component in a time series better will be the forecasts.

So, thanks to the implementation of Kalman filter in MATLAB, first of all, we made the analysis on the state of art of fishery sector and we made forecasts on time series under investigation. To complete the task we used the results of first part of the investigation and we developed a methodology to detect boom and bust cycles on the analysed time series. The main challenge was to identify price thresholds beyond which classify the cycle as in a boom period or in a bust period.

With the support of the economics literature (Gerdesmeier et al., 2012), and through many tests performed on the data it seemed reasonable to argue that we can talk about boom or bust if prices are greater than the 85th percentile or below the 15th percentile. Furthermore, in order to avoid false signals, we classify a set of values beyond thresholds as a group if inside the set we don't have more than three consecutive monthly observations below the thresholds. This method allows avoidance of the formation of two booms or two busts in close periods just because there is a single value in the set that falls inside the percentiles used as a threshold. The classification method used to reduce the false signals produces smoother cycles.

The Kalman filter identifies the cycles in function of the data structure and returns us, if it exists, the amplitude of the cycle. The method of classification of values in periods of boom and bust needs, as a parameter, the amplitude of the cycle as it is not able to generate it as the Kalman filter does. So to calibrate this parameter information from the Kalman filter has been used. Sometimes in the case of stochastic cycle or cycle with negligible variation of prices the amplitude of the cycle in the method of classification of the boom and bust was set a priori at 36 months. The choice was made looking for a compromise between the length of the economic cycle defined by the literature (60 months) and the length of the time series we have. In fact forcing the cycle length to 60 months in our time series of no more than 120 months we risk losing information on the existence of the cycle.

The method of classification of values which determines the periods of boom and bust, sometimes by setting in advance the length of the cycles and generating smoother cycles, can lead to results that, when compared with the plots of the Kalman filter cycles, may seem not exactly accurate, but really they represent the best approximation below the classification constraints and the need to smooth the cycles.

Data sources and data availability

The choice of data sources and their availability has been a significant challenge. The institutional sources (i.e. Eurostat, FISHSTATJ, FAO) almost always turned out to be very poor in information under the point of view of length and continuity of the time series, or due to the presence of outliers or non-homogeneous values. The long study on the quality of the data led us to choose as data source the data collected by European Market Observatory for Fisheries and Aquaculture Products (Eumofa), by SECRETARÍA DE ESTADO DE TURISMO Y COMERCIO (Spain) and by Institute of Services for the Agricultural and Food Market (ISMEA, Italy). In order to have the highest level of data consistency in most of the analysis we used the Eumofa data and wherever possible we have preferred to use a single supplier because we believe that the uniformity of the collection method is crucial to compare different time series.

For the analysis time series of monthly prices on different markets have been used: first sale, wholesale, retail, import and export. The table below shows which country / species combinations were to be conducted analysis and their respective data availability on Eumofa or at least in some other sources.

Table 4 Caption: f = first sale, w = wholesale, r = retail, i = import, e=export, na=not available.

Investigations												
	Canada	Iceland	Norway	Spain	UK	Denmark	Faroe	Germany	Italy	Turkey	Greece	Vietnam
Cod	na	e	f	r	f r							
Herring		e	f		f	f	na	f r				
Salmon			e		r		na					
Trout				f w r(1)	f r	f r			na(2)	na		
Seabass				r					f r(2)		na	
Seabream				f w r(1					f r(2)		na	
Pangasius												na

(1). SECRETARÍA DE ESTADO DE TURISMO Y COMERCIO. (2) ISMEA.

In many cases the cells containing the "na" code because the time series are not present on Eumofa nor in what our suppliers have given us and what we were able to find did not satisfy the criterion used to define usable data. More detailed, speaking about Canada, the length of data time series was on a yearly basis starting from 2000. Faroe Islands data are on yearly basis starting from 2000 and ending in 2004.

The tables reported in Annex 1 show the years when there is availability of data and the number of months for each year in which we have data for each singles times series used for the study of boom and bust cycles.

Results

The decomposition of the price time series

The countries analysed are: Canada, Denmark, Germany, Greece, Iceland, Norway, Spain, United Kingdom and Italy.

The analysis aimed at understanding the trends and cyclical nature of the first sale/landing prices, wholesale, retail and import or export price time series.

The trend analysis and the cycles is based on the factorization of the phenomenon observed in various components (e.g. price level, increasing or decreasing long term trend, seasonality -fluctuations within the year which tend to be repeated, cyclical -deviation from long-term trends-, and irregular component -exceptional events - outliers).

This methodological approach allows us to decompose the trend of prices for components and assigning each part the stochasticity and deterministic features. The classification of a component as stochastic or deterministic is important because it helps understanding in more detail whether the price trend analysis can be considered "fixed" or "probabilistic".

This decomposition should allow us to predict what will be the selling price in the future (seasonal; summer, winter, etc.) according to price forecast.

The Graph reporting Forecast includes Confidence charts. The user can choose the confidence level based on risk aversion. The range of confidence levels helps the user to understand the precision of the prediction.

For every chart and table, showing the decomposition of time series, a short comment has been reported by the authors. However, the chart itself should be quite explanatory for the price trend in the observed period.

The items Slope, Seasonal, Cycle and Irregular yield have values in the interval [0, 1]. The unit of the item Period refers to months.

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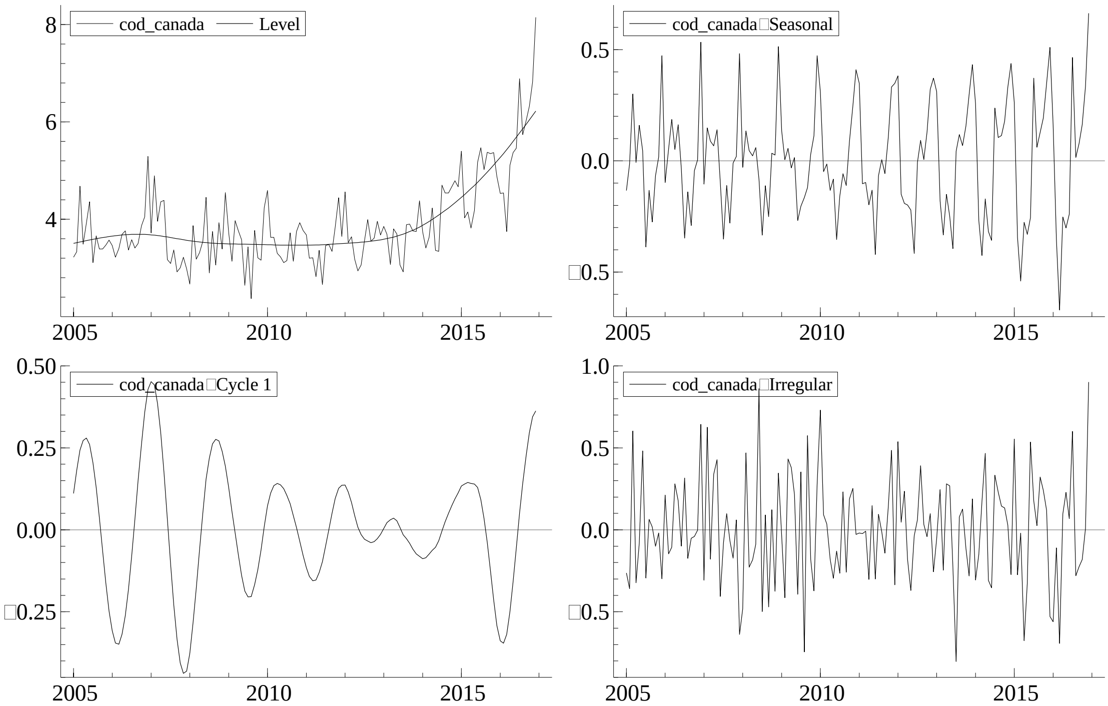
Canada

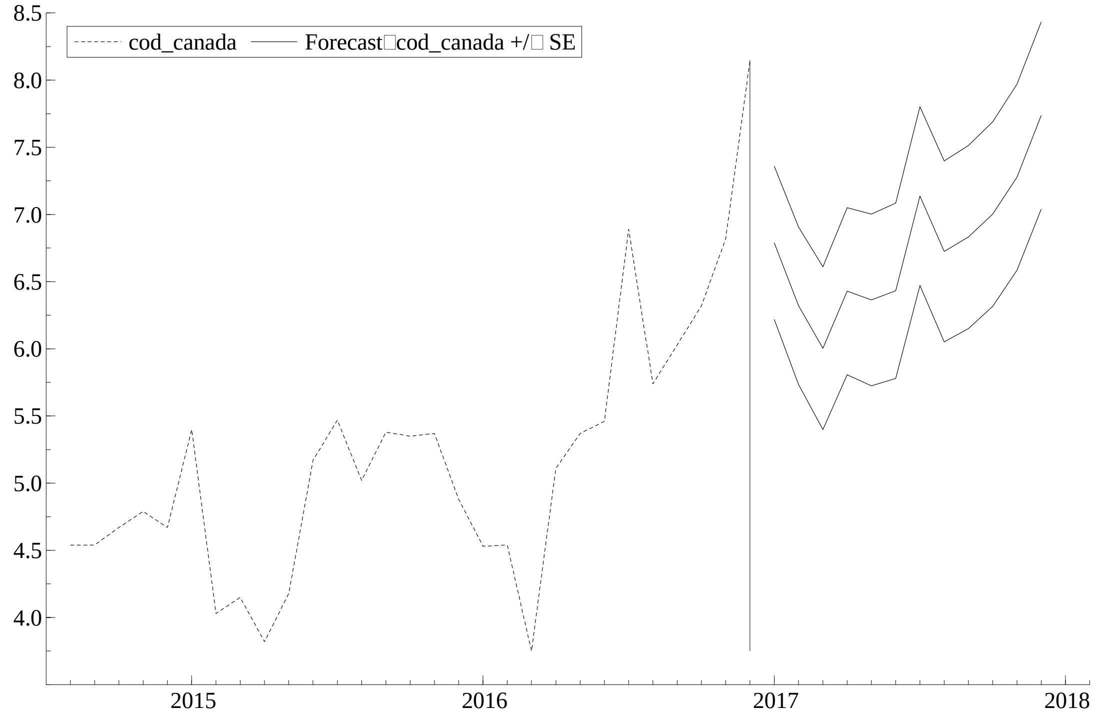
Canada cod first sale

The market had a steady level of prices until 2013 and then began a steady growth. During the entire period, the price level is deterministic. The price fluctuation range varies from 3€ to 8 € and does not have a strong regularity of the seasonality with a range of 1€, with the lowest prices in the first months of the year and the highest prices in late summer. The strong irregularities do not allow the model to explain completely the phenomenon. The cycle has a range of 20 months and is deterministic.



Level	0.000000 (0.0000)
Slope	3.99474e-005 (0.0002447)
Seasonal	0.000390652 (0.002393)
Cycle	0.00264726 (0.01622)
Irregular	0.163228 (1.000)
Period	20.66095

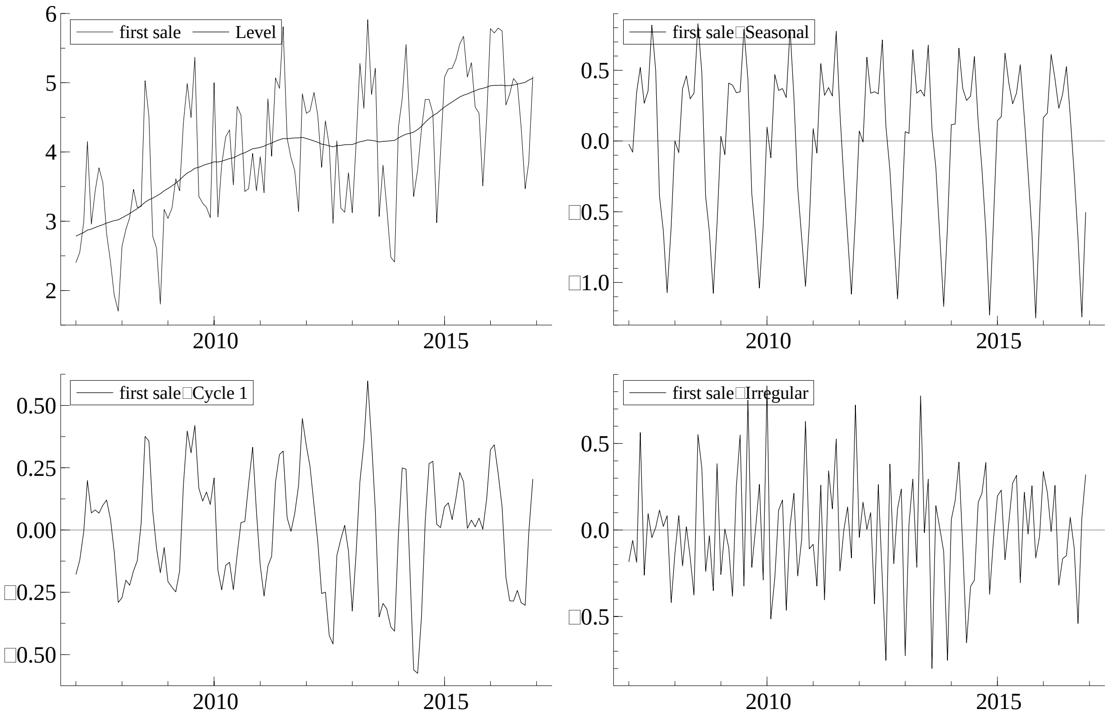
The price forecast for the next 12 months shows a downward trend until the late February, and a growth until the end of the year.



Denmark

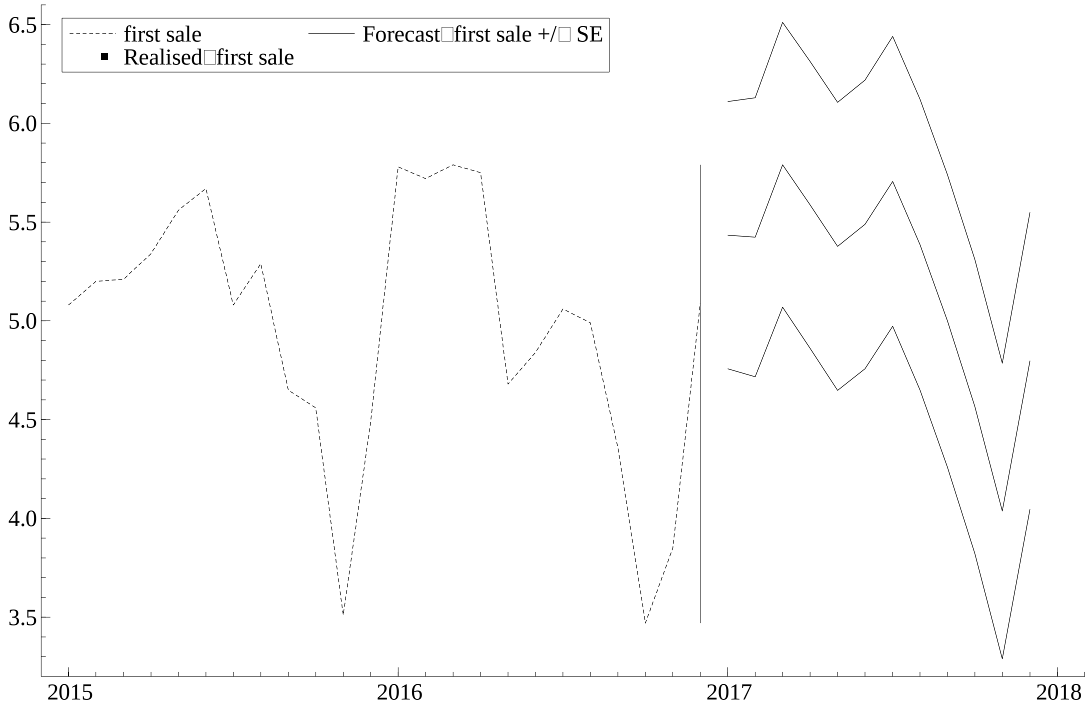
Denmark trout first sale

The market shows a steady increase in the price level during the whole observed period and the price level is influenced by a small stochasticity. The price fluctuation range is from 1.5€ to 6 € and has a good regularity of seasonality with a range of 1.8 € with the lowest prices in November and the highest prices during the Spring. These strong irregularities do not allow the model to explain completely the phenomenon. The cycle lasts about 12 months.



Level	0.00653778 (0.03265)
Slope	0.000000 (0.0000)
Seasonal	0.000248495 (0.001241)
Cycle	0.0720834 (0.3600)
Irregular	0.200218 (1.000)
Period	11.60794 months

The price forecast for the next 12 months shows a downward trend until October / November and a growth in December.



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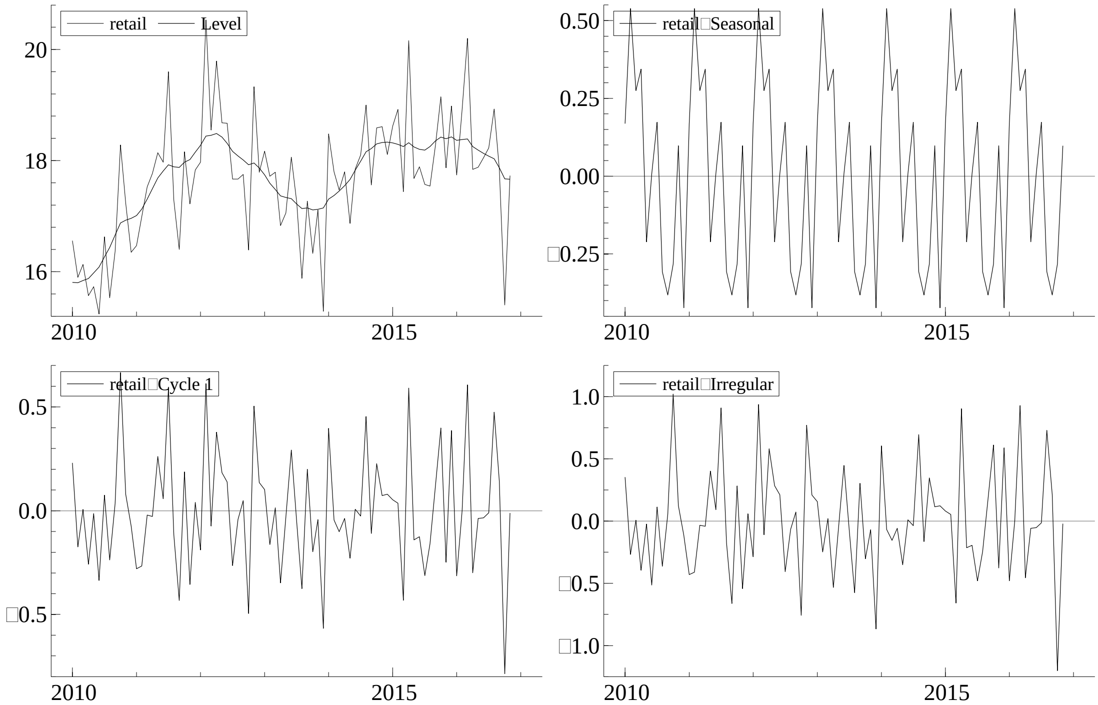
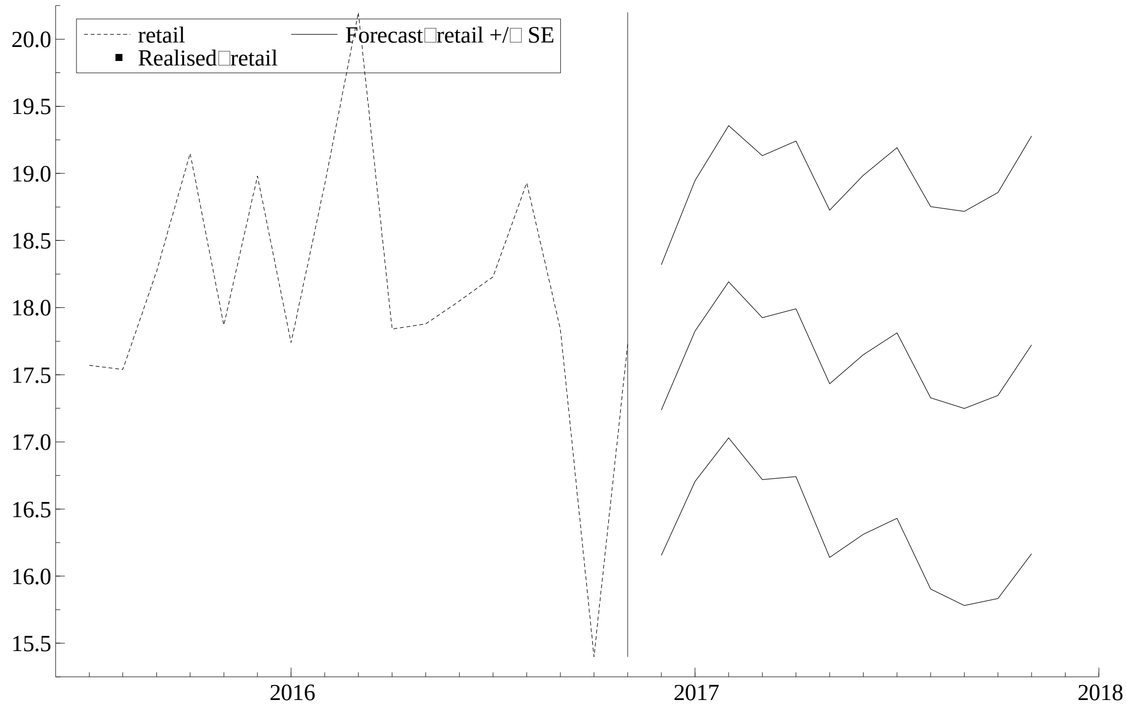
Denmark Trout Retail

The market shows a steady increase in the price level up to the beginning of 2013 and then declines until 2014 and grows until the end of 2015. During the period the price level is slightly influenced by stochasticity. The price fluctuation range is from 15 € to 18.5 € and has a good regularity of the seasonality with a range of 1 € with the lowest prices in early December and highest prices in late December / January. These strong irregularities do not allow the model to explain completely the phenomenon. The cycle lasts two months.



Level	0.0698087 (0.1597)
Slope	8.43900e-005 (0.0001931)
Seasonal	0.000000 (0.0000)
Cycle	0.285340 (0.6528)
Irregular	0.437072 (1.000)
Period	2.20480 months

The price forecast for the next 12 months shows a downward trend until the beginning of 2017, then a slight decrease followed by a growth at the end of the period.



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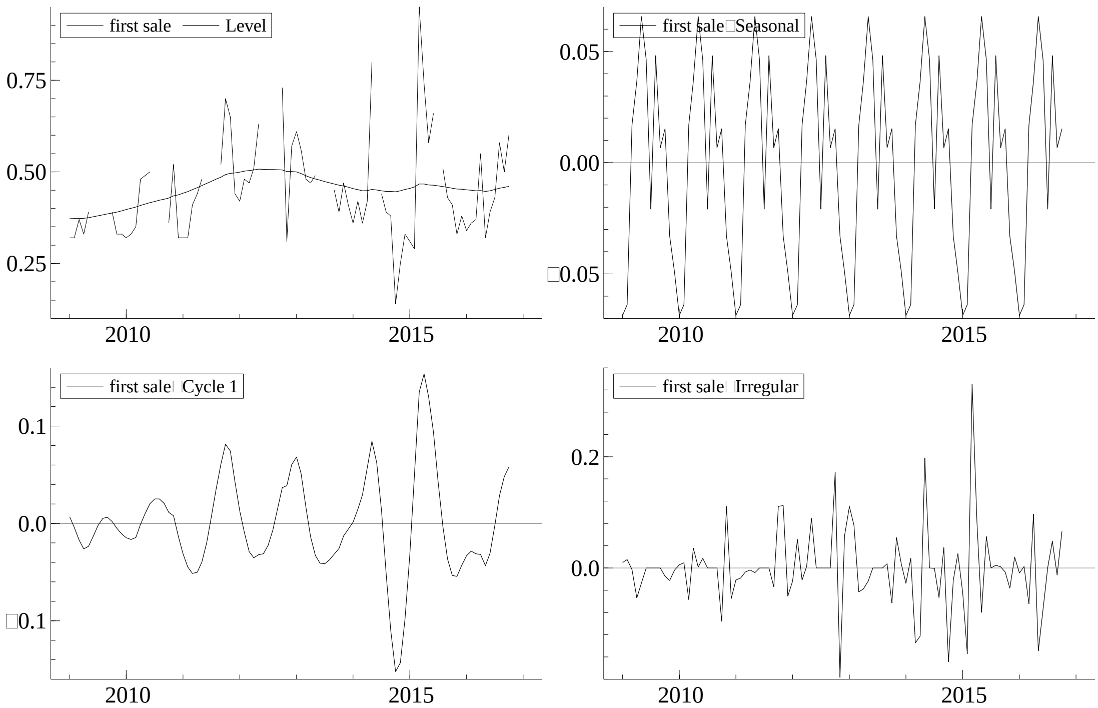
Germany

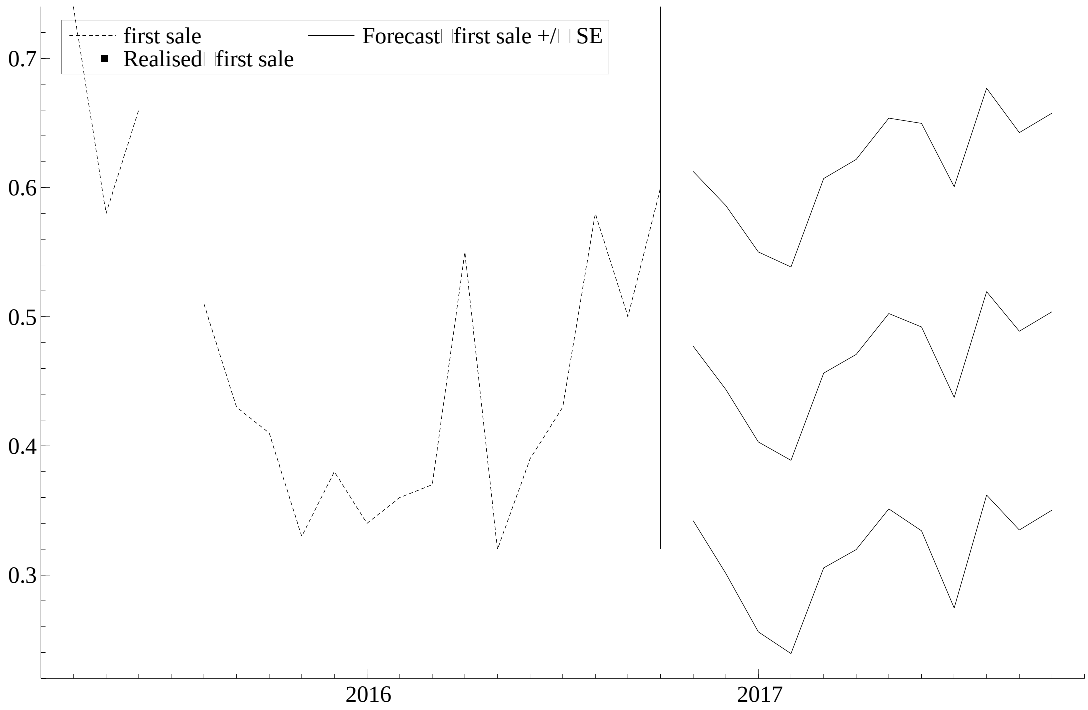
Germany herring first sale

The market has a level with strong but steady price fluctuations throughout the period. During the entire period the price level is deterministic. The fluctuation range of prices ranges from about € 0.25 to € 0.1 and presents a regularity of quite strong seasonality with an amplitude of 0.05€. The seasonality chart has a misleading trend because of recursive presence of missing values in the summer months. The strong irregularity does not allow the model to explain completely the trend. The loop has a width of about 13 months and is deterministic.



Level	0.000268344 (0.02593)
Slope	0.000000 (0.0000)
Seasonal	0.000000 (0.0000)
Cycle	0.000991927 (0.09585)
Irregular	0.0103484 (1.000)
Period	12.98082 months

The price forecast for the next 12 months shows a small growing trend after January 2017.



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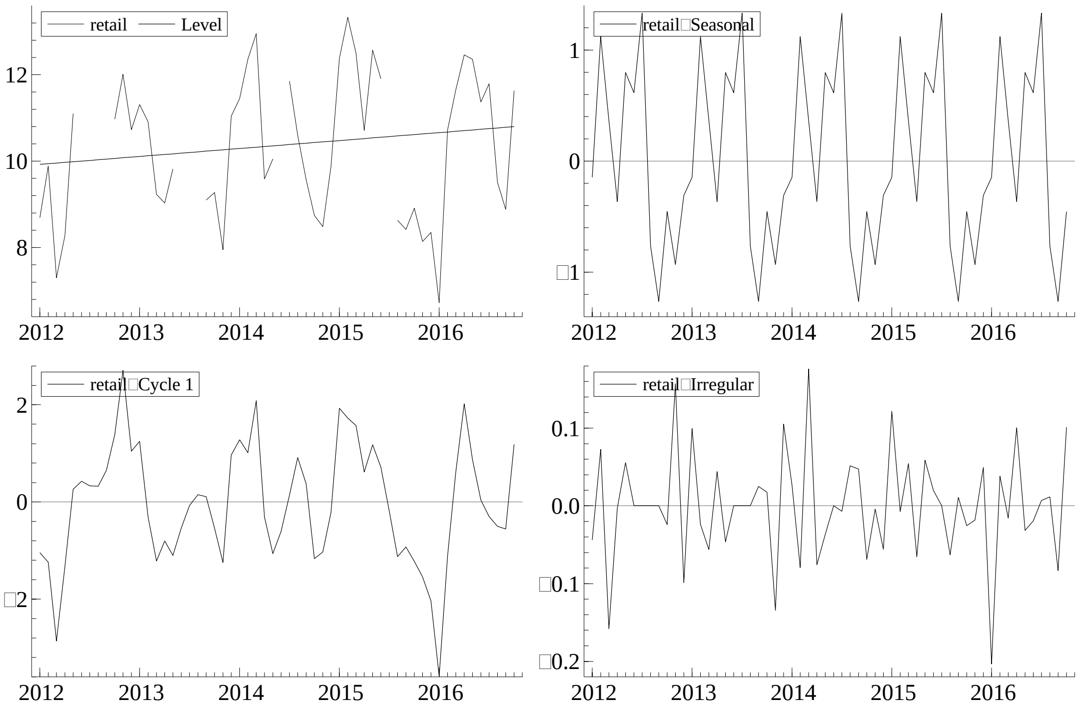
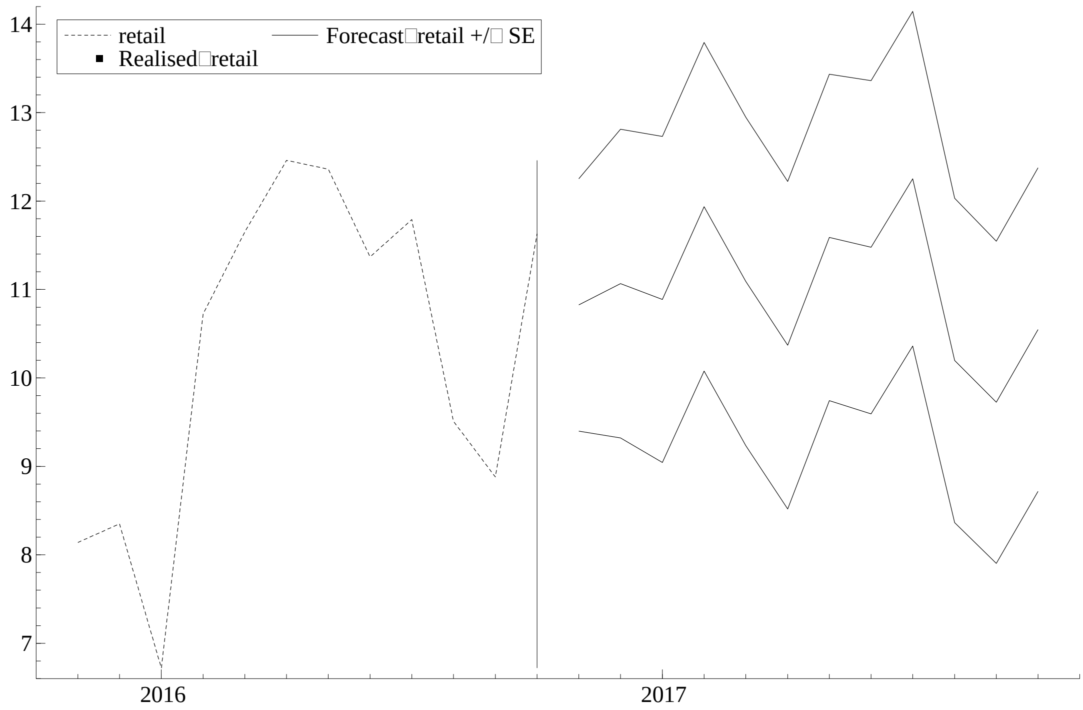
Germany herring retail

The market has a level with strong fluctuation prices with a small increase in the whole period. During the entire time period the price level is deterministic. The price fluctuation range varies from about 7€ to 13€ and has a regularity seasonality with a range of € 2.45. The seasonality chart has a misleading trend because of recursive presence of missing values in the summer months. The loop has a width of about 11 months and is deterministic.



Level	0.000000 (0.0000)
Slope	0.000000 (0.0000)
Seasonal	0.000000 (0.0000)
Cycle	1.18097 (1.000)
Irregular	0.0944273 (0.07996)
Period	11.49314

The prices forecast of the next 12 months shows a small decrease trend after January 2017.



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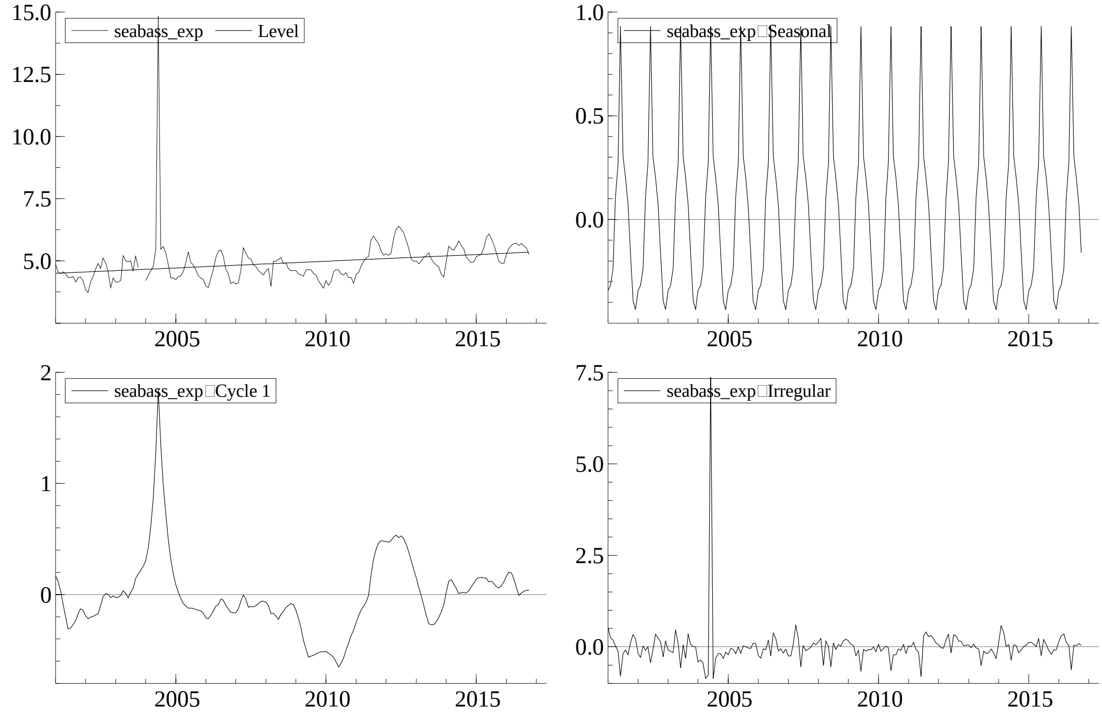
Greece

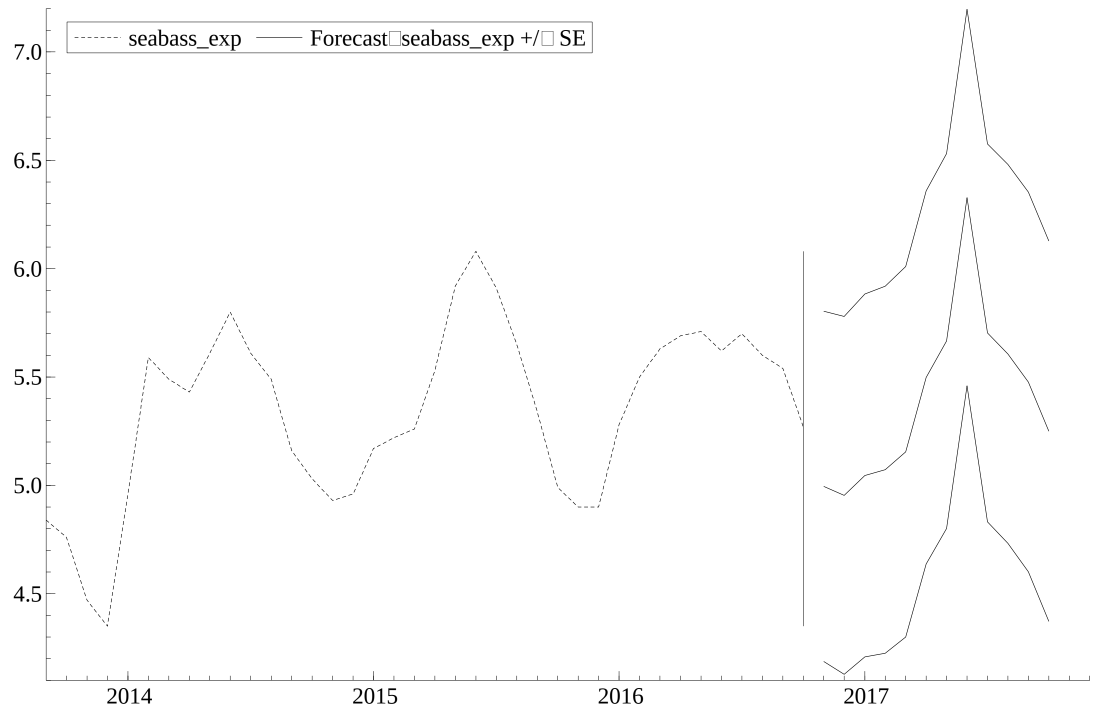
Greece seabass export

The market presents a level of deterministic prices with slightly rising trend and stationary prices. The range of fluctuation of prices changes from about 4€ to 6€ except for a peak in 2004 and presents a strong regularity of the seasonality with a range of 1.4 €. The chart of seasonality presents the highest prices in spring and the minimum prices at the end of the year. The nature of the cycle is partially stochastic but the presence of the irregular component leads to an unreasonable estimate.



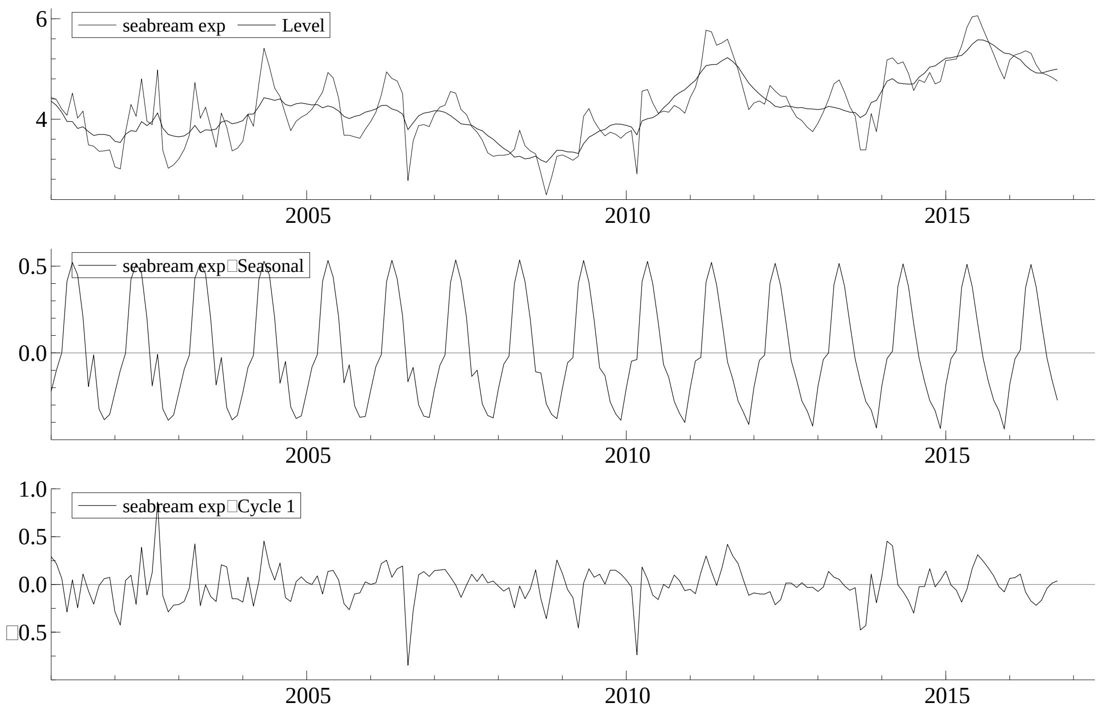
Level	0.000000 (0.0000)
Slope	0.000000 (0.0000)
Seasonal	0.000000 (0.0000)
Cycle	0.0605137 (0.1304)
Irregular	0.464136 (1.000)
Period	10000.00000 months

The price forecast for the next 12 months shows a strong upward trend until the end of May and then decreases until the end of the period.



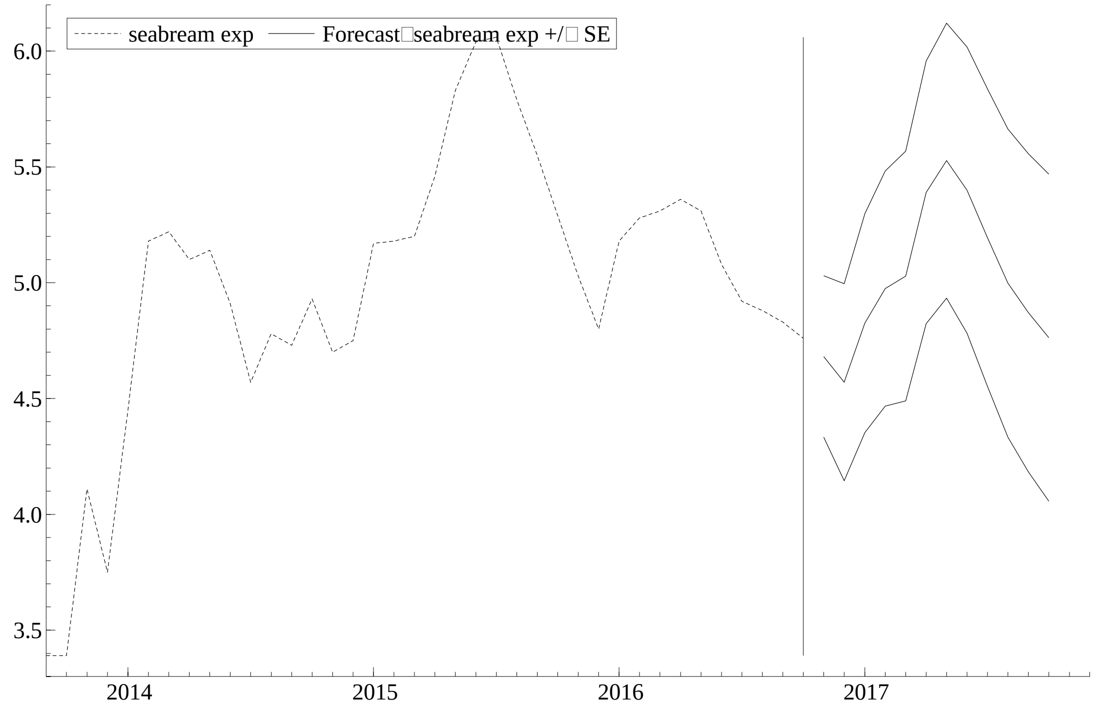
Greece seabream export

The market present a strong stochastic price level. The price fluctuation range varies from about 3 € to 6 € and has a regularity of quite strong seasonality with an amplitude equal to 0.8 €. The seasonality chart contains the highest price in the first half of the year and the minimum in the second half. The nature of the cycle is stochastic and cannot be calculated.



Level	0.0284976 (0.4604)
Slope	0.000000 (0.0000)
Seasonal	1.86541e-005 (0.0003014)
Cycle	0.0618921 (1.000)
Irregular	0.000000 (0.0000)
Period	10000.00000

The price forecast for the next 12 months shows an upward trend until April and then decreases until the end of the period.



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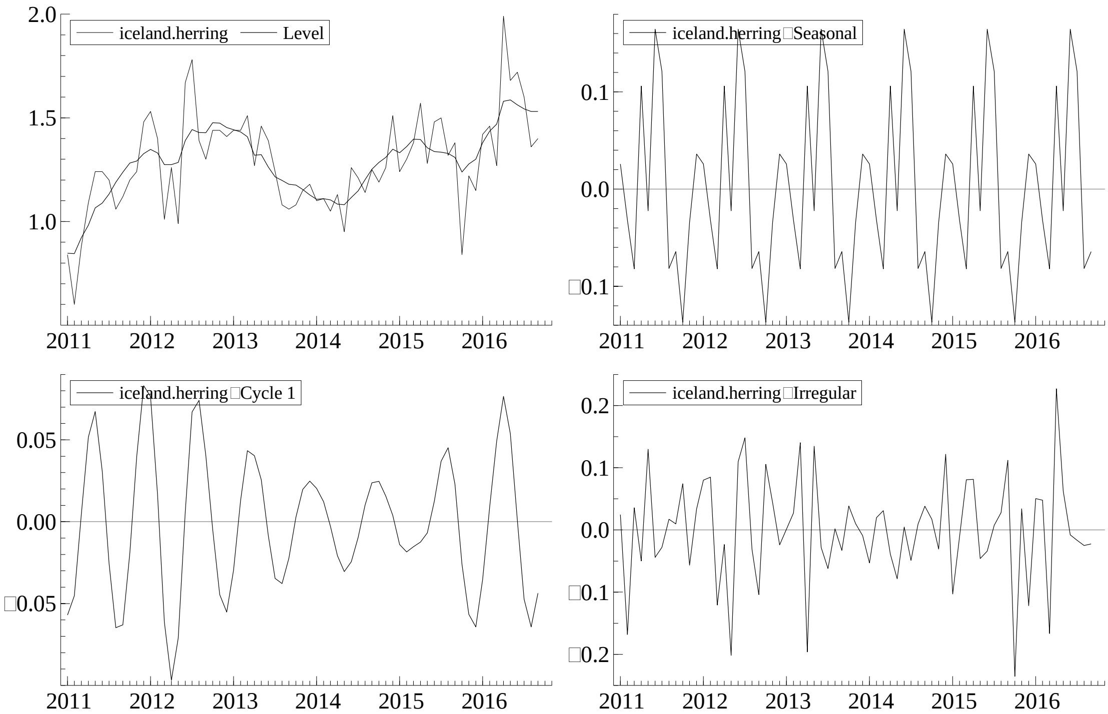
Iceland

Iceland Herring Export prices

The market has a number of fluctuations in the period and the cycle has frequent but small variations around the trend. During the entire period the price level is influenced by stochasticity. The price fluctuation range is from 0.8 € to 2 € and has a good regularity of seasonality with a amplitude of 0.26 €. The marked irregularities emphasizes that the model cannot explain well the behavior of prices. The cycle lasts only eight months.



Value (q-ratio)
Level 0.00680259 (0.4652)
Slope 0.000000 (0.0000)
Seasonal 0.000000 (0.0000)
Cycle 0.000654123 (0.04473)
Irregular 0.0146233 (1.000)
Period 7.97107 Months

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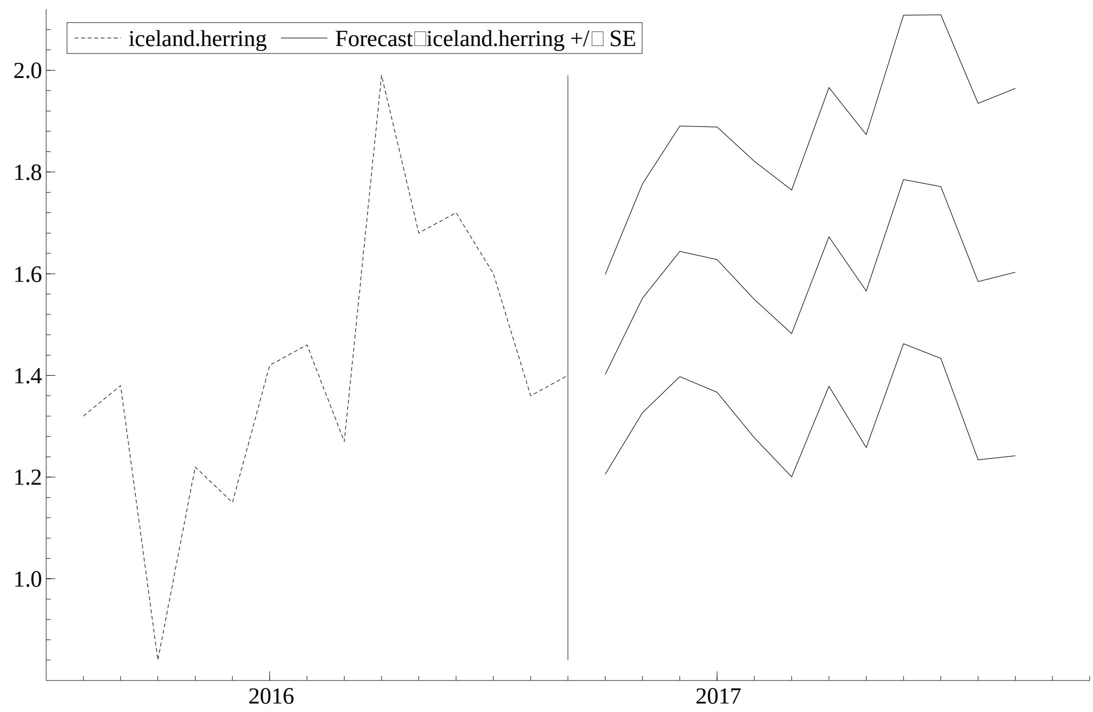
The price forecast for the next 12 months showed a slight upward trend in the period and is bound by a quite large confidence band due to the presence of the irregular component.



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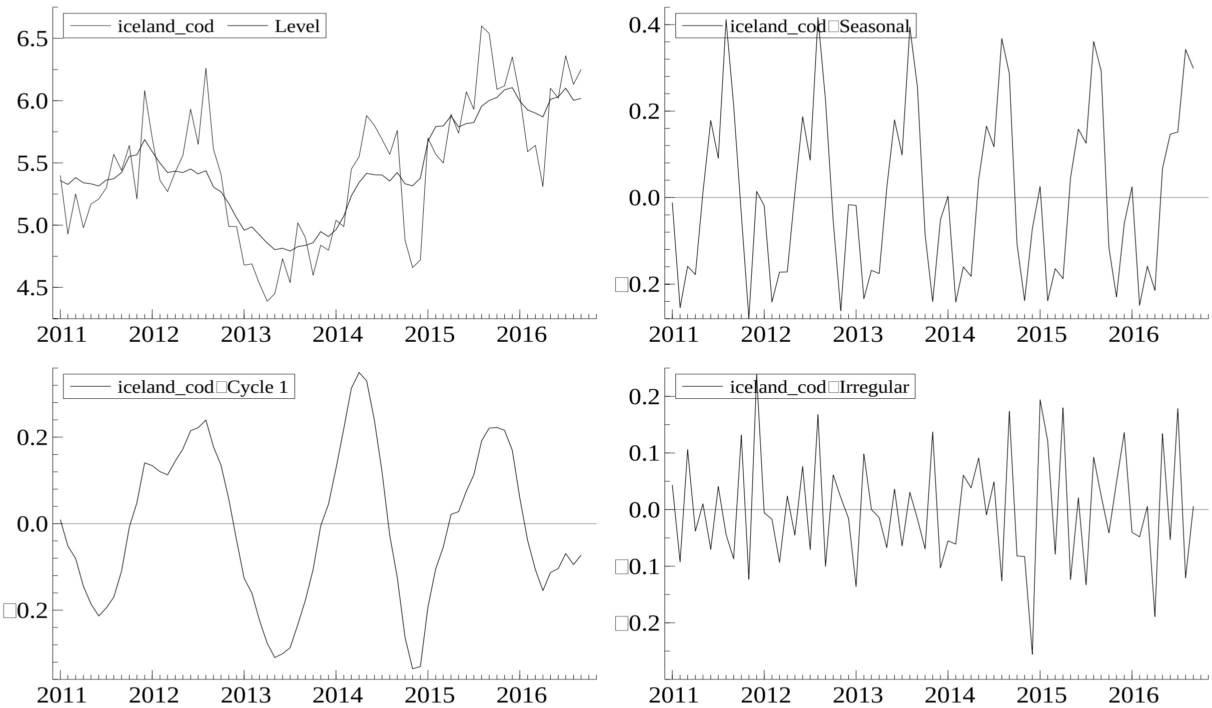
Iceland Cod Export prices

The market has a slight decrease of price in mid-2011, 2013, end of 2015 and a growth in mid-2012, early and mid-2014. During the entire period, the price level is influenced by strong stochasticity. The price fluctuation ranges from € 4.6 to € 6.5, and has a good seasonality regularity with a range of 0.6 € with the lowest prices in November and the highest prices in August. The strong stochasticity level and cycle associated with strong irregularities do not allow the model to explain properly the phenomenon. The cycle lasts 20 months.



Level	0.0242611 (0.9223)
Slope	0.000000 (0.0000)
Seasonal	4.18382e-005 (0.001591)
Cycle	0.00856055 (0.3254)
Irregular	0.0263039 (1.000)
Period	20.49843 months

The price forecast for the next 11 months showed an upward trend during the period and is bound by a quite large confidence band due to the presence of the irregular component.

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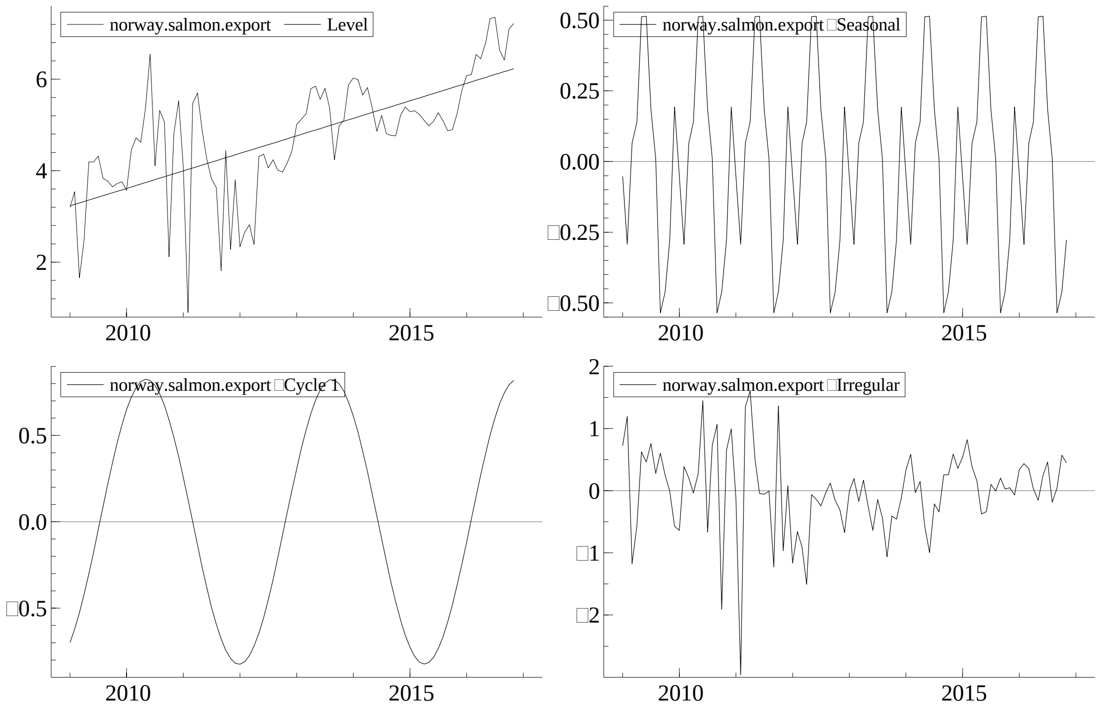
Norway

Norway Salmon Export prices

The market has a number of variations in the period and the cycle has frequent but small variations of the trend with the exception of the collapse of the first month of 2011. During the entire time period the price level is not affected by stochasticity. The price fluctuation range changes from € 1.6 to more than € 7 and has a good regularity of the seasonal range of 1.2 €. The irregularities emphasize that the model cannot explain well the price trend. The cycle lasts 39 months.



	Value	(q-ratio)
Level	0.000000	(0.0000)
Slope	0.000000	(0.0000)
Seasonal	0.000000	(0.0000)
Cycle	1.09681e-005	(1.889e-005)
Irregular	0.580699	(1.000)
Period	39.27666	

The price forecast for the next 12 months showed a significantly decreasing trend in the period and is defined by a quite large confidence band due to the presence of the irregular component.

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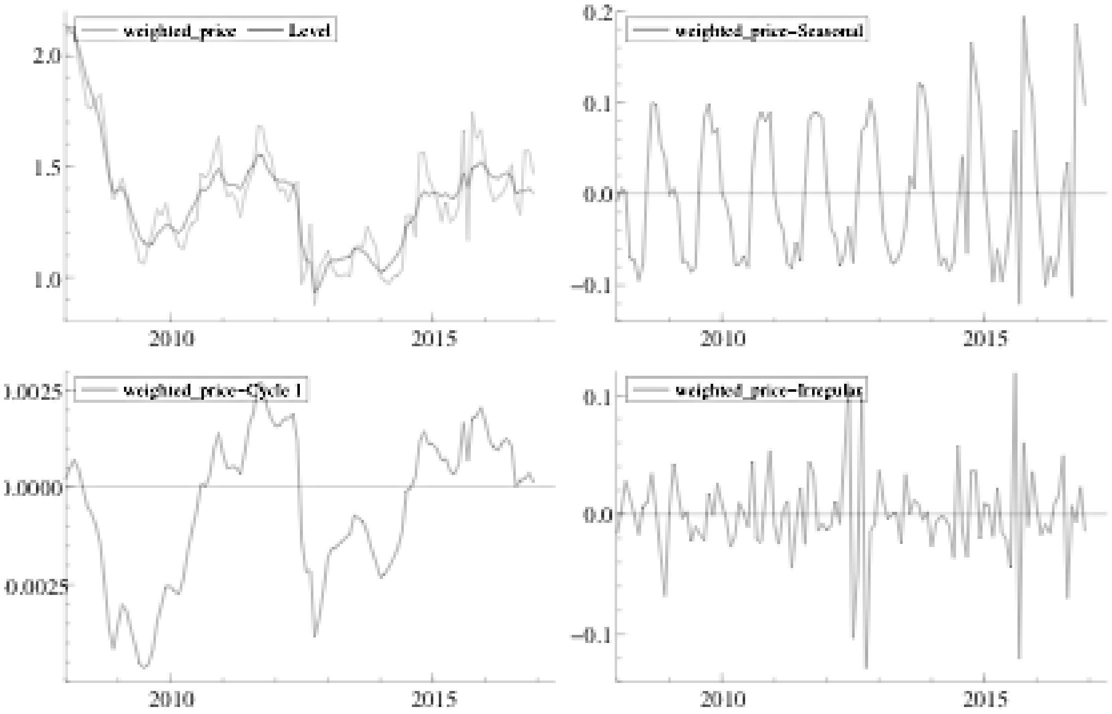
First Sale Price Cod - Norway

The market presents a sharp fall in prices up to mid-2009, a rise until mid-2011 and then a strong decrease towards the minimum of the time series (the last months of 2012), after that a slow recovery. During the whole period the price level is strongly influenced by stochasticity. The price fluctuation range is from € 2.4 to € 0.9, and has a good regularity of the seasonal amplitude of 0.2 €; you have the lowest prices in mid-year and the highest prices in the autumn. The strong stochasticity level and cycle associated with a strong irregularities do not allow the model to explain the phenomenon leading to not interesting results of the cycle period, since defined around 800 years.



	Value (q-ratio)
Level	0.00479298 (1.000)
Slope	3.26754e-005 (0.006817)
Seasonal	2.28307e-005 (0.004763)
Cycle	6.43653e-005 (0.01343)
Irregular	0.00383071 (0.7992)
Period	10000.00000
Period in years	833.33333

The price forecast for the next 11 months showed an upward trend at the end of the period and is related by quite large confidence bands due to the presence of the irregular component.

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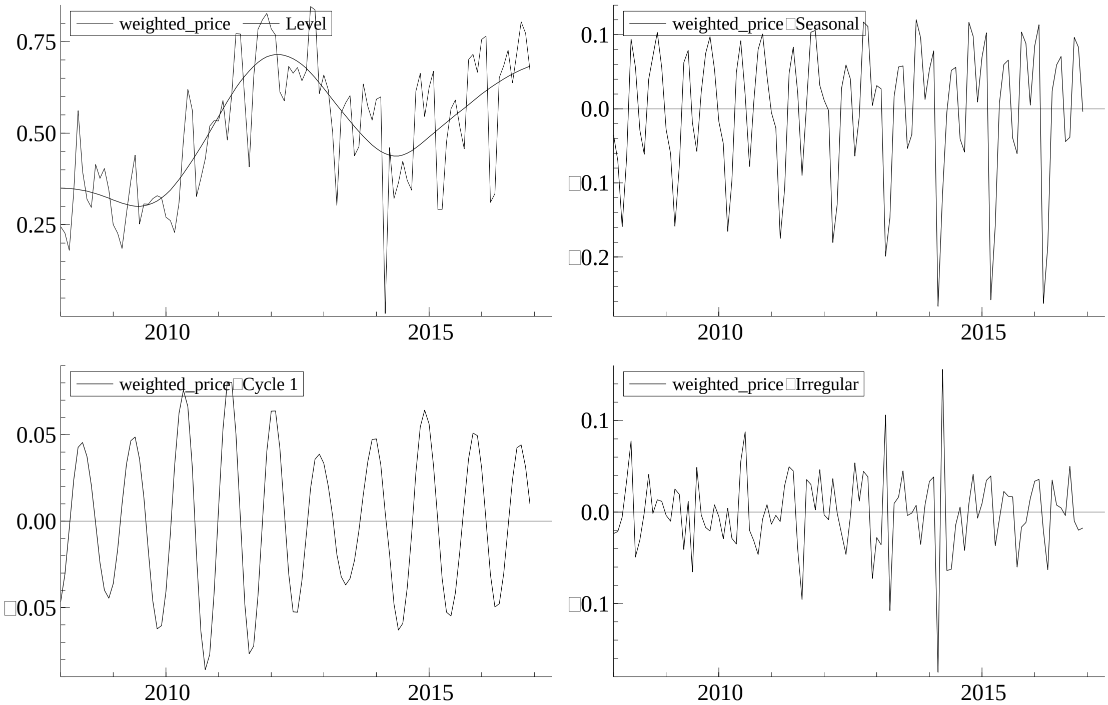
First Sale Price Herring - Norway

The market shows a sharp rise in prices until the beginning of 2012, a decline until mid-2014 and then rise again. During the whole period the price level is without stochasticity. The price fluctuation range is from € 0.35 to 0.75 € and has a good regularity of the seasonal range of 0.25 € you have the lowest prices early in the year and the highest prices at the end of year. This ten-year trend assumes great importance to the loop component which is slightly stochastic and lasts about 11 months with price spikes in 2010 and 2011 and in 2015. The strong presence of irregular component implies that the model is not accurate nor able to explain the trend satisfactorly.



	Value (q-ratio)
Level	0.000000 (0.0000)
Slope	1.80767e-005 (0.005185)
Seasonal	1.85871e-005 (0.005332)
Cycle	0.000127967 (0.03671)
Irregular	0.00348607 (1.000)
Period	11.10448
Period in years	0.92537

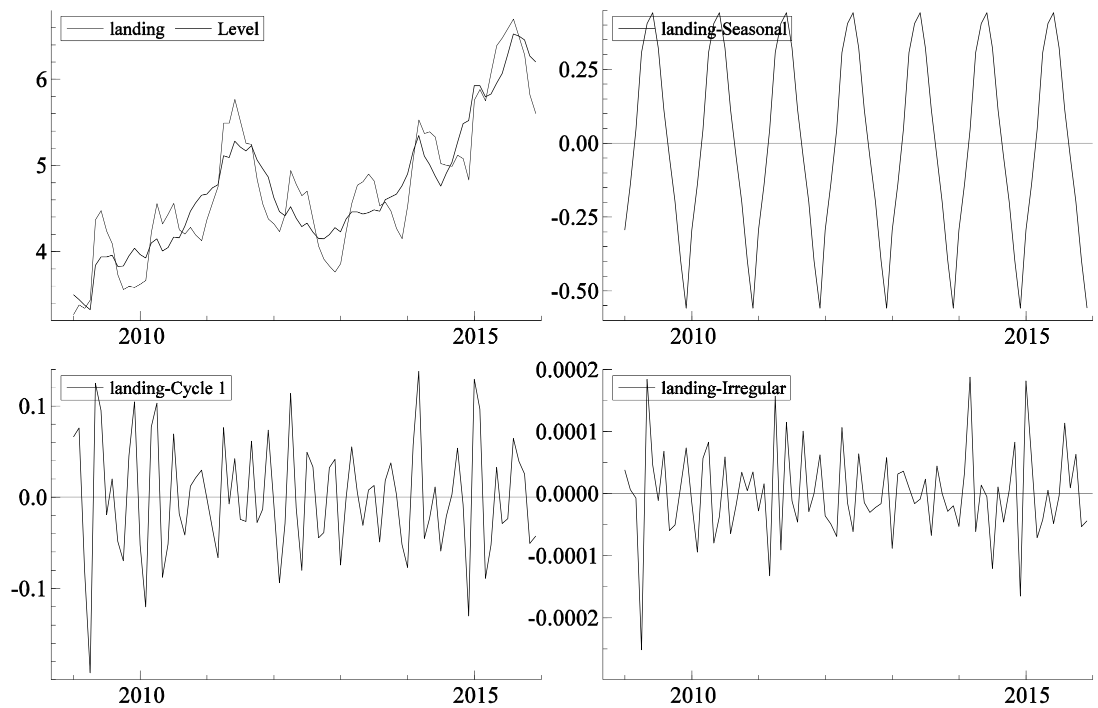
The price forecast for the next 11 months showed a fall in February and March and then grew rapidly up to end of the year and is related by large confidence bands due to the presence of the irregular component.

Spain

Analysis of seabream prices in all stages of the supply chain

Available data (source SECRETARÍA DE ESTADO DE TURISMO Y COMERCIO) are the historical series of monthly seabream prices (wild and farmed) in the three stages of the supply chain from 2009 to 2015 in the Spanish market. The quality of the data is good for the analysis.

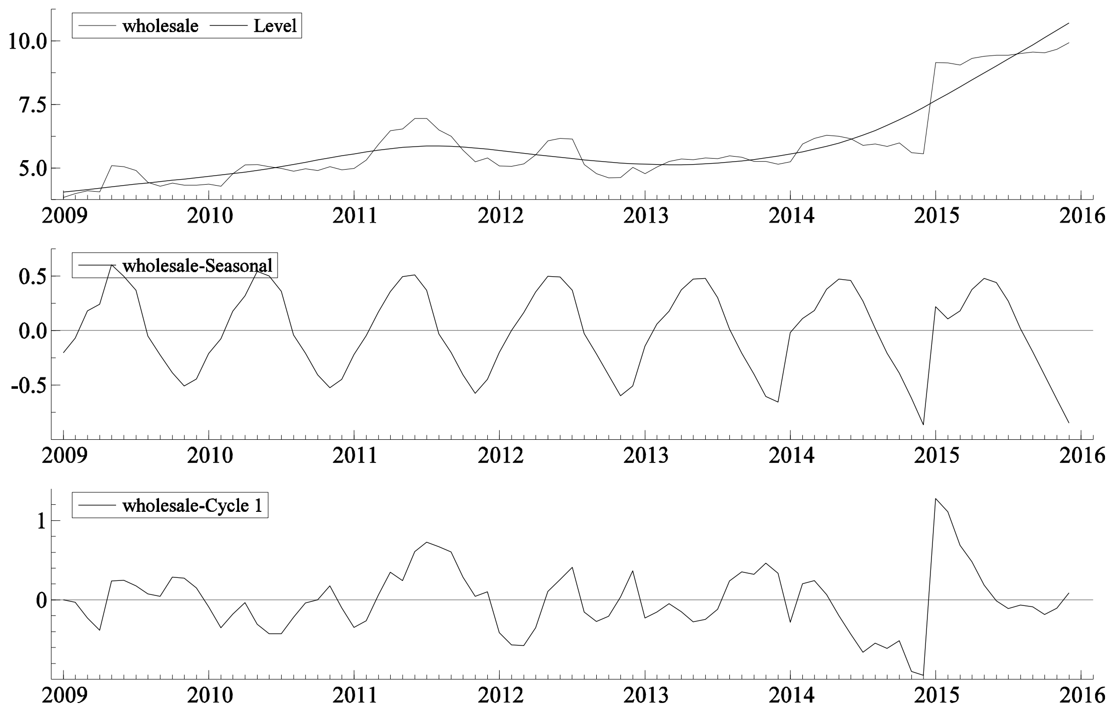
FIRST SALE/LANDING: The analysis of the first sale/market (though not entirely reliable because the data reconstruction) has a significant rise in prices until the mid-2011 and then decreases and rises up again from the end of 2013 onwards. During the entire period the price level is influenced by strong stochasticity. The range of fluctuations in prices is from € 3.26 to € 6.70 and has a considerable regularity of the seasona with a range of 0.7 € with the lowest prices in November and the highest prices in May. This trend takes good account of the cycle component that is stochastic in nature and lasts for about 4 months with price peaks in 2011 and 2015. The presence of irregular component implies that the model is able to explain the trend with good precision but it is not excellent.



Variances of disturbances:	(q-ratio)
Level	(1.000)
Slope	(0.0000)
Seasonal	(0.0000)
Cycle	(0.2004)
Irregular	(0.0004453)
Period	4.23982

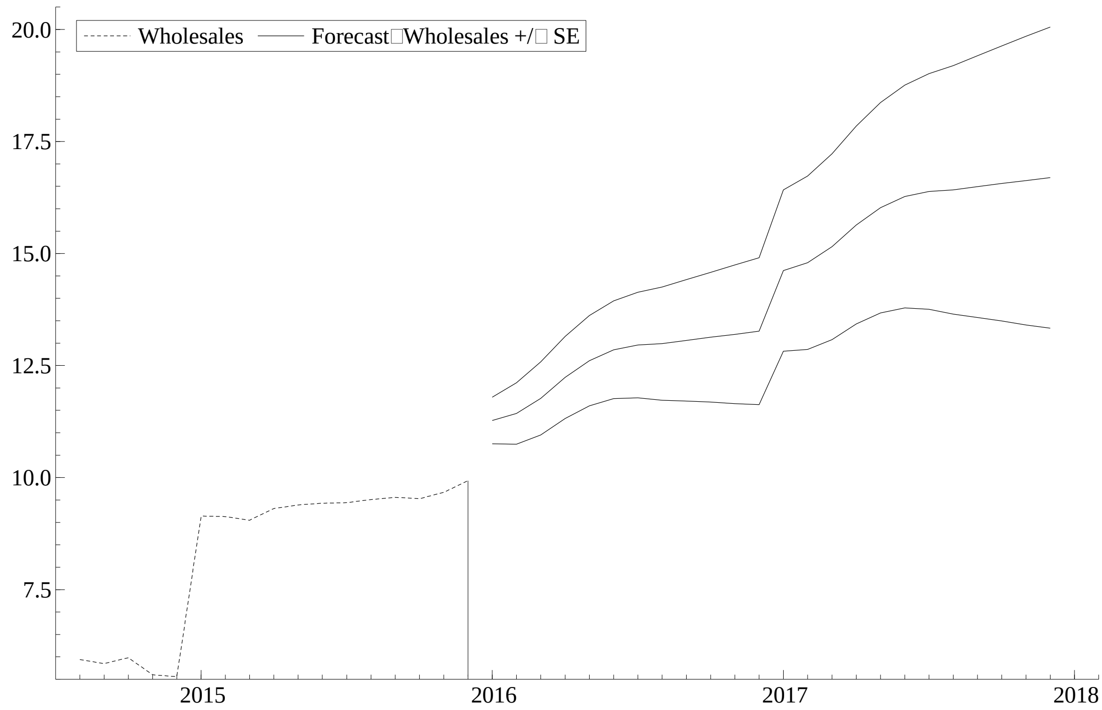
The price forecast for the next two years shows an upward trend until the mid-2016 before falling at the end the year, growing again until May 2017 before falling back.

WHOLESALE: The price trend presents a small growth until 2015 when prices almost double. The fluctuation range of prices is from € 3.84 to € 9.93 and has a small stochastic seasonality with a range bigger than 1 € with the lowest prices in November and the highest prices in June. For this trend, the cycle component becomes important being stochastic in nature and has a duration of about 18 months with price peaks in 2011 and 2015.

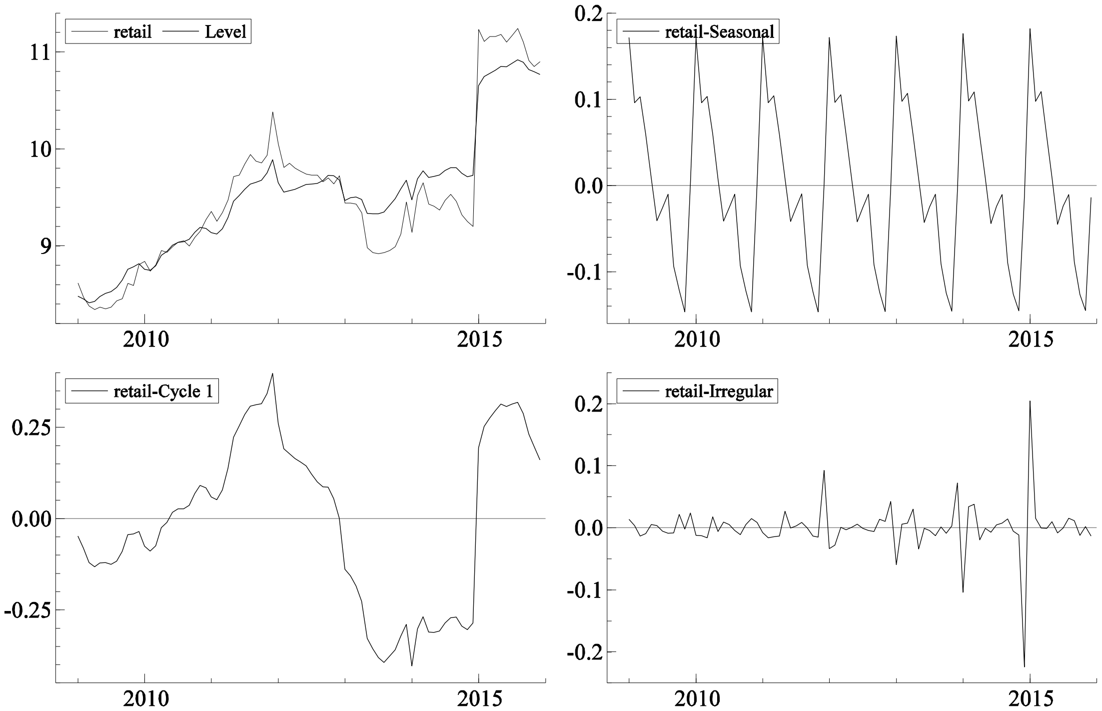


Variances of disturbances:	(q-ratio)
Level	(0.0000)
Slope	(0.009834)
Seasonal	(0.001833)
Cycle	(1.000)
Irregular	(0.0000)
Period	18.19115

The price forecast for the next two years showed a strong upward trend up with values close to € 17.

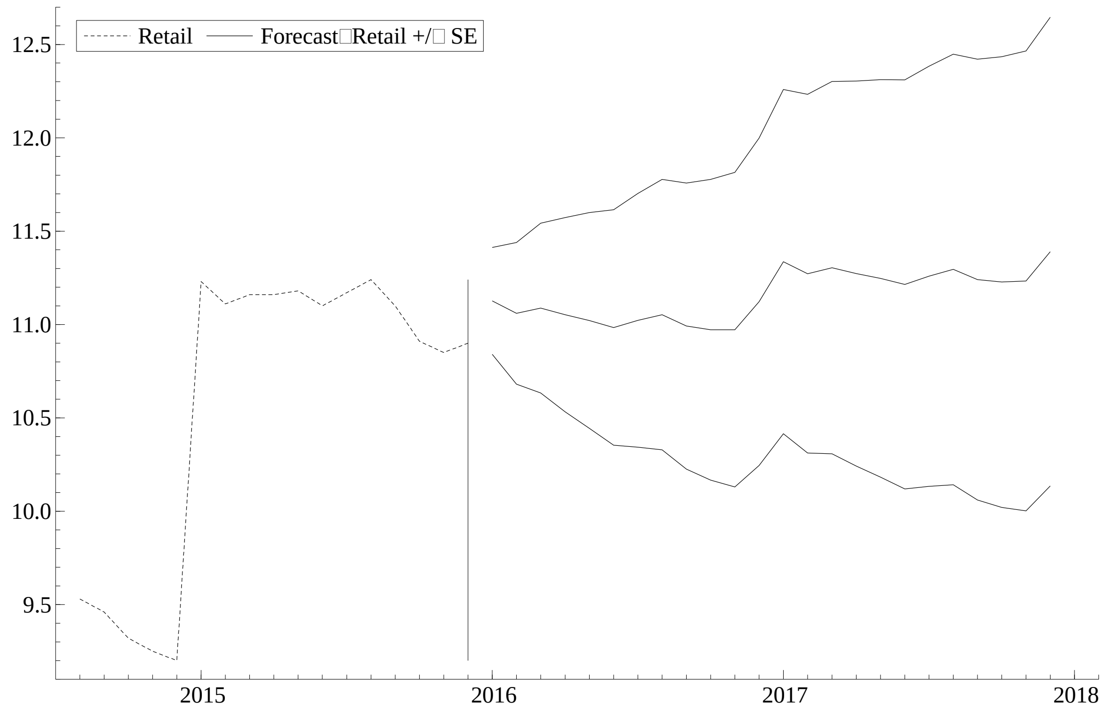


RETAIL: The price level has a significant price growth until the mid-2012 and then remained steady until 2015 when it started rising again. During the entire period the price level is influenced by strong stochasticity. The fluctuations in price range are from € 8.34 to € 11.24 and have considerable seasonal regularity with a range of 0.3 € which has the lowest prices in November and the highest prices in February. For this trend, the cycle component becomes significant being stochastic and lasts for about 74 months with price peaks in 2013 and 2015. The presence of irregular component implies that the model is able to explain the trend with good precision but is not excellent.



Variances of disturbances:	(q-ratio)
Level	(1.000)
Slope	(0.0000)
Seasonal	(7.928e-005)
Cycle	(0.4776)
Irregular	(0.2456)
Period	74.55070

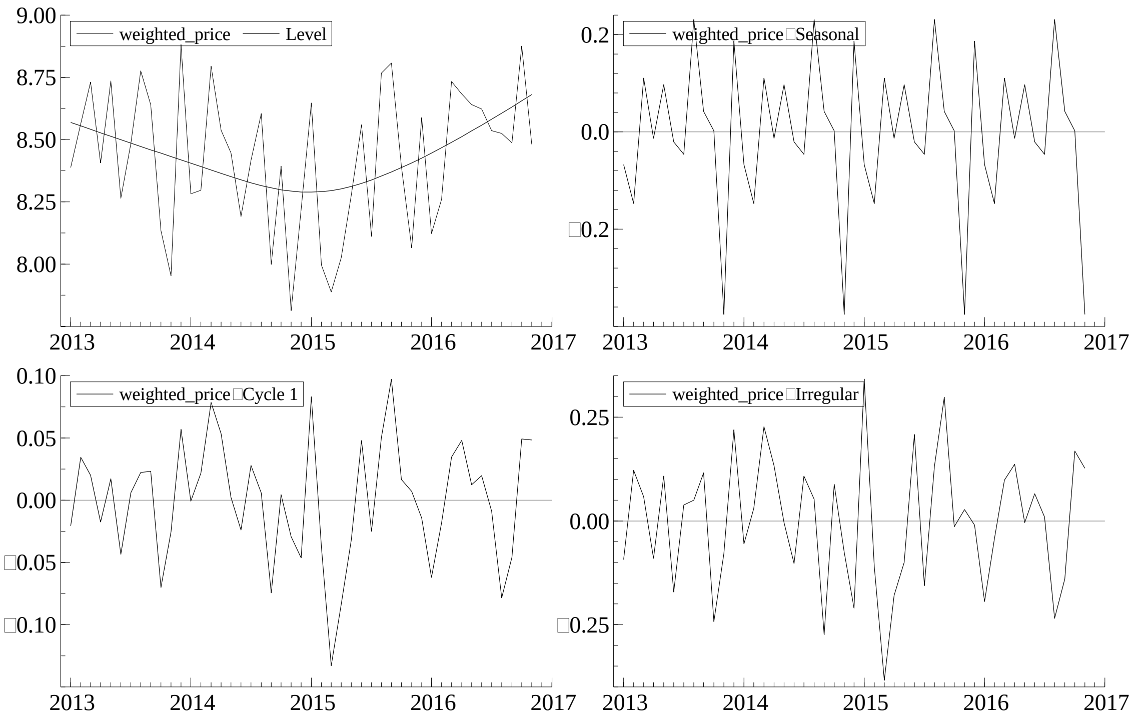
The price forecast for the next two years shows a stable trend between 11 and 11.50 €.



This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 635761

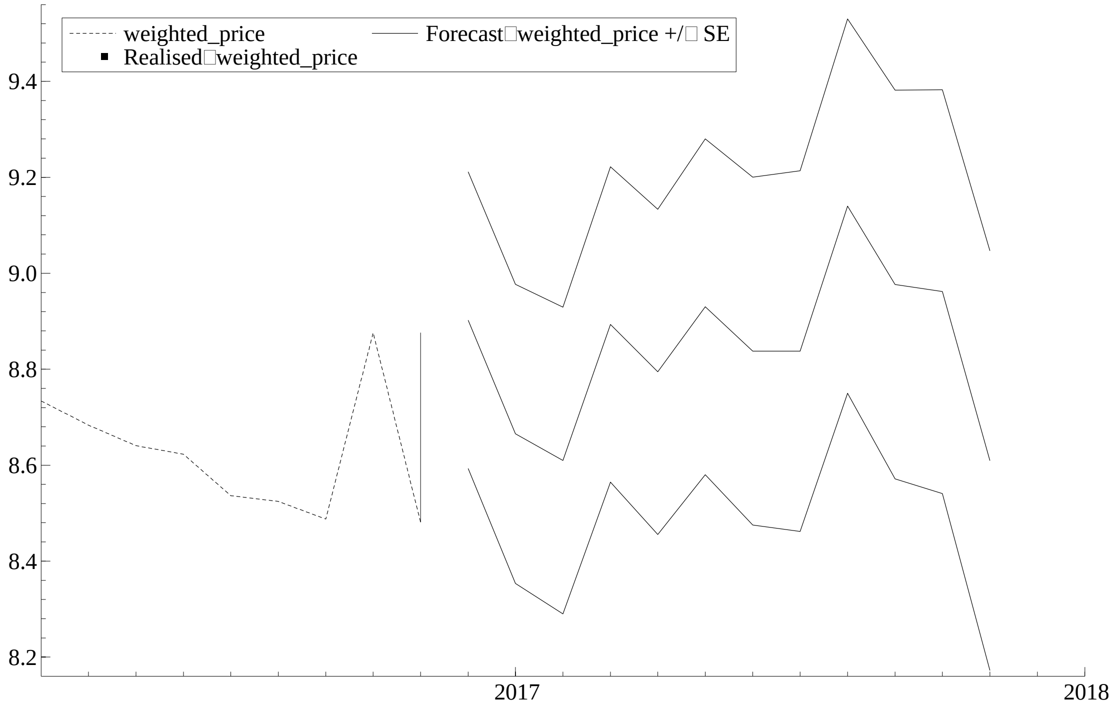
Retail Seabass - Spain

The market shows a slight decrease in prices until early 2015, and a steady recovery until 2017. During the whole period the price level does not present stochasticity. The price fluctuation range is from 8.38 € to 8.60 € and has a good seasonal regularity range of 0.5 €. It presents the lowest prices in November and the highest prices in August and December. This trend takes good account of the cycle component that is slightly stochastic in nature and has a duration of about 9.5 months with a significant price change in the first two months of 2015. The strong presence of an irregular component implies that the model is not able to accurately explain the trend.



	Value (q-ratio)
Level	0.000000 (0.0000)
Slope	4.32503e-005 (0.0009619)
Seasonal	0.000000 (0.0000)
Cycle	0.0128015 (0.2847)
Irregular	0.0449634 (1.000)
Period	9.56526
Period in years	0.79711

The price forecast for the next 12 months showed a fall in the last three months.



This project has received funding from
the European Union's Horizon 2020
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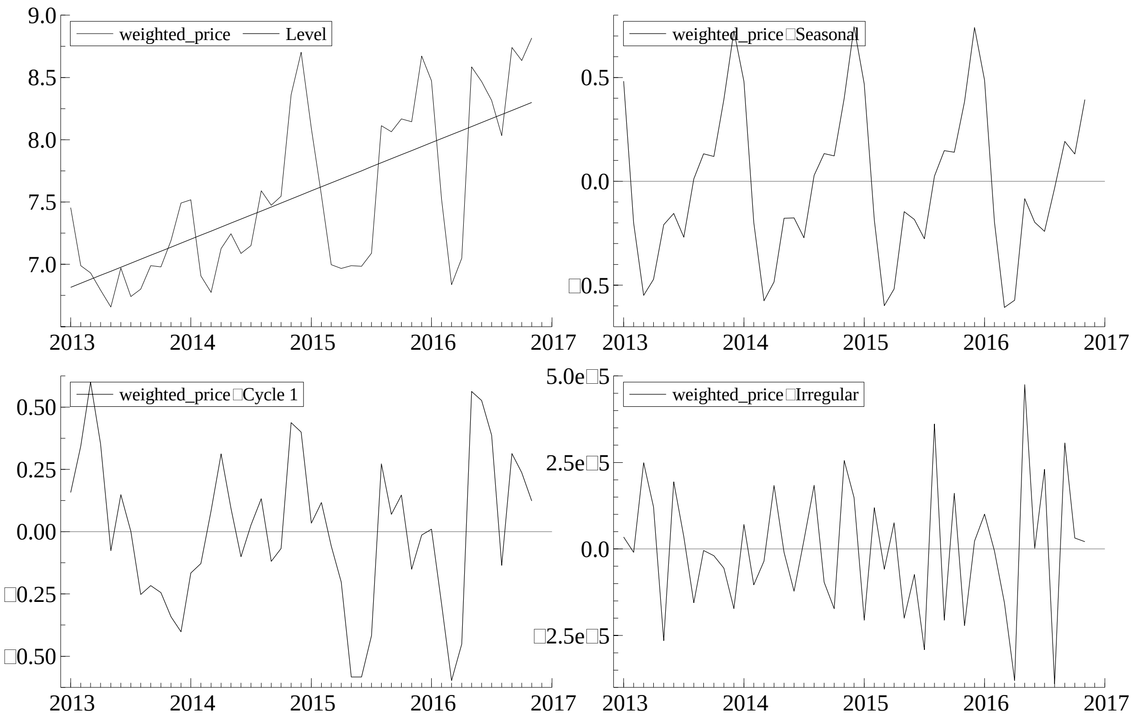
under grant agreement No 635761

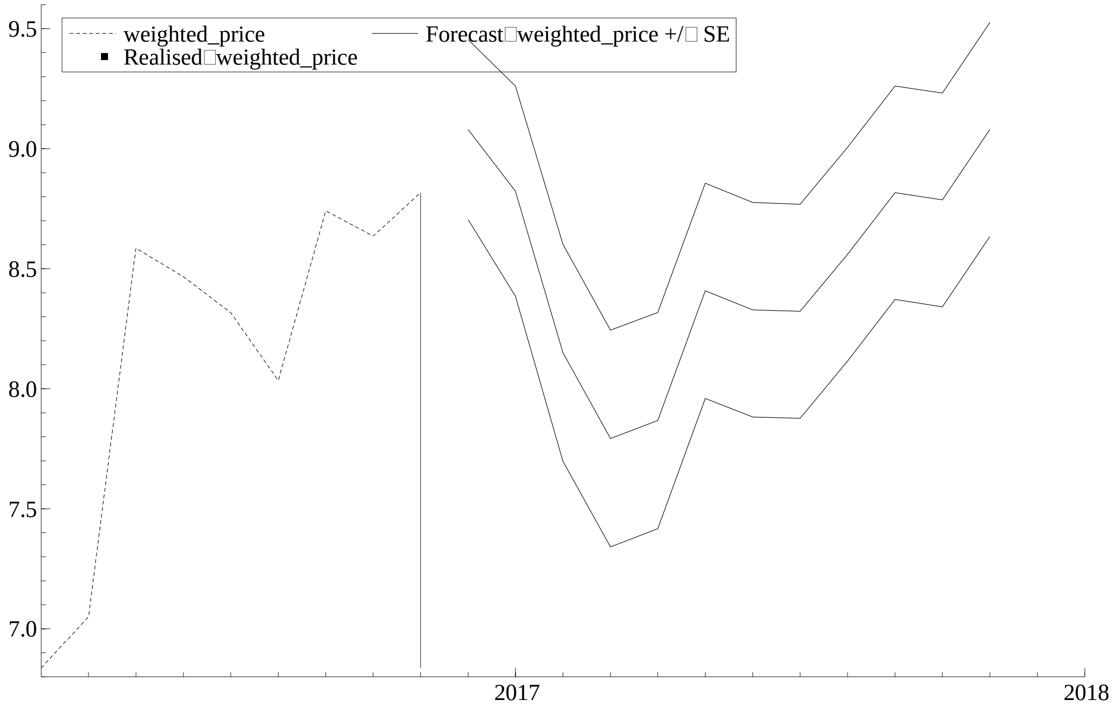
Retail Cod - Spain

The market has a clear trend of price growth also characterized by strong fluctuations. We have noticed price spikes at the end of 2014 and in early 2016, collapsing in the spring of 2015 and early spring of 2016. During the whole period the price level does not have a strong stochasticity. The price fluctuation range is from 6.5 € to 9.00 € and has a considerable seasonal regularity range of 1€ with lowest prices in February and the highest prices in December. In this trend the cycle component is accounted for being stochastic and lasts about 10 months. The absence of the irregular component implies that the model is able to explain the trend with very good precision.



Value (q-ratio)
Level 0.000000 (0.0000)
Slope 0.000000 (0.0000)
Seasonal 9.24653e-005 (0.001229)
Cycle 0.0752102 (1.000)
Irregular 5.95824e-006 (7.922e-005)
Cycle other parameters:
Variance 0.13099
Period 10.45586
Period in years 0.87132

The price forecast for the next 11 months showed a fall in February and March and then grows rapidly until the end of year.

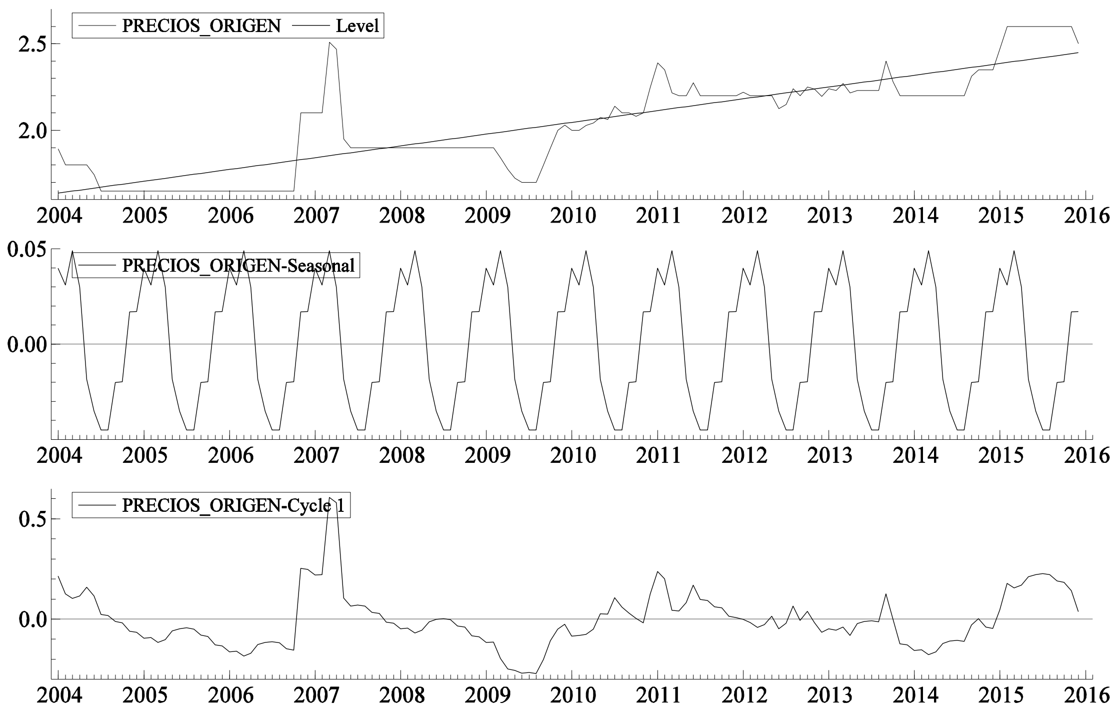


Trout prices at three stages of supply chain - SPAIN

Data used is the historical series of average monthly trout prices at the landing (aquaculture and fishing), wholesale and retail phases 2004-2015 on the Spanish market (Source SECRETARÍA DE ESTADO DE TURISMO Y COMERCIO). Data is structured satisfactorily for the wholesale and retail markets, while for the harvest prices there is sometimes no variation over more than two years, and the historical series appear to have been reconstructed.

HARVESTING: Although the analysis may not be completely reliable because of the reconstructed nature of the data, it shows a steady rise in prices over the entire ten-year period, which is not affected by stochastic elements. Prices fluctuate between €1.65 and €2.60 and show regular seasonal variations of up to €1, with prices lowest in August and highest in February. The cyclical component of 47 months is stochastic and has very clear price peaks in 2007 and 2015.

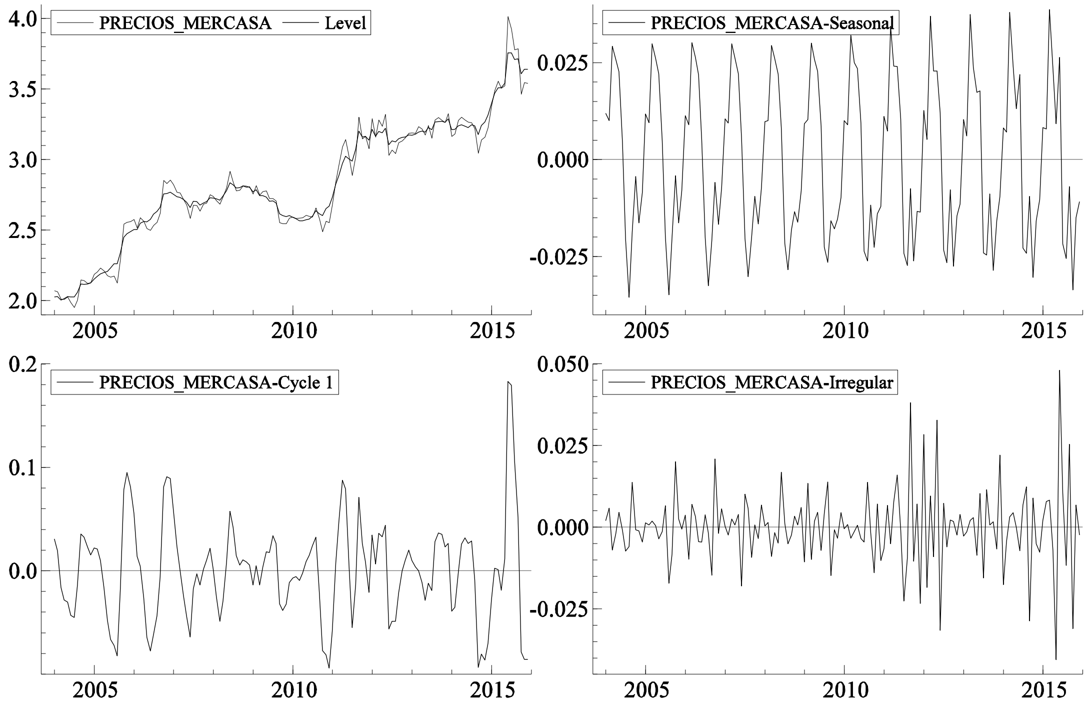
Given the unreliable nature of the data, it is not useful to base forecasts on this model.



Variances of disturbances:	(q-ratio)
Level	(0.0000)
Slope	(0.0000)
Seasonal	(0.0000)
Cycle	(1.000)
Irregular	(0.0000)
Period	47.07263

The items Slope, Seasonal, Cycle and Irregular yield results in the interval [0,1]. The unit of the item Period is one month.

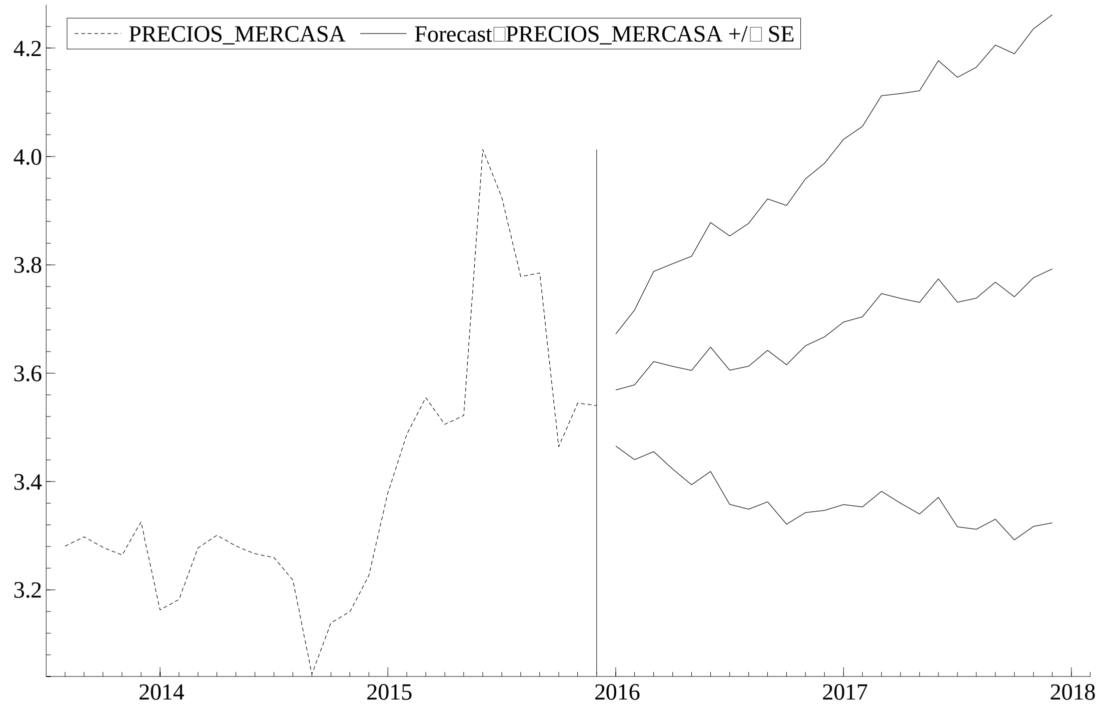
WHOLESALE: The wholesale market shows prices rising until mid-2008, then falling in 2010, followed by a steady growth up to 2015. Over the whole ten-year period, prices show high stochasticity. Prices fluctuate between €1.55 and €4.00, and show seasonal regularity with variations of up to €0.5, with prices lowest in August and highest in February. The cyclical component of about 13 months is stochastic and has very clear price peaks in 2007-2008 and 2015. The presence of irregularity implies that the model can account for trends with satisfactory but not optimum precision.



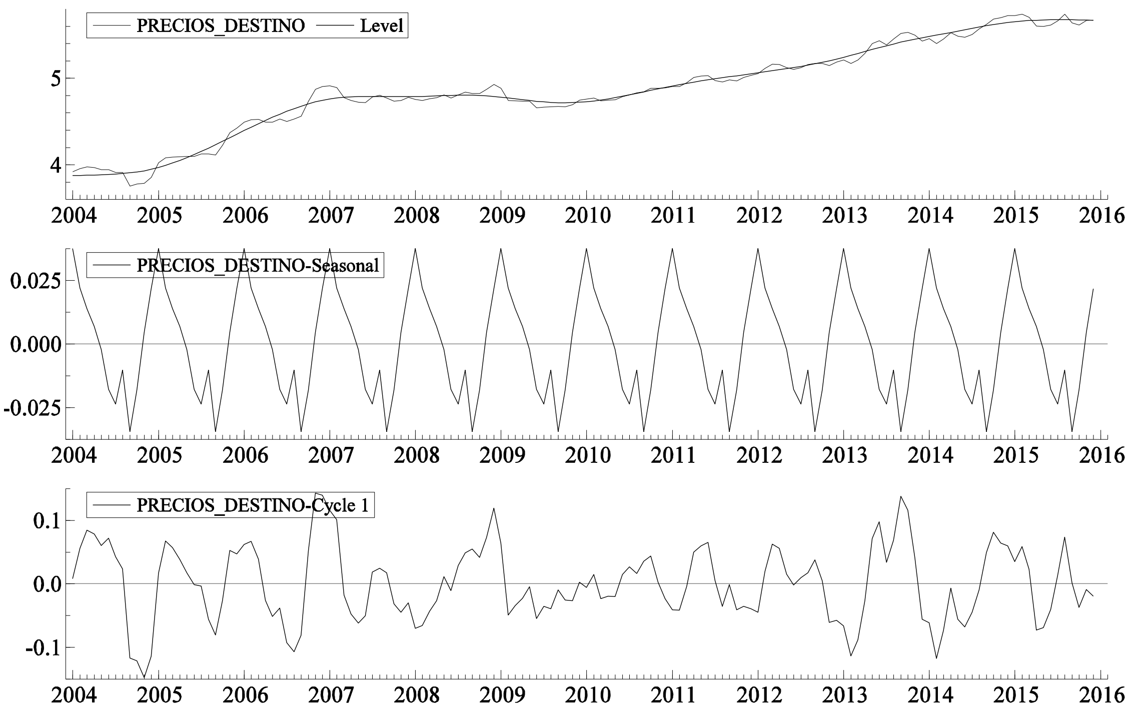
Variances of disturbances:	(q-ratio)
Level	(1.000)
Slope	(0.0000)
Seasonal	(0.0002916)
Cycle	(0.5364)
Irregular	(0.2252)
Period	12.83038

The items Slope, Seasonal, Cycle and Irregular yield results in the interval [0,1]. The unit of the item Period is one month.

Forecasts for the next two years are for rising prices, limited by the fairly wide confidence interval given by the component of irregularity.



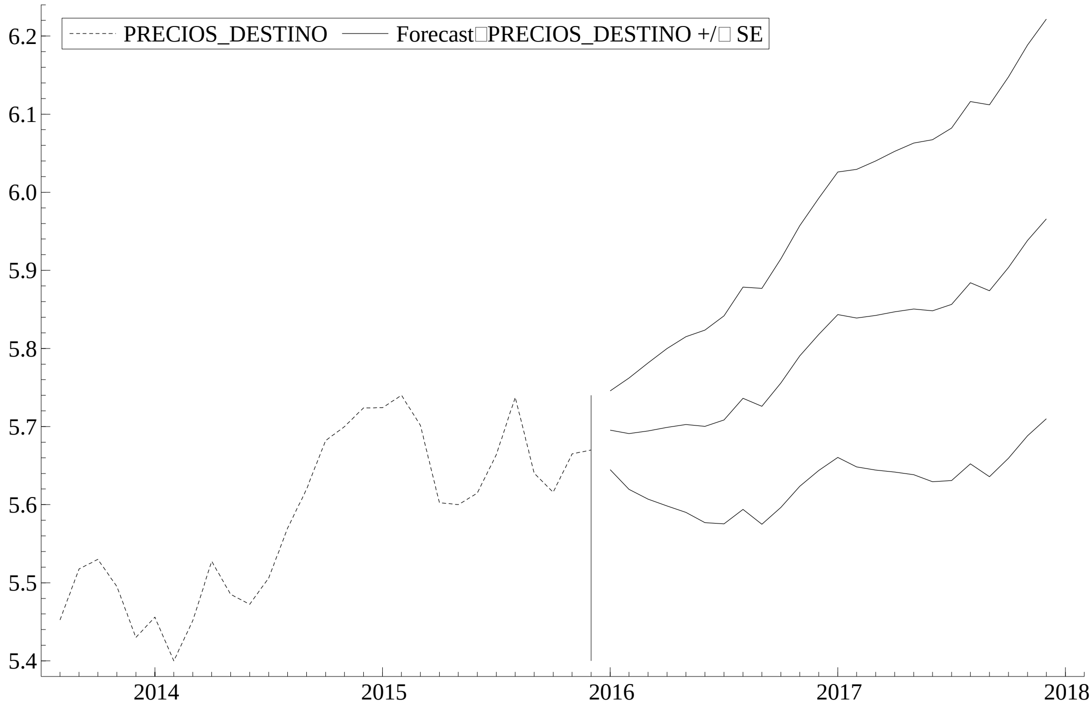
RETAIL: Retail market prices rose up to mid-2008, fell slightly in 2010 and grew steadily up to 2015. Over the entire ten-year period, the price level was deterministic. Prices fluctuated between €3.75 and €5.74 and showed seasonal regularity with maximum variation of €0.6, with prices lowest in August and highest in December and January. The cyclical component of about 12.5 months is stochastic and is very clear in the price peaks in 2007-2008 and 2015. There is no component of irregularity in this model, which is thus well fitted to the trend.



Variances of disturbances:	(q-ratio)
Level	(0.0000)
Slope	(0.02761)
Seasonal	(0.0000)
Cycle	(1.000)
Irregular	(0.0000)
Period	12.49322

The items Slope, Seasonal, Cycle and Irregular yield results in the interval [0,1]. The unit of the item Period is one month.

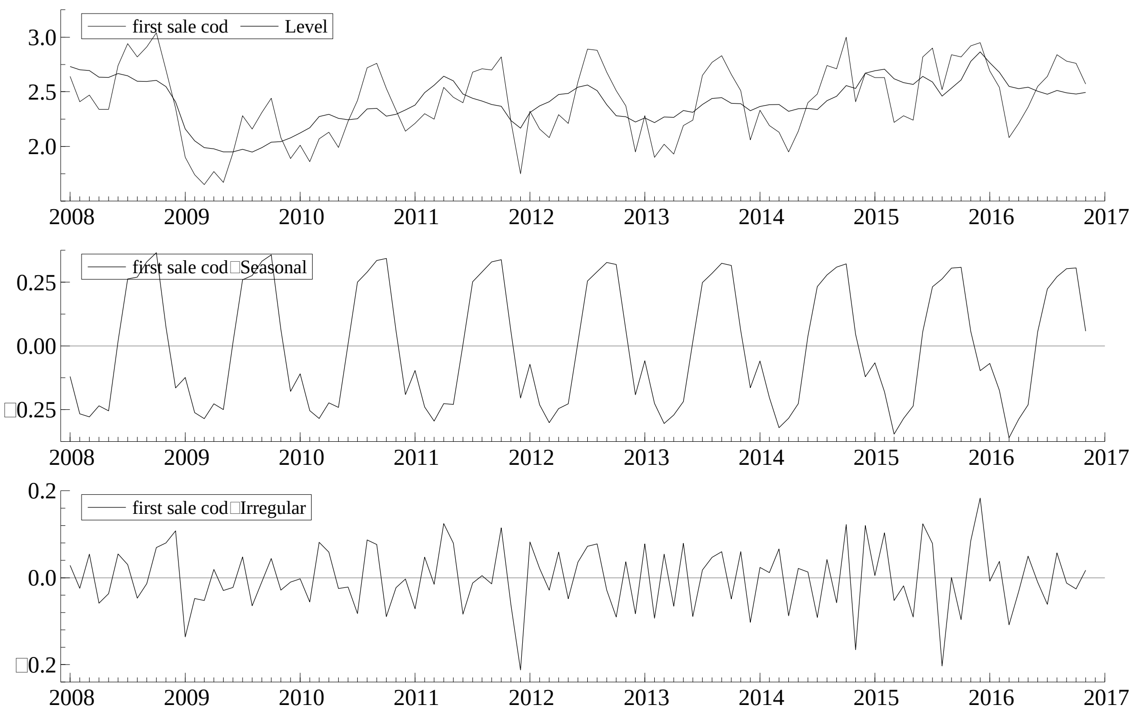
Forecasts for the next two years are for steadily rising prices, limited by the confidence interval, which, however, as there is no irregularity, is narrower than for wholesale prices.



United Kingdom

UK cod first sale

The market has a steady level of prices. During the whole period the price level is affected by stochasticity. The price fluctuation varies from 2 € to 2.75 € and has a good seasonal regularity with a range of 0.25 € and the lowest price in December and throughout the first quarter of a year and the highest price from mid-year in October. These strong irregularities do not allow the model to explain completely the phenomenon. The cycle of the data do not converge and cannot be calculated.



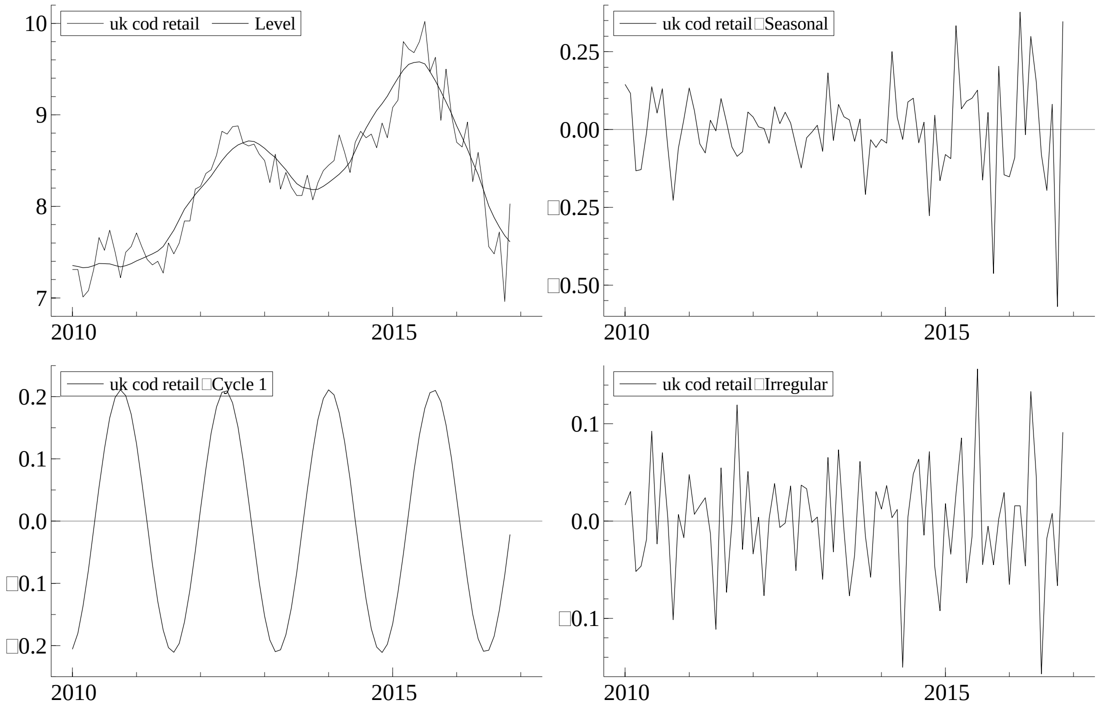
Level	0.0120098 (1.000)
Slope	0.000000 (0.0000)
Seasonal	2.04116e-005 (0.001700)
Irregular	0.0120087 (0.9999)

The price forecast for the next 12 months shows a downward trend until late February, a peak to the end of September and a decrease again.

This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 635761

UK cod retail

The market shows a steady increase until mid-2012 and then decreased in the following year and grew again until 2015. This year presents sharp contractions until they reach the levels of 2010. During the entire period the price level is suffering from a slight stochasticity. The price fluctuation ranges from 7 € to 10 € and does not present a good seasonal regularity. The marked irregularities do not allow the model to explain the phenomenon completely. The cycle is very regular and has a range about of 20 months.



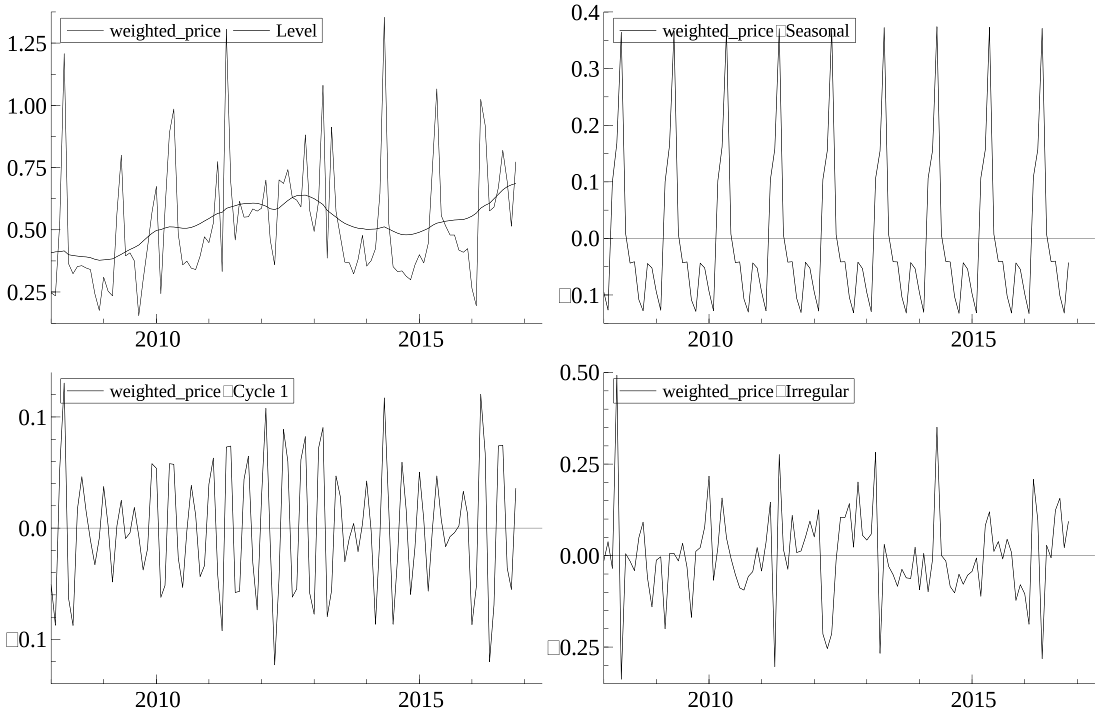
Level	0.00180910 (0.1752)
Slope	0.00125137 (0.1212)
Seasonal	0.000203698 (0.01972)
Cycle	5.16005e-008 (4.996e-006)
Irregular	0.0103280 (1.000)
Period	19.53217 months

The price forecast for the next 12 months showed a downward trend until the end of September and a growth in the following months.

This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 635761

FIRST SALE PRICE HERRING - UK

The market shows a slight increase in prices until 2013, followed by a slight decrease and then a steady recovery until 2017. During the whole period the price level is almost without stochasticity. The price fluctuation range is from € 0.2 to € 1.3, and has a good seasonal regularity range of 0.4 € with the lowest prices early in the year and in the autumn and the highest prices in the spring. This trend has a good link to the cycle component that is stochastic in nature and lasts for about 4 months with relevant price changes in 2012, 2014 and 2016. The strong presence of an irregular component implies that the model is able to accurately explain the trend but not fully satisfactorily.

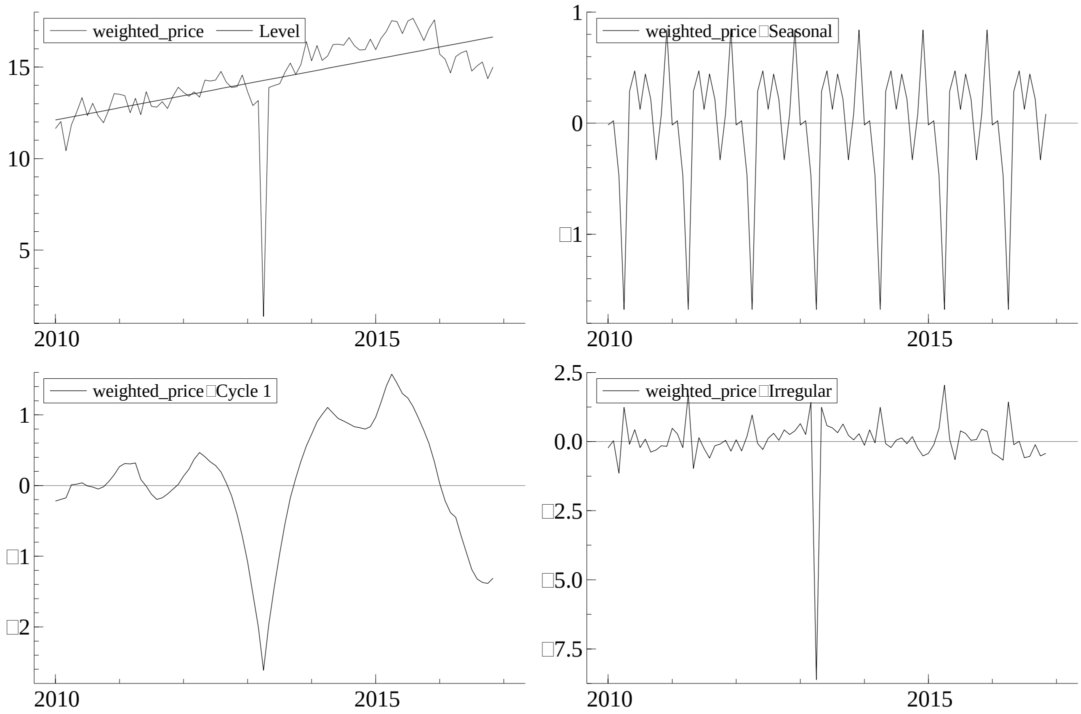


	Value	(q-ratio)
Level	0.000938053	(0.03819)
Slope	0.000000	(0.0000)
Seasonal	1.90733e-006	(7.765e-005)
Cycle	0.00210678	(0.08577)
Irregular	0.0245643	(1.000)
Period	4.13542	
Period in years	0.34462	

The price forecast for the next 12 months showed a price peak in April and a subsequent collapse.

RETAIL SALMON UK

The market shows a small but steady increase in prices with a slump in 2013 (perhaps due to a not reliable data, definitely outlier). During the whole period the price level is almost without stochasticity. The price fluctuation range from 10 € to 18 € and has a good smooth seasonality with a range of 2.8 € with the lowest prices in March / April and the highest prices in November / December. This trend takes good relief the nature of the cycle component is a little bit stochastic and lasts about 46 months with more significant price changes in 2013, 2014.2015 and 2016. The strong presence of irregular component implies that the model is not able to explain the exact course.



	Value (q-ratio)
Level	0.000000 (0.0000)
Slope	0.000000 (0.0000)
Seasonal	0.000000 (0.0000)
Cycle	0.227084 (0.1278)
Irregular	1.77747 (1.000)
Period	45.72842
Period in years	3.81070

The price forecast for the next 12 months showed a negative peak price in April, a recovery until August and the following collapse.

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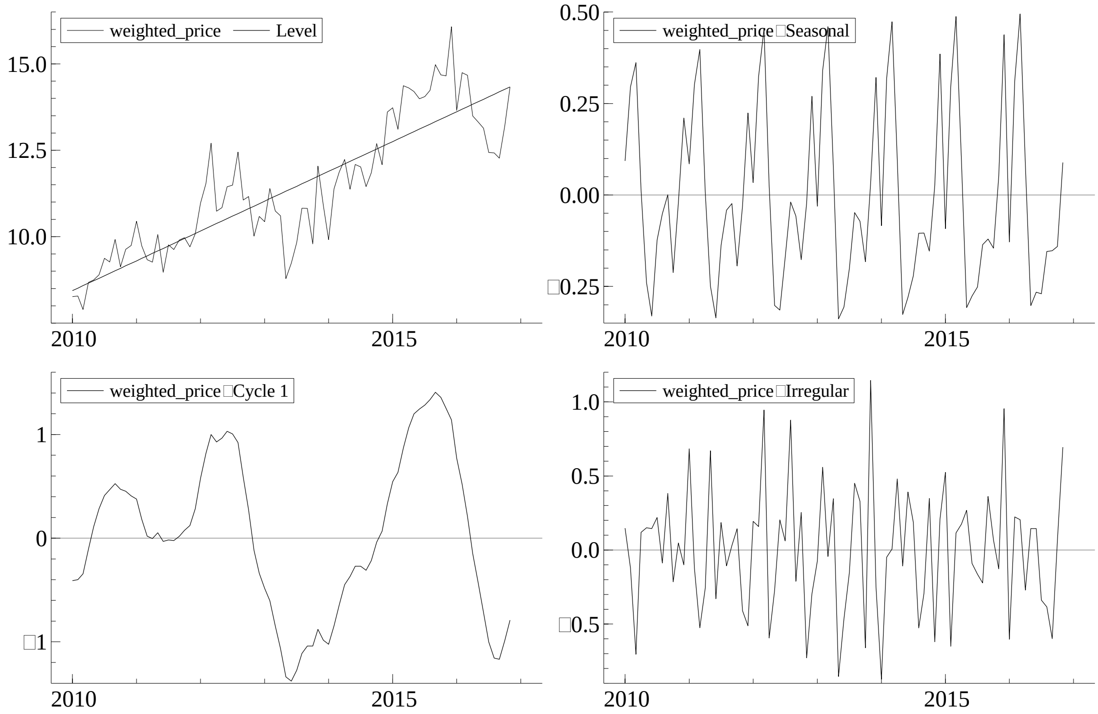
under grant agreement No 635761

TROUT RETAIL - UK

The market presents a constant increase in prices with a peak in 2012 and 2015 and collapses in 2013 and 2016. During the entire period the price level is almost without stochasticity. The price fluctuation range goes from 8 € to 16 € and has a good smooth seasonality with a range of 0.8 € you have the lowest prices in May and the highest prices in February and December. This trend assumes great importance is the loop component that is slightly stochastic nature and has a duration of about 38 months with price changes more pronounced in 2013, 2014, 2015 and 2016. The strong presence of irregular component implies that the model is able to explain the exact course not too satisfactory.



	Value (q-ratio)
Level	0.000000 (0.0000)
Slope	0.000000 (0.0000)
Seasonal	0.000221577 (0.0007345)
Cycle	0.0667920 (0.2214)
Irregular	0.301690 (1.000)
Period	37.67641
Period in years	3.13970

The price forecast for the next 12 months showed a negative peak price in January and a recovery until the end of the year.

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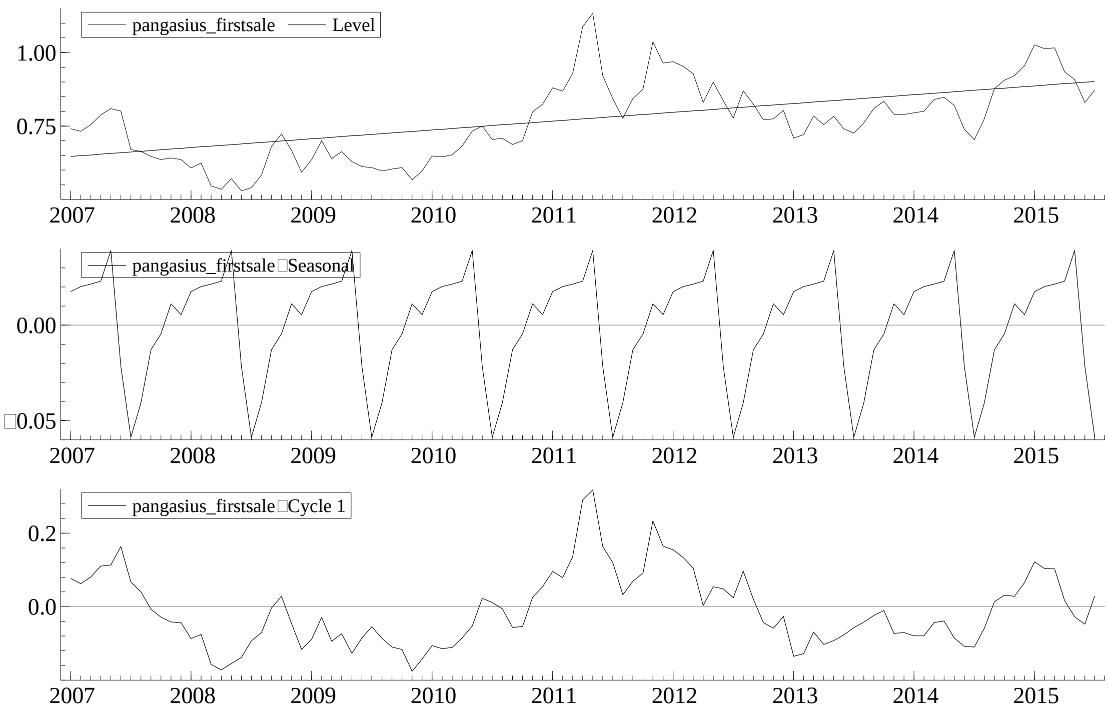
the European Union's Horizon 2020
research and innovation program
under grant agreement No 635761

Vietnam

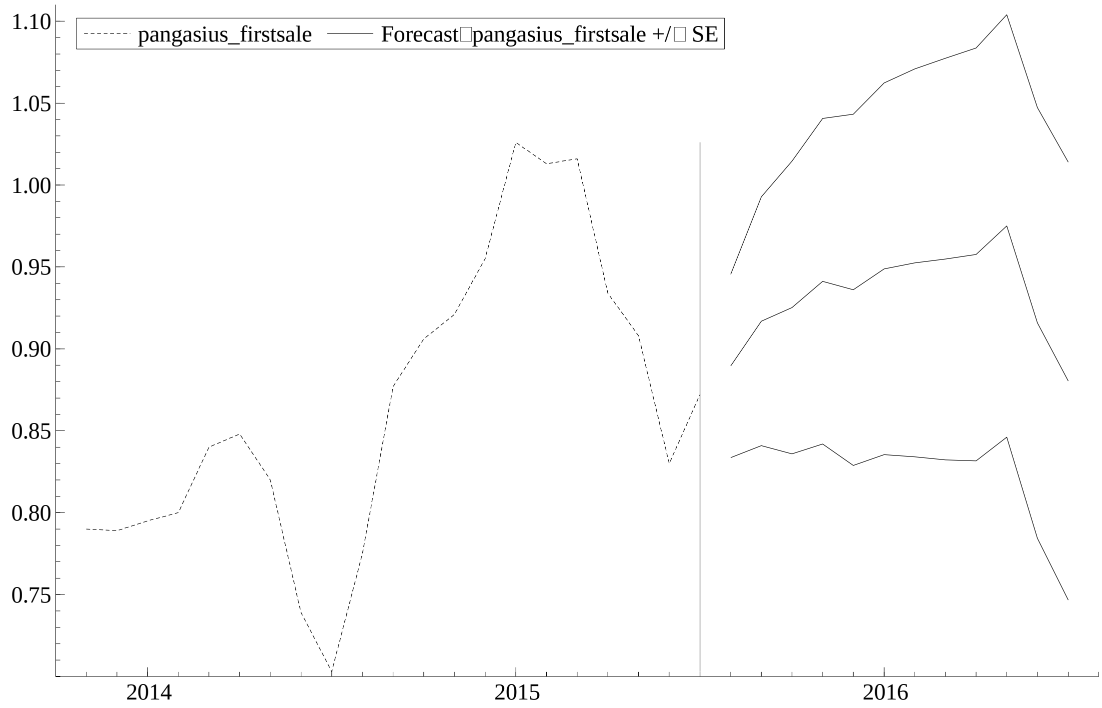
Pangasius

The market presents a level of deterministic prices with slightly rising trend with some strong price changes. The price fluctuation range varies from € 0.6 to € 1.1, and has a regularity of seasonality with a range of 0.1 €. The seasonality chart shows the highest price in the spring and the minimum in late-June. The cycle is of stochastic nature and the presence of irregular component leads to an estimate not reasonable.



Level	0.000000 (0.0000)
Slope	0.000000 (0.0000)
Seasonal	0.000000 (0.0000)
Cycle	0.00272138 (1.000)
Irregular	0.000000 (0.0000)
Period	10000.00000

The price forecast of 12 months showed an upward trend until April 2016 and then decreases rapidly until the end of the period.



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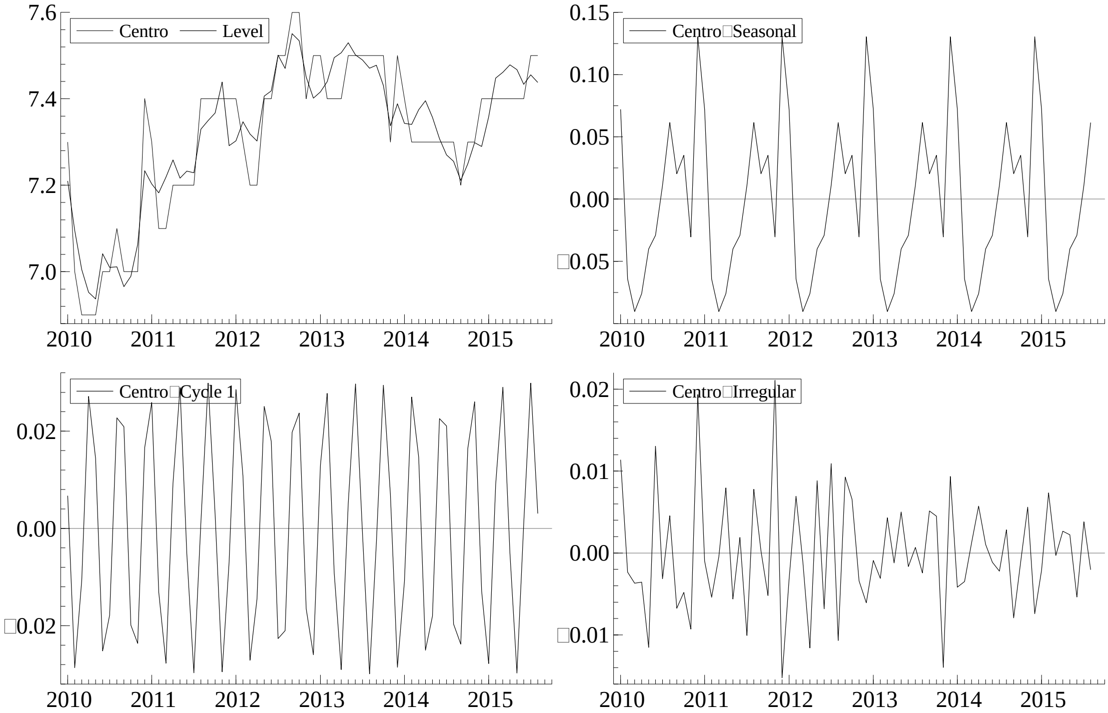
Italy

Analysis of first sale of sea bass

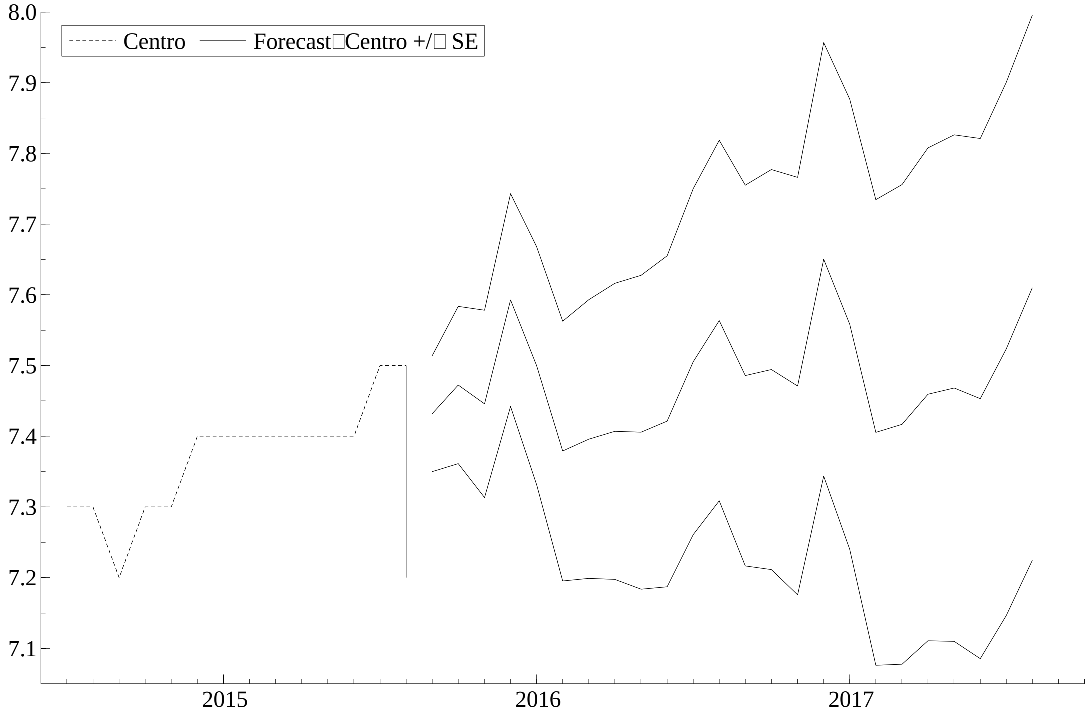
Available data (sourse: ISMEA) are the historical series of the average monthly prices of seabass (from aquaculture) in four geographical Italian areas (Central, Northern east, Northern west and Southern) between years 2010-2015 (EURO/KG, VAT included, farm gate value).

Central Italy: Deterministic seasonality has a small effect on prices. The cycle is stochastic and short (about 4 months)



Variances of disturbances:	(q-ratio)
Level	(1.000)
Slope	(0.000)
Seasonal	(0.000)
Cycle	(2.343e-007)
Irregular	(0.09636)
Period	4.18235

Level, Slope, Seasonal, Cycle e Irregular have values between 0 and 1. The item "Period" refers to months.


Centro
Forecast Centro +/- SE
8.0
7.9
7.8
7.7
7.6
7.5
7.4
7.3
7.2
7.1
2015
2016
2017

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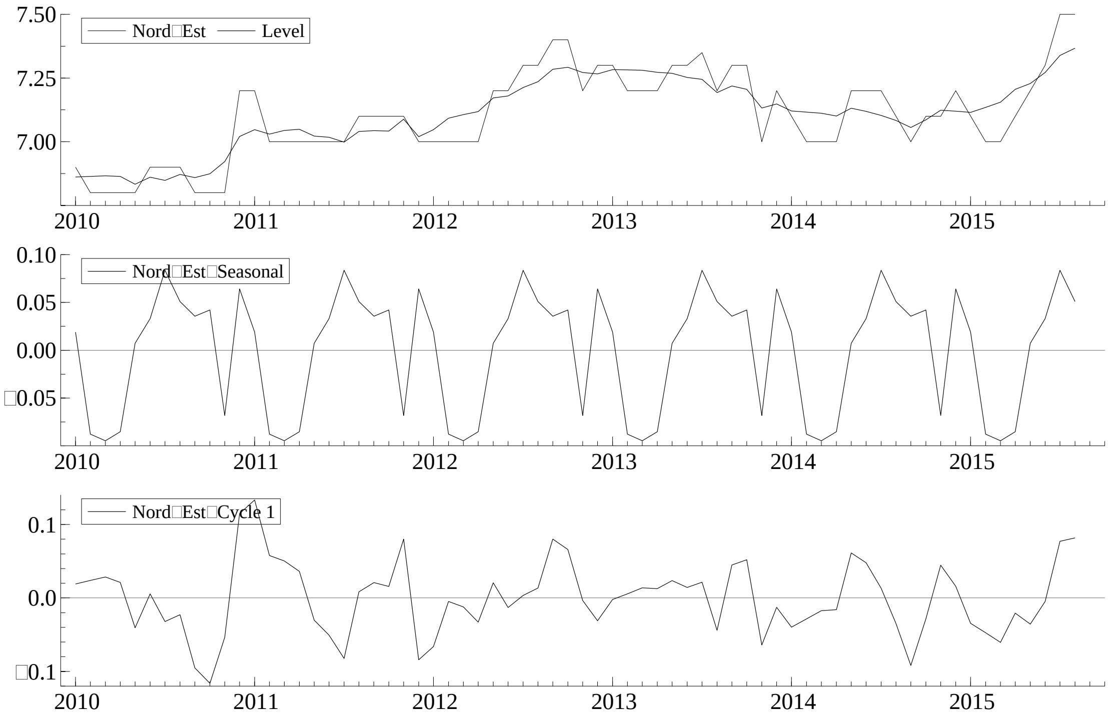
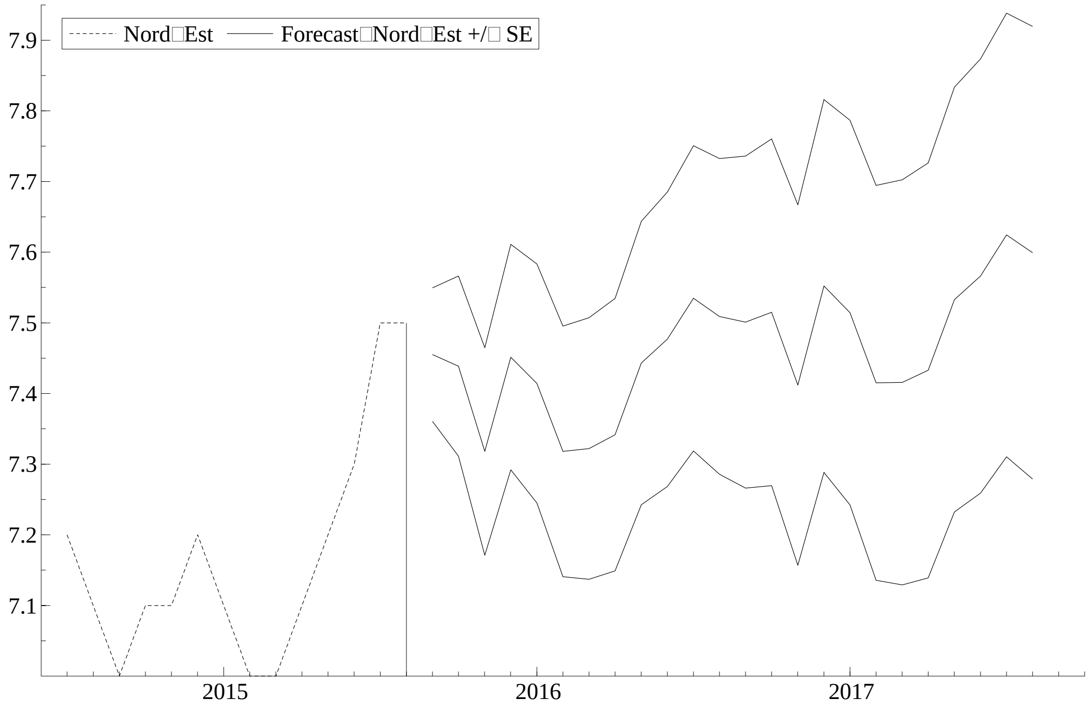
Northern-east Italy: Deterministic seasonality has a small effect on prices. The cycle is stochastic and lasts 11 months.



Variances of disturbances:	(q-ratio)
Level	(0.8559)
Slope	(0.000)
Seasonal	(0.000)
Cycle	(1.000)
Irregular	(0.000)
Period	11.21302

Level, Slope, Seasonal, Cycle e Irregular have values between 0 and 1. The item "Period" refers to months.


Nord Est
Forecast Nord Est +/- SE
7.9
7.8
7.7
7.6
7.5
7.4
7.3
7.2
7.1
2015
2016
2017

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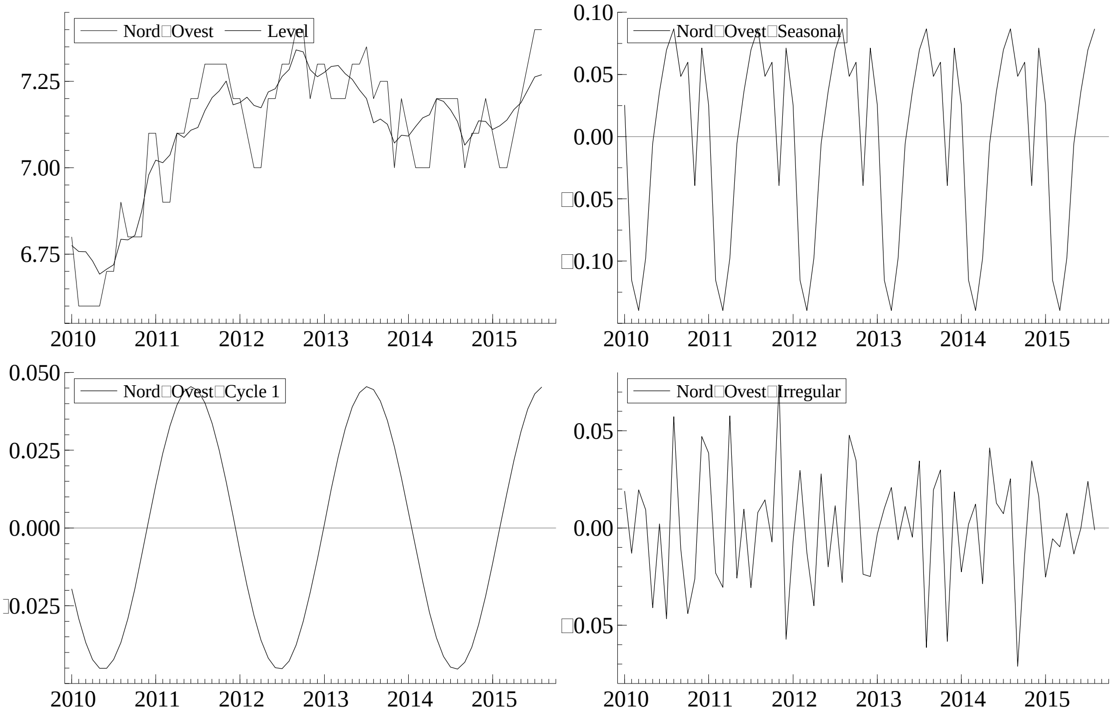
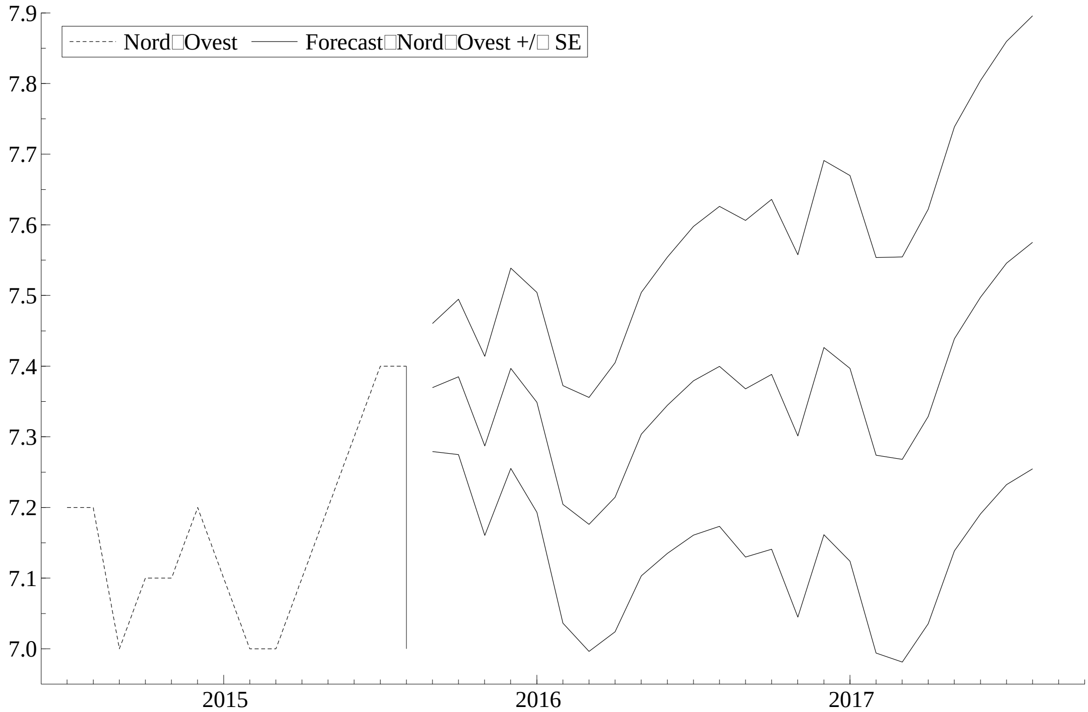
Northern-west Italy: Deterministic seasonality has a small effect on prices. The cycle is stochastic and lasts 25 months. The cycle also presents irregularities but of lower range.

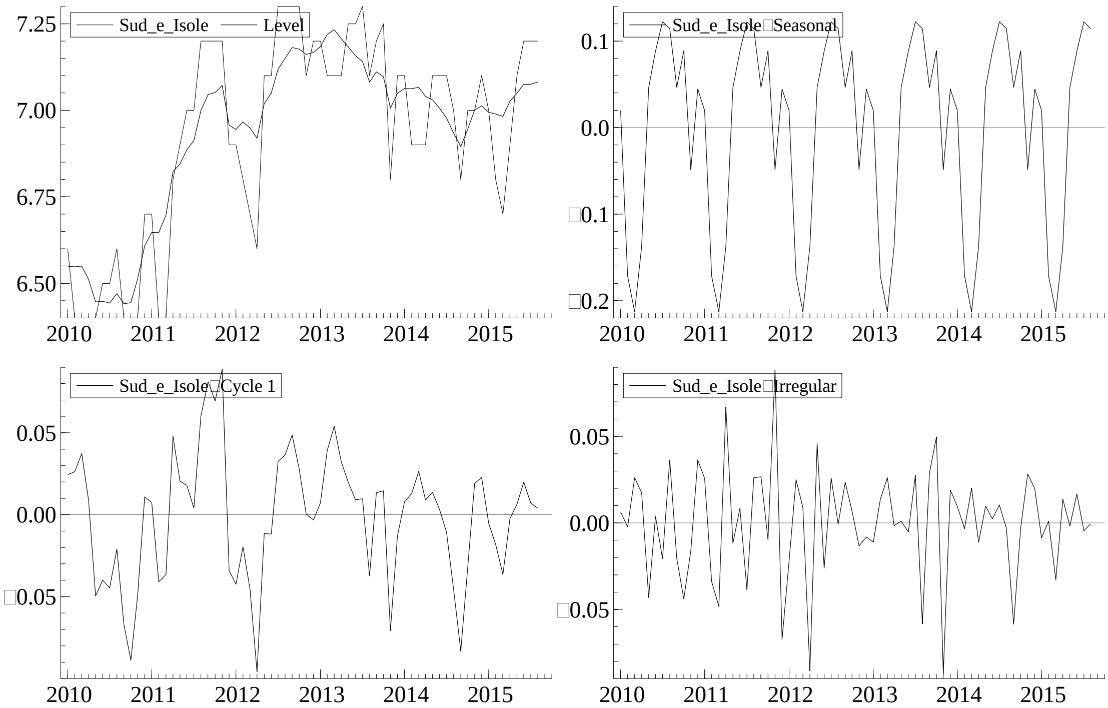


Variances of disturbances:	(q-ratio)
Level	(1.000)
Slope	(0.000)
Seasonal	(0.000)
Cycle	(2.582e-008)
Irregular	(0.7600)
Period	25.11509

Level, Slope, Seasonal, Cycle e Irregular have values between 0 and 1. The item "Period" refers to months.

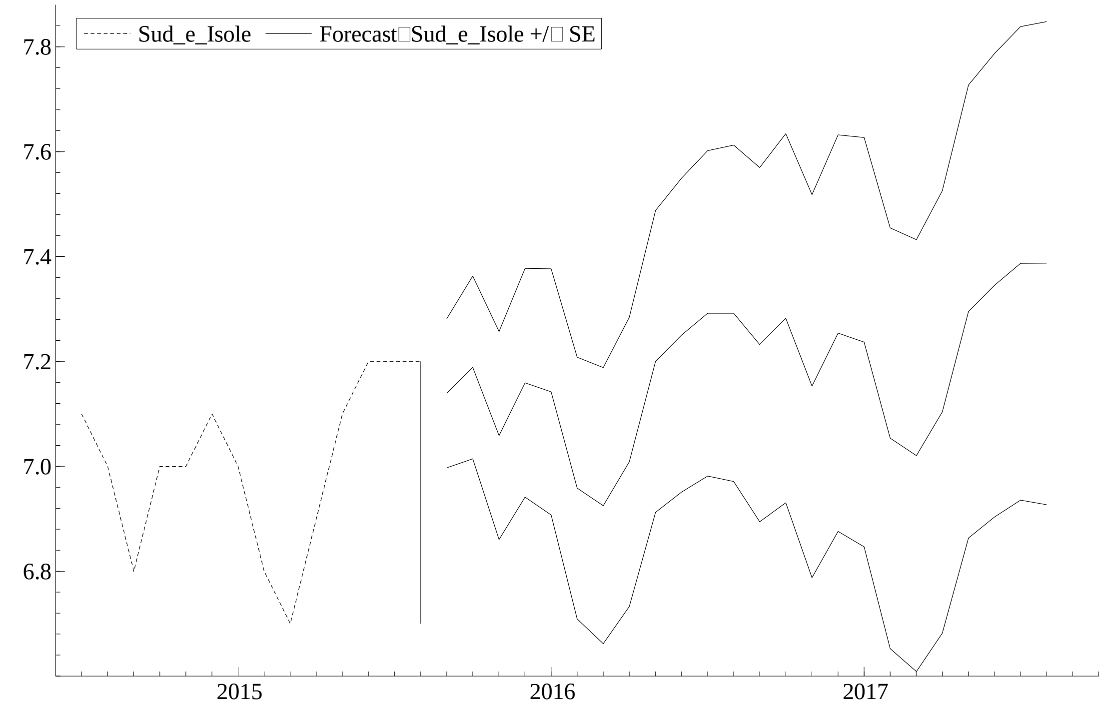

7.9
7.8
7.7
7.6
7.5
7.4
7.3
7.2
7.1
7.0
Nord Ovest
Forecast Nord Ovest +/ SE
2015
2016
2017

Southern Italy (odd data): Deterministic seasonality has a small effect on prices. The cycle is strongly stochastic and it does not allow to define the range. The cycle also presents irregularities and in some parts strong.



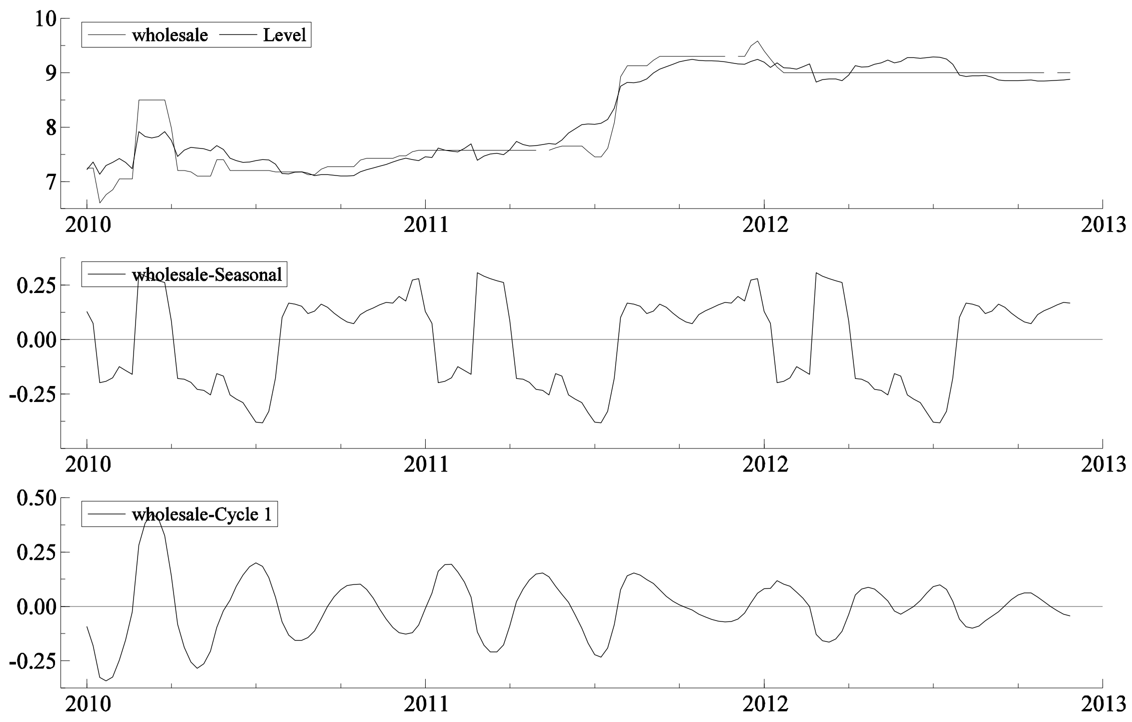
Variances of disturbances:	(q-ratio)
Level	(1.000)
Slope	(0.000)
Seasonal	(0.000)
Cycle	(0.7599)
Irregular	(0.6529)
Period	Indefinite

Level, Slope, Seasonal, Cycle e Irregular have values between 0 and 1. The item "Period" refers to months.


Sud_e_Isole
Forecast Sud_e_Isole +/- SE
7.8
7.6
7.4
7.2
7.0
6.8
2015
2016
2017

Weekly price Italian seabass – wholesale

The price level has strong stochasticity in the whole revealed period. Seasonality is deterministic and has a peak at the beginning of the year and the minimum in the middle of the year with a range of about 0.8 €. The nature of the cycle component is slightly stochastic without irregularities. The cycle lasts approximately 15 months.



Level	0.0213438 (1.000)
Slope	0.000000 (0.0000)
Seasonal	0.000000 (0.0000)
Cycle	0.00415036 (0.1945)
Irregular	0.000000 (0.0000)
Period	15.27178

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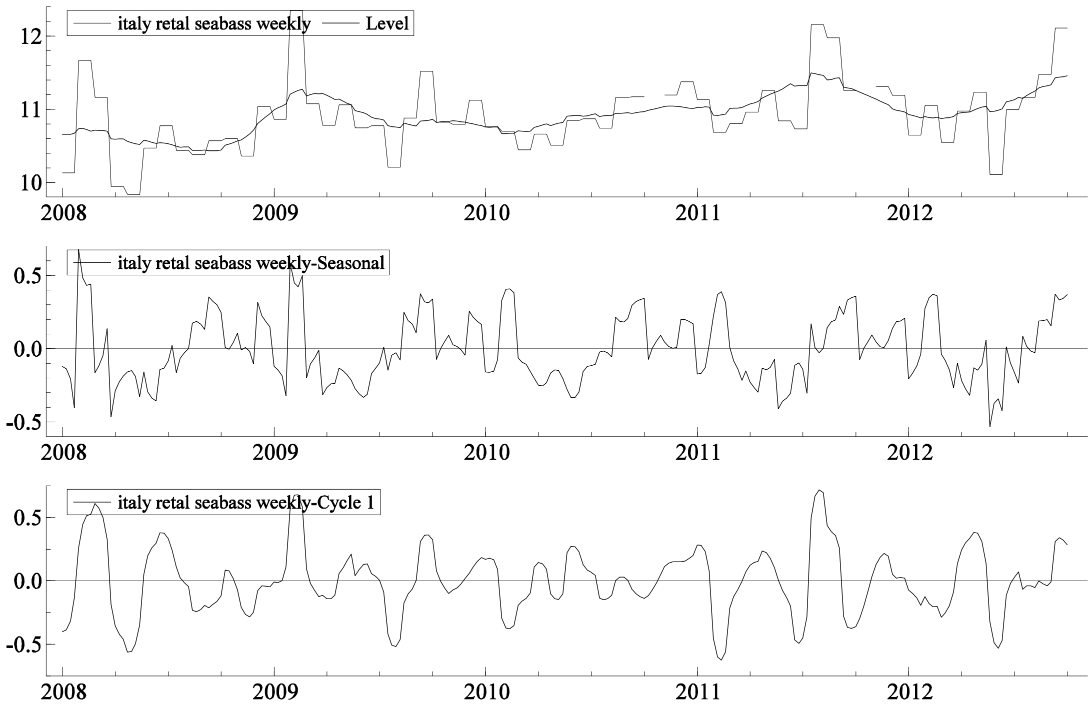
Weekly Retail price analysis - seabass

The price level has small variability in the referred period with a moderate stochastic component. The price trend of seasonality is deterministic with a range of about € 1.2. The nature of the cycle component is stochastic and implies that the model is not able to explain the trend accurately.



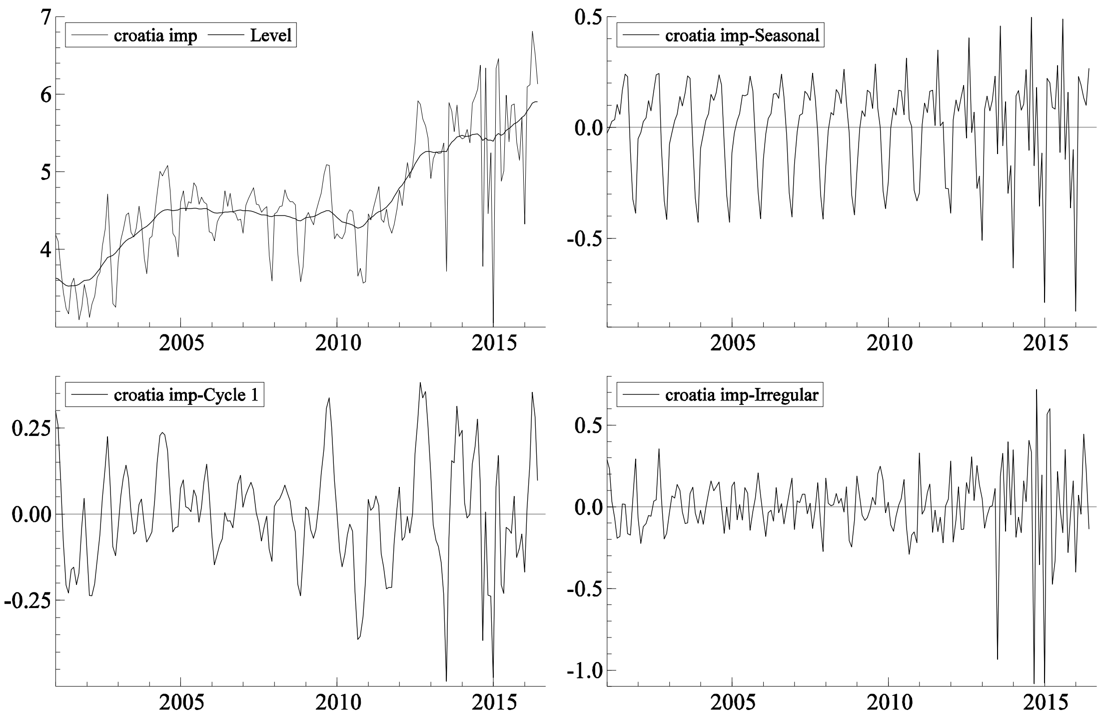
Level	0.00850567 (0.3647)
Slope	0.000000 (0.0000)
Seasonal	9.88238e-006 (0.0004237)
Cycle	0.0233218 (1.000)
Irregular	0.000000 (0.0000)
Period in years	0.32956

This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 635761

Analysis of import/export price series of seabass in Italy

Wholesale import Croatia

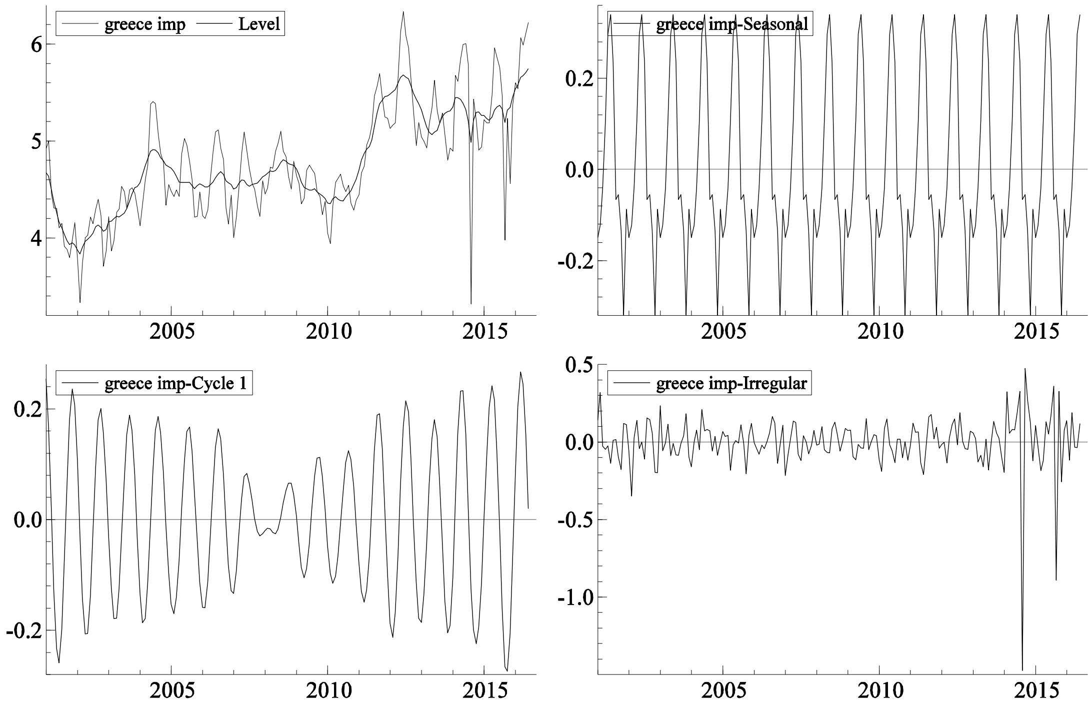
The price level is constant from 2005 to 2010 with a period of growth until 2005 and after 2010. During the whole period the price level is influenced by stochasticity. The price trend shows moderate stochasticity of seasonality with a range of 0.6 € until 2012 and increase to € 1.4 after 2012. The component of this cycle is stochastic and it is influenced by a strong stochastic irregularities which does not allow to determine the range of the cycle. The presence of irregular component indicates that the model is not able to explain accurately the trend, especially after 2013.



Level	0.00732168 (0.07726)
Slope	0.000000 (0.0000)
Seasonal	0.000121190 (0.001279)
Cycle	0.0478968 (0.5054)
Irregular	0.0947647 (1.000)
Period in years	833.33333

Greece Import

The price level has seen a fall in the first year, followed by a raise until 2008, then there is a small decrease and a spread on a new prices level from 2012 onwards. During the whole period the price level is influenced by a small stochasticity. The price trend has no stochastic seasonality with a range of 0.6€ with peaks in the middle of the year and falls in November. The nature of the cycle component has a small stochasticity and is influenced by irregularities in 2014 and 2015. The cycle last approximately 11 months.



Level	0.0145845 (0.3038)
Slope	0.000000 (0.0000)
Seasonal	0.000000 (0.0000)
Cycle	0.00104000 (0.02166)
Period in years	0.93474

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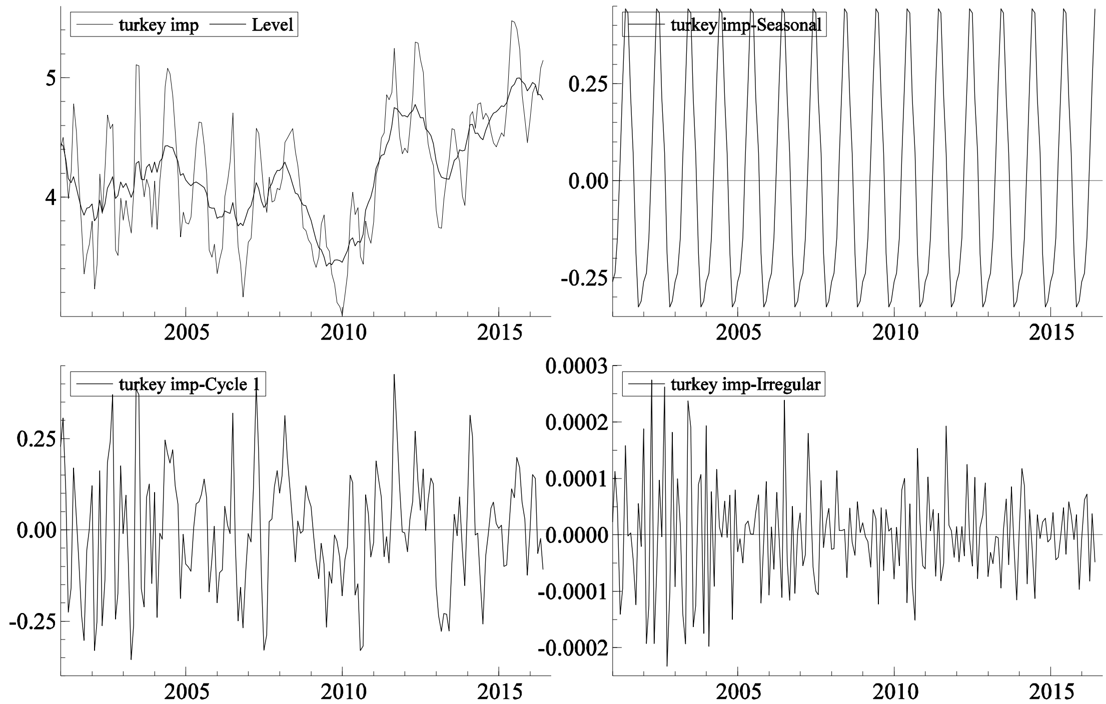
Turkey Import

The price level presents a strong variability in the observed period with a strong stochastic component. The price trend of seasonality is deterministic with a magnitude of about 0.5 €. The component of this cycle is stochastic and it is influenced by strong stochastic irregularities that do not allow determining the range of the cycle. The presence of the irregular component means that the model is not able to explain precisely the trend, especially in the early years of the observations.



Level	0.0160186 (0.4584)
Slope	0.000000 (0.0000)
Seasonal	0.000000 (0.0000)
Cycle	0.0349459 (1.000)
Irregular	1.81271e-005 (0.0005187)
Period in years	6.95735

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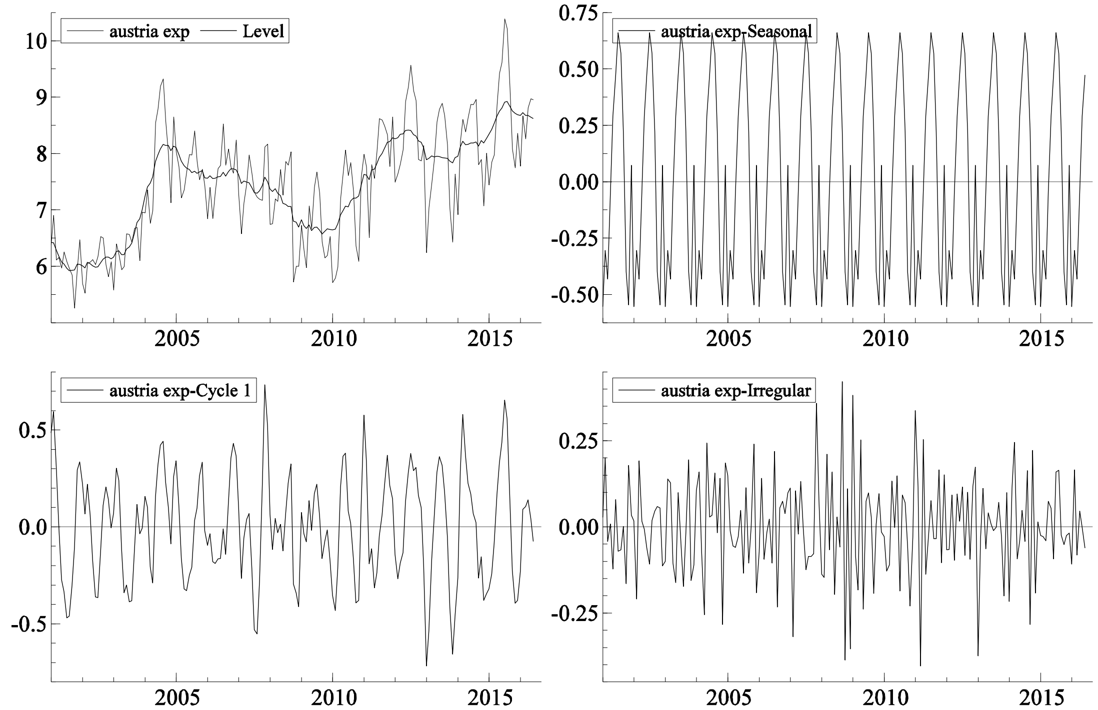
Export Austria

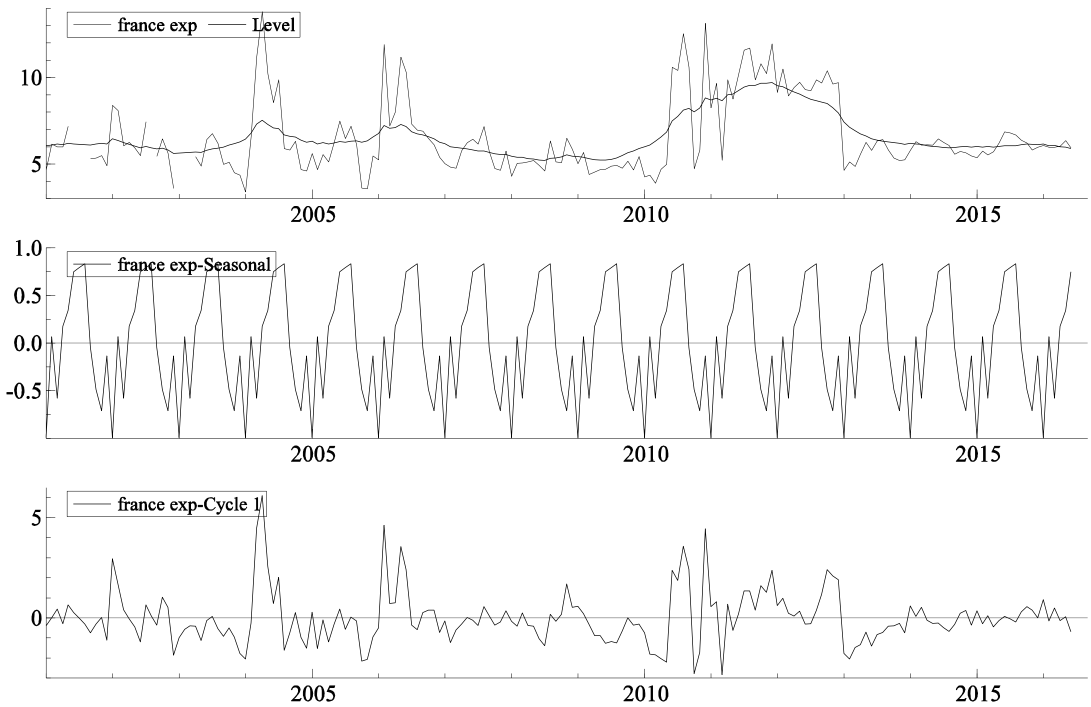
The price level has a strong variability in the observed period with a strong stochastic component. The price trend of seasonality is deterministic with a range of about € 1.1. The nature of the cycle component is stochastic and is influenced by irregularity that does not allow determining the range of the cycle. The presence of the irregular component means that the model is not able to explain precisely the trend.



Level	0.0351636 (0.6075)
Slope	0.000000 (0.0000)
Seasonal	0.000000 (0.0000)
Cycle	0.0578805 (1.000)
Irregular	0.0565446 (0.9769)
Period in years	0.92520

Export France

The price level has shown a small stochastic component and is constant excluding the period 2010-2013. The price trend of seasonality is deterministic with a range of about € 1.7. The nature of the cycle component is stochastic and is influenced by irregularity that does not allow determining the range of the cycle.



Level	0.204434 (0.1117)
Slope	0.000000 (0.0000)
Seasonal	0.000000 (0.0000)
Cycle	1.82952 (1.000)
Irregular	0.000000 (0.0000)
Period in years	833.33333

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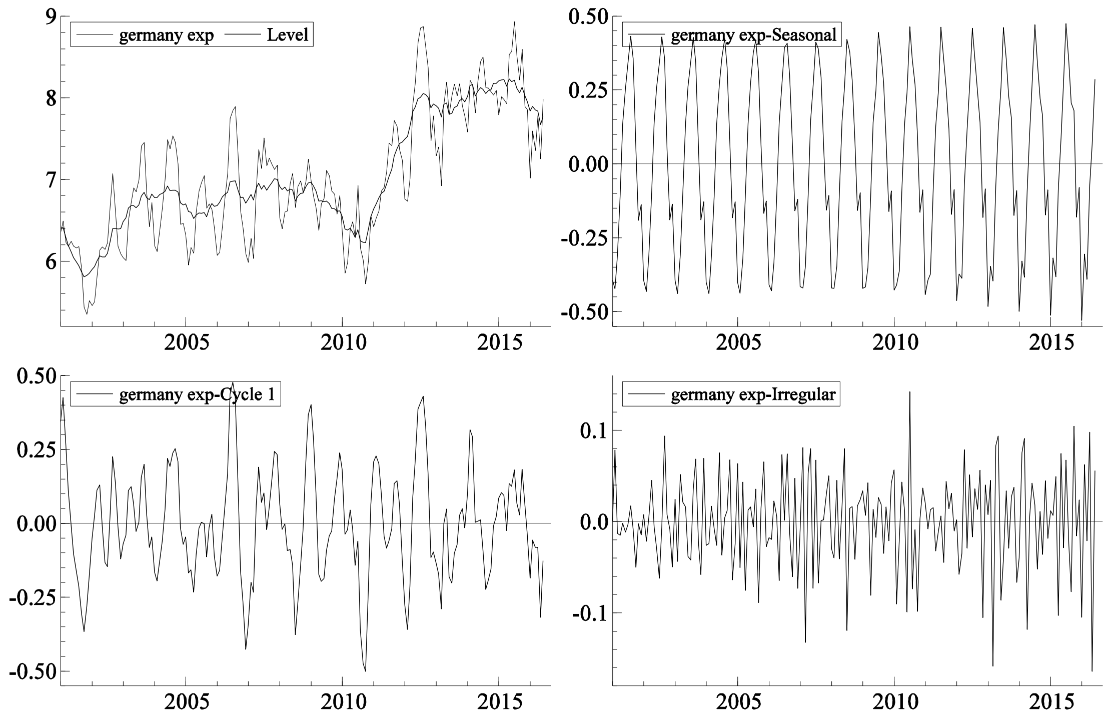
Export Germany

The price level has shown a strong growth between 2011 and 2013 with a strong stochastic component. The prices trend of seasonality is deterministic with magnitude of 0.8 € with peaks in the middle of the year. The nature of the cycle component is stochastic and is influenced by irregularity that does not allow determining the range of the cycle. The presence of the irregular component means that the model is not able to explain precisely the trend.



Level 0.0192030 (0.8502)
Slope 0.000000 (0.0000)
Seasonal 1.91139e-005 (0.0008462)
Cycle 0.0225870 (1.000)
Irregular 0.0118033 (0.5226)
Period in years 1.22965

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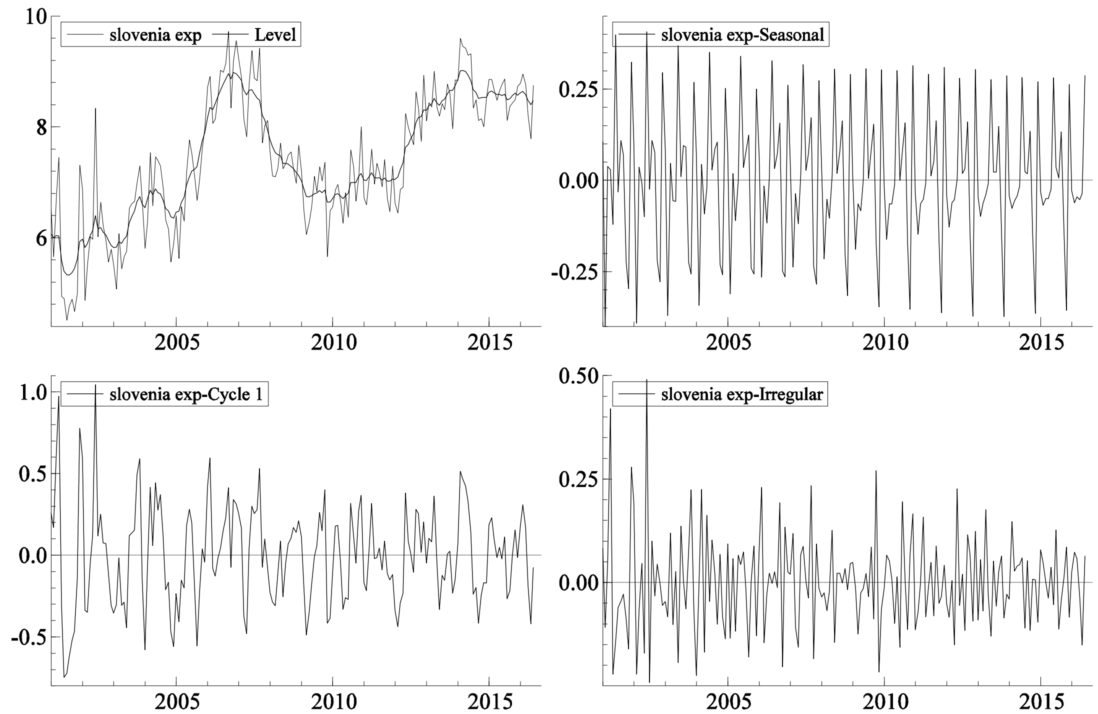
Export Slovenia

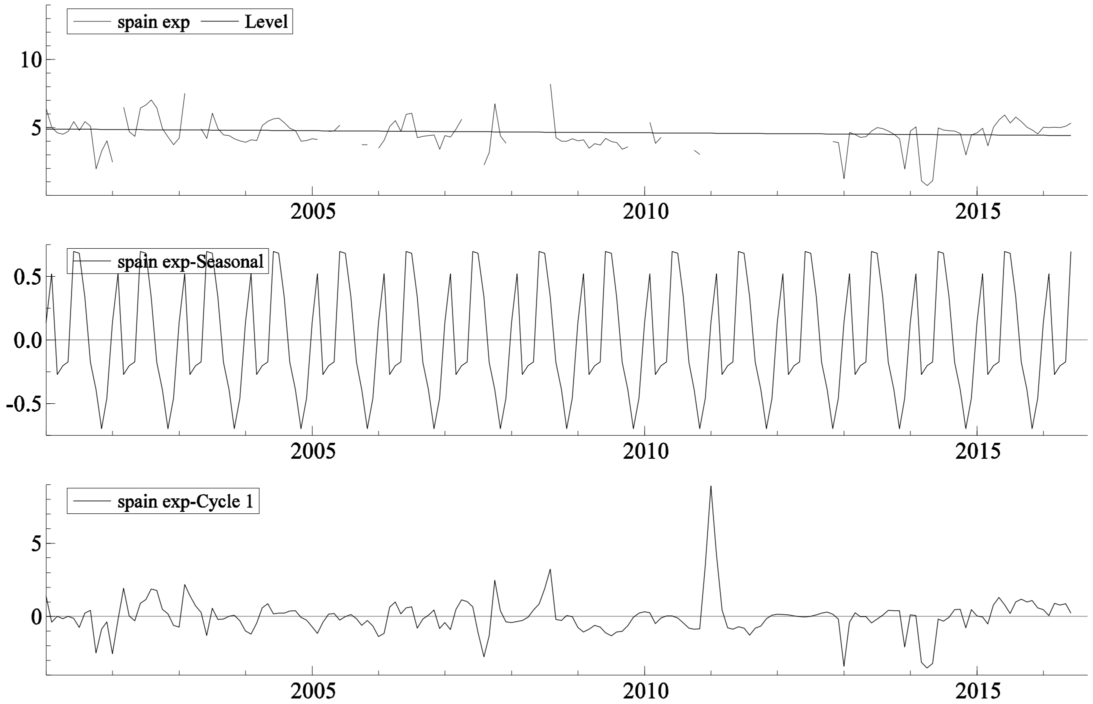
The price level has great variability in the observed period with a strong stochastic component. It present raises n prices until 2007, a fall from 2007 to 2010 and a raise again in 2014. The price trend of the seasonality is deterministic with a magnitude of about 0.5 €. The nature of the cycle component is stochastic and is influenced by irregularity that does not allow determining the range of the cycle.



Level	0.0580124 (0.4262)
Slope	0.000000 (0.0000)
Seasonal	6.73308e-005 (0.0004947)
Cycle	0.136108 (1.000)
Irregular	0.0575217 (0.4226)
Period in years	1.28194

Export Spain

The data for the Spanish market show the presence of a stochastic cycle but results cannot be reliable because data have too many missing values.



Level	0.000000 (0.0000)
Slope	0.000000 (0.0000)
Seasonal	0.000000 (0.0000)
Cycle	1.25271 (1.000)
Irregular	0.000000 (0.0000)
Period in years	0.81982

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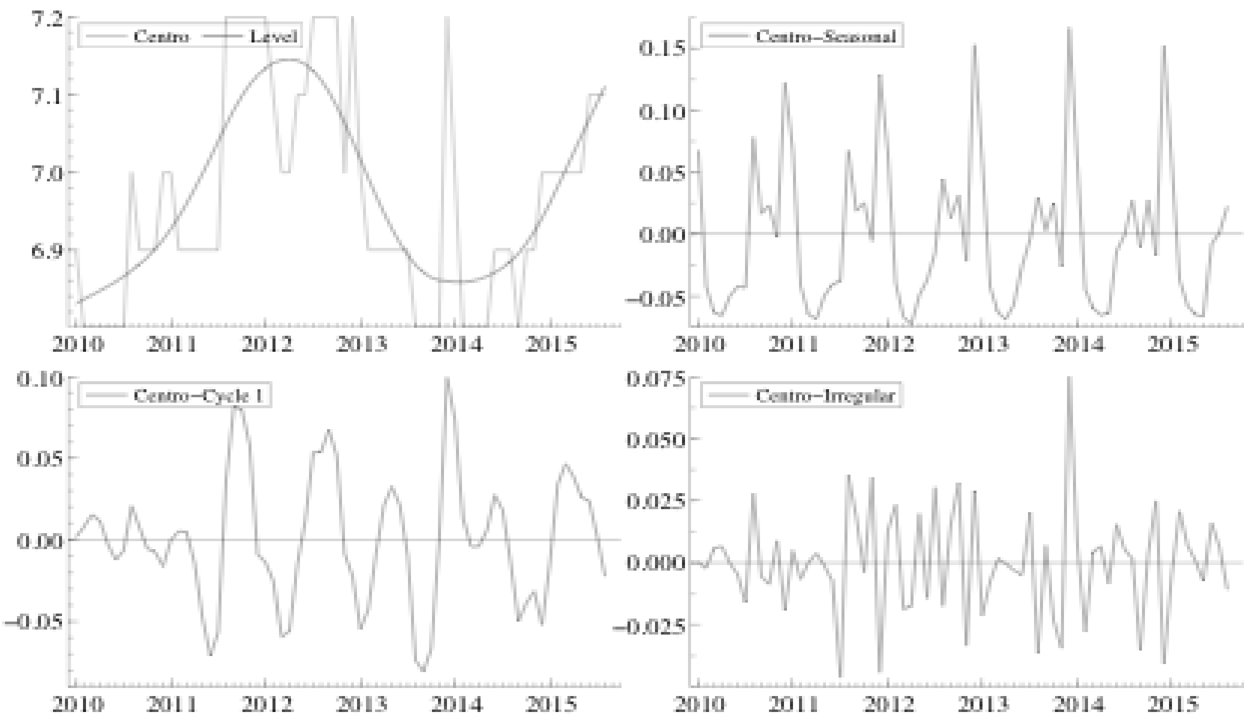
Sea bream

First sale prices

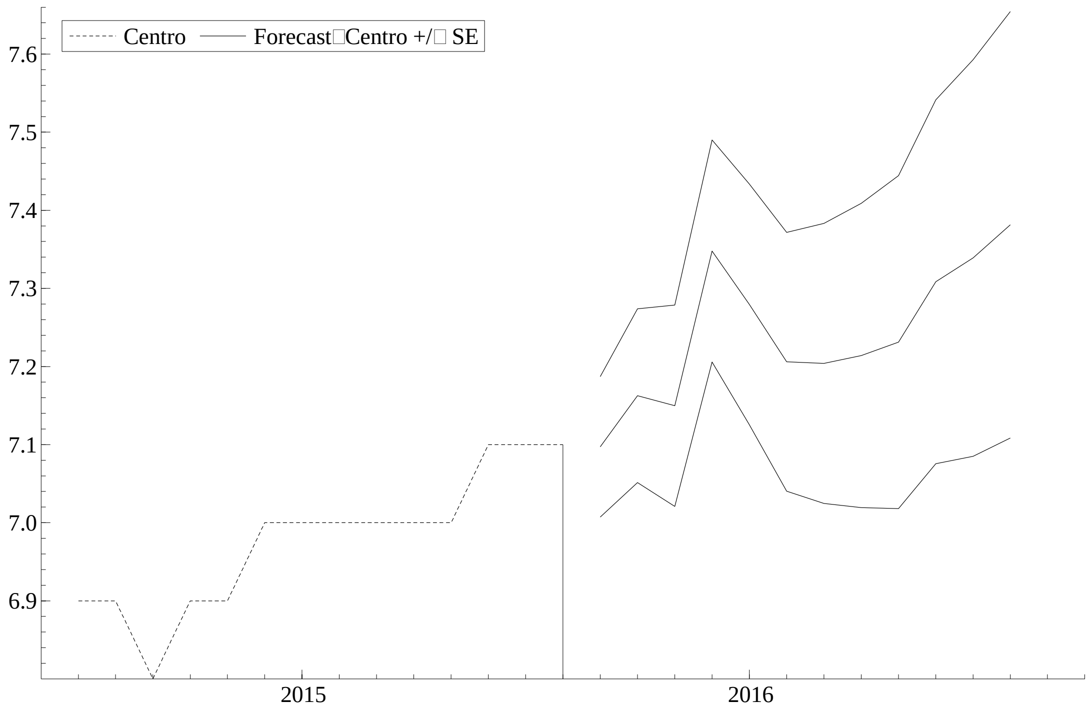
Available data (source: ISMEA) are the historical series of the average monthly prices of seabream (from aquaculture) in four geographical Italian areas (Central, Northern east, Northern west and Southern) between 2010-2015 (EURO/KG, VAT included, farm gate value).

Central Italy

The analysis of the market first sale prices (though not entirely reliable because the data manipulation) shows an increase in prices until 2012, followed by a minimum at the beginning of 2014 and then a raise again. The price fluctuation range is from € 6.9 to € 7.1, and has a strong regularity of seasonality with a range of 0.20 € with the lowest prices in March and the highest prices in December / January. In this trend it is particularly important that the cycle component is stochastic and lasts approximately 10 months with price peaks between 2011 and 2014. However, all this analysis have the limitations that the starting data are not very reliable.



Variances of disturbances:	(q-ratio)
Level	(0.0000)
Slope	(0.03155))
Seasonal	(0.005005)
Cycle	(0.8285)
Irregular	(1.0000)
Period	9.91133



Level, Slope, Seasonal, Cycle e Irregular have values between 0 and 1. The item "Period" refers to months.

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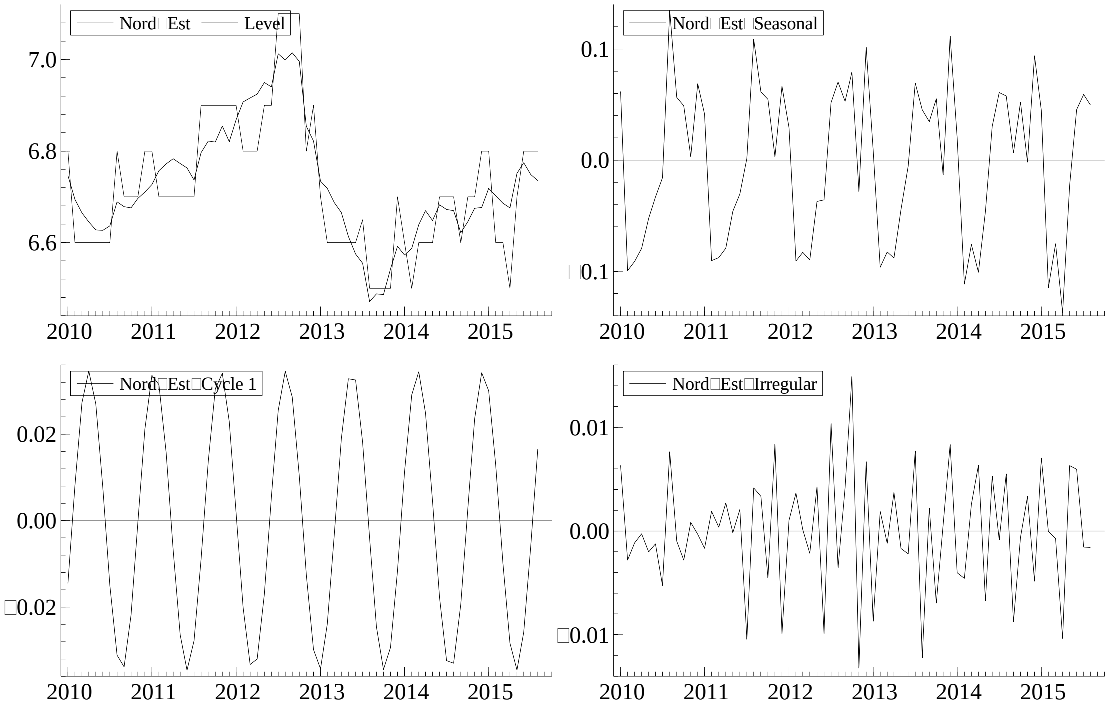
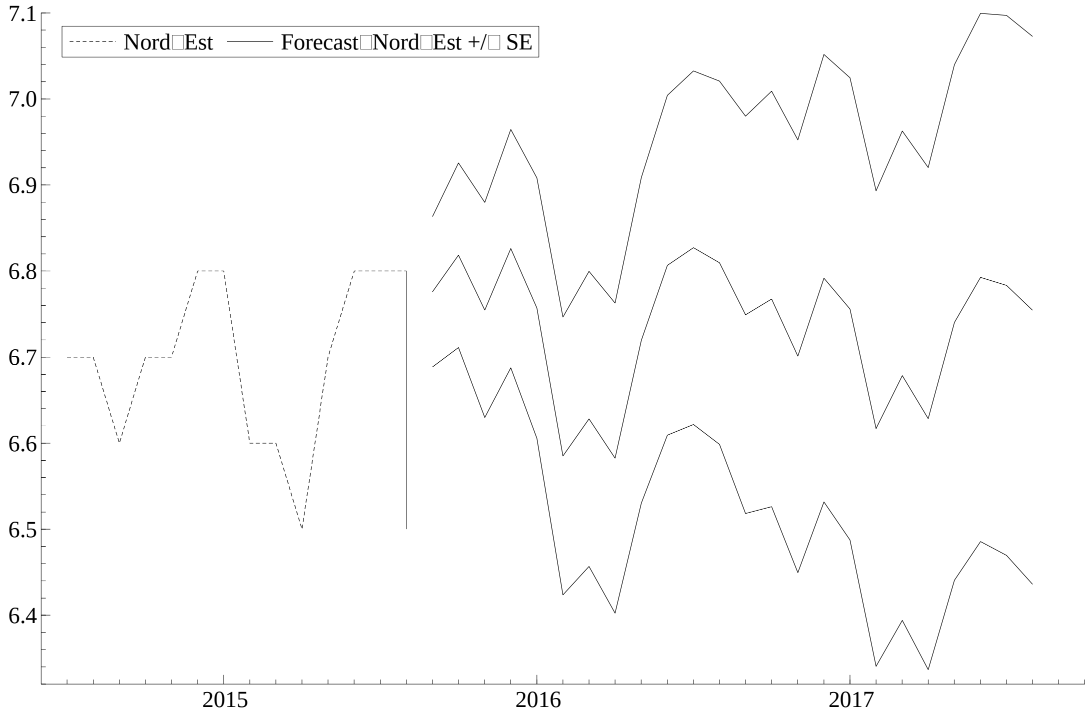
Northern-East: Results show a peak in prices at the end of 2012, which it continued the following year. The seasonality is present but stochastic and the range is of 0.20 €. The cycle is present and lasts approximately 9 months. The adapted model does not explain data well, especially for the period at the end of 2012 and mid-2013.



Variances of disturbances:	(q-ratio)
Level	(1.0000)
Slope	(0.0000)
Seasonal	(0.005294)
Cycle	(4.574e-009)
Irregular	(0.1212)
Period	9.37278



Level, Slope, Seasonal, Cycle e Irregular have values between 0 and 1. The item "Period" refers to months.

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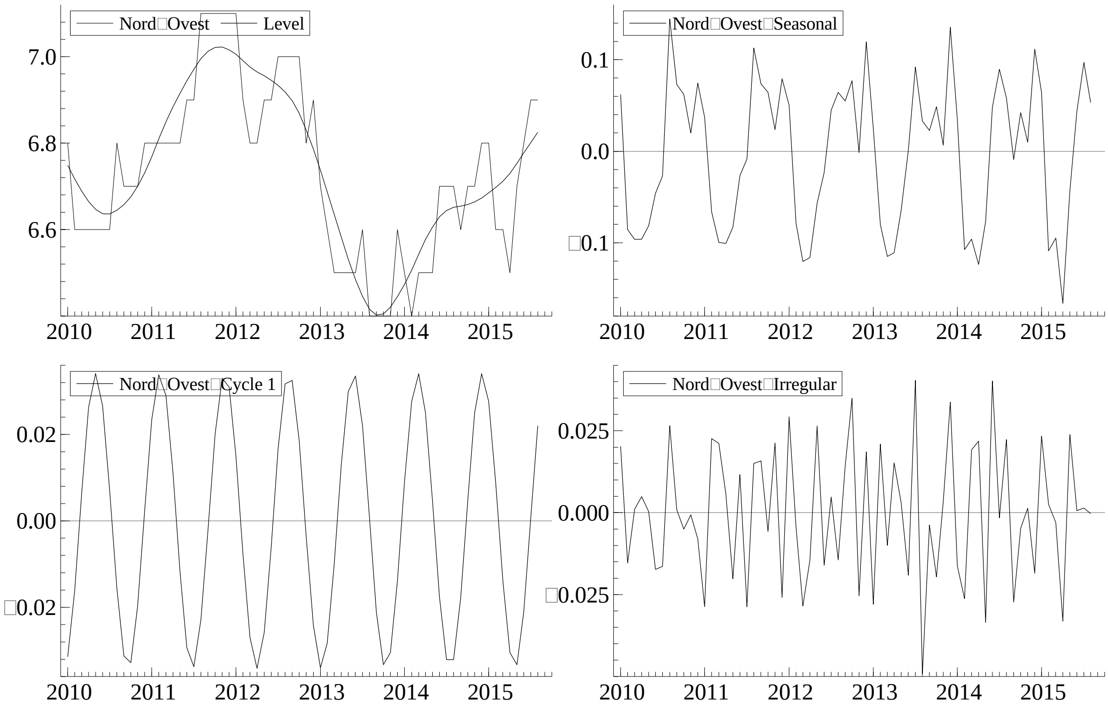
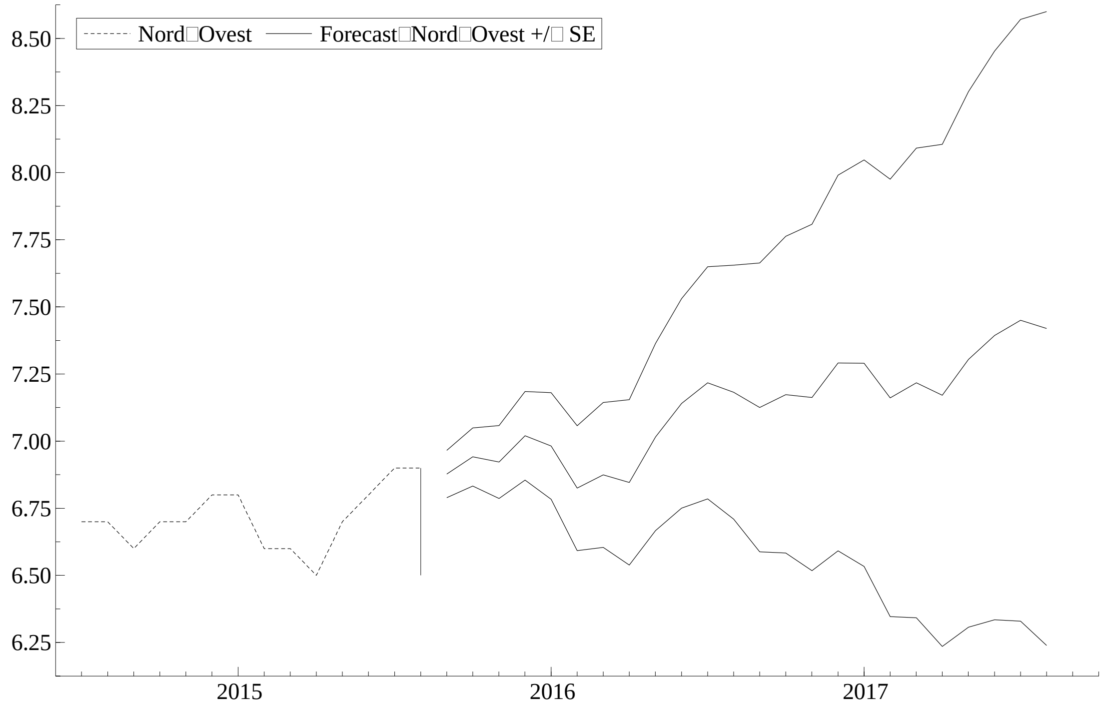
Northern-West: Peak prices in mid-2011 with an ongoing fall until mid-2013. The seasonality is present but slightly stochastic and the range of variation is about 0.20 €. The cycle is present and has a duration of approximately 9 months. The adapted model does not explain well, especially in mid-2013, however the magnitude of the irregularities is very low.



Variances of disturbances:	(q-ratio)
Level	(0.000)
Slope	(0.1830)
Seasonal	(0.01569)
Cycle	(1.079e-006)
Irregular	(1.000)
Period	9.17993

Level, Slope, Seasonal, Cycle e Irregular have values between 0 and 1. The item "Period" refers to months.


Nord Ovest
Forecast Nord Ovest +/ SE
8.50
8.25
8.00
7.75
7.50
7.25
7.00
6.75
6.50
6.25
2015
2016
2017

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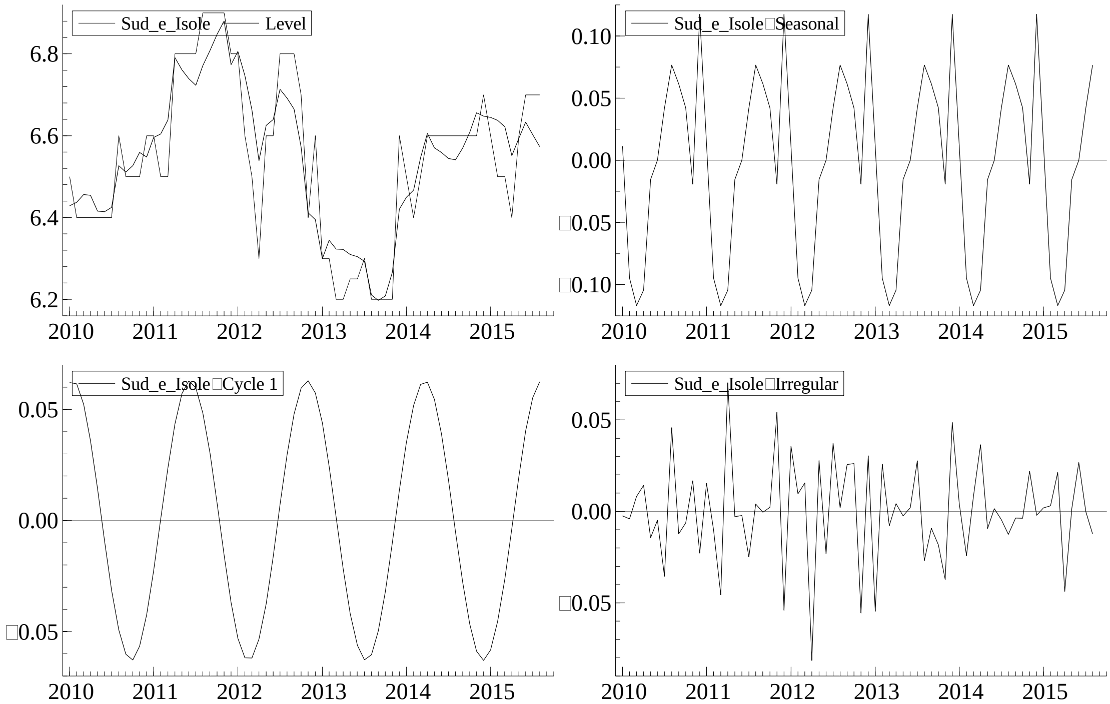
Southern Italy and Islands. Results indicate a peak in prices in mid-2011 and an ongoing fall up to mid-2013. The seasonality is present and deterministic with a range of about 0.25 €. The cycle is present and lasts approximately 17 months. The adapted model does not explain well, especially in May 2012. However, the magnitude of the irregularities is very small.



Variances of disturbances:	(q-ratio)
Level	(1.000)
Slope	(0.000)
Seasonal	(0.000)
Cycle	(9.385e-009)
Irregular	(0.3881)
Period	16.72471

Level, Slope, Seasonal, Cycle e Irregular have values between 0 and 1. The item "Period" refers to months.


Sud_e_Isole
Forecast Sud_e_Isole +/- SE
7.2
7.1
7.0
6.9
6.8
6.7
6.6
6.5
6.4
6.3
6.2
2015
2016
2017

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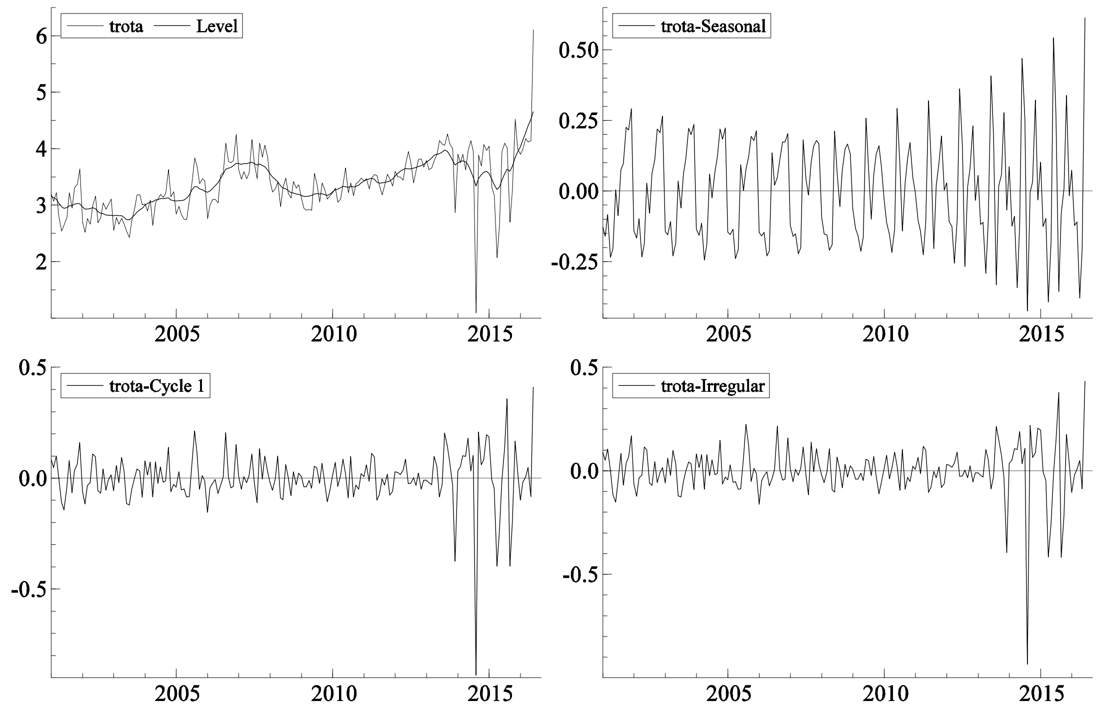
Import/export prices for Trout

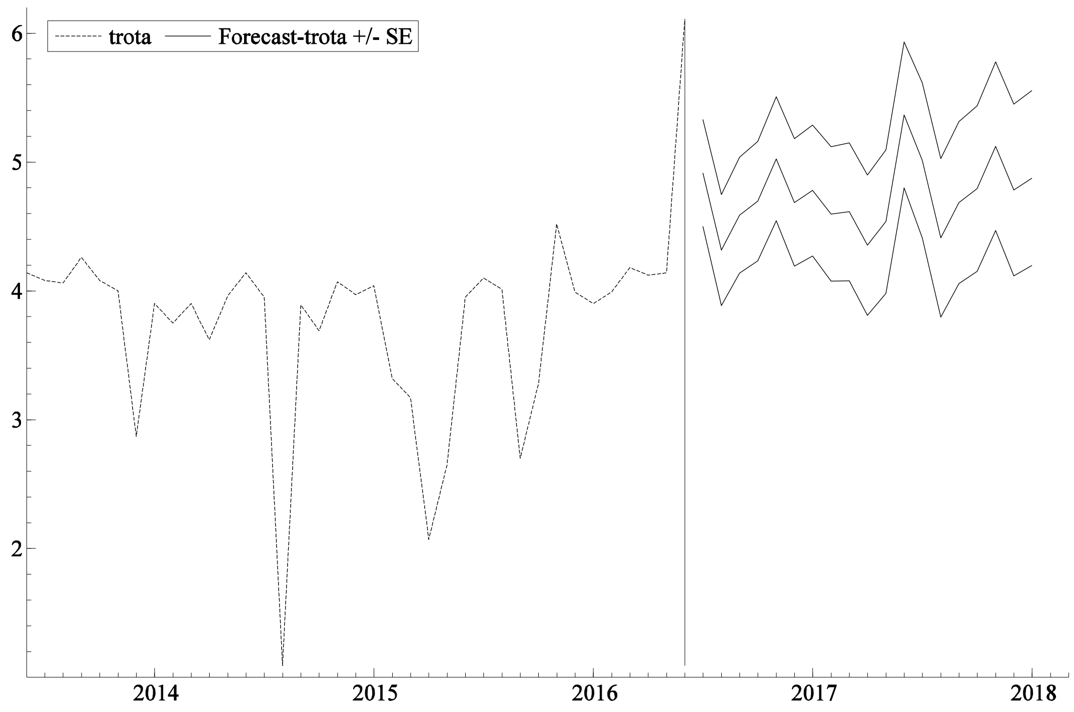
The time series analysis is related to the import / export prices of trout in Italy for the period 2001-2016 (source EUMOFA).

The price level is steady from 2001 to 2013 with a low range fluctuation. During the entire time period the price level is not influenced by stochasticity. The price trend shows a moderate stochasticity of seasonality with a range of 0.5 € until 2010 and increasing to € 1 after 2010, with peaks in the second half of the year and from mid-2010 onwards. In this trend it becomes important the cycle component that is stochastic in nature and lasts approximately 153 months with extreme changes in 2014, 2015 and 2016. The presence of irregular component implies that the model is not able to explain accurately the trend, especially after 2014.



Variances of disturbances:	
	Value (q-ratio)
Level	0.0138345 (0.2985)
Slope	0.000000 (0.0000)
Seasonal	9.96454e-005 (0.002150)
Cycle	0.0440179 (0.9498)
Irregular	0.0463455 (1.000)
Period	153 months

The price forecast of the next year showed a steady trend with a price about 5€.

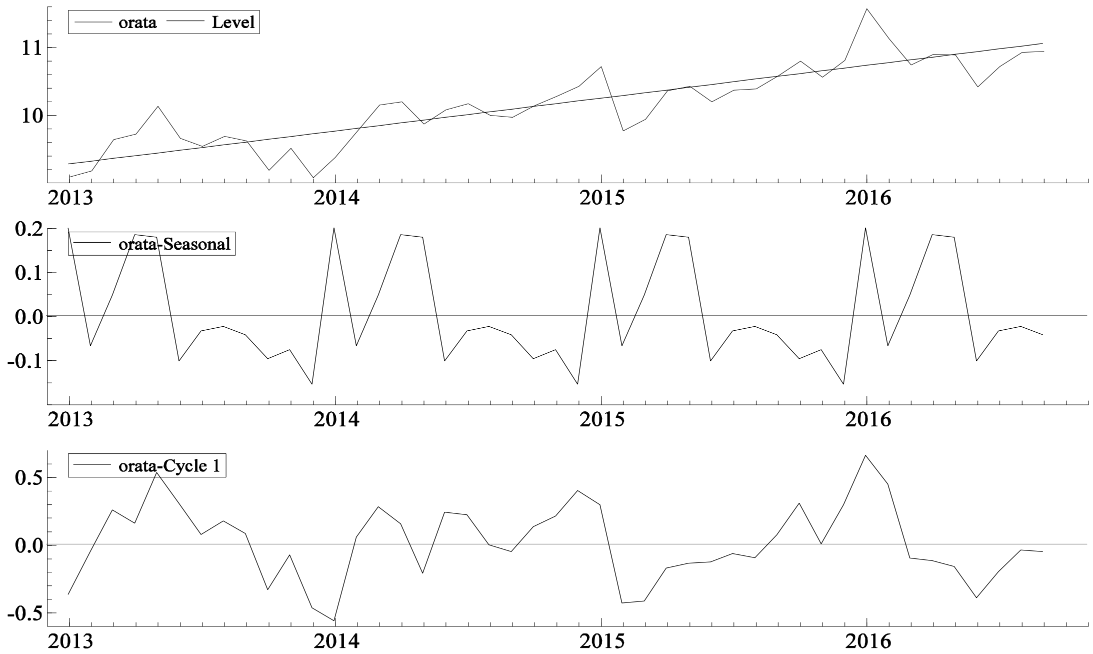


Retail prices of seabass, seabream, trout and salmon (Italy)

The historical time series analysis were about consumer prices in Italy for sea bream, sea bass, salmon and trout (Source: ISMEA). The reference period is about 42 months starting from January 2013. The general assessment from the time series analyses do not give much information. Despite the monthly periodicity of the data, the time series is too short to give reliable results. A clear example is by examining the range of the cycle of sea bream and sea bass value (10,000 months) generated by perfectly stochastic cycles. In these two cases, the shortness and the values of the series do not allow to draw any conclusion. Otherwise, for salmon and trout, even if the range period is the same, the cycles are not perfectly stochastic.

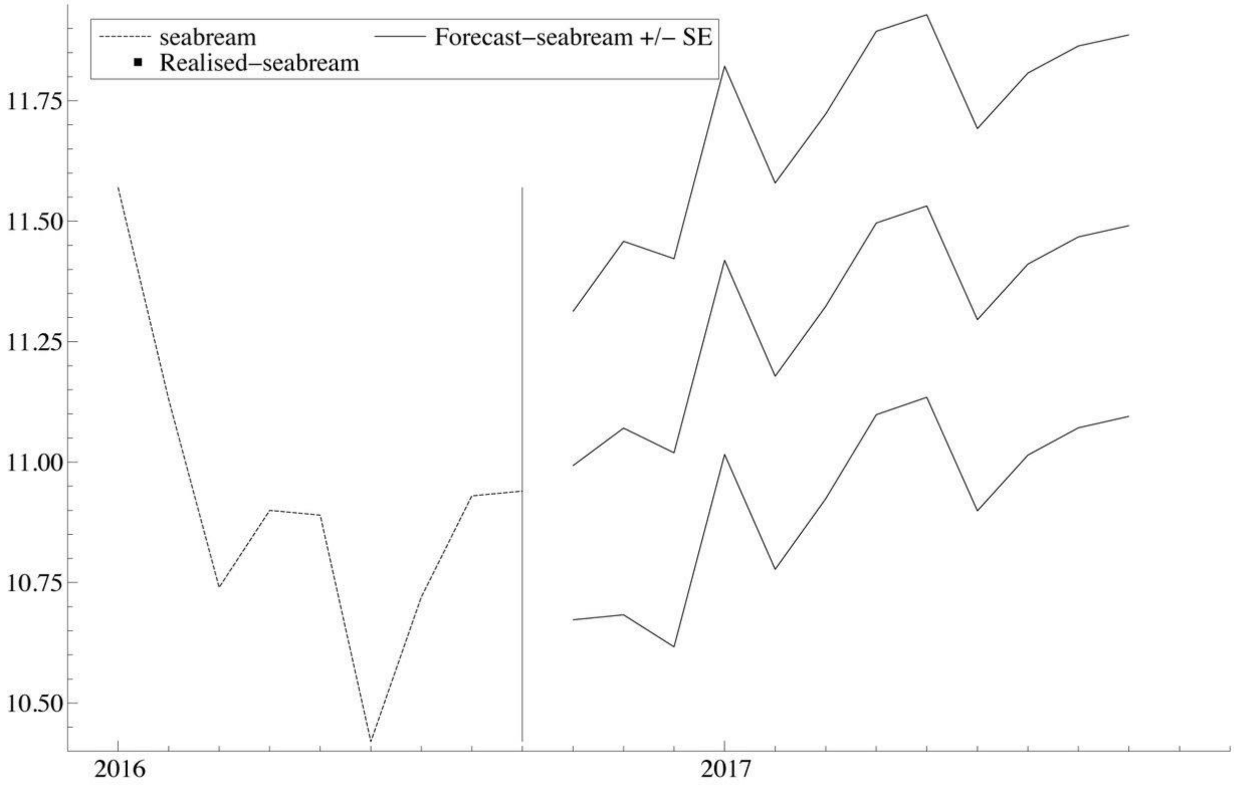
Sea bream

The prices level shows a regularly along the analysed period (despite fluctuations within the years). During the entire time period the price level is not affected by stochasticity. The price trend shows a considerable regularity of the seasonal range of 0.3 € with peaks in April and slumps in the second half of the year. This trend takes great relief the cycle component that is stochastic in nature and generate an untrusted cycle of 833 years. The presence of irregular component implies that the model is able to explain the trends but not with accurately precision.



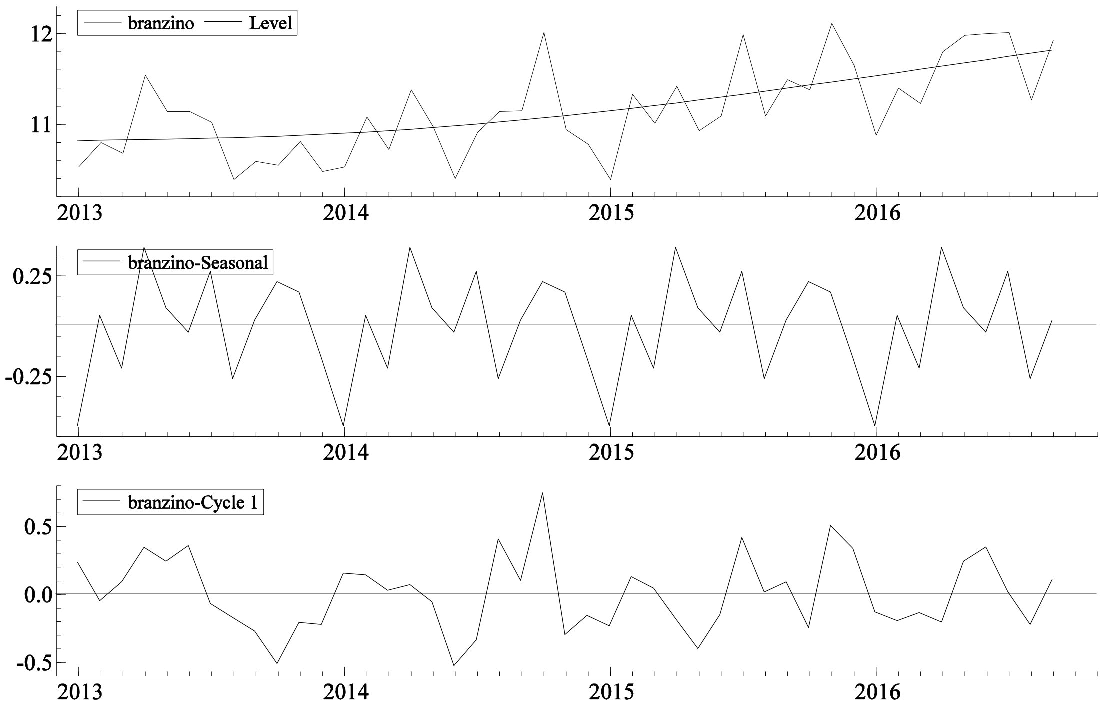
Variances of disturbances:		
	Value	(q-ratio)
Level	0.000000	(0.0000)
Slope	0.000000	(0.0000)
Seasonal	0.000000	(0.0000)
Cycle	0.0777924	(1.000)
Irregular	0.000000	(0.0000)

The prices forecast of the next year showed a rising trend up to 11.50 €.

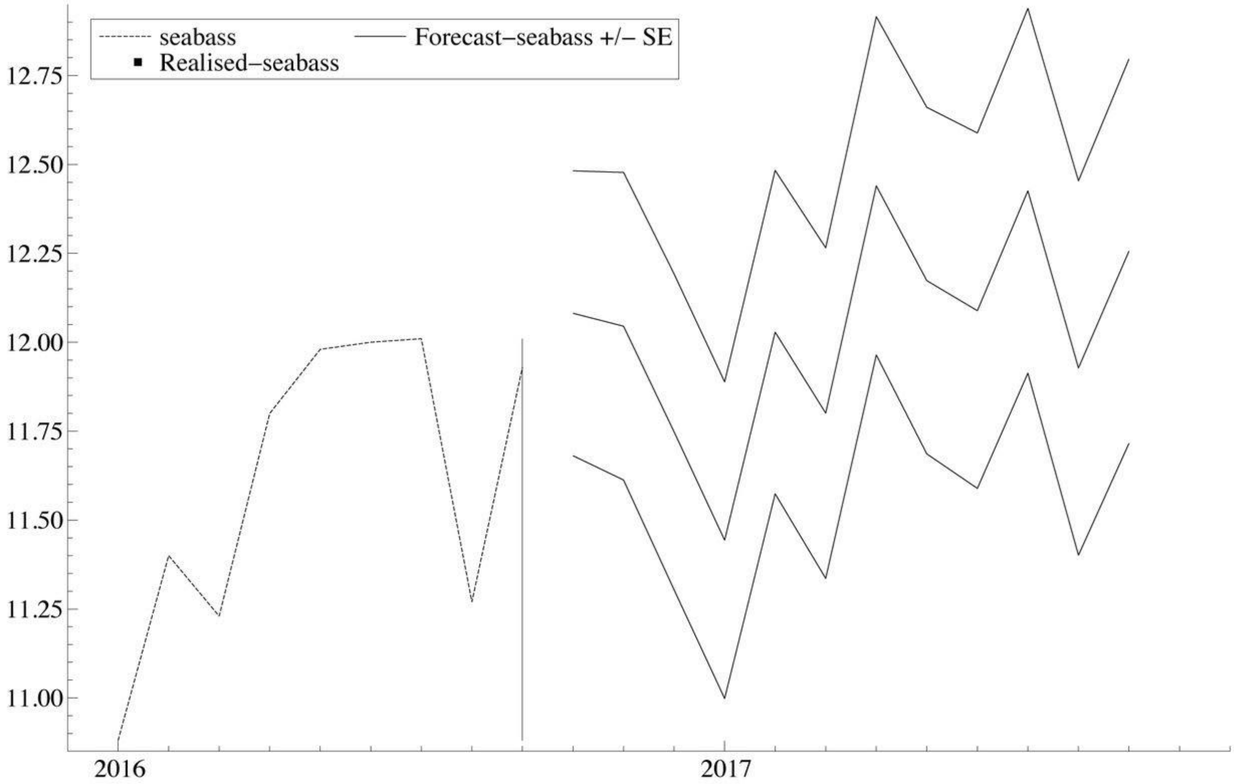


Sea bass

The prices level shows a slow increase along the analysed period (despite fluctuations within the years). During the entire time period the price level is not affected by stochasticity. The price trend shows a considerable regularity of the seasonal range of 0.75 € with peaks in March/April and slumps in July/August and December/January. This trend takes great relief the cycle component that is stochastic in nature and generate an untrusted cycle of 833 years. The presence of irregular component implies that the model is able to explain the trends but not with accurately precision. The prices forecast of the next year showed a rising trend up to 12.50 €.



Variances of disturbances:	
	Value (q-ratio)
Level	0.000000 (0.0000)
Slope	3.76674e-005 (0.0003613)
Seasonal	0.000000 (0.0000)
Cycle	0.104267 (1.000)
Irregular	0.000000 (0.0000)


seabass
Forecast–seabass +/– SE
Realised–seabass
12.75
12.50
12.25
12.00
11.75
11.50
11.25
11.00
2016
2017

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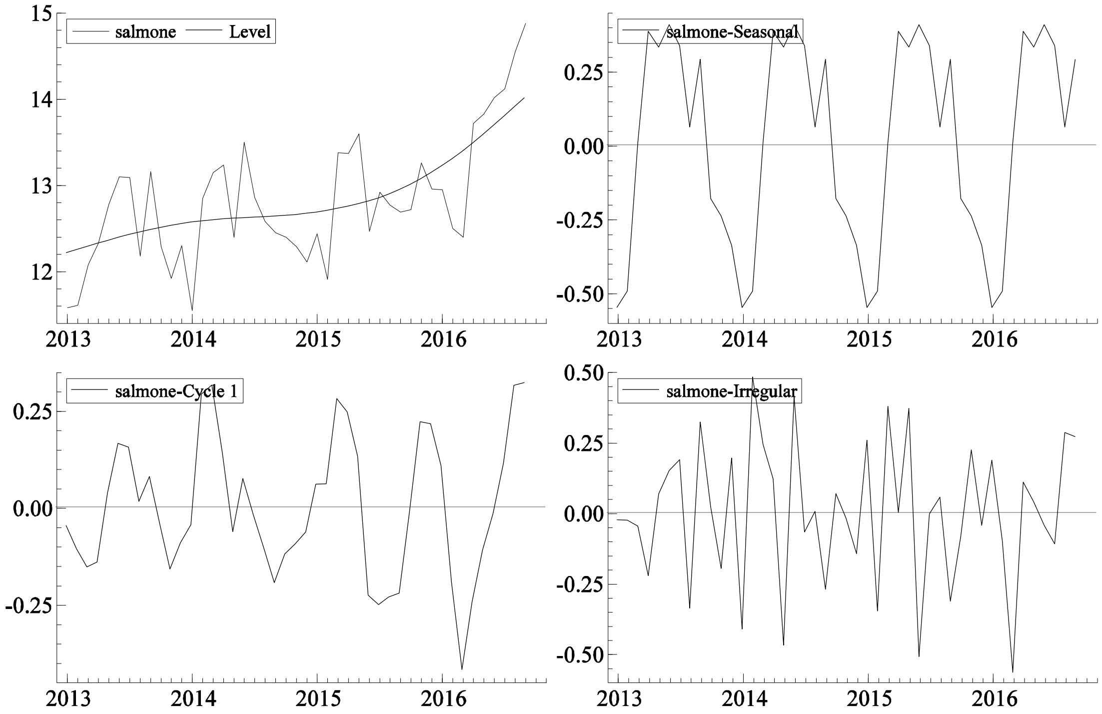
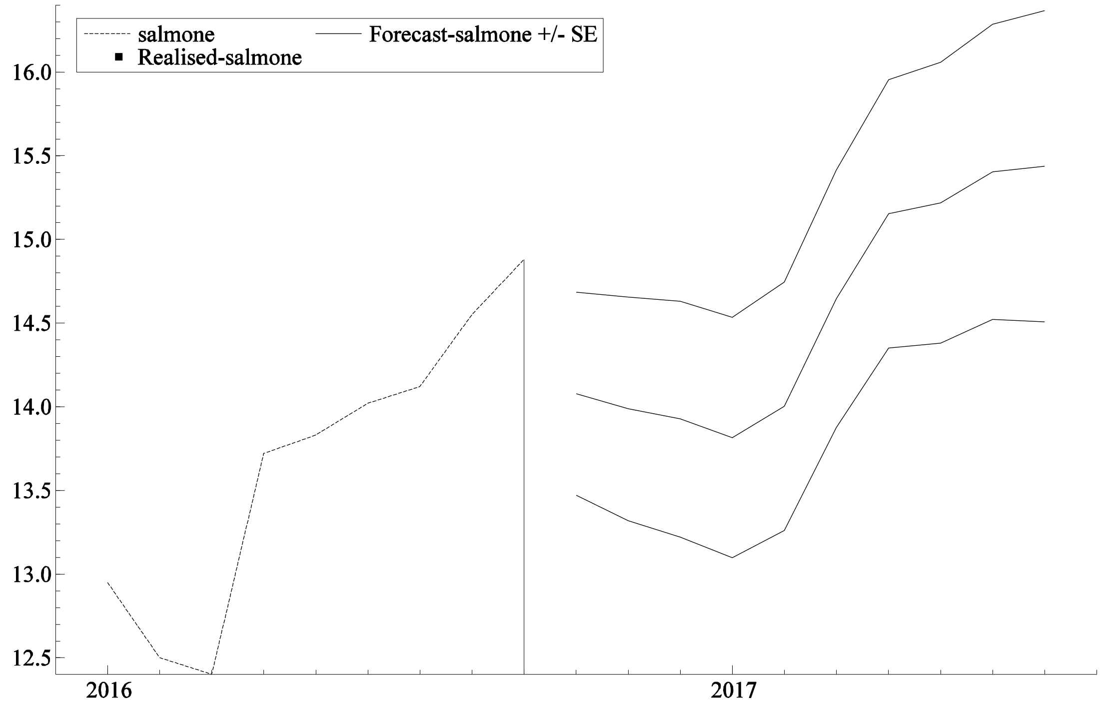
Salmon

The prices level shows a regularly increase until the mid-2016 (despite fluctuations within the years). During the entire time period the price level is not affected by stochasticity. The price trend shows a considerable regularity of the seasonal range of 0.9 € with peaks in the springs and slumps at the end of the year. This trend takes good relief the cycle component that is stochastic in nature and lasts about 9 months with price booms in 2014 and 2016. The presence of irregular component implies that the model is able to explain the trends but not with accurately precision. The prices forecast of the next year showed a rising trend up to 15.50 €.



Variances of disturbances:
Value (q-ratio)
Level 0.000000 (0.0000)
Slope 0.000321869 (0.002378)
Seasonal 0.000000 (0.0000)
Cycle 0.0499428 (0.3690)
Irregular 0.135343 (1.000)


salmone
Forecast-salmone +/- SE
Realised-salmone
16.0
15.5
15.0
14.5
14.0
13.5
13.0
12.5
2016
2017

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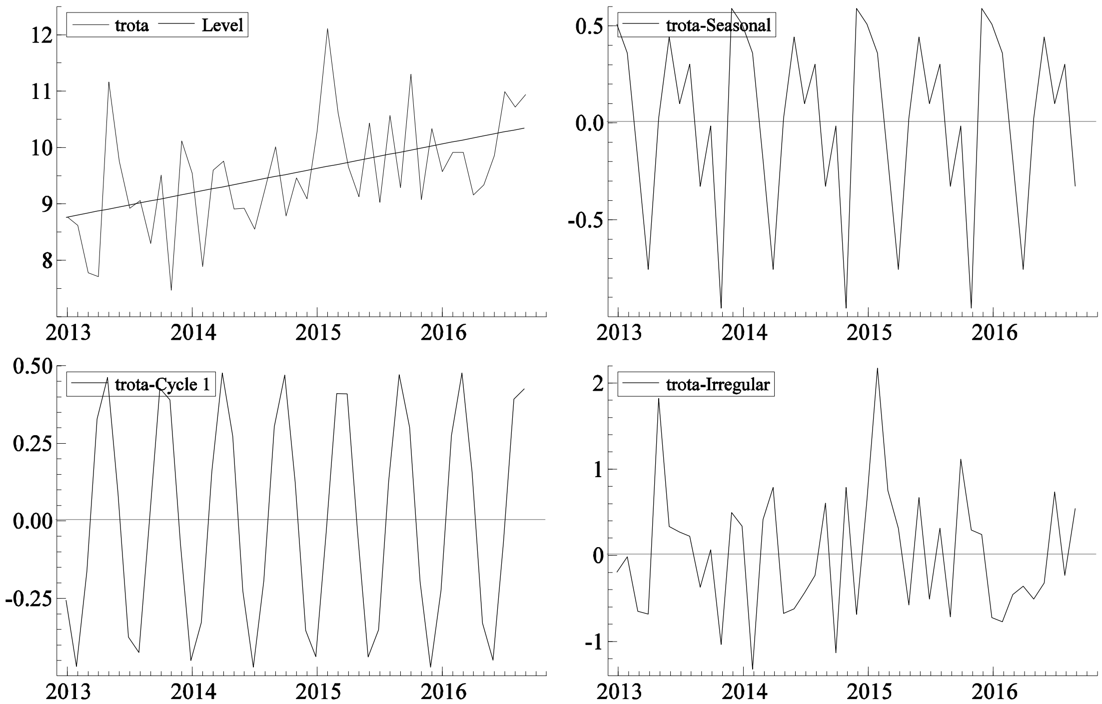
Trout

The price level presents a steady growth throughout the reporting period (despite fluctuations within the years). The price trend shows a considerable regularity of the seasonal range of 0.7 € with peaks in January, February and June and slumps in April and November. In this trend the cycle component is significantly deterministic and lasts for about 5 months with peaks in spring and autumn and the slumps in the summer and at the end of the year. The presence of irregular component implies that the model is not able to explain the trend accurately. The price forecast for next years shows a similar pattern to previous years.



Variances of disturbances:		
	Value	(q-ratio)
Level	0.000000	(0.0000)
Slope	0.000000	(0.0000)
Seasonal	0.000000	(0.0000)
Cycle	3.76445e-008	(4.820e-008)
Irregular	0.780928	(1.000)

Period 5.68827 months

Discussion on "boom & bust"

The application of the Kalman filter to the data from the fisheries and aquaculture sectors made decomposition possible for the time series into elementary parts such as trend, cycle, seasonality and an irregular component. For each of the price series available the fundamental tendency (towards the increasing, the reduction or even to price stability) has been detected, apart from accidental variations (irregularities or outliers), seasonal and cyclical. The irregular component represents unforeseeable and accidental variations related to all the most varied types of events. This component in some cases may include extreme values or outliers. The Kalman filter as well, breaks down the price trend in building blocks that may be allocated to each member of the characteristics of stochasticity and determination. The classification of a component as a stochastic or deterministic is of particular importance since it allows us to understand more in detail what inside price trend analysis can be considered as "fixed" or "probabilistic". The Kalman filter also allows us to determine if the individual components are stochastic or deterministic. The classification of a component as a stochastic or deterministic is of particular relevance since a larger deterministic component in a time series improves the forecasts.

So, for each time, series of available prices are presented in the Forecasts, it becomes more reliable within a short-medium horizon, less for long-term scenarios. The information could help to predict what will be selling price in time (seasonal), summer or winter. The question that arises if we can predict it with precision. The production of confidence Graphs (the three threshold) can easily help the user to understand the precision of the prediction. User (for each market level) can decide what type of confidence level he wants based on risk aversion.

The table summarize the time series with available prediction.

Table 5. Possibilities to carry out price forecasts based on our analysis

	Canada	Iceland	Norway	Spain	UK	Denmark	Germany	Italy	Greece	Vietnam
Cod	e	e	f	R	f r					
Herring		e	f		f	f	f r			
Salmon			e		r			r		
Trout				f w r	f r	f r		na		
Seabass				r				f r	e	
Seabream				f w r				f r	e	
Pangasius										f

Legend: e= export price; f: first sale price; f r : first sale and retail price; w=wholesale price. n.a=no suff. data

To complete the task, starting from the results of the first part of the investigation, a methodology has been developed to detect "boom and bust cycles" on the analysed time series. The main challenge was to identify price thresholds beyond classifying the cycle as in a boom period or in a bust period, as reported above.

As concerning B&B detection (see page 18 in the methodology), the complete list of Boom and Bust has been reported in Appendix 2: List of all Boom and Bust identified, begin of boom or bust, type of event, country, species and level of the Market.

Here reported some tables describing the B&B. All these B&B need to be discussed with stakeholders to go on the analysis of selected cases, in the framework of WP5.

As concerning Boom has been identified 81 cases, distributed in the 10 countries studied and distributed according species.

According to Species, trout compares with a total of 22 Boom and Seabass with 15 Boom. According to countries, Spain accounts for 23 Boom and Italy for 13 (Table 6).

BOOM	Canada	Denmark	Germany	Greece	Iceland	Italy	Norway	Spain	United Kingdom	Vietnam	Total
Cod	1				2		2	1	4		10
European seabass				5		8		2			15
Gilt-head seabream				5		5					10
Herring		2	3		2		2				9
Pangasius										3	3
Salmon							3		2		5
Seabream								7			7
Trout		7						13	2		22
Total	**1**	**9**	**3**	**10**	**4**	**13**	**7**	**23**	**8**	**3**	**81**

Considering Bust, it has been identified 86 cases, distributed in the 10 countries studied and distributed according to species.

According to Species, Trout compares with a total of 22 Bust and Seabass with 15 Bust. According to countries, Spain accounts for 20 Bust and Italy, Greece and Denmark for 13 Bust.

Clearly, there is an effect of Species and also a country effect.

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Table 7: Boom and Bust for Species and Countries

BUST	Canada	Denmark	Germany	Greece	Iceland	Italy	Norway	Spain	United Kingdom	Vietnam	Total
Cod	1				3		2	2	5		13
European seabass				6		8		1			15
Gilt-head seabream				6		4					10
Herring		2	5		2		2				11
Pangasius										3	3
Salmon							2		3		5
Seabream								7			7
Trout		10						10	2		22
Total	**1**	**12**	**5**	**12**	**5**	**12**	**6**	**20**	**10**	**3**	**86**

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Concerning the level of the market, here below the occurred "boom and bust" are listed.

Table 8: Boom occurred according to Species, level of the Market and Country

	Canada	Denmark	Germany	Greece	Iceland	Italy	Norway	Spain	United Kingdom	Vietnam	Total
Cod	1				2		2	1	4		10
Export					2						2
first sale	1						2		2		5
Retail								1	2		3
European seabass				5		8		2			15
consumption						2					2
Export				5							5
first sale						3					3
Retail						3		2			5
Gilt-head seabream				5		5					10
Export				5							5
first sale						2					2
Retail						3					3
Herring		2	3		2		2				9
Export					2						2
first sale		2	2				2				6
Retail			1								1
Pangasius										3	3
first sale										3	3
Salmon							3		2		5
Export							3				3
Retail									2		2
seabream								7			7
first sale								2			2
Retail								2			2
wholesale								3			3
Trout		7						13	2		22
first sale		5						6			11
Retail		2						3	2		7
wholesale								4			4
Total	**1**	**9**	**3**	**10**	**4**	**13**	**7**	**23**	**8**	**3**	**81**

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As expected, data show that the number of B&B are considerable higher for First Sale (50% of the total occurrence) and Export than for Wholesale and Retail (only 4 cases).

Table 9: Number of B&B for Market Level

	First sale	Wholesale	Consumption/Retail	Export	Total
Boom	32	7	25	17	81
Bust	31	6	30	19	86
Total	63	13	4	36	167

In the following table detailed list of the cases.

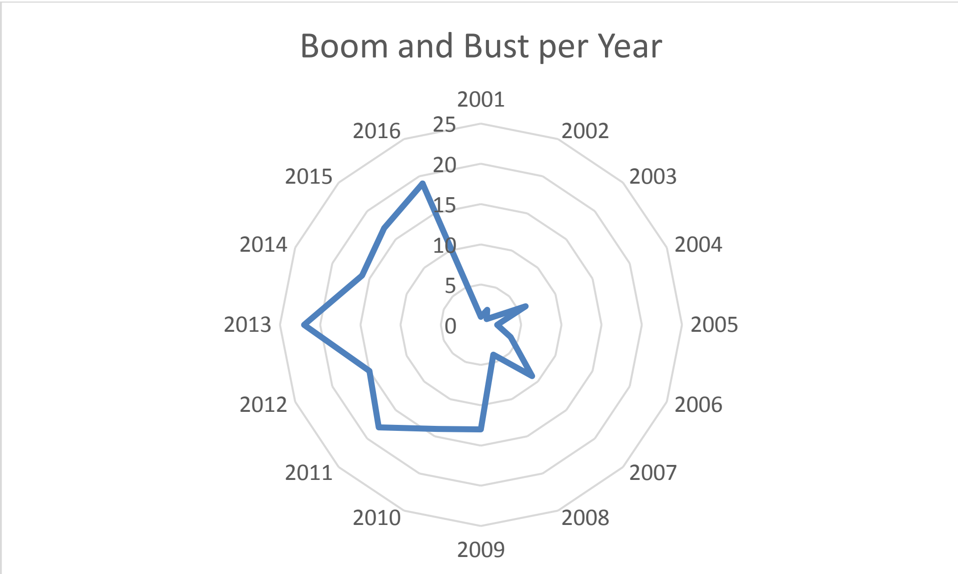
Table 10: Bust occurred according to Species, Level of the Market and Country

	Canada	Denmark	Germany	Greece	Iceland	Italy	Norway	Spain	United Kingdom	Vietnam	Total
Cod	1				3		2	2	5		13
Export					3						3
first sale	1						2		2		5
retail								2	3		5
European seabass				6		8		1			15
consumption						2					2
Export				6							6
first sale						3					3
retail						3		1			4
Gilt-head seabream				6		4					10
Export				6							6
first sale						1					1
retail						3					3
Herring		2	5		2		2				11
Export					2						2
first sale		2	3				2				7
retail			2								2
Pangasius										3	3
first sale										3	3
Salmon							2		3		5
Export							2				2
retail									3		3
seabream								7			7
first sale								3			3
retail								2			2

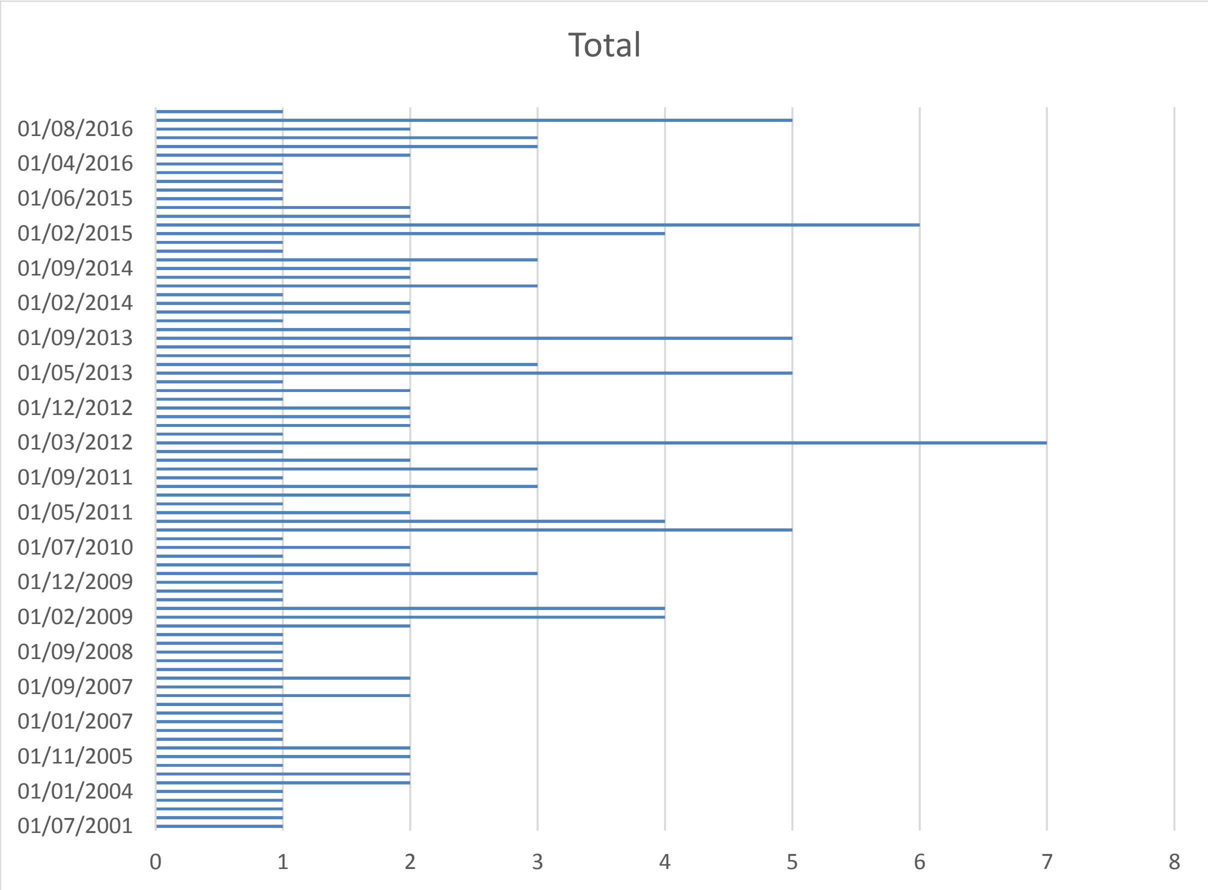
wholesale								2			2
Trout		10						10	2		22
first sale		6						3			9
retail		4						3	2		9
wholesale								4			4
Total	**1**	**12**	**5**	**12**	**5**	**12**	**6**	**20**	**10**	**3**	**86**

As concerning the timing of B&B occurrence here reported the numbers of B&B per year.

Graph 1 shown here is only a simplification to connect the results with previous results from the literature review.



Utilising the data in the Annex 2 it's possible to distinguish also at monthly level.



Comparing the B&B identified for our case studies (Graph 2, Number of B&B) and the literature review, after 2009 the numbers of occurrence of B&B, as identified in the Report, increased meanwhile in the international market volatility also increased, showing an increasing degree of commodities/products interconnection which leads to a fast propagation of shocks. No recent available literature review allows to analyse price volatility and to compare it with the more recent shocks.

Potential effect of macroeconomic fundamentals: booms and busts of Pangasius price

Vietnamese Pangasius industry-A History

Pangasius catfish (*Pangasius hypophthalmus*) was originally farmed for local domestic consumption in the Mekong Delta since 1960s which relied on wild fry, and virtually unknown as a food fish outside Asia. From the late 1980s, market liberalization in Vietnam coupled with the development of artificial propagation techniques in the late 1990s resulted in expanding production from this time onwards. In the 1990s, pangasius was produced typically on a small scale in ponds, but volumes rapidly increased as the industry expanded into net pen culture since the early 2000s. The industry's development has been characterized by periods of rapid growth and dramatic shifts in production practices (SeafoodWatch, 2014).

Since 1990s, Pangasius catfish has been one of the fastest growing aquaculture species globally (FAO, 2010), with annual production of over 1 million tons (FishStatJ, 2014). Of which, Vietnam is the major producer, representing more than 75% of the global production and 95% of global export value (EPA, 2014). In 2015, the production of Vietnamese pangasius was approximately estimated as 1.1 million metric tons (VASEP, 2016), a slightly deduction from its peak of 1.4 million tons in 2012.

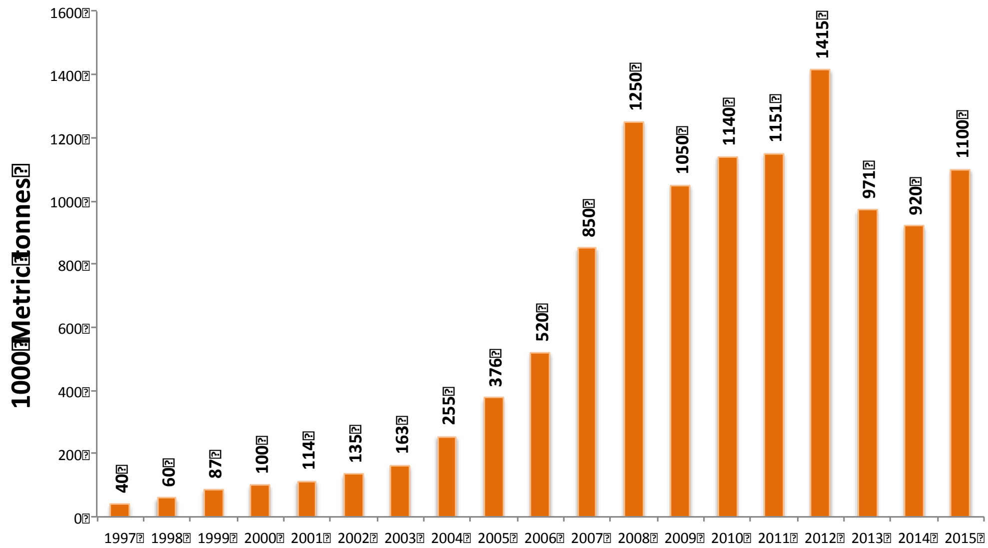


Figure 1. Vietnamese pangasius production. Source: VASEP, 2016

In Vietnam, pangasius is farmed mostly within ten provinces in the Mekong Delta River including An Giang, Dong Thap, Tien Giang, Can Tho, Vinh Long, Ben Tre, Hau Giang, Soc Trang, Tra Vinh and Kien Giang. In 2012, the total pangasius farming areas of Vietnam was 3,586 ha, in which household accounts for 48.7%, farming companies for 49.1% and farmer collective represent only 2.1% (Tung et al., 2014). In recent years, the farming area has increased significantly and had reached the peak in 2015 at 5,900 ha (MARD, 2016). With an average one million metric tons of pangasius produced annually, the Food and Agriculture Organisation has categorized Vietnamese pangasius production as hyper-intensive. Due to possible intensive and high-density culture, the production figures can be reached of over 200-300 tons per ha per crop; and with around 1.45 crops per year, as much as 400-600 tons per ha per year. Belton et al. (2011) described pangasius as the most intensive and productive food production system on earth.

Over 97% of the production was used as raw materials for approximately 140 processing plants (EPA, 2014; VASEP, 2016). The vast majority of these processing establishments are located in the provinces in the Mekong River Delta (CBI, 2012). There were 291 pangasius exporters in 2010, of which two-thirds of these exporters can be considered small exporters with an export volume of less than 1,000 tons. One-third of large exporters have a share of almost 75% of the total export volume.

Table 11 Number of pangasius processors per province

Province	Processing unit	Export volume (1000 tons)	Value ($ million)
An Giang	15	159	342
Dong Thap	12	115	277
Can Tho	22	166	350
Tien Giang	13	97	202
Hau Giang	1	6	14
Ben Tre	3	14	32
Vinh Long	2	11	19
Ho Chi Minh	19	37	78
Tra Vinh	2	6	16
Kien Giang	1	3	6
Vung Tau	1	1	2
Da Nang	2	3	4
Others	>47	42	87
Total	**>140**	**660**	**1,429**

Source: CBI (2012)

The development of the Pangasius industry is oriented for exports. Like the production, the export of pangasius also increased significantly during 2000-2010. In 2000, the volume of the export was 700 tons, while this volume has increased to 660,000 tons with a value of USD 1.4 billion after only ten years (CBI, 2012). The EU and the U.S. are the most important destination markets for pangasius. In 2012, 24.4% of Vietnamese pangasius volume was exported to the EU and 20.8 % was exported to the U.S. The remaining 50% are being exported to countries in Asia, Mexico, Brazil, China and others (SFP, 2015). Exports were initially mainly to the U.S. market but protectionist trade measures imposed in 2002 led the Vietnamese industry to seek more diversified global markets. As a result, the exports have grown almost exponentially since this time (Belton et al., 2011) with the export value increased several

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times.

Boom & Burst Circle of Pangasius Production

Pangasius products are exported mostly as frozen fillets that account for 98% of the total export values (EPA, 2014). Until the year of 2012, Europe was a booming market for Vietnamese Pangasius, with imports growing every year. However, the largest markets for pangasius in Europe, i.e. Spain, the Netherlands and Germany, all saw their import value go down during 2012 – 2014. Although the value of pangasius imports is decreasing, the demand still remains strong as pangasius remains positioned as a low-value white fish across Europe. In fact, the pangasius export value to Europe has decreased since 2008. This might be the result of the strong competitiveness in the European whitefish market during the past few years that has put downward pressure on the export prices of pangasius (CBI, 2015).

Figure 2 presents average export prices ($/kg) of Pangasius across the markets. The data of the importing countries were aggregated into seven market regions based on geographical locations. The seven regions include ASEAN and Easters Asian (10 Asian countries, and China, Hong Kong, Japan, Taiwan, and Korea), North American (Canada and USA), Oceania (Australia and New Zealand), Russia and Eastern EU (Russia and former Soviet Union countries), South and Central America, Western EU, and Rest of the World (ROW).

From Figure 2, it is important to recognize that there is a decreasing trend in export price in the period 2007–2014. The highest export price is to North America and the lowest is to Russia and Eastern EU. The fluctuation in prices of pangasius across the markets is also recorded in the data.

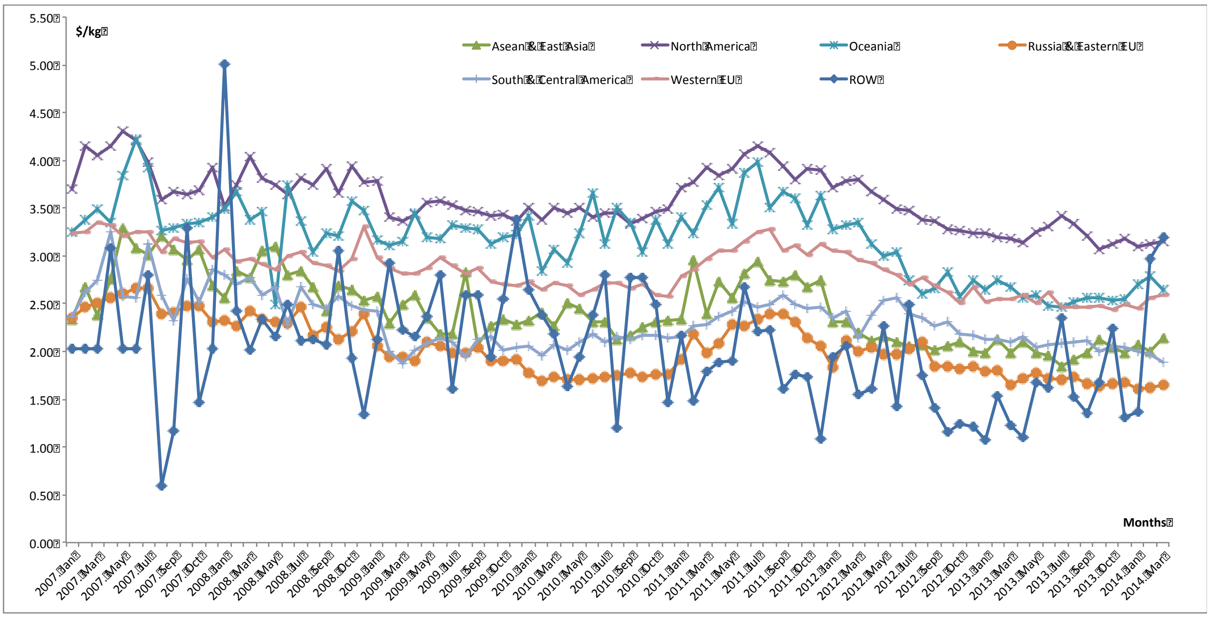

Figure 2. Average export prices of pangasius in period of 2007-2014. Source: ITC (2015) & Thong et al (2016)

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In order to provide a deeper image on the development of pangasius prices, the farming price and retail price are also collected and analysed, for example in Germany and Denmark. The farming price used in this study is monthly average farm-date price of pangasius in the Mekong delta over the period of 2009 -2012.

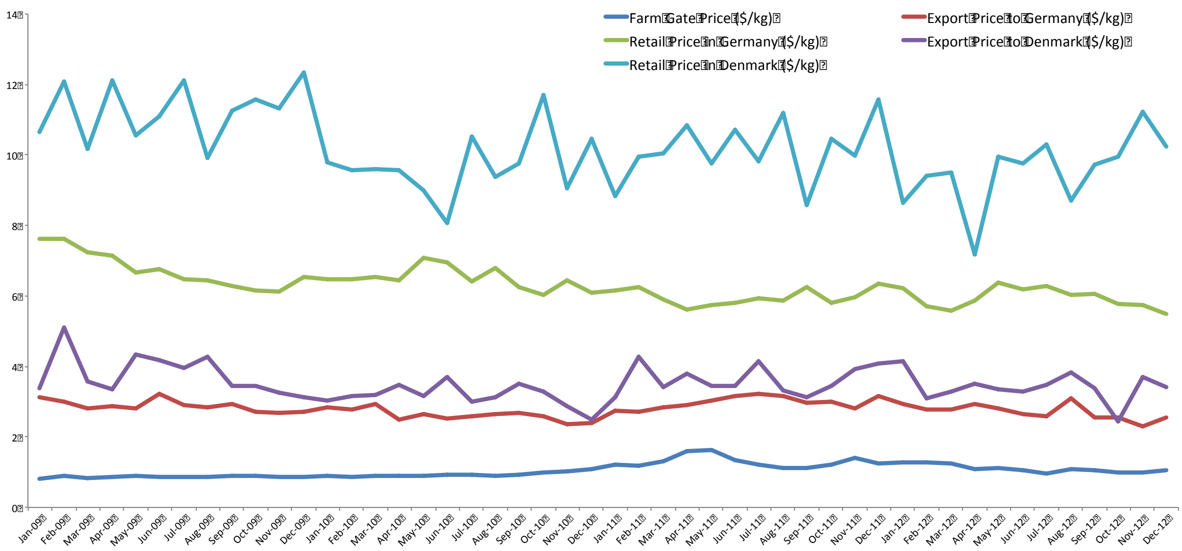


Figure 3. Prices of pangasius along the value chain

The farm gate and export prices of pangasius are much lower than the retail prices in the Germany and Denmark. On average, retail price are twice as high as the producer prices. The export and retail prices appear to show a decreasing trend while the farm gate price shows an upward trend. In addition, the export and retail prices in Denmark are recorded as more fluctuating than the ones in Germany.

Macroeconomic Variables and Boom & Burst Cycle

Booms and busts analysis for the price of seafood products and pangasius in particular are very important. From the macro policy point of view, commodity booms and busts have great economic and social impact as well as the development of a certain industry in the nations, especially in developing countries (UNDP, 2016). Accordingly, dependence on commodities often fails to generate development because volatile international prices can lead to macroeconomic and political instability. Under business perspectives, the misalignments in prices can affect the production plans of enterprises.

Macroeconomic fundamentals are often used as the popular assessments of the causal source of booms and busts in commodity prices. In the literature, macroeconomic fundamentals have been investigated as indicators of booms and busts in commodity price (Carter et al., 2011; Orden, 2012;

Rausser et al., 1986) as well as asset and stock prices (Machado and Sousa, 2006; Gerdesmeier et al., 2012). Carter et al., (2011) assess macroeconomic linkages, including exchange rates and interest rates, to commodity booms and busts, using as examples the two largest and most dramatic events since World War II: the booms and busts of 1973-1974 and 2007-2008. Orden (2002) analyses the effects of exchange rate on agricultural trade. Rausser et al., (1986) construct the econometric model to test macroeconomic linkages, taxes, and subsidies in the U.S. agricultural sector.

The seafood export demand may be affected by some factors such as exchange rate fluctuations (Xie et al., 2008), type of currency (Straume, 2014), distance to import markets (Eaton and Kortum, 2002; Asplund, Friberg and Wilander, 2007), tariffs (Kinnucan and Kyrland, 2005) and non-tariff barriers raised in import markets (Duc, 2010), supply volume/production growth (Thong et al., 2016) and seasonal effects (Wessells and Wilen, 1994).

An Illustration of Modelling Boom & Burst Cycle-Next Steps

Detecting boom and bust cycle of commodity price has always represented an extremely challenging work. According to Gerdesmeier et al. (2012), the methods that have been applied in order to identify periods of booms and busts can be classified into two broad categories. The first category includes purely statistical methods, which identify particularly strong or weak commodity price developments (Bordo and Jeanne, 2002; Gerdesmeier et al., 2010; IMF, 2009). The second category consists of model-based analysis of the fundamental drivers of the development in commodity price indices (Machado and Sousa, 2006; Gerdesmeier et al., 2012).

In general, defining a specific threshold is the first step in the quantify price misalignment or booms and busts. The threshold can be defined as the average growth rate less a multiple (1.3) of the standard deviation of the growth rates (Bordo and Jeanne, 2002); or choosing a different multiple of the standard deviation (Gerdesmeier et al., 2010) or a constant value (IMF, 2009). Then, booms and busts are identified as periods when these misalignments are larger than a certain threshold. For the purpose of this study, we adopt “boom and bust” definition from Gardesmeier et al., 2012, in which booms/busts are represented by observations falling outside the [20, 80] interval (for booms and busts, respectively).

In the next steps (D2.3.2) boom & burst cycle of five fish species within PrimeFish plus pangasius exported to the EU will be identified and quantified. We will apply the quantile regression to detect whether the fish prices are undervalued or overvalued by comparing the individual market indices with the levels which would be implied by macroeconomic variables. In the literature, macroeconomic fundamentals have been investigated as indicators of booms and busts in commodity price (Carter et al., 2011; Orden, 2012; Rausser et al., 1986) as well as asset and stock prices (Machado and Sousa, 2006; Gerdesmeier et al., 2012). For instance, Carter et al., (2011) assess macroeconomic linkages, including exchange rates and interest rates, to commodity booms and busts, using as examples the two largest and most dramatic events since World War II: the booms and busts of 1973-1974 and 2007-2008. Orden (2002) analyses the effects of exchange rate on agricultural trade. Rausser et al., (1986) construct the econometric model to test macroeconomic linkages, taxes, and subsides in the U.S. agricultural sector.

As an illustration, we present an estimate of boom & burst cycle for pangasius frozen fillets exported to the EU markets. Exchange rate (VND/Euro) is used as a sole independent variable determining the boom & burst cycle. Monthly export price (€/kg) of Vietnamese pangasius to the Western European is available from the International Trade Centre (www.trademap.org). Exchange rate (VND/EUR) is monthly value and collected from website www.investing.com.

The price of Pangasius on the European market ranges from 1.95 € /kg (25% quartile) to approximately 2.25 (75% quartile). In the period of observation, the exchange rates fluctuate in the range of 24,000 (25% quartile) to 28,000 (75% quartile) VND/EUR. Generally, the price of Pangasius is negative relationship with the exchange rate. However, some observations on the right of 75% quartile (Q3 + 1.5*IQR) of exchange rate show a positive relation (see Figure 4).

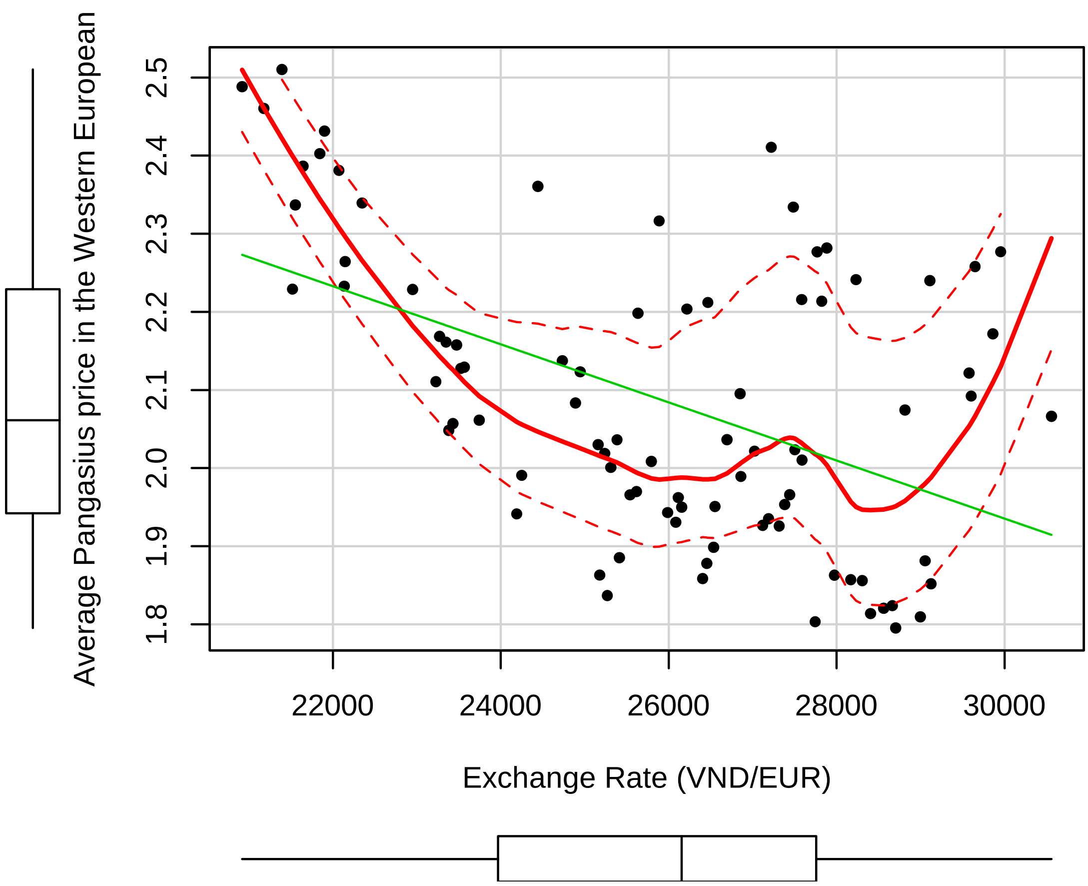


Figure 4. Overview relationship between Pangasius price and Exchange rate

In order to better quantify the effect of exchange rate on the specific quantiles of the pangasius price, the quantile regressions have been designed for the 20th quantile, 50th quantile (median) and 80th quantile. Table 2 reports the results of quantile regressions with respect to three levels of quantiles.

Table 12 Quantile regression results

	Dependent variable: log(Price in EUR)		
	τ = 0.2	τ = 0.5	τ = 0.8
log(VND_EUR)	-0.668***	-0.643***	-0.323***
	(0.072)	(0.125)	(0.110)
Constant	7.458***	7.237***	4.097***
	(0.743)	(1.267)	(1.112)
Observations	87	87	87
Note:	*p<0.1;	**p<0.05;	***p<0.01

The results show the exchange rate has negative relation with the price of pangasius, indicating that a devaluating VND will lead to a lower export price to the EU market. These effects are statistical significance at all levels but with differences in the coefficients across the quantiles. In particular, the 1% increase in exchange rate (VND/EUR) leads to the decrease in price of pangasius in the Western European market by 0.668% at the 20th percentile, by 0.643% at the 50th percentile and

The next task is to detect booms and busts in pangasius prices based on the results of quantile regressions. Using the estimated coefficients, we calculate fitted values for specific quantiles of the conditional distribution and plot them against the development in real pangasius prices. If pangasius prices move into the highest (lowest) quantile, this can be dubbed as a boom (bust) period as showed in Figure 5.

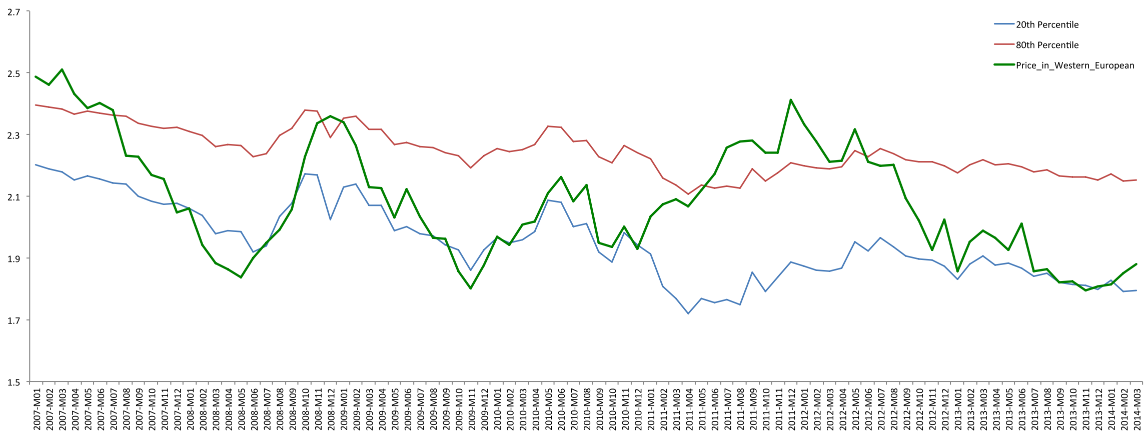


Figure 5. Booms and busts in pangasius price using quantile regression

Accordingly, booms are identified in the 2007-M01 – M07; 2008-M12; 2011-M06 – 2012-M05. Busts are detected in the periods 2007-M12; 2008-M02 – M06; 2008-M08 – M09; 2009-M08; 2009-M10 – M12; 2010-M02, 2010-M12, 2013-M11 and 2014-M1. The following figure 6 offers a visual look on booms and busts of pangasius prices.

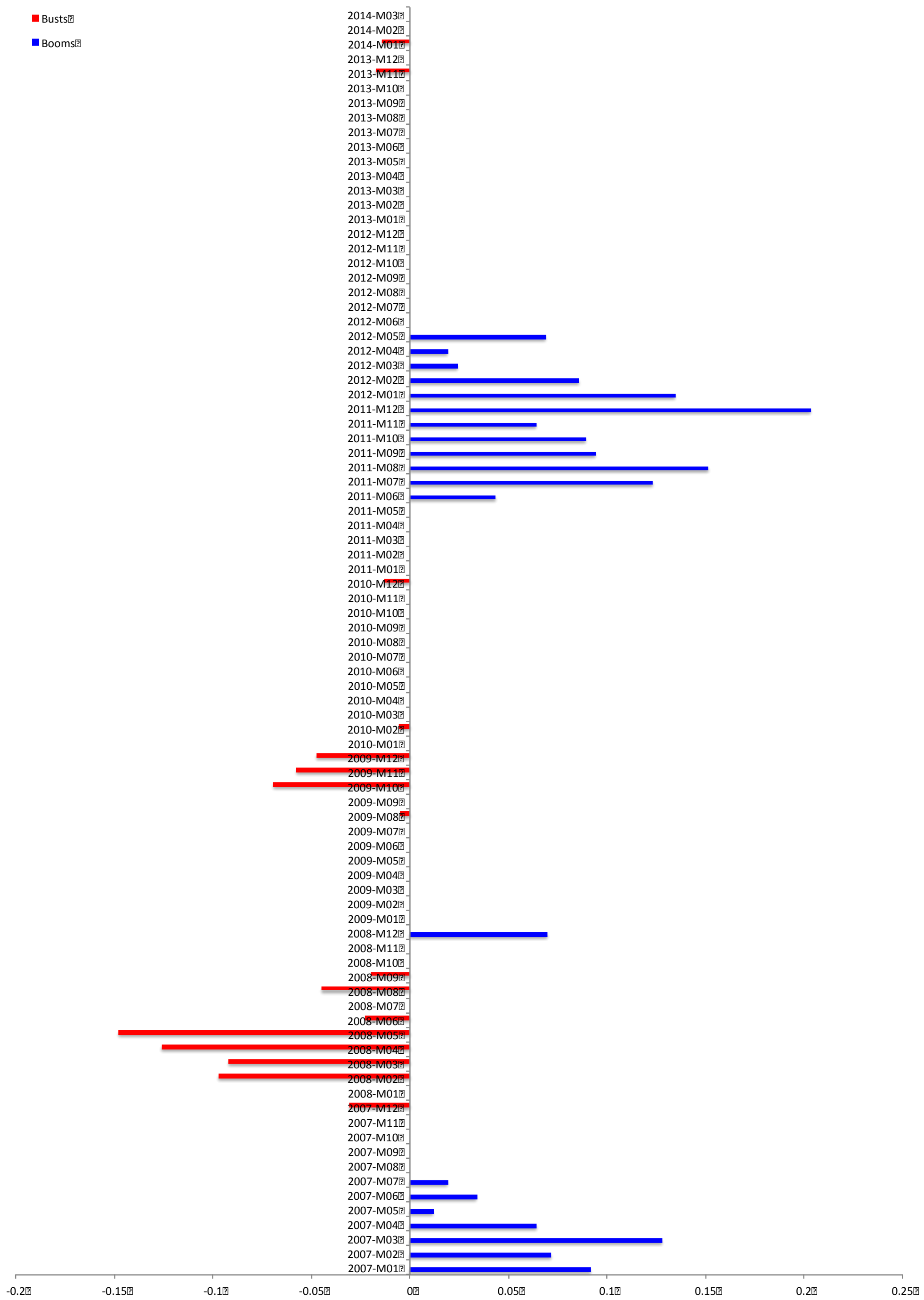


Figure 6. Visualization of booms and busts of pangasius prices

Price transmission and Market Integration

In this part of the deliverable price transmission along the value chains has been analysed. The analysis is available for the species with "good"data as described in the chapter devoted to boom & bust analysis.

Price transmission refers to the process in which upstream (producer) prices affect downstream (retail) prices. The relationships between different stages in the value chain (upstream and downstream), based on a simultaneous equilibrium, have been described by the theory of derived demand.

The absence of complete pass-through of price changes and costs from one market to another has important implications for economic welfare. Price transmission studies provide important insights into how changes in one market are transmitted to another, and consequently reflect the extent to which markets function efficiently.

It is important to study whether markets function efficiently because imperfect price transmission can be a sign of the existence of market power.

However, this method is very data demanding, and, in practice, is often impossible to perform. Therefore, only the prices at the different levels of the market chain are usually analysed, especially for primary products.

The price difference of a product between two stages of the market chain is the margin. In price transmission analysis, causality is used to determine whether a price at a market stage changes as a consequence of changes in a price at another market stage.

For fresh product markets, in the long-run, the causal relation is often considered to be upward (i.e. the price from the production sector to the retail sector grows up). In order to assess the strength of the causal relation a causality test is performed. A time series is said to cause another one if the values of the first series provide statistically significant information about values of the second series. Here we report results (in different markets/countries) where the first sale price is assumed to cause the retail price.

Because of the non-stationary pattern of prices in the long term, it is also important to analyse the common trends shared in the price transmission. Therefore, a further study of the cointegration and implementation of error correction models become both important.

The general formulation is driven by the empirical evidence is that there is strong support to use a Granger causal model (mixed with Autoregressive Moving Average [ARMA] model) However the effect of lagged causality of X(t-1) over Y(t) can be hidden as absorbed by the time-evolution modelled with the ARMA model. The formal definition of the ARMA model with the explanatory variable is

$$Y_t = c + \phi_1 Y_{\{t-1\}} + \theta_1 \epsilon_{\{t-1\}} + \gamma_0 X_t + \gamma_1 X_{\{t-1\}} + \epsilon_t,$$

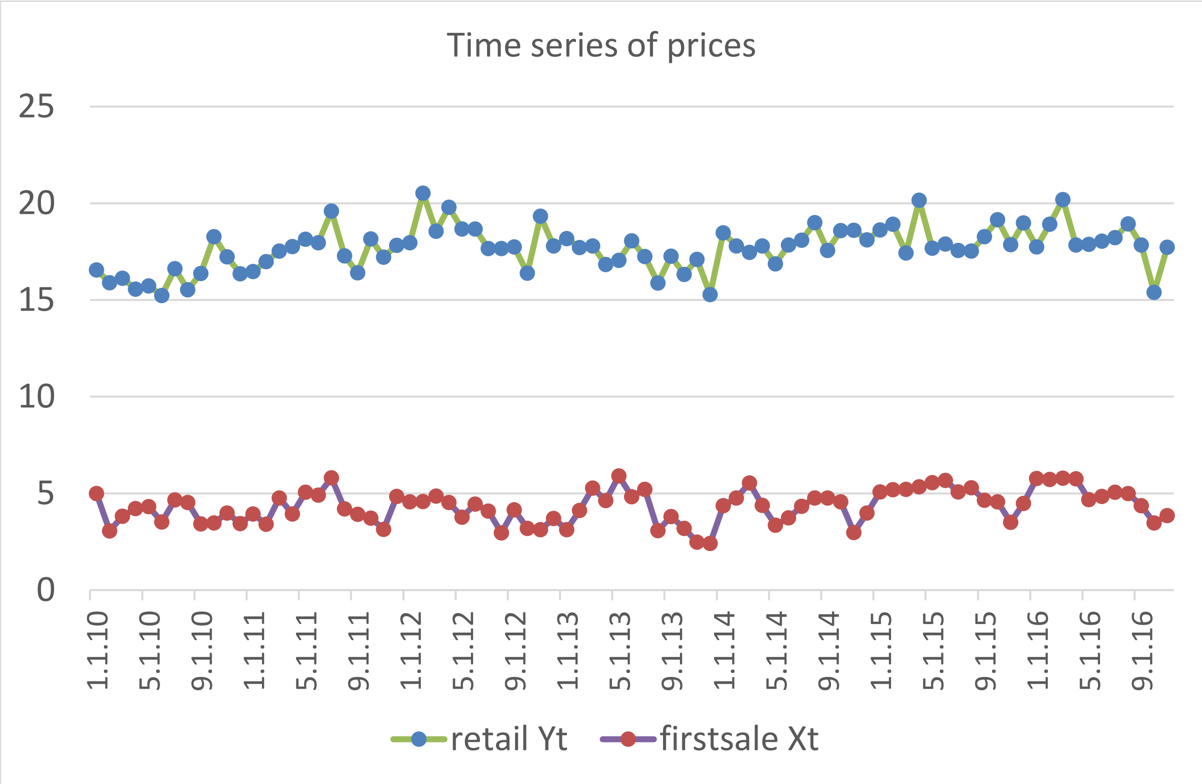
where ϵ_t is a White Noise (assumed Gaussian) error term. The model can be used only when FIRST SALE price and RETAIL price are both available for a sufficiently long time period (with monthly data) and no missing data. So, in the sequel, only combinations of fish/country where these restrictions are met will be under investigation.

Under the model assumptions it is expected that changes in X will cause changes in Y. This cause-effect transmision works if the time series share, at least, a mild common pattern (i.e. Y is large when X is large and vice-versa) and have a kind of long-term steady mean-stationary.

The parameter c and γ_0 are probably the two most important in terms of economic interpretation. The constant c is the fixed mark-up and γ_0 is the proportional mark-up (elasticity). Price transmission elasticity is defined as "the relative change in retail price to the relative change in producers' price when other factors affecting processors behaviour are held constant". So, the elasticity of price transmission measures the percentage change in the price at a downstream stage of the market chain, in relation to the relative change in the price of the same product at an upstream stage in the market chain.

The statistical hypothesis will assess the significance of the parameters via their p-value and only relevant parameters will be included. The comments to parameters will be mostly economical referred to the magnitude at which the prices are transmitted from first sale to retail. When common trend are found a modification to the above model will take into account the cointegration term.

Trout Denmark



The two price series seem to have a similar pattern and the full model can then be fitted. Running the optimization with GRETL the output reports the following results

	Coefficient	*Std. Error*	*z*	*p-value*
c	16.0064	0.767021	20.8683	<0.0001
ϕ_1	0.902918	0.0795657	11.3481	<0.0001
θ_1	−0.654951	0.117306	−5.5833	<0.0001
γ_0	0.469741	0.137525	3.4157	0.0006
γ_1	−0.109701	0.134881	−0.8133	0.4160

There is a parameter with large p-value that must be discarded from the complete model. The irrelevant variable is X(t-1). Thus, fitting a complete model suggests that Granger causality does not hold when no lags are considered, so lagged effects are excluded from the full model. A reduced form has the expression

$$Y_t = c + \phi_1 Y_{\{t-1\}} + \theta_1 \epsilon_{\{t-1\}} + \gamma_0 X_t + \epsilon_t,$$

Running into GRETL the output is reported in the following table

	Coefficient	*Std. Error*	*Z*	*p-value*
c	15.6909	0.645011	24.3265	<0.0001
ϕ_1	0.905419	0.0759269	11.9249	<0.0001
θ_1	−0.657933	0.114342	−5.7541	<0.0001
γ_0	0.428907	0.128688	3.3329	0.0009

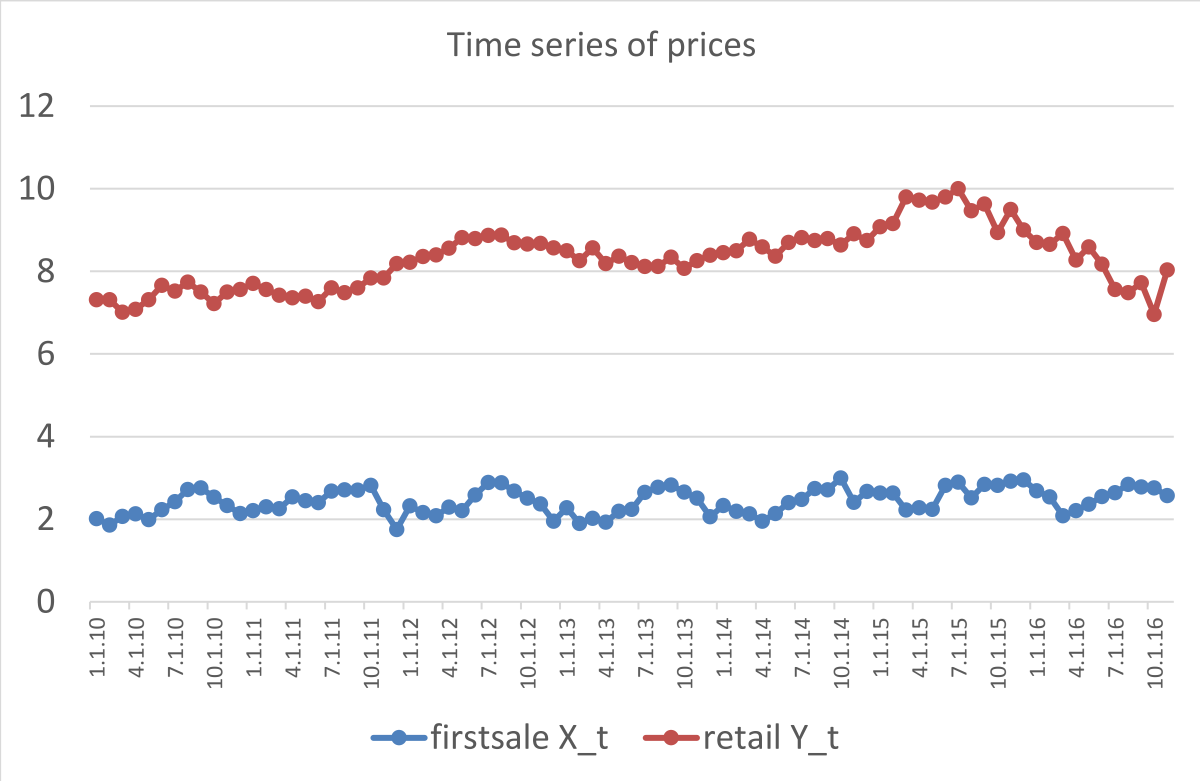
All parameters are now statistically significant.

The interpretation is the following: the value of c is the fixed margin when the trout is traded from first sale to retail. So, there is an average constant mark-up of 15.7 Euro.

The ARMA parameters ϕ_1 and θ_1 somehow compensate each other. There is a positive relationship between the price Y(t) and Y(t-1), but the magnitude is less than 1 (approximately 0.9 so that stationarity is implied and forced) and a mean-reversion effect is observed. That suggests the following: if there is an "extreme" price at month t (either very large or very small) there is an average effect to return to "normality" the subsequent month t+1. A similar comment holds for -0.66.

Finally, the value of $\gamma_0 = 0.43$ is the proportional mark-up. It tells that (holding fixed the temporal effects) for a relative increase of unit price in the first sale the relative increase in the retail price grows of about 0.43. We have positive elasticity, but with magnitude less than proportional so that retailers tend to absorb sharp increase of price arising at first sale, without a "full transmission" to the retail level.

Cod United kingdom



The two price series seem to have a similar pattern and the full model can then be fitted. Running the optimization with GRETL the output reports the following results

	Coefficient	*Std. Error*	*z*	*p-value*
c	8.33785	0.625086	13.3387	<0.0001
ϕ_1	0.963981	0.0276193	34.9024	<0.0001
θ_1	−0.280184	0.0885191	−3.1652	0.0015
γ_0	−0.0688335	0.126521	−0.5440	0.5864
γ_1	−0.0700435	0.126859	−0.5521	0.5809

There are two parameters with large p-value that must be discarded from the complete model. Since the most important variable for price transmission is X(t) it would be sensible to discard one variable at a time and the choice is to start discarding X(t-1), but this does not lead to significant improvement.

The irrelevant variables are X(t) and X(t-1). Thus, fitting a complete model suggests that Granger causality does not hold at all for this pair fish/market. In other words there is a fixed mark-up from the retailer but all shocks in the first sale market will not be absorbed by the retailer and transmitted to the final customer "the way they come". The reduced form has the expression

$Y_t = c + \phi_1 Y_{\{t-1\}} + \theta_1 \epsilon_{\{t-1\}} + \epsilon_t,$

Running into GRETL the output is reported in the following table

	Coefficient	*Std. Error*	*Z*	*p-value*
ϕ_0	0.423809	0.284329	1.4906	0.1361
ϕ_1	0.949816	0.0333402	28.4886	<0.0001
θ_1	−0.273421	0.107892	−2.5342	0.0113

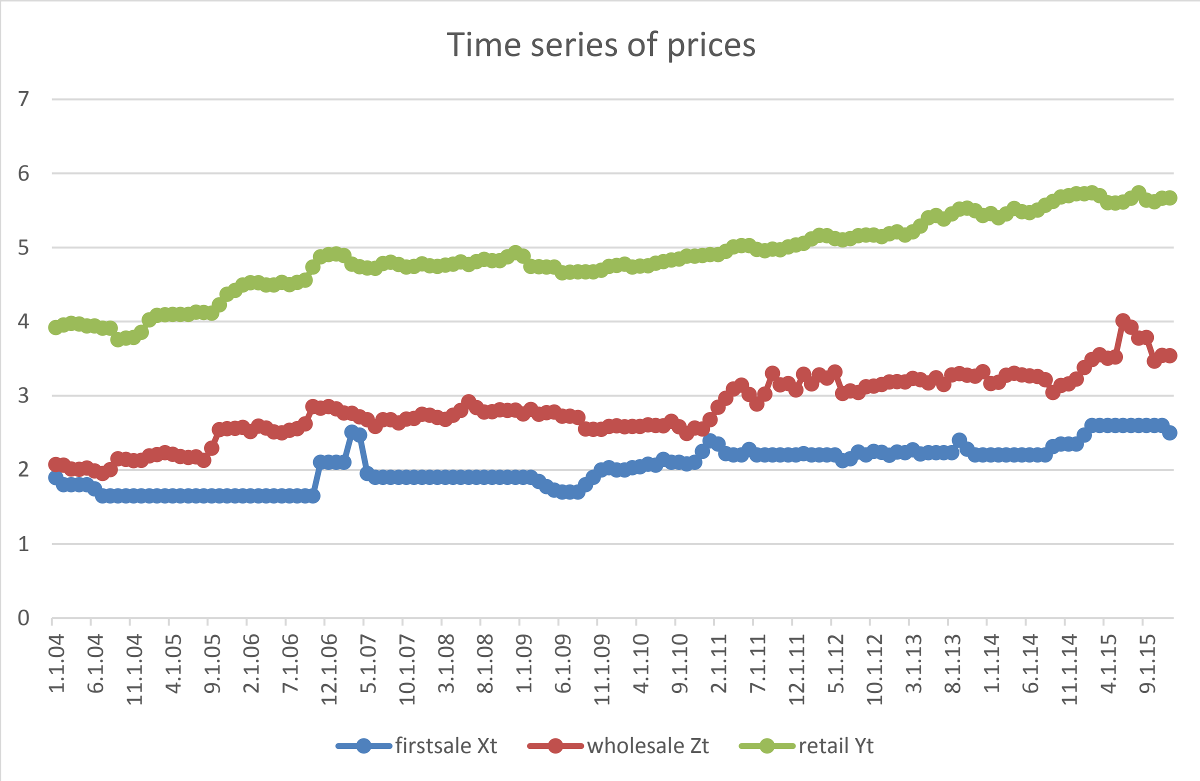
When a simple ARMA model is fitted the constant has to be mapped back into the original scale/unit of measure. This is achieved by

$$c = \frac{\phi_0}{1 - \phi_1} = 8.44$$

which represents the average mark-up, in Euro, that the retailer applied to the first sale market. All parameters are now statistically significant.

The ARMA parameters ϕ_1 and θ_1 have opposite sign but the magnitude of the AR is dominating. This suggests that on average the retail there is a strong relationship between the prices Y(t) and Y(t-1) where again the overall magnitude is less than 1 and a mean-reversion effect is observed. Also for this pair fish/country if there is an "extreme" price at month t (either very large or very small) there is an average effect to return to "normality" the subsequent month t+1.

Trout Spain



For this pair fish/country there are more observations available. The quality of First sale is, however, questionable, as no variability is observed for many consecutive monthly data.

First investigation is price transmission from X (first sale) to Z (Wholesale). The fitted causal Granger model, however, does not offer anything relevant from an economical view point. The AR(1) is the only significant component (but some issues about stationarity have to be raised) as the estimated parameter is approximately 0.98 (very close to the unity). The price transmission from first sale to wholesale is the constant mark-up of approximately 2.49 Euro. However, because of the quality of the X(t) it is advisable to trust little the inference from this model

	Coefficient	*Std. Error*	*Z*	*p-value*
c	2.48572	0.441623	5.6286	<0.0001
ϕ_1	0.983896	0.0156609	62.8249	<0.0001

Much more interesting is the price transmission form wholesale to retail. To adjust the notation the model is written by replacing Z (wholesale) to X (first sale).

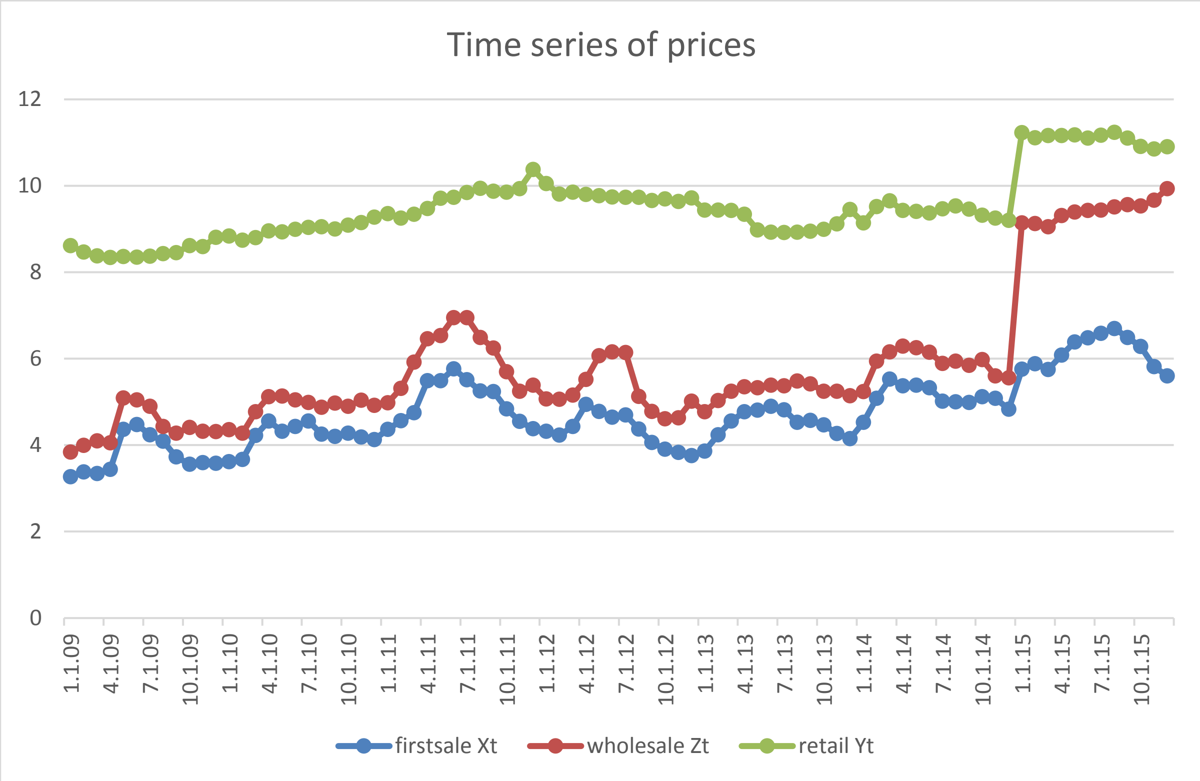
$$Y_t = c + \phi_1 Y_{\{t-1\}} + \theta_1 \epsilon_{\{t-1\}} + \gamma_0 Z_t + \gamma_1 Z_{\{t-1\}} + \epsilon_t,$$

Running the optimization into GRETL gives the results reported in the table below. The first order causal Granger model holds in this case. The fixed mark-up from wholesale to retail is of 4.38 Euro. There is a very strong AR effect showing some "long memory" in the retail price, i.e., holding fixed everything else, there is a tendency for retail prices to stay around a mean level for several months before changing mean level (0.99).

The proportional elasticity is very small (even if positive). This implies that spikes in the wholesale market price are unlikely to be fully transmitted to retail prices, since the magnitude is of order 0.07 and 0.09 respectively. So, using approximate numbers to help reading, nearly 16 cents of Euro (summing the two relative elasticities) are transmitted to retail prices. This looks a negligible amount (yet statistically significant) when compared to the fixed mark up of nearly 4.4 Euro. There is, then, a price transmission from wholesale to retail which has small relative magnitude, so that retail market absorbs most of the shocks that may affect the wholesale prices and does not transmits those shocks to the final consumer.

	Coefficient	*Std. Error*	*z*	*p-value*
c	4.37729	0.585273	7.4791	<0.0001
ϕ_1	0.995296	0.00590263	168.6191	<0.0001
θ_1	0.352421	0.084924	4.1498	<0.0001
γ_0	0.0682548	0.0409827	1.6655	0.0958
γ_1	0.0902727	0.0412757	2.1871	0.0287

Seabream Spain



A relevant feature is clearly the sudden spike that arose in the wholesale and retail markets from January 2015. This is clearly an outlier which can affect all model structure and an intervention analysis can be performed to assess the influence of such level-shift.

Since the level shift does not appear at first sale level, it makes sense to investigate directly the price transmission from wholesale to retail (the optimizer does not even converge when price transmission from X to Z is sought).

To adjust the notation the model is written by replacing Z (wholesale) to X (first sale), as in the previous case. However, the only there is not lagged effect of Z on Y, so a reduced Granger causality is found under the representation

$$Y_t = c + \phi_1 Y_{\{t-1\}} + \gamma_0 Z_t + \epsilon_t,$$

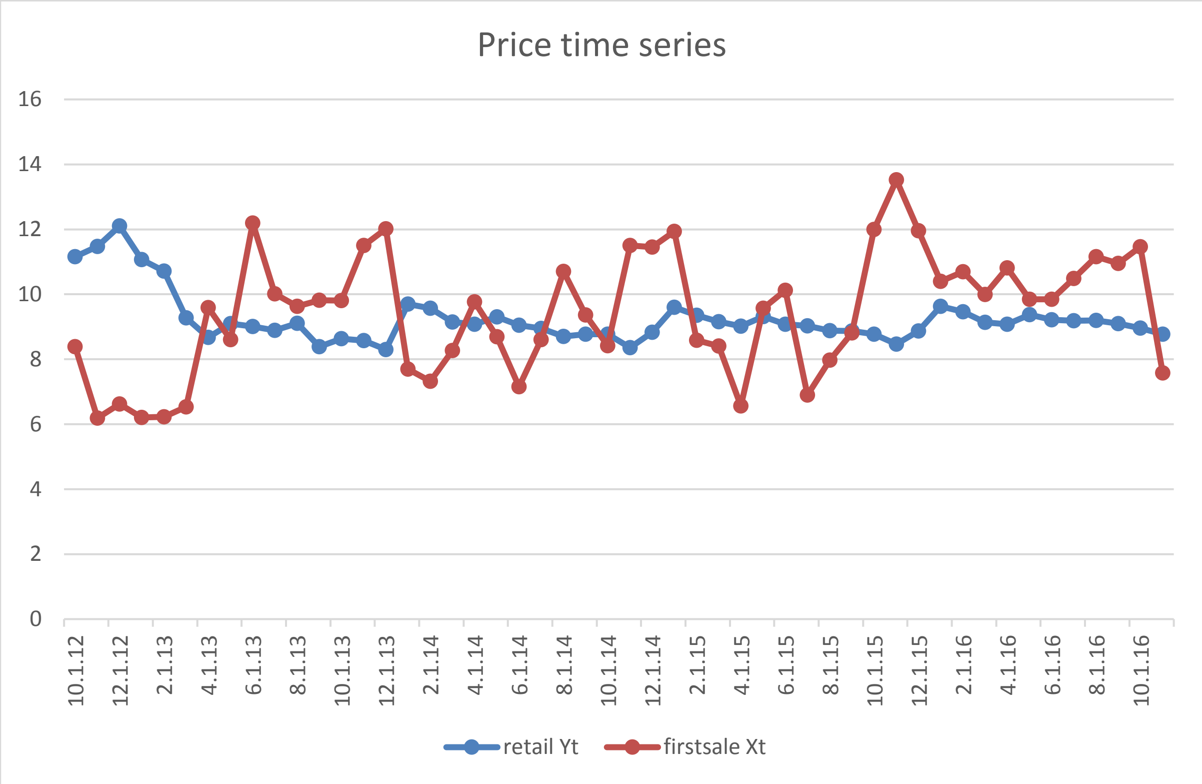
Running the optimization into GRETL gives the results reported in the table below.

The fixed mark-up from wholesale to retail is of 7.12 Euro. There is again an AR(1) effect showing some persistency to stay around the same level (0.88).

The proportional elasticity is again positive and with a magnitude that is again less than one. The economical interpretation is that any potential shock in the wholesale market is absorbed by the retail market which is not transmitting the full shock to the final customer. That is evident from the plot of the data where the spike in the wholesale is (relatively) larger than the spike in the retail price.

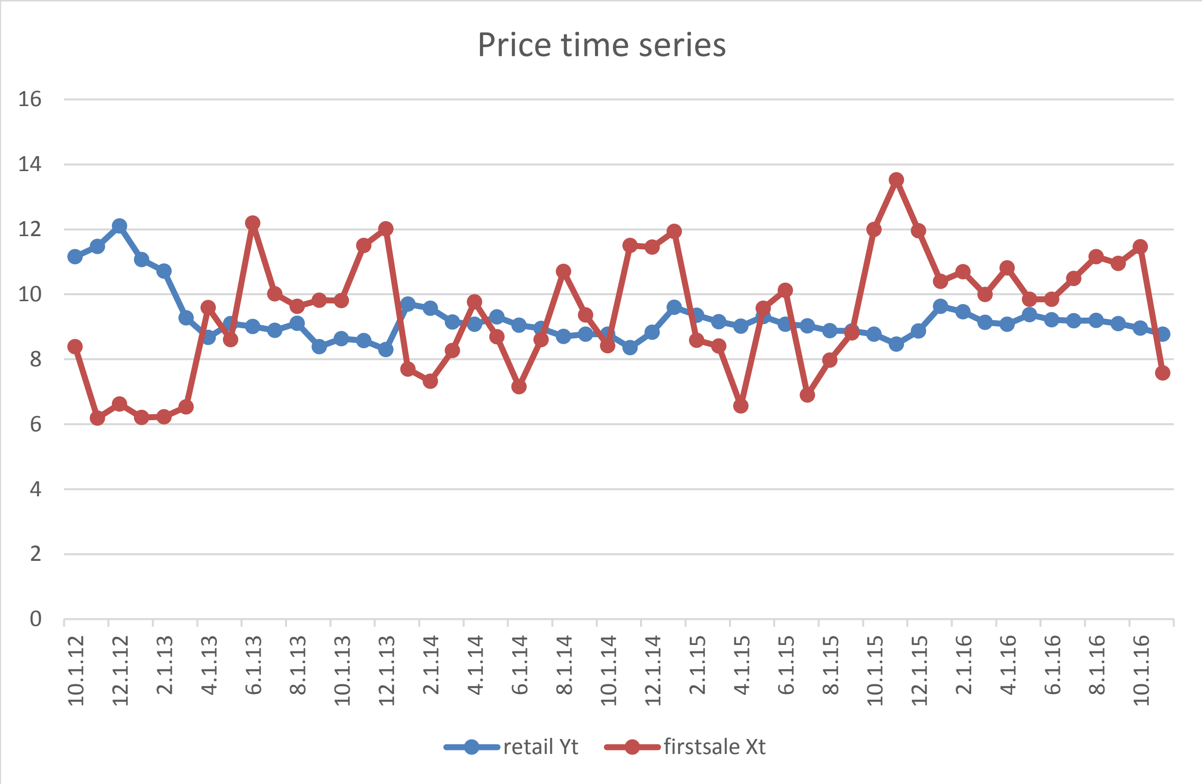
	Coefficient	*Std. Error*	*z*	*p-value*
C	7.12887	0.256312	27.8133	<0.0001
ϕ_1	0.880791	0.0483471	18.2181	<0.0001
γ_0	0.40201	0.0355455	11.3097	<0.0001

Seabream Italy



This series is very challenging as for several months the first sale price is larger than the retail price. It is difficult to trust the Granger model in this example which, effectively show no variables statistically significant. There is no evidence of price transmission from first sale to retail.

Seabass Italy



Also in this pair fish/country there is overlap between first sale price and retail price which suggest that if there is any Granger causal test, then it will be showing a negative proportional elasticity.

The model is reduced as only one AR parameter is significant and X(t) affects Y(t) with a negative coefficient. The model is

$$Y_t = c + \phi_1 Y_{\{t-1\}} + \gamma_0 Z_t + \epsilon_t,$$

and the optimizer in GRETL returns the following results

	Coefficient	*Std. Error*	*z*	*p-value*
C	10.1069	0.481172	21.0047	<0.0001
ϕ_1	0.849451	0.0847128	10.0274	<0.0001
γ_0	−0.0796078	0.0362281	−2.1974	0.0280

There is a constant mean value of nearly 10 Euros showing the average price in retail market it is the mark-up that retailers place to the final customer. A mild persistency is in action as 0.85 is the parameter driving the auto regression, suggesting that, on average, the price from month t to month t+1 is connected positively (i.e. a month with low is likely to be followed by a month with a similar price and vice versa).

Finally, as expected a priori, there is a negative relative elasticity. The estimate is small, in magnitude, but statistically significant (at least at 5% level).

This is suggesting that the retailers are "cooling" the spikes in the first sale market and keep an average price at relatively constant level even if the first sale price is moving well above the average. In other words, retailers seem to alternate months of losses and gains. It is remarkable to observe that recent months are likely to have been economically negative for retailers, which have absorbed most of the spread difference in the prices.

Price transmission and Market Integration

In this part of the deliverable a preliminary analysis of price transmission among markets and between species has been tested and described for selected time series for Italy.
The first step of the analysis was to determine the correlation between import/export prices within available data, to the correlation between import prices in Italy and exports from Italy of seabass.
The import/export countries were chosen based on their importance of import and export of seabass for Italy (Croatia, Greece, Turkey, Austria, France, Germany, Slovenia, Spain).

The period under analysis run from January 2001 to June 2016.

Table 13: Correlation matrix

	Croatia Imp	*Greece Imp*	*Turkey Imp*	*Austria Exp*	*France Exp*	*Germany Exp*	*Slovenia Exp*	*Spain Exp*
Croatia Imp	1.00							
Greece Imp	0.65	1.00						
Turkey Imp	0.50	0.71	1.00					
Austria Exp	0.65	0.75	0.65	1.00				
France Exp	0.05	0.30	0.30	0.33	1.00			
Germany Exp	0.73	0.77	0.67	0.72	0.17	1.00		
Slovenia Exp	0.57	0.54	0.27	0.56	0.07	0.61	1.00	
Spain Exp	0.01	-0.02	0.25	0.12	0.18	0.01	-0.11	1.00

The correlation between Croatia and Greece Imp as well as Turkey and Greece Imp is strong (> 0.65).

There is also a strong link between export prices in Austria and import prices from Greece, Turkey and Croatia. Results show how for the export prices in Germany there is a strong correlation with the import prices from Croatia and Greece, as well as with the prices for exports in Austria.

A second step was to insert into the previous matrix a number of domestic prices.
After excluding ISMEA monthly data because available only at regional level, it was planned to use weekly data to the retail level and Wholesale.

It was not possible to turn the weekly data in monthly because there are years of 48 weeks and others between 49 and 53, all in the absence of dates (on EUMOFA database). Subsequent checks on weekly data shows that although the weekly data present there are no monthly. So there are no processes from weekly to monthly from EUMOFA, but only the pure inclusion of data from other sources (apparently by ISMEA).

Therefore it is not possible to obtain the monthly historical series starting from weekly data, which would have been used as import prices series.

In order to sort the problem out, analysis aimed to extract the needed data from Eumofa. Unfortunately, in Eumofa the available monthly time series are not the same as those available on a weekly basis.

The monthly data that we were able to collect are Import / Export Italy and First sale Italy. The two series were used to assess the correlations between these variables with the other sets of import or export prices.

Countries: Croatia, Greece, Turkey, Austria, France, Germany, Slovenia, Spain, Italy.

Reference period: from October 2012 to June 2016.

Table 14: Correlation matrix

	Croatia Imp	*Greece Imp*	*Turkey Imp*	*Austria Exp*	*France Exp*	*Germany Exp*	*Slovenia Exp*	*Spain Exp*	*Italy Import/Export*	*First sale price Italy*
Croatia Imp	1,00									
Greece Imp	0,09	1,00								
Turkey Imp	0,24	0,38	1,00							
Austria Exp	0,28	0,36	0,80	1,00						
France Exp	0,14	0,08	0,20	0,27	1,00					
Germany Exp	0,11	0,09	0,52	0,54	0,21	1,00				
Slovenia Exp	0,00	0,28	0,12	0,15	-0,06	0,17	1,00			
Spain Exp	0,08	0,02	0,41	0,38	0,08	0,19	-0,26	1,00		
Italy Import/Export	0,24	0,96	0,49	0,48	0,19	0,19	0,28	0,09	1,00	
First sale price Italy	-0,10	-0,10	0,09	-0,04	-0,28	0,05	-0,07	0,08	-0,11	1,00

Results show how between the Italian Imports / exports and Greece imports there is a strong correlation, confirming the theory that the two markets are strongly linked, so the import price to Italy from Greece becomes relevant into the Italian market. Moreover, there is a strong link between export prices in Austria and import prices from Turkey; export prices in Austria are correlated to exports prices in Germany. For first sale prices is not evident correlation with import prices. Only a small correlation with the export prices in France.

A preliminary analysis of price transmission among markets and between species has been tested and described for selected time series for Italy. In the Table are reported positive correlation bigger than 0,4 and negative bigger than 0,3 (in absolute value). It's evident that each correlation has to be verified, in real sense.

More specific and detailed analysis will be carried out for specific species, in the next period, covered by WP5.

Variable 1	Variable 2	Correlation Index
export_European_seabass_italy	export_Gilt_head_seabream_italy	0,628619008
export_European_seabass_italy	import_trout_finland	0,531309068
export_European_seabass_italy	import_Gilt_head_seabream_italy	0,493012705
export_European_seabass_italy	import_Gilt_head_seabream_cyprus	0,492645602
export_European_seabass_italy	import_Gilt_head_seabream_malta	0,477027117
export_European_seabass_italy	import_trout_portugal	0,472259776
export_European_seabass_italy	import_salmon_spain	0,465100947
export_European_seabass_italy	export_salmon_united_kingdom	0,449743897
export_European_seabass_italy	import_pangasius_sweden	0,448327706
export_European_seabass_italy	import_salmon_sweden	0,434292255
export_European_seabass_italy	export_salmon_germany	0,434214007
export_European_seabass_italy	import_pangasius_finland	0,432507185
export_European_seabass_italy	export_cod_italy	0,420775121
export_European_seabass_italy	import_trout_italy	0,42014081
export_European_seabass_italy	import_pangasius_malta	0,412711919
export_European_seabass_italy	import_herring_finland	0,412071252
export_European_seabass_italy	import_trout_netherlands	0,408839211
export_European_seabass_italy	export_cod_finland	0,404926812
export_European_seabass_italy	import_Gilt_head_seabream_germany	0,402502755
import_European_seabass_italy	import_pangasius_italy	-0,316296628
import_European_seabass_italy	export_pangasius_sweden	-0,366769868
import_European_seabass_italy	export_salmon_cyprus	-0,437661023
import_European_seabass_italy	export_cod_cyprus	-0,669706358
import_European_seabass_italy	export_European_seabass_ireland	-0,808259805
import_European_seabass_italy	export_herring_malta	-0,905742609

Table 15: price transmission among markets and between species

The first impression from this general overview of data analysis is that in a spatial scale in the last years above all those countries (in particular in the case of net importers of seafood, tended to be the most vulnerable to shocks to the system and become more correlated to each other.

The results of Task 2.3 will be used as main input materials to develop simulation models in WP5.

An insight in Price: gathering data in the case of trout, seabass and seabream in Italy

As there is a lack of appropriate production and socio-economic data (e.g., on supply and demand and trading information for various stages in the supply-chain) the idea behind the project is to gather data. Gathering data not only on aggregate level (publically available sources), but also from interviews to individual production companies (Annex 1), industry and sales organisations and other marketing channels or through mystery marketing activities.

Mystery shopping

A huge numbers of public or private founded researches analyse the causal relationship between different potential drivers for prices, such as demand growth, supply growth, changes in input prices or stocking policy. Some analysts are convinced that recent price developments are entirely explicable by market fundamentals, i.e. supply and demand. In addition, to adverse weather conditions, volatility in exchange rates, stock-to-use ratios, the impact of biofuel policies, the co-movements of commodity prices (energy, metals, etc.) and the increasing financialisation of agricultural commodity markets.

In this paragraph the focus is on price differences:

- for different market levels (first sale, retailers pricing and marketing strategies, due to marketing margins)
- for different area (regionally and internationally (import price))
- by quality attributes (from fishery to aquaculture, according to size, level of processing, etc.),
- price variability with over time (seasonal and cyclical variations, trends, and random behaviour)
- finally, some price show a different trends according to markets, fish size and seasonality.

Here reported the "the most cited issues" linked to **trout price evolution** in Italy from ISMEA report. These reports named "*Tendenze*" (Trends) (available in Italian language) are published four times a year. Here reported some parts for the last four years, used to discuss the behaviour of price for the Italian trout market and its main drivers.

The most cited "issues" linked to price

According to the quoted analysis by ISMEA, the most cited "issues" linked to price are:

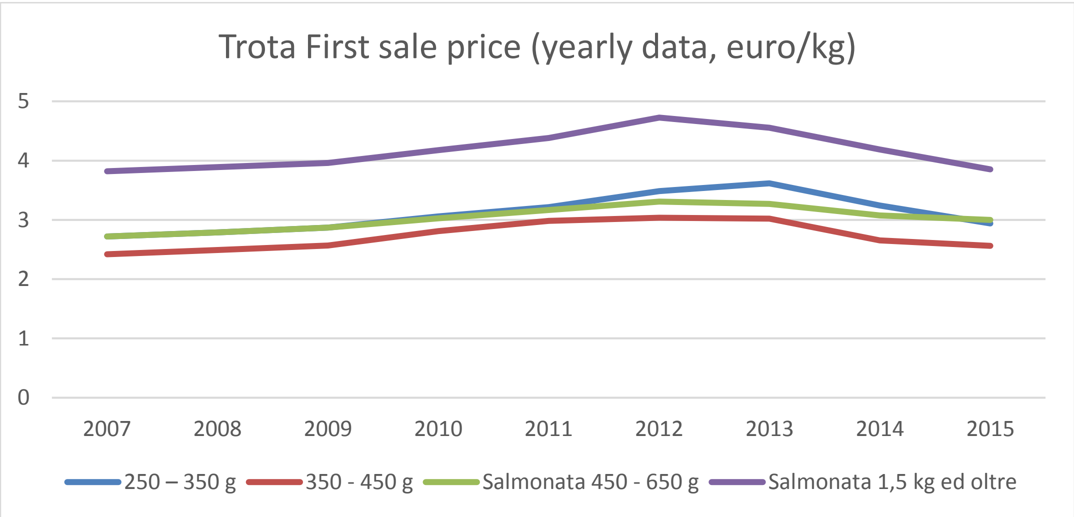
- Price varied with diverse magnitude for different grading (for fish species and for each species according size, level of processing and origin –aquaculture versus fisheries, national versus imported)
- In general price for smaller fishes is less variable than for bigger fishes

- Fish consumption shows a seasonality: high consumption in the summer and near Christmas holidays,
- Price fall in October-November and at the beginning of the year
- The marine products are more price sensitive to demand for traditional retailer
- The demand from Large Retailer in December shows an increasing quota also for aquaculture products (due to lower medium prices), in particular for salmon trout (the best substitute of salmon). It is connecting with the Large retailers strategy to "have the products" available in storage.
- Demand from Large Retailer is very important, and an important quota of products in under "umbrella brand" or private label. For these type of products, the price promotion (discounts) is important, in particular when there is a "low" demand. Typically, the discount is around 30%, more present for smaller fish and the products already "ready to cook" are increasing.
- In the reported period price tends to decrease (international trend?).

Example of price differentiation:

the case of TROUT

Species and size: the most valuable product is Salmon Trout or small sized trout (250-350 gr)

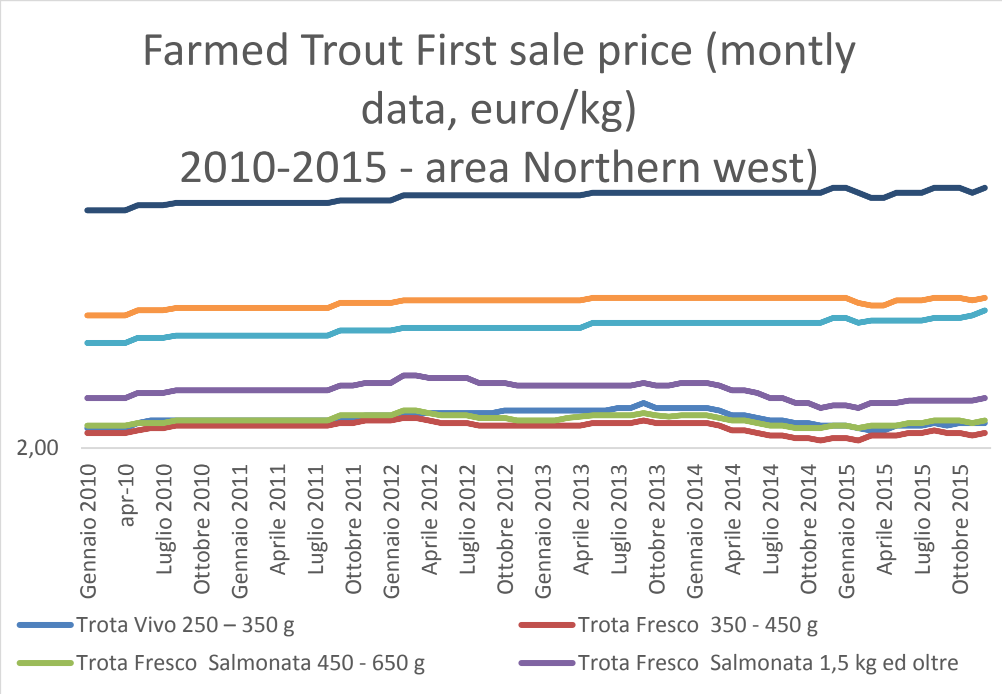


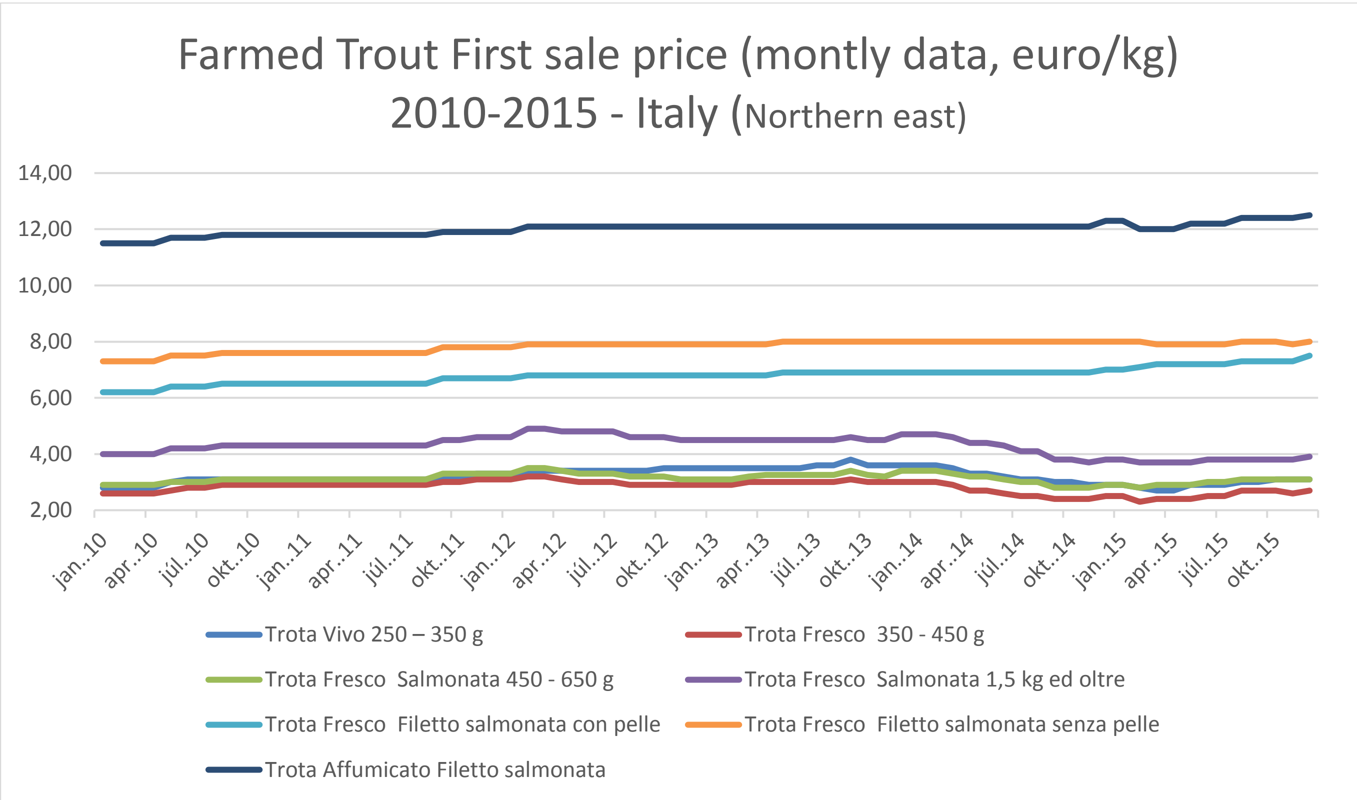
Source: our elaboration on ISMEA data

Price differences in different area (regionally): The prices in the graph are collected from local market, from 2010 to September 2015. Prices are available for four regional level (Northern-east Italy, Northern-west Italy, Central and Southern Italy)

Here reported the price for Northern-east Italy and Northern-west Italy area, for trout. The price shows different magnitude for similar trends.

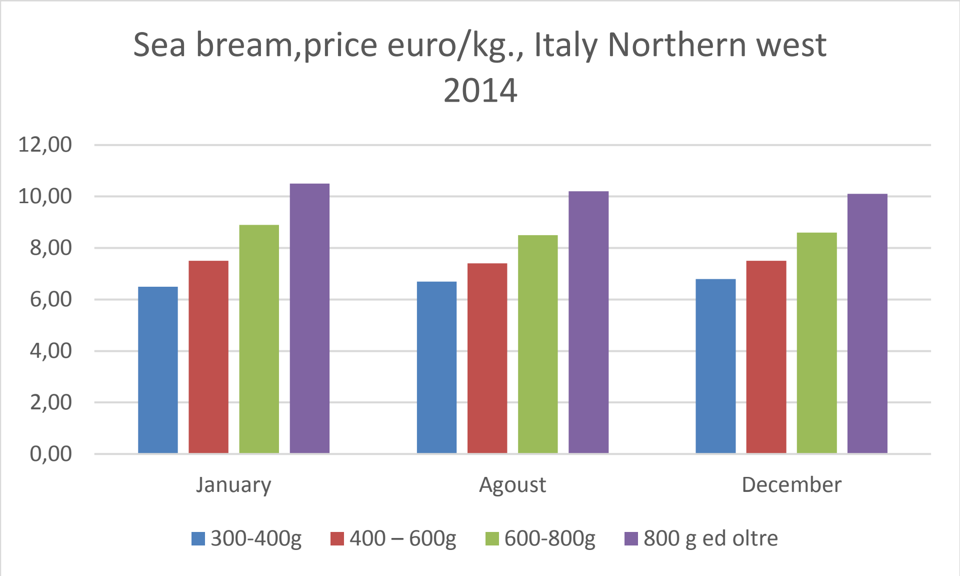
This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 635761

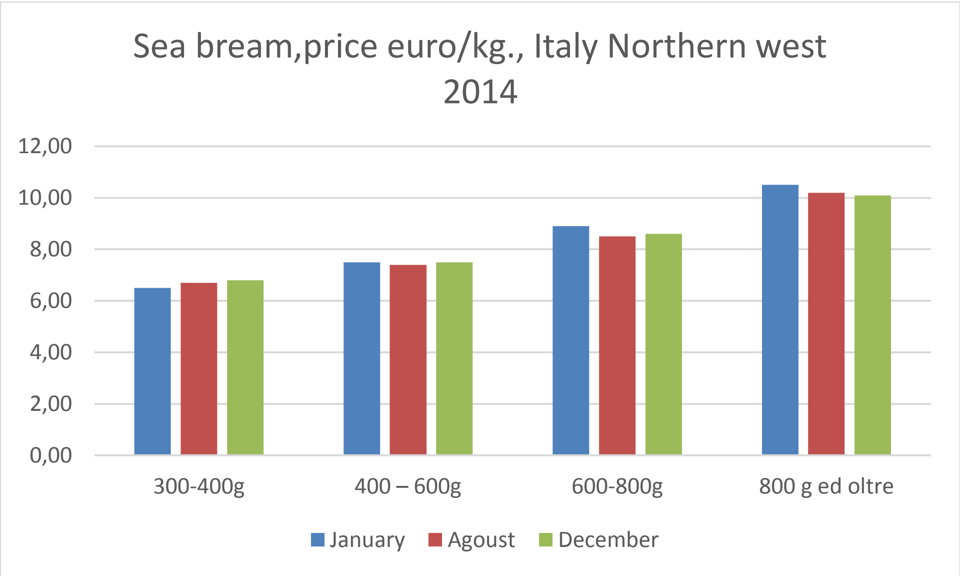




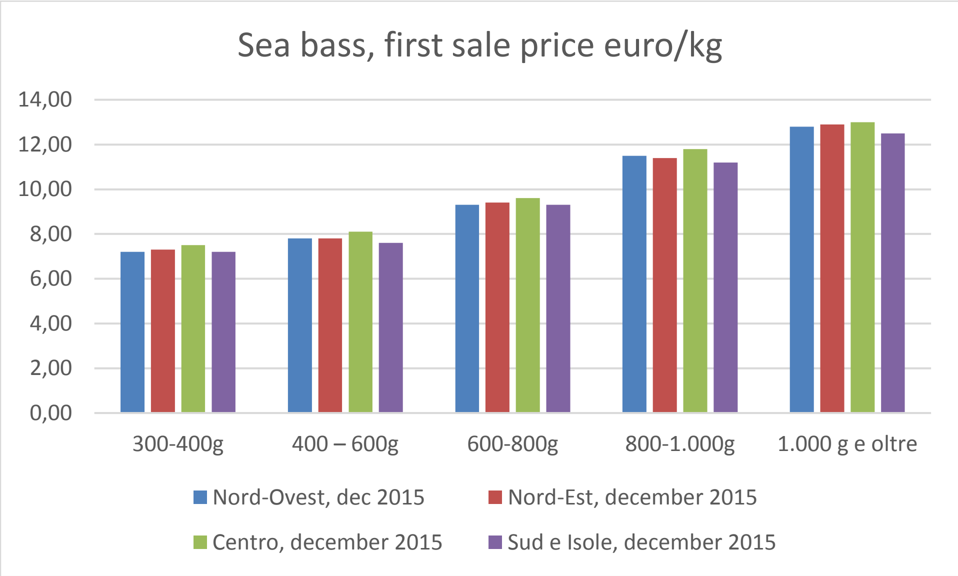
The case of Seabream

Looking at the example of sea bream, prices for Northern west of Italy in three months of 2014, January, August and December, presents similar "seasonality" effect among the products.



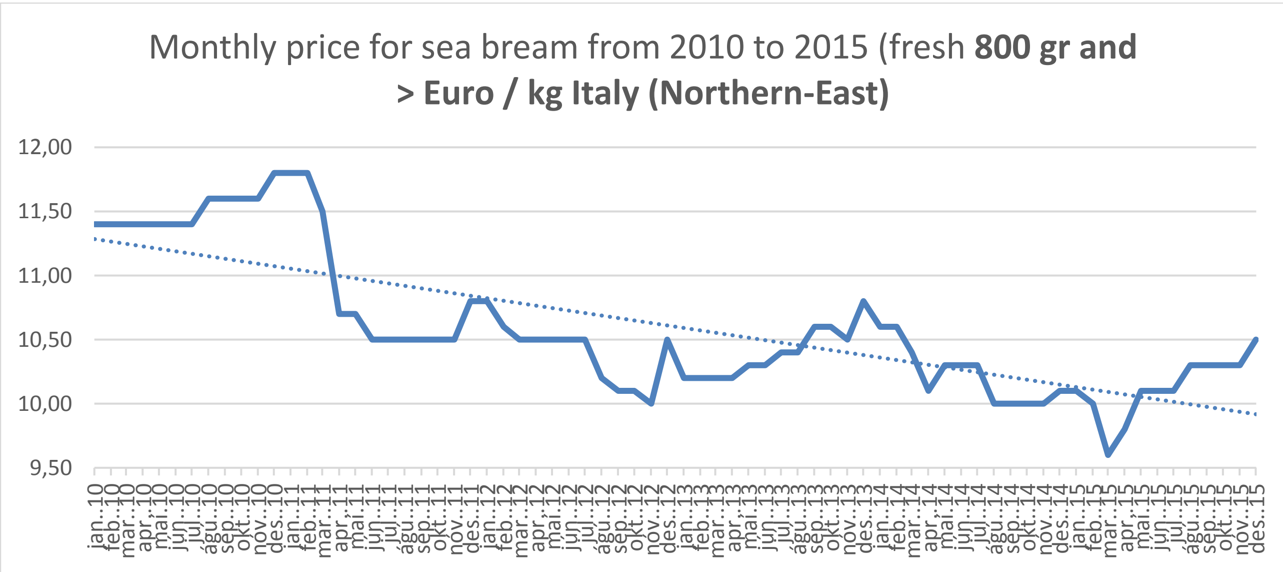


Price for Northern west of Italy in three months of 2014, January, August and December, we will note that "seasonality" differs among the products. The quotation is summer (august) is the higher for small products, in January, after Christmas holidays, the quotation is higher for big (more valuable) products (December prices show higher demand) for all type of products.



The case of Sea bass

Sea bass first sale price for different areas, (December 2015).
The Graph confirm that most valuable products are big products, but show also that the price in the area Centro, is higher than other areas price, for all type of products; the contrary for the South.



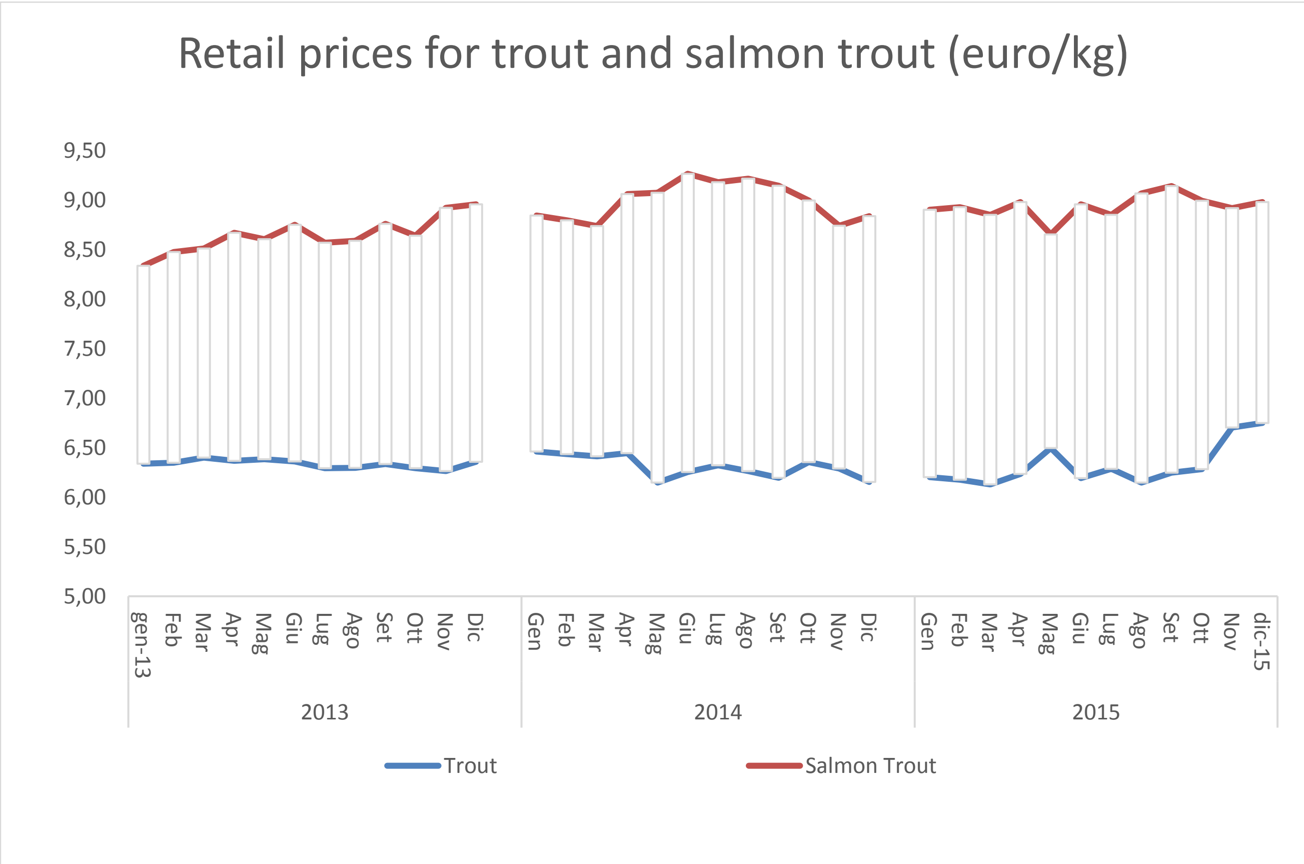
Graphing monthly production price for sea bream from 2010 to 2015. Visual analysis confirms that the trend is clearly decreasing (demand side effects), with peaks in November-December connected with higher demand, decreasing after winter and grow in the summer. The trend in consumption over the years shows that the consumption of fresh fish has undergone a sharp slowdown, first for white trout and sea bass, then for salmon trout and sea-bream. However in recent years, sea bream, sea bass and white trout have seen a decline even more important compared of the species considered most valuable by the consumers (salmon and sole). (From ISMEA Report)

Retail prices

Graphing retail prices for example, for trout and salmon trout from 2013 to 2015 (only data available). Visual analysis confirm that the trend is slightly decreasing (demand side effects) for trout and increasing for salmon trout (that benefits of more positive image). Seasonality of demand influences also on retailer prices.

The effects of imported fish may cause a shift between national and imported products, with more important effect on trout (in particular small dimension).

For example, according to the COMMISSION IMPLEMENTING REGULATION (EU) 2015/309 of 26 February 2015, imposing a definitive countervailing duty and collecting definitively the provisional duty imposed on imports of rainbow trout (trout < 1.2 kg) originating in Turkey, import price for Turkey remaining above EU price from 5 to 20 % in the period 2010-2012 (Annex 1).



The pricing policy of different retailers is also important aspects to be considered, and the pressure on market margins differ.

Promotion remain an important strategy: salmon trout from Italy, with a discount of price of 30%, the final price is 6.50 euro/kg, the product is branded with the Private Label (shop check February 5th 2016)

Segmentation by origin

In general, retailers offer seabass, seabream and trout from Italy with a premium price, compared to Greece or Turkish products. However, this premium is mainly linked to the size: since Italian seabream is generally marked at size 300-400 gr or more, bigger than Greek fishes (mainly 250-300 gr).

Turkey and Malta also supply low/average quality and small sizes. Turkey farmers now act on the market without subsidies from their country (Annex 2).

In Spain and France, there are higher quality and bigger size fishes. Moreover, a part of wild seabream in the export volume partly explains the higher average price. These products represent a niche market.

A recent shop check (February 2017) shows that segmentation from origin may be encompassed in real behaviour, in particular in the case of sea bream.

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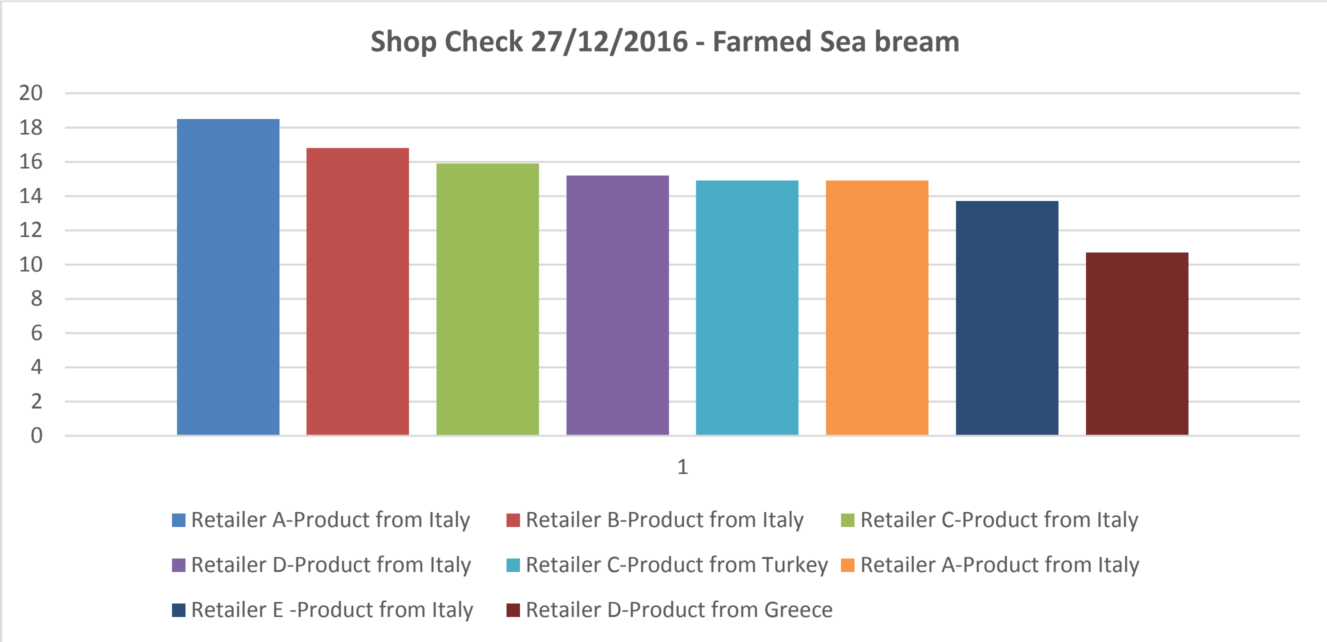

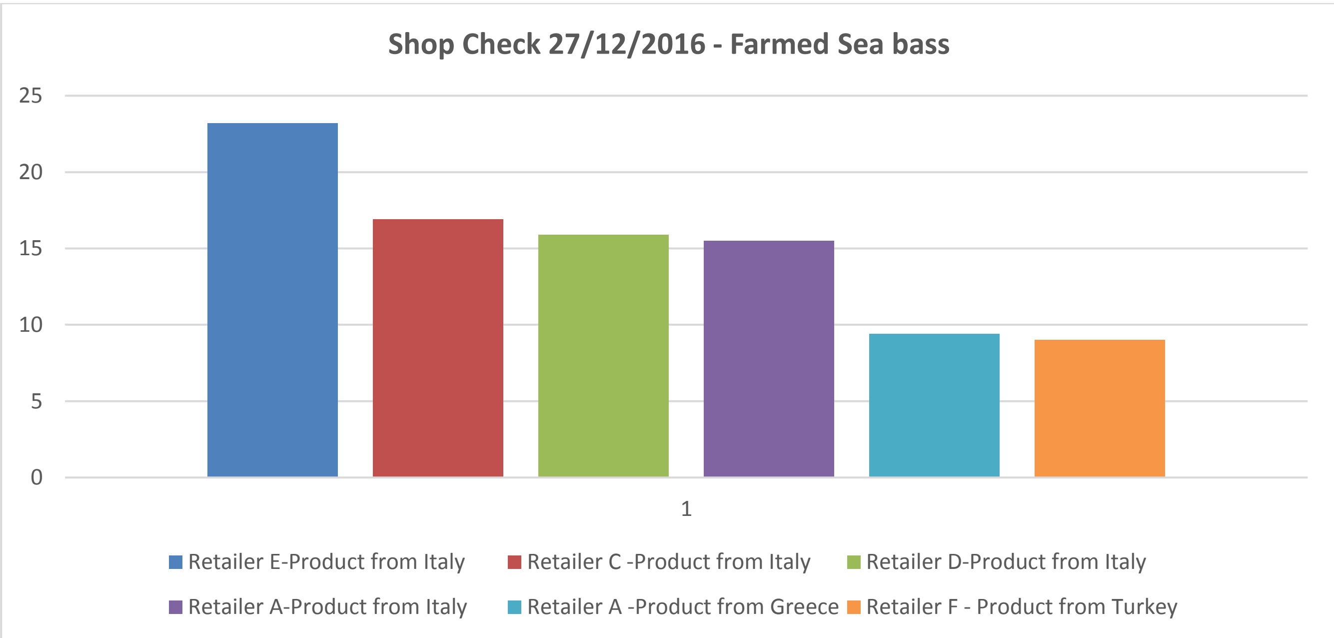

Conclusions

The seafood production and trade system is exposed to a variety of disruptions including fishery collapses, natural disasters, policy changes and price spikes. Especially the shocks caused by the latter are particularly negative for fisheries and aquaculture operations because they limit the ability to generalize or predict and, consequently, to adequatevely response to the market's shocks. The overall objective of PrimeFish is to enhance the economic sustainability of European fisheries and aquaculture sectors to inform operators and help them to identify potential risks and opportunities to build resilience in the global food system. As part of WP2 "Economic performance and prices" in PrimeFish, this Deliverable 2.4 is devoted to provide a detection of the component of time series of prices and an analysis of the occurrence for "boom and bust" cycles for the selected species studied in PrimeFish.

In particular, data were first analysed through analysis of the literature about the main historical shocks on the market of the main agricultural commodities and fish products (in general) to assess the points linked to the Boom and Bust identified (critical factors for "boom and bust" cycles).

This study simply investigated patterns in the price – without trying to explain it beyond time components i.e. year - trends, seasonality – months and potentially otter cyclical patterns.

The critical factors which are responsible for the principal prices' turbulences and drops and spikes in the prices of agricultural commodities in world markets has been explored through literature obtained from the principal databanks such as Web of Science for the last 10 years. Next, a similar literature review for price volatility of both fisheries and aquaculture markets has been realized. The sequence of price shocks presented in the metaanalysis is further empirically compared with the price series analyses executed using the method of Kalman's filters.

Comparing the B&B identified for our case studies and the literature review, after year 2009 the numbers of occurrence of B&B, as defined in the Report, increased meanwhile in international market volatility also increased, showing an increasing degree of commodities/products interconnection which leads to a rapid propagation of shocks. No recent manuscripts (e.g. peer-review papers, reports, etc.) have shown results about price volatility in the fish sector.

An example of how macroeconomic factors, such as household income, market prices, production volume, tariff and non-tariff barriers and exchange rates, can affect the occurrence and development of boom-and-bust cycles has been described in the case of Pangasius.

Impact of macro-economic effects on "boom-and-bust" cycles will be analysed more in details in a scientific paper (due to Month 40).

Price co-integration analysis has been carried out to implement the analysis of price transmission and market integration between species along their value chains. This is suggesting that the retailers are "cooling" the spikes in the first sale market and keep an average price at relatively constant level even if the first sale price is moving well above the average. In other words, retailers seem to alternate months of losses and gains. It is remarkable to observe that recent months are likely to have been economically negative for retailers, which have absorbed most of the spread difference in the prices.

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A preliminary analysis of price transmission among markets and between species has been tested and described for selected time series for Italy. The first impression from these general overview of data analysis is that in a spatial scale, according to a mechanism of increasing imports and decreasing supply (Gephart et al., 2017), furthermore according to Gephart et al. (2016), in the last years, above all those countries that were net importers of seafood, tended to be the most vulnerable to shocks to the system and become more correlated to each other.
The last part of the deliverable devoted to an exploratory analysis of prices reported In the Italian market that gives an insight to the analysis of price mechanism after a shop checking of single products.

WP5 (Task 5.2 Months 24-36) will be devoted to analyse in more detail some of the cycles identified in Task 2.3 and the results and data from this report have to be carefully discussed with stakeholders and they be used as main input materials to develop simulation models in WP5. In particular our efforts will be devoted to analyse more in depth the differences between aquaculture and fisheries case studies.

Using the MatLab FSDA (Flexible Statistics for Data Analysis) toolbox, simulation and prediction models will be carried out and can be used 1) to predict price behaviour and give early warning signals of a potential "boom and bust" cycle 2) to highlight the presence of eventual dumping phenomena and/or other infringements That affect the market competitiveness of the European fisheries and aquaculture sectors. Later, the new robust models will be integrated into PrimeDSS in WP6.

BOOM AND BUST ANALYSIS AND TOOL – UNIPARMA

Months 1-24	•Task 2.3 Identifyng Boom and bust cycles
Month 24	•D 2.4 Report on boom and bust cycles for selected European fisheries and aquaculture species
Months 6-36	• Task 5.2 Boom and bust analysis - Simulations Models - Prediction Models
Month 36	• D 5.2 Boom and Bust Model: Demonstration (confidential)
Months 40	•D 2.5 Manuscript to a peer-review journal on boom and bust cycles in European seafoods markets
Months 46	•D 5.6 Scientific review paper "Early warning signs for "Boom and bust" cycles"
Months 24-46	•(Task 6.3) Participate to the development and implementation of PrimeDSS (Decision Support System)

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Appendix

APPENDIX 1

The tables in Annex 1 show the the years when there is availability of data and the number of months for each year in which we have data for each singles times series used for the study of boom and bust cycles.

	Denmark		
	Herring	Trout	
year	first sale	retail	first sale
2007	12		12
2008	12		12
2009	12		12
2010	12	12	12
2011	12	12	12
2012	12	12	12
2013	12	12	12
2014	12	12	12
2015	12	12	12
2016	12	11	12

	Germany	
	Herring	
Year	retail	first sale
2007		
2008		
2009		8
2010		9
2011		9
2012	12	8
2013	12	9
2014	12	11
2015	12	11
2016	11	10

	Italy				
	European seabass		Gilt-head seabream		Trout
year-month	Retail	first sale	retail	first sale	first sale
2007					
2008					
2009	12		12		
2010	12		12		
2011	12		12		
2012	12	3	12	3	
2013	12	12	12	12	2
2014	12	12	12	12	6
2015	12	12	12	12	4
2016	11	12	11	12	1

	Norway		
	Cod	Herring	Salmon
year-month	first sale	first sale	export
2007			
2008	12	12	12
2009	12	12	12
2010	12	12	12
2011	12	12	12
2012	12	12	12
2013	12	12	12
2014	12	12	12
2015	12	12	12
2016	12	12	12

	Spain							
	Cod	European seabass	Gilt-head seabream			Trout		
year-month	retail	export	first sale	wholesale	retail	first sale	wholesale	retail
2001		12						
2002		12						
2003		12						
2004		12				12	12	12
2005		12				12	12	12
2006		12				12	12	12
2007		12				12	12	12
2008		12				12	12	12
2009		12	12	12	12	12	12	12
2010		12	12	12	12	12	12	12
2011		12	12	12	12	12	12	12
2012		12	12	12	12	12	12	12
2013	12	12	12	12	12	12	12	12
2014	12	12	12	12	12	12	12	12
2015	12	12	12	12	12	12	12	12
2016	11	12						

	United Kingdom							
	Cod		Herring	Salmon		Trout		
year-month	retail	first sale	first sale	retail	first sale	retail	first sale
2007							
2008		12	12		3		4
2009		12	12		3		5
2010	12	12	12	12	3	12	9
2011	12	12	12	12	3	12	6
2012	12	12	12	12	4	12	6
2013	12	12	12	12	3	12	4
2014	12	12	12	12	3	12	3
2015	12	12	12	12	3	12	6
2016	11	11	11	11	3	11	4

	Iceland	
	Cod	Herring
year-month	export	export
2011	12	12
2012	12	12
2013	12	12
2014	12	12
2015	12	12
2016	11	11

Appendix 2: List of all Boom and Bust identified, begin of boom or bust, type of event, country, species and level of the Market

Begin	End	Event	Country	Species	Market
01/01/2007	01/04/2007	Boom	Denmark	Herring	first sale
01/02/2009	01/10/2009	Bust	Denmark	Herring	first sale
01/08/2011	01/04/2012	Boom	Denmark	Herring	first sale
01/02/2014	01/10/2014	Bust	Denmark	Herring	first sale
01/12/2007	01/08/2008	Bust	Denmark	Trout	first sale
01/06/2010	01/02/2011	Boom	Denmark	Trout	first sale
01/12/2012	01/08/2013	Bust	Denmark	Trout	first sale
01/06/2015	01/02/2016	Boom	Denmark	Trout	first sale
01/01/2011	01/02/2011	Bust	Iceland	Cod	Export
01/12/2011	01/09/2012	Boom	Iceland	Cod	Export
01/05/2013	01/12/2013	Bust	Iceland	Cod	Export
01/04/2015	01/04/2015	Boom	Iceland	Cod	Export
01/11/2016	01/11/2016	Bust	Iceland	Cod	Export
01/01/2011	01/04/2011	Bust	Iceland	Herring	Export
01/04/2012	01/09/2012	Boom	Iceland	Herring	Export
01/10/2013	01/04/2014	Bust	Iceland	Herring	Export
01/05/2015	01/09/2015	Boom	Iceland	Herring	Export
01/02/2009	01/08/2009	Bust	Italy	European seabass	consumption
01/07/2011	01/03/2012	Boom	Italy	European seabass	consumption
01/01/2014	01/08/2014	Bust	Italy	European seabass	consumption
01/06/2016	01/11/2016	Boom	Italy	European seabass	consumption
01/10/2012	01/12/2012	Bust	Italy	European seabass	first sale
01/06/2014	01/01/2015	Boom	Italy	European seabass	first sale
01/08/2016	01/12/2016	Bust	Italy	European seabass	first sale
01/02/2009	01/10/2009	Boom	Norway	Cod	first sale
01/07/2011	01/05/2012	Bust	Norway	Cod	first sale
01/02/2014	01/09/2014	Boom	Norway	Cod	first sale
01/07/2016	01/12/2016	Bust	Norway	Cod	first sale
01/04/2009	01/12/2009	Bust	Norway	Herring	first sale
01/08/2011	01/07/2012	Boom	Norway	Herring	first sale
01/04/2014	01/11/2014	Bust	Norway	Herring	first sale
01/08/2016	01/12/2016	Boom	Norway	Herring	first sale
01/03/2010	01/08/2010	Boom	Norway	Salmon	Export
01/10/2011	01/04/2012	Bust	Norway	Salmon	Export
01/06/2013	01/11/2013	Boom	Norway	Salmon	Export
01/01/2015	01/07/2015	Bust	Norway	Salmon	Export
01/09/2016	01/11/2016	Boom	Norway	Salmon	Export
01/12/2009	01/05/2010	Bust	Spain	Seabream	first sale
01/05/2011	01/11/2011	Boom	Spain	Seabream	first sale
01/12/2012	01/05/2013	Bust	Spain	Seabream	first sale

01/06/2014	01/11/2014	Boom	Spain	Seabream	first sale
01/12/2015	01/12/2015	Bust	Spain	Seabream	first sale
01/09/2010	01/11/2010	Bust	Spain	Seabream	retail
01/03/2012	01/06/2012	Boom	Spain	Seabream	retail
01/07/2013	01/04/2014	Bust	Spain	Seabream	retail
01/02/2015	01/10/2015	Boom	Spain	Seabream	retail
01/05/2009	01/08/2009	Boom	Spain	Seabream	wholesale
01/09/2010	01/03/2011	Bust	Spain	Seabream	wholesale
01/05/2012	01/08/2012	Boom	Spain	Seabream	wholesale
01/10/2013	01/03/2014	Bust	Spain	Seabream	wholesale
01/04/2015	01/08/2015	Boom	Spain	Seabream	wholesale
01/05/2004	01/05/2004	Boom	Spain	Trout	first sale
01/11/2005	01/10/2006	Bust	Spain	Trout	first sale
01/11/2006	01/04/2007	Boom	Spain	Trout	first sale
01/03/2009	01/09/2009	Bust	Spain	Trout	first sale
01/01/2011	01/02/2011	Boom	Spain	Trout	first sale
01/06/2011	01/06/2011	Boom	Spain	Trout	first sale
01/09/2013	01/09/2013	Boom	Spain	Trout	first sale
01/01/2014	01/04/2014	Bust	Spain	Trout	first sale
01/02/2015	01/11/2015	Boom	Spain	Trout	first sale
01/01/2004	01/02/2004	Boom	Spain	Trout	retail
01/07/2004	01/07/2005	Bust	Spain	Trout	retail
01/02/2006	01/01/2007	Boom	Spain	Trout	retail
01/09/2007	01/03/2008	Bust	Spain	Trout	retail
01/04/2013	01/05/2013	Bust	Spain	Trout	retail
01/08/2014	01/03/2015	Boom	Spain	Trout	retail
01/08/2004	01/12/2004	Bust	Spain	Trout	wholesale
01/01/2006	01/06/2006	Boom	Spain	Trout	wholesale
01/07/2007	01/12/2007	Bust	Spain	Trout	wholesale
01/01/2009	01/06/2009	Boom	Spain	Trout	wholesale
01/07/2010	01/12/2010	Bust	Spain	Trout	wholesale
01/02/2012	01/06/2012	Boom	Spain	Trout	wholesale
01/08/2013	01/12/2013	Bust	Spain	Trout	wholesale
01/02/2015	01/06/2015	Boom	Spain	Trout	wholesale
01/10/2007	01/01/2008	Bust	Denmark	Trout	first sale
01/03/2009	01/08/2009	Boom	Denmark	Trout	first sale
01/09/2010	01/01/2011	Bust	Denmark	Trout	first sale
01/03/2012	01/08/2012	Boom	Denmark	Trout	first sale
01/09/2013	01/01/2014	Bust	Denmark	Trout	first sale
01/03/2015	01/08/2015	Boom	Denmark	Trout	first sale
01/09/2016	01/12/2016	Bust	Denmark	Trout	first sale
01/03/2012	01/08/2012	Boom	Denmark	Trout	retail
01/03/2015	01/08/2015	Boom	Denmark	Trout	retail

01/10/2007	01/01/2008	Bust	Denmark	Trout	retail
01/09/2010	01/01/2011	Bust	Denmark	Trout	retail
01/09/2013	01/01/2014	Bust	Denmark	Trout	retail
01/09/2016	01/12/2016	Bust	Denmark	Trout	retail
01/03/2012	01/07/2012	Boom	United Kingdom	Trout	retail
01/05/2013	01/01/2014	Bust	United Kingdom	Trout	retail
01/03/2015	01/11/2015	Boom	United Kingdom	Trout	retail
01/06/2016	01/11/2016	Bust	United Kingdom	Trout	retail
01/05/2010	01/08/2010	Bust	United Kingdom	Salmon	retail
01/10/2011	01/03/2012	Boom	United Kingdom	Salmon	retail
01/05/2013	01/08/2013	Bust	United Kingdom	Salmon	retail
01/10/2014	01/04/2015	Boom	United Kingdom	Salmon	retail
01/05/2016	01/09/2016	Bust	United Kingdom	Salmon	retail
01/01/2008	01/10/2008	Boom	United Kingdom	Cod	first sale
01/02/2009	01/02/2010	Bust	United Kingdom	Cod	first sale
01/01/2011	01/06/2011	Boom	United Kingdom	Cod	first sale
01/09/2016	01/11/2016	Bust	United Kingdom	Cod	first sale
01/05/2011	01/07/2011	Bust	United Kingdom	Cod	retail
01/05/2012	01/08/2012	Boom	United Kingdom	Cod	retail
01/06/2013	01/08/2013	Bust	United Kingdom	Cod	retail
01/02/2015	01/10/2015	Boom	United Kingdom	Cod	retail
01/05/2016	01/11/2016	Bust	United Kingdom	Cod	retail
01/02/2013	01/04/2013	Bust	Spain	Cod	retail
01/06/2014	01/12/2014	Boom	Spain	Cod	retail
01/01/2016	01/04/2016	Bust	Spain	Cod	retail
01/06/2013	01/08/2013	Boom	Spain	European seabass	retail
01/10/2014	01/04/2015	Bust	Spain	European seabass	retail
01/06/2016	01/09/2016	Boom	Spain	European seabass	retail
01/03/2007	01/07/2007	Bust	Vietnam	Pangasius	first sale
01/09/2008	01/01/2009	Boom	Vietnam	Pangasius	first sale
01/03/2010	01/07/2010	Bust	Vietnam	Pangasius	first sale
01/09/2011	01/01/2012	Boom	Vietnam	Pangasius	first sale
01/03/2013	01/08/2013	Bust	Vietnam	Pangasius	first sale
01/09/2014	01/02/2015	Boom	Vietnam	Pangasius	first sale
01/03/2002	01/07/2002	Bust	Greece	European seabass	export
01/08/2003	01/05/2015	Boom	Greece	European seabass	export
01/05/2004	01/09/2004	Bust	Greece	European seabass	export
01/11/2005	01/03/2006	Boom	Greece	European seabass	export
01/05/2007	01/09/2007	Bust	Greece	European seabass	export
01/10/2008	01/03/2009	Boom	Greece	European seabass	export
01/05/2010	01/09/2010	Bust	Greece	European seabass	export
01/10/2011	01/03/2012	Boom	Greece	European seabass	export
01/05/2013	01/09/2013	Bust	Greece	European seabass	export

01/10/2014	01/01/2001	Boom	Greece	European seabass	export
01/07/2016	01/10/2016	Bust	Greece	European seabass	export
01/07/2001	01/11/2001	Bust	Greece	Gilt-head seabream	export
01/12/2002	01/05/2003	Boom	Greece	Gilt-head seabream	export
01/07/2004	01/11/2004	Bust	Greece	Gilt-head seabream	export
01/01/2006	01/05/2006	Boom	Greece	Gilt-head seabream	export
01/07/2007	01/11/2007	Bust	Greece	Gilt-head seabream	export
01/12/2008	01/05/2009	Boom	Greece	Gilt-head seabream	export
01/07/2010	01/11/2010	Bust	Greece	Gilt-head seabream	export
01/12/2011	01/05/2012	Boom	Greece	Gilt-head seabream	export
01/07/2013	01/11/2013	Bust	Greece	Gilt-head seabream	export
01/12/2014	01/05/2015	Boom	Greece	Gilt-head seabream	export
01/07/2016	01/10/2016	Bust	Greece	Gilt-head seabream	export
01/03/2012	01/07/2012	Bust	Germany	Herring	retail
01/09/2013	01/01/2014	Boom	Germany	Herring	retail
01/03/2015	01/07/2015	Bust	Germany	Herring	retail
01/03/2009	01/07/2009	Bust	Germany	Herring	first sale
01/09/2010	01/01/2011	Boom	Germany	Herring	first sale
01/03/2012	01/07/2012	Bust	Germany	Herring	first sale
01/09/2013	01/01/2014	Boom	Germany	Herring	first sale
01/03/2015	01/08/2015	Bust	Germany	Herring	first sale
NA	NA	Boom	Canada	Cod	first sale
NA	NA	Bust	Canada	Cod	first sale
01/10/2012	01/11/2012	Boom	Italy	Gilt-head seabream	first sale
01/12/2013	01/04/2014	Bust	Italy	Gilt-head seabream	first sale
01/05/2015	01/11/2015	Boom	Italy	Gilt-head seabream	first sale
01/01/2009	01/02/2009	Boom	Italy	Gilt-head seabream	retail
01/03/2010	01/07/2010	Bust	Italy	Gilt-head seabream	retail
01/08/2011	01/02/2012	Boom	Italy	Gilt-head seabream	retail
01/03/2013	01/07/2013	Bust	Italy	Gilt-head seabream	retail
01/08/2014	01/01/2015	Boom	Italy	Gilt-head seabream	retail
01/03/2016	01/07/2016	Bust	Italy	Gilt-head seabream	retail
01/05/2013	01/07/2013	Boom	Italy	European seabass	first sale
01/09/2014	01/03/2015	Bust	Italy	European seabass	first sale
01/04/2016	01/07/2016	Boom	Italy	European seabass	first sale
01/03/2009	01/07/2009	Boom	Italy	European seabass	retail
01/08/2010	01/01/2011	Bust	Italy	European seabass	retail
01/03/2012	01/07/2012	Boom	Italy	European seabass	retail
01/08/2013	01/01/2014	Bust	Italy	European seabass	retail
01/03/2015	01/07/2015	Boom	Italy	European seabass	retail
01/09/2016	01/11/2016	Bust	Italy	European seabass	retail

Annex 1

Stakeholder interview

- **Market trends which significantly influenced the seafood sector (especially for trout, sea bass and sea bream)**

✓ Strong increase of feed prices and other raw materials

✓ European regulations or national laws which have favored or impede the development of the sector

✓ Decision of Large retailers and HoReCa to favorite or impede the consumption of fish to consumers

✓ In the last decades, the Italian fish market has been growing significantly, due to a greater awareness by the consumers about the positive benefits of the diet based on seafood. At the same time, there has been slow but progressively decrease of wild-catches, this trend brought to a significant increase of the import volume. Today, Italy is the European country that has been mostly damaged by this not balance state with the level of import reached the record figure of 70% yearly. It is a trend which probably will increase in the future.

✓ Italy is one of the main consumption countries of farmed fishes (seabass, seabream). Out of a global production of more of 300,000 tons, Italy consumes at least one third (100,000 tons which is equal to 2 kg pro capite).

✓ Italy is suffering from an unfair commercial market competition in which seabass and seabream are farmed in regions that have low production costs compared to European countries. However, consumers are not aware of this aspect.

✓ For example, Turkey has been receiving government funds (subsides) and it became the first producer.

✓ Italy import daily from Turkey, Croatia (almost all the production), Greece, Spain, France, Albania, Cyprus and probably in the near future also from Tunisia.

✓ Stabilization of aquaculture production in Italy where the number of new facilities is not growing. In the last 10 years, in Italy, the production is not increased and therefore import raised. However, the positive aspect is that the price is higher because consumers look for national product.

✓ Sometimes, national economic crises such as happened in Greece for many fisheries has led to a decreases the price below the cost of production in order to sell and have cash flow. Today many of these companies are own by the banks.

✓ Russian export ban towards European food products

✓ Increase of the sales of Pangasius (low cost)

✓ Lack of raw materials useful to produce feed

✓ Expensive price of feed which sometimes brought use alternative formula less efficient

Drivers and barriers of several market:

✓ Trout: limited geographical market/price too low which bring to low quality perception from the consumers. It is difficult to increase the market for a freshwater fisher in Italy that is surrounded by seawater.

- ✓ Seabream&Seabass: there should not be barriers, however prices can be considered as a barrier because it is not easy to process the product.

What are the primary actions that the European and Italian legislators should address to favorite the market without fluctuation of production costs?

- ✓ EU should guarantee that the market trade is not fair (subsidy from Turkey government, use of not allowed products) and should keep an eye on several issues (feed quality, pharmaceutical products, animal welfare, etc.).
- ✓ What can do a big difference is the introduction of the catch/farmed date on the label for all the seafood products on the market. National market would have a great advantage. However, lobbies (Large retailers, HoReCa) are not in favor of this change.
- ✓ Another law should guarantee the consumption of aquaculture products in the school canteens/cafeteria

What have been the last innovations in the sectors (production, consumption, communication) for trout, sea bass and seabream?

- ✓ Not easy to do innovation because we have seen: low prices completion, no vision from legislators, no authorizations.
- ✓ For trouts: no technological innovation
- ✓ For sea bass and seabream: increase use of cages in the sea (with a diameter of 28m)
- ✓ Lower use of protein feed and fish oil (Better environmental output). But with a risk of food safety

The issue of consumer's perception on aquaculture products is not a real problem.

Annex 2:

Measures for anti-subsidy proceeding concerning imports of Rainbow Trout, European sea bass and gilthead sea bream products originating from Turkey

1) Rainbow trout

On Jan. 3, 2014 by Danish Aquaculture Association on behalf of producers representing more than 25 % of the total Union production of certain rainbow trout complained that Turkish producers were competing unfairly due to domestic subsidies. On Feb. 14, 2014, the European Commission opened an investigation of subsidy and injury covered the period from 1 January 2013 to 31 December 2013. The examination of trends relevant for the assessment of injury covered the period from 1 January 2010 to the end of the investigation period. The Commission notified the Government of Turkey (GOT) prior to initiation and invited the GOT for consultations with the aim of clarifying the situation as regards the contents of the complaint and arriving at a mutually agreed solution. Consultations between the Commission and the GOT were subsequently held. During the consultations, no mutually agreed solution could be found. **In parallel to the anti-subsidy investigation, the Commission initiated an anti-dumping investigation.**

In details, regarding Union industry, the sample consisted of nine Union producers, accounting for more than 12% of the total Union production. Due to the highly fragmented nature of the industry (with more than 700 producers).
As regards exporting producers, the Commission selected a sample of four groups of exporting producers based on the largest representative volume of exports to the Union which could reasonably be investigated
within the time available, considering also the geographical spread. The sampled group of companies account for almost 64% of the declared export sales to the Union. The sample is representative. The European Commission imposed a provisional countervailing duty on imports of certain rainbow trout originating in Turkey by Implementing Regulation (EU) No 1195/2014.
On the 26th February 2015 the Commission implemented REGULATION (EU) 2015/309 which impose a definitive countervailing duty and collecting definitively the provisional duty imposed on imports of certain rainbow trout originating in Turkey.

Investigation concluded by the imposition of definitive duties
Anti-subsidy investigations

Product	**Originating from**	**Complainant**	**Regulation N°**	**Type and level of measure**
Rainbow trout (*Oncorhynchus mykiss*) within the CN codes ex 0301 91 90, ex 0302 11 80, ex 0303 14 90, ex 0304 42 90, ex 0304 82 90 and ex 0305 43 00.	Turkey	Danish Aquaculture Association	COMMISSION IMPLEMENTING REGULATION (EU) 2015/309 of 26 February 2015 imposing a definitive countervailing duty and collecting definitively the provisional duty imposed on imports of certain rainbow trout originating in Turkey	Individual CVD Duty ranging 6,7% - 9,5%; Residual duty 9,5%

Investigation terminated without the imposition of measures

Anti-dumping investigations

Product	**Originating from**	**Decision N**	**Main reason for termination**
Rainbow trout (*Oncorhynchus mykiss*) within the CN codes ex 0301 91 90, ex 0302 11 80, ex 0303 14 90, ex 0304 42 90, ex 0304 82 90 and ex 0305 43 00.	Turkey	Commission Impl. Dec. (EU) 2015/316 26.02.2015b terminating the anti-dumping proceeding concerning imports of certain rainbow trout originating in Turkey	Withdrawal of complaint

2**) European sea bass and gilthead sea bream**

New investigation initiated during the period 1 January – 31 December 2015

Anti-subsidy investigations

Product	**Originating from**	**Complainant**	**Document**
European sea bass (*Dicentrarchus labrax*) and gilthead sea bream (*Sparus aurata*), fresh, chilled or frozen	Turkey	APROMAR (Asociación Empresarial de Productores de Cultivos Marinos)	Notice of initiation of an anti-subsidy proceeding concerning imports of European sea bass and gilthead sea bream originating in Turkey (2015/C 266/06)

In 2015, the European Commission has received a complaint alleging that imports of European sea bass and gilthead sea bream originating in Turkey are being subsidised and are thereby causing material injury to the Union industry.

The complaint was lodged on 1 July 2015 by APROMAR Asociación Empresarial de Productores de Cultivos Marinos (APROMAR, 'the complainant') on behalf of producers representing more than 25 % of the total Union production of European sea bass and gilthead sea bream.

On 14 August 2015, the European Commission initiated an anti-subsidy investigation with regard to imports into the Union of European sea bass and gilthead sea bream originating in Turkey

The investigation of subsidisation and injury covered the period from 1 July 2014 to 30 June 2015. The examination of trends relevant for the assessment of injury will cover the period from 1 January 2012 to the end of the investigation period.

The Commission therefore concludes that the anti-subsidy proceeding concerning imports of European sea bass and gilthead sea bream originating in Turkey should be terminated without the imposition of measures, after that on 5 May 2016 a Decree was published in the Turkish Official Gazette, by which the Turkish authorities withdrew the main subsidy scheme with the effect of 1 January 2016 (COMMISSION IMPLEMENTING DECISION (EU) 2016/1360 of 8 August 2016).