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Roberto J. Garcia

Influencing factors in Norway's fresh salmon export to China

Xuan Ling
Master of Science in Economics
School of Economics and Business

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Abstract

With the governments long term vision of restructuring Norway to a competitive, low carbon footprint society, a vision labeled "Green Competitiveness", how to replace oil becomes a key concern. The government has singled out marine aquaculture as the example to emulate. The growth of the industry depends on markets with growth potential and, with its size and rapid growth, China is particularly attractive.

The objective of the study is the attainment of a broad view for successful strategies to realize the vision of "Green Competitiveness", particularly in relation to the Norway-China fresh salmon trade. To the best of my knowledge, previous, related research either address other issues or, with depth, lack scope. The key research question is: what are factors that determine the success of Norwegian salmon exports to China in the period from January 2000 to August 2017.

The study includes variables for well known interactions related to China's import demand - income, price and substitute price, exchange rate as well as sanctions against the trade. An autoregressive distributed lag (ARDL) model is built, and ordinary least squares (OLS) estimation method is applied to the model.

The findings indicate, within a 95% confidence interval, that Norwegian fresh salmon, in the Chinese marketplace, is elastic with respect to income by a cumulative factor of 1.09, and price inelastic by a factor of -0.27. These are characteristics of a luxury product, with a degree of perceived uniqueness, making it hard to replace. Substitute price increases have a positive effect (0.88) on the import demand within a 90% confidence interval. The study also found an overall limited effect of exchange rate, which supports the findings of Xie et al. (2008). As expected, sanctions against trade exerts strong negative influence on demand, with a demand curve shift of 80.33 units.

The implication of these findings is that any strategy to maintain and strengthen the position of Norwegian salmon in China, will do well to bolster a luxury and uniqueness narrative for the national brand of Norwegian salmon and "Seafood from Norway".

Keywords: *Import demand, ARDL model, salmon trade, Norway, China, green competitiveness, elasticity of import demand, branding.*

Contents

1 Introduction

Norway's oil and gas industry has, since the 1970s, been the backbone of the Norwegian economy, but no industry offers a guarantee of long-term economic growth. Global demand for oil is expected to decrease with the increasing affordability of renewable, "green" energy technology. Norway, in the company of 194 other nations, signed the Paris climate accord and made commitments to participate in the mitigation of global warming. New industries must replace old. To this effect, aquaculture and, in particular salmon farming, is blazing a trail for other sectors to follow. The government is working to open up new or closed markets to facilitate growth of the industry. But what are key influencing factors in China's salmon market? Through a case study of imports of Norwegian salmon to the Chinese market, this thesis attempts to find out.

In 2016, the government of Norway (GoN) under Prime Minister Solberg presented a vision of the future, where Norway establishes itself as a successful and competitive, small carbon footprint society. The label given to this vision is "Green Competitiveness" (GoN 2016b). An outline of the way forward was presented and there are two types of required actions described: (1) to reduce the carbon footprint of big offenders, such as the oil and gas industry and transportation, and (2) to encourage new and existing industry with smaller carbon footprints.

Only two existing industries are specifically mentioned as vehicles to the desired end: forestry and aquaculture. Amongst the two, aquaculture - and specifically salmon farming - is already perceived to be the template for other sectors to emulate. In a press release from September 2015, the minister of fisheries, Elisabeth Aspaker, said: "The development and creativity that we see today, in aquaculture technology, is a good example of what the green shift is in practice"(MoTIF 2018[a]). Though salmon is the primary engine driving Norway's seafood exports, there are of course other areas of importance and salmon is indeed also part of and dependent on a greater ecosystem. For instance, fish feed for salmon includes products from capture fisheries. Across the whole ecosystem, the notion of strengthening Norway as a leading maritime nation is, to the Solberg government, a central one (MoTIF 2018[b]).

Success in building and maintaining Norway as a force to be reckoned with in the aquaculture industry, is a complex issue, but one thing that can be said for sure, is that without markets to trade the products in, all else will be futile.

Improving market access in the most populous country with the largest consumer market, where the economy is growing and the position of fish as a source of protein is improving, would make a lot of sense. It is not hard to understand why the Norwegian government has been working on normalizing relations with China.

In the years to come, to facilitate growth in their share of the Chinese salmon market, policy makers in the Norwegian government will need a good understanding of influencing factors in the fresh salmon export to China. This thesis is the result of an attempt, given available data, to shed some light on key influencing factors, by way of econometric analysis.

1.1 Research questions

Based on monthly time series data from January 2000 to August 2017, this study builds an autoregressive distributed lag (ARDL) model, and uses ordinary least squares (OLS) method to estimate how China's monthly import of fresh whole salmon (HS 030214) is influenced by China's income, exchange rate between Norwegian kroner and Chinese yuan, the price of salmon, price of a substitute for salmon, as well as by policy.

By studying how China's import of fresh salmon to China has changed from 2000 to 2017 and what factors have influenced the trade, this study will attempt to answer the following question:

In a marketing- or political strategy, what are the key components that can help increase Norway's salmon export to China and thereby contribute to the realization of "Green Competitiveness"?

1.2 Organization of the thesis

There are six chapters in this thesis. Chapter one is an introduction of the general problem and the thesis's objective and motivation. Chapter two gives an overview of salmon farming in Norway and the salmon trade between Norway and China. In chapter three a theoretical analysis of the factors that influence salmon import demand is provided, as well as a discussion on brand equity and the significance of consumer perceptions. In chapter four a regression model for import demand is developed and in chapter five the results are presented. Chapter six provides a summary and conclusions and offer recommendations to the Norwegian government, as well as a discussion of the limitations of the study and suggestions for further research.

2 Background

2.1 Norwegian aquaculture

Farmed salmon is one of Norway's most important export products and also an area where Norway has become a world leader. Norway is the leading producer and exporter of salmon in the world. The bias is clearly tilted towards fresh or chilled salmon export, which was 24 times as great as frozen salmon by weight, in 2016 (UN Comtrade 2018). Norway's total export of salmon was NOK 64.67 billion in 2017, which accounted for 68.4 percent of its total seafood export value (NSC 2018[a]). There are salmon farms all along the coast of Norway. With cool, stable water temperatures, the conditions for salmon farming are good. Figure 2.1 shows that Norway's export volumes of whole salmon have increased substantially between 2000 and 2016. Fresh salmon exports have always been the major part of the Norwegian salmon trade.

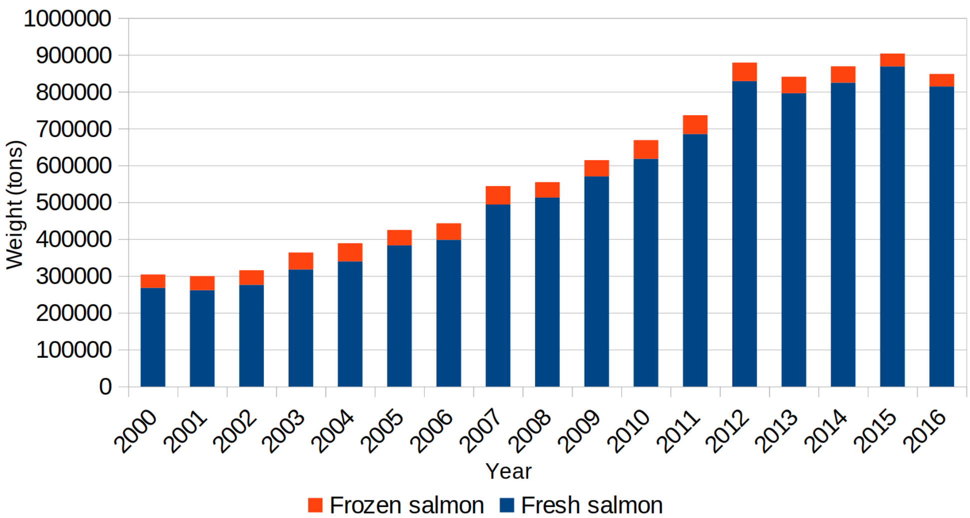


Figure 2.1: Norway's export of whole salmon to the world in volume. (UN Comtrade 2018)

2.1.1 Historical roots and current state of affairs

The industry has its roots in pioneering efforts, made during the 1950s and 1960s, that evolved into small scale, local production in the 1970s-80s before it was scaled up in the 1990s into a large-scale industry through consolidation and restructuring (NFK 2018). From the beginning of the 1990s, the increase in production has been formidable. In 1993, the combined fresh/frozen export was 132 000 tonnes. By

2016, it was up to 848 000 tonnes (UN Comtrade 2018). The productivity upgrade was instrumental for the success of the industry. For Norway, being a high cost country, high productivity rates are essential to keep costs down. Norway's export volumes, values and prices of fresh and frozen salmon to the world during 2000-16 are reported in Table 2.1. The table shows that, between 2000 and 2016, the share of frozen salmon has been decreasing, and price and volume has been relatively stable. For fresh salmon, the opposite is the case. Prices have doubled, and volume and share has tripled.

Table 2.1: Export volume, value and price for Norwegian fresh and frozen salmon

Weight in 1000 tonnes, value in 100.000 USDs and price in USD/tonne								
	Fresh Salmon (HS 030214)			Frozen Salmon (HS 030313)			Total	
Year	Weight	Value	Price	Weight	Value	Price	Weight	Value
2000	268	9583	3576	36	1526	4239	304	11109
2001	262	7531	2874	38	1116	2937	300	8647
2002	276	8121	2942	40	1145	2863	316	9266
2003	318	9411	2959	46	1494	3248	364	10905
2004	340	11333	3333	49	1737	3545	389	13070
2005	383	15615	4077	42	1703	4055	425	17318
2006	398	19801	4975	45	2323	5162	443	22124
2007	494	22425	4539	50	2193	4386	544	24618
2008	513	24979	4869	42	1973	4698	555	26952
2009	570	28005	4913	44	1973	4484	614	29978
2010	618	38391	6212	51	2724	5341	669	41115
2011	685	39092	5707	51	2769	5429	736	41861
2012	829	39413	4754	50	2076	4152	879	41489
2013	796	53864	6767	45	2369	5264	841	56233
2014	825	53823	6524	44	2330	5295	869	56153
2015	869	46677	5371	35	1451	4146	904	48128
2016	814	58346	7168	34	1541	4532	848	59887

Trout has also been farmed since the very beginning, but salmon has, so far, been the easiest to market and has fetched better prices. In 2017, the trout volume was dwarfed by a factor of 22.6. Salmon exports in 2017 was valued at NOK 64.67 billion, while trout was valued at NOK 2.86 billion (NSR 2018). Thus, salmon has been and remains, irrevocably associated with Norwegian aquaculture.

Consolidation in the industry has been considerable, starting in the beginning of the 1990s. In 2016 it was reported that the ten biggest seafood companies controlled 69 percent of the farms in Norway. However, the consolidations are not limited to Norway alone. In fact, compared to the other main regions for salmon production: North America, United Kingdom and Chile, - Norway is the least consolidated. This is a result of Norwegian policymakers reining in consolidations through restrictive concessioning, to maintain a higher degree of local ownership and more decentralized structures. Fewer demands on ownership structures have been enforced in other regions, allowing the industry to grow faster (Marine Harvest 2017).

Interestingly, the top Norwegian aquaculture companies, are also heavily involved in other regions. For instance, Marine Harvest and Grieg Seafood are in the top five in UK. Combined, they have a 41 percent share of the total production. In North America, the same two companies have a 36 percent share. If we add Cermaq, another Norwegian company, it is up to 51 percent. However, if measuring Norwegian influence and control in the global industry is the goal, then it might make sense to exclude Cermaq, because it is a fully owned subsidiary of Mitsubishi. Similarly, in the case of Chile, Marine Harvest has an 8 percent share and with Cermaq added, it amounts to 17 percent (Marine Harvest 2017). Thus, it is a mistake to make the simplification that one country's industry is competing with that of another. As demonstrated, the industry operates, to a large degree, across borders and regions.

2.1.2 Biological boundaries: Diminishing growth in salmon supply

There has been a yearly increase of Atlantic salmon supply of 8 percent in the years from 1995 until 2005, when it slowed down to 5 percent until 2016. There is an expected growth rate of 3 percent between 2016 and 2020, as noted by Marine Harvest (2017): "The background for this trend is that the industry has reached a production level where biological boundaries are being pushed. It is therefore expected that future growth can no longer be driven only by the industry and regulators as measures are implemented to reduce its biological footprint. This requires progress in technology, the development of improved pharmaceutical products, implementation of non-pharmaceutical techniques, improved industry regulations and inter-company cooperation. Too rapid growth without these measures in place adversely impacts biological indicators, costs, and in turn output"(Marine Harvest 2017, p. 25). Within any population of high density, such as mono-cultures in aquaculture, there will be considerable challenges to overcome in keeping the population healthy. As such one can expect that production volume will be at odds with health and subsequently also quality.

2.2 Government, industry and Green Competitiveness

2.2.1 The go-between: Norwegian Seafood Council

The Norwegian Seafood Council (NSC) is a fully state-owned corporation under the Ministry of Trade, Industries and Fisheries. When it was founded in 1991, its purpose was clear in its original name, "The Export Committee for Fish". The NSC's mission statement is to increase the value of Norwegian fish through "market insights, market development, market risk management and reputational risk management in select markets around the world"(NSC 2018[b]). NSC has a strong international prescence with representatives throughout the world, promoting the national brand, "Seafood from Norway".

All operations of the NSC are funded by the industry, directly, through statutory fees imposed on all seafood exports. The firms in the industry are dependent on the NSC for approval as exporters. Moreover, the NSC aims to be a central source of market insights based on "statistics, trade information, consumption and consumer insight"(NSC 2018[b]). The goal is to assist the industry with knowledge to base strategic decisions on and help create competitive advantage. At the same time the NSC functions as advisory to the Ministry of Trade, Industries and Fisheries. So, the NSC is an inter-mediator and a gatekeeper between international markets and the fishery industries operating in Norwegian territory and an extension of the Norwegian government.

2.2.2 The government: Ministry of Trade, Industries and Fisheries (MoTIF)

Through its MoTIF, the Norwegian government sets its aims, as indicated in a mission statement (MoTIF 2018[b]): to strengthening Norway as a "leading maritime nation". The capture fishery production has been mostly stagnant since the 1980s, while aquaculture has grown from providing 7 percent of fish for human consumption in 1974 to, in 2018, providing approximately 60 percent. Marine aquaculture has become of central importance to the governments ambitions. Capture fisheries struggle with sustainability and, the trend is negative, as assessed by the Fisheries and Aquaculture Department of the UN Food and Agriculture Organization: "the share of fish stocks within biologically sustainable levels has exhibited a downward trend, declining from 90 percent in 1974 to 68.6 percent in 2013. ... Thus, 31.4 percent of fish stocks were estimated as fished at a biologically unsustainable level and therefore overfished." In addition: "Of all the stocks assessed in 2013, 58.1

percent were fully fished. [...] Only 10.5 percent were deemed underfished"(FAO 2016, p. 38). It may therefore be fair to speculate that the most potential for growth is perceived, by industry and government alike, to be in aquaculture.

In a press release entitled "Realizing the commercial potential of the sea", the MoTIF stated that: "In the years to come, Norway will be developing a new maritime industry. Our budget proposal therefore includes funding to increase so-called 'blue knowledge'. This takes place both by increasing allocations for research, and by strengthening research communities"(MoTIF 2018[b]). The press release lists some key budget increases agreed upon:

- "The Government proposes increased efforts in aquaculture research and knowledge about new marine species totalling NOK 14 million."
- "Strengthening resource research and monitoring by NOK 11 million through an increase in revenue from the fisheries research fee."
- "The Government proposes an allocation of NOK 11 million for a research expedition to the Antarctic in the winter of 2018-2019. The objective of the expedition is to gain better knowledge about the krill population in order to better utilise the commercial potential for harvesting krill."
- "The Government wants to cluster the marine communities in Bergen in order to realise the commercial potential of the sea and along the coast, and is proposing an allocation of NOK 10 million for further study of a co-location."
- "The Government proposes an allocation of NOK 5 million for a new centre in Tromsø devoted to maritime and Arctic issues" (MoTIF 2018[b]).

It may seem that, under key measure number 3, the government is allocating funds to the development of a new, or strengthened capture fishery - and they are - but also here there is a link to aquaculture. Krill is predominantly used in the production of fish feed.

The rest of the key measures listed are, as I interpret them, either directly towards aquaculture or towards areas where aquaculture shares interests with other areas of marine industry. The point made being that the Norwegian government has taken a keen interest in the future of aquaculture as a source of revenue for the country.

2.2.3 Government funded R&D: Innovation Norway

A third government actor in the relationship between government and industry is Innovation Norway. In their own words: "Innovation Norway is the Norwegian Government's most important instrument for innovation and development of Norwegian enterprises and industry. We support companies in developing their competitive advantage and to enhance innovation"(Innovation Norway 2018).

The current government "[...] has proposed a NOK 10 million increase in the allocation for Innovation Norway in order to strengthen Norway's profile as a leading maritime nation. The Government is also proposing a NOK 30 million allocation for marine and maritime pilot and demonstration projects through Innovation Norway. This effort will help reduce the cost and risk associated with testing and demonstration of new technology and new solutions"(MoTIF 2018[e]).

The MoTIF states that, as aquaculture will be an important driving force in the Norwegian economy in the years to come, it is important that more producers develop and adopt new and improved technologies to realize their full potential (MoTIF 2018[e]). An example of where development of new technologies are directly linked to industry output, is the governments new "traffic light" system. While opening up for growth of 3% per year, the coastline is divided into regions, based on environmental impact assessments. Most importantly, it is the amount and impact of salmon lice from farms on the wild salmon population that is assessed. If you are in a "green" area you may apply for production increases. If you are in a "yellow" area, it is wait and see. A "red" area means reducing production (MoTIF 2018[c]). Consequently, if a producer can develop or adopt technology that reduces salmon lice, growth is allowed. One startup that has received funding from Innovation Norway to this end, is Blue Lice, a company that has developed methods for prevention of salmon lice, rather than what today is the industry standard, treatment (Blue Lice 2018).

2.2.4 A vision of the future: Green Competitiveness

In June 2015 the government appointed a panel of experts to produce a report to advise on how Norway can achieve "Green Competitiveness", which they define in following manner: "What actions are needed from politicians and authorities, and what can industries and business do themselves, to make Norway a competitive low-emission society by 2050?" (GoN 2016a, p. 2). Only two industries are specifically identified as areas with great growth potential in the panel's vision of

“Green Competitiveness”: forestry and aquaculture.

A key focal point for the advisory panel is achieving the goals of the Paris Climate accord, so reduction of carbon footprints across industries, and supporting industries that produce less carbon, is emphasized. Indeed, the Norwegian Government also has a vested self-interest in a reduction of the global level of carbon emission, particularly in relation to the future of aquaculture. By far the most popular species is Atlantic salmon, which needs cool waters. Warmer waters will lead to reduced production, especially in the summer season.

The report points out that: “Compared with red- and white meats, seafood - and particularly farmed salmon, have a small carbon footprint”. They further concur with UN’s Food and Agriculture Organization (FAO), that aquaculture is the industry with the greatest potential to increase the global food production in the years to come. They also point out that Norway, with its big, nutritionally dense marine areas, has a great potential for value creation and that marine industry supply products that are needed in the small carbon footprint society envisioned for the future. Provided the environmental challenges that come with aquaculture are met, for example disease control, waste management, sustainable feed production, reduction of transportation emissions, - a sustainable development of the industry is possible. “The possibilities are great, both for present day products and further development of new products. An expert group, commissioned by the Royal Norwegian Society of Sciences and Letters and the Norwegian Technical Science Academy, have estimated that the potential for increased value creation in bio-marine industry is six times, from NOK 80 billion in 2010 to NOK 550 billion in 2050. [. . .] The greatest increase is expected to come from farmed salmon, supply industry and marine ingredient industry”(GoN 2016b, pp. 78–79). There are, however, challenges to be met to realize the growth potential. The report concludes that the salmon farming industry has five central problems that must be dealt with: disease (including salmon lice), escape, feed supply, resource efficiency and territorial disputes. To solve these problems, industry, policymakers and tech all needs to pull in the same direction (GoN 2016b, p. 81).

2.3 Salmon in China

2.3.1 Demand and market growth in China

The overall trend in China is an increasing consumption of protein. Data from UN FAO shows that there has been a steady increase of protein consumption ever since its first estimation in 1963. The estimations are based on 3 year averages and the last estimation was in 2013. There has been a steady increase over 5 decades. However, protein sourced from animals has had a much greater increase than plant-based protein, as seen in Figure 2.2.

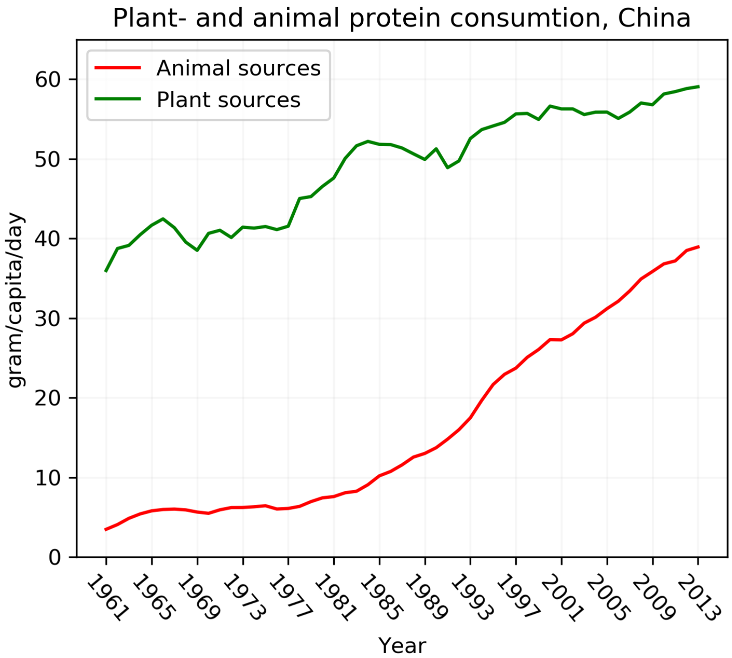


Figure 2.2: Plant protein vs. animal protein in China, from 1961 to 2013. (FAO 2018)

By examining the main sources of animal protein, in Figure 2.3, the greatest increase was in consumption of pork as well as fish and seafood. Pig meat is the top source of animal protein, with a 3-year average in 2013 of 11.58 g/capita/day. Fish and seafood comes in second. In 2013, fish and seafood accounted for 8.33 g of daily protein intake. These two top sources of protein has also had the greatest increase of all the animal protein sources (FAO 2018).

The relevance of the above mentioned statistics, in relation to salmon, is difficult to properly assess. Of course, on a very general note, salmon has a greater chance of success if there is a positive attitude towards fish and other seafood. But, it is important to realize that most seafood consumed in China is locally produced. Indeed China is responsible for more than 60 percent of the world aquaculture production and is also the world leader in capture fisheries production (FAO 2016, pp 2-6). Salmon is, relatively speaking, an expensive import and its popularity might follow a different market dynamic than seafood in general.

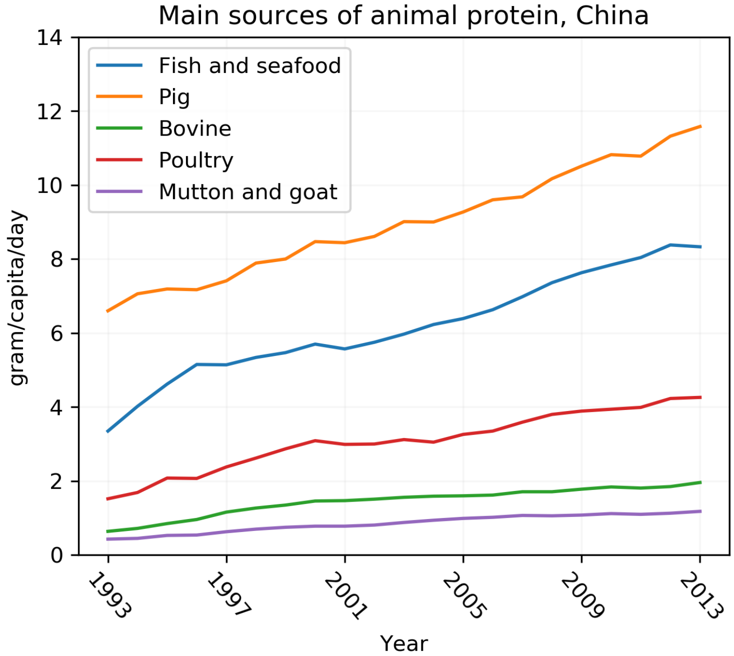


Figure 2.3: Consumption of protein from various animal sources in China. (FAO 2018)

Admittedly, good data to estimate demand in China is lacking. Gorjan Nikolik, seafood industry analyst at Rabobank, refers to this area of analysis as "the dark side of the moon". The assumption, however, is growth. Nikolik forecasts a 25 percent pa growth in demand for salmon in China. With economic development, logistical infrastructure in China has been significantly improved and import of fresh seafood has become possible. Chinese consumer behavior has changed, with increasing distrust of local seafood. Young and middle class consumers prefer imported products because of their perceived higher quality. Online sales are growing and Nikolik believes this represents an opportunity for Norwegian exporters, that have allready been successful marketing salmon online. There are also changes with respect to Chinese traditional cuisines, such as shark fin soup, due to increased environmental awareness among consumers, which means there is a gap to fill. (Nikolik 2018). According to Wild Aid, shark fin consumption has fallen by more than 80%, since 2011 (Wild Aid 2018).

Figure 2.4 shows the popularity of imported fresh salmon in China. The historical development in China's fresh salmon import demand from 2000 to 2016 is presented in the figure. China's fresh salmon import volume was nearly 3300 tons in 2016, an increase of 2445 percent compared with 2000.

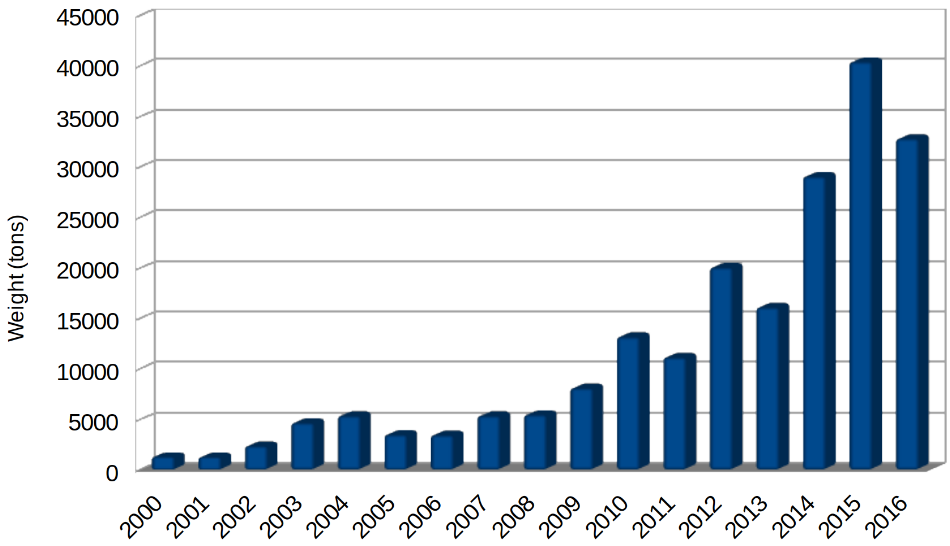


Figure 2.4: China's import demand of fresh salmon. (UN Comtrade 2018)

2.3.2 Norway – China fresh salmon trade history

October 1954, Norway and China officially established diplomatic relations. Since then, the two countries have had a wide range of economic, political, and cultural exchanges. Norway did very well in fresh salmon export to China until a diplomatic impasse hit in 2010, with the awarding of the Nobel Peace Prize to a Chinese dissident.

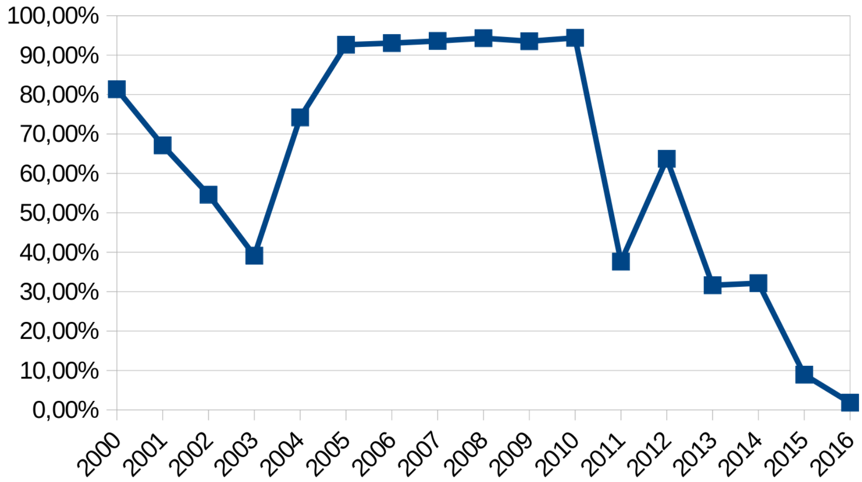


Figure 2.5: Norway's share of Chinese fresh salmon market (UN Comtrade 2018)

As shown in Figure 2.5, in 2010 Norway had a staggering 94 percent share of the Chinese fresh whole salmon market. Although any causal relationship was denied by Chinese officials, the dominance of Norwegian salmon came to an end in that very year, when Chinese dissident Liu Xiaobo, was awarded the Nobel Peace Prize in Oslo. A decline followed and by 2016, the share of Norwegian salmon had decreased to less than 2 percent (UN Comtrade, 2018). The fact that the Chinese fresh salmon market inflated to two and a half times the size of the 2010 market, during those years, perhaps has not made the pill any less bitter to swallow. Table 2.2 shows the development.

Table 2.2: China's import of fresh salmon from the World and Norway in volume (UN Comtrade 2018)

Year	World (tonnes)	Norway (tonnes)	Norway's share (%)
2000	1289	1049	81.34
2001	1259	845	67.10
2002	2344	1280	54.59
2003	4641	1815	39.12
2004	5341	3962	74.18
2005	3483	3226	92.64
2006	3431	3193	93.05
2007	5334	4992	93.59
2008	5459	5146	94.28
2009	8103	7578	93.52
2010	13177	12434	94.36
2011	11150	4192	37.60
2012	20054	12772	63.69
2013	16111	5095	31.62
2014	29065	9343	32.14
2015	40418	3609	8.93
2016	32810	598	1.82

In Figure 2.6, the historical development in Chinese import demand of fresh salmon from the world and Norway during 2000 to 2016, is presented. The figure shows that Chinese total import demand of fresh salmon has increased substantially over the period as a whole, with import demand growth every year, except 2005, 2011, 2013 and 2016. Chinese import demand of fresh salmon from Norway increased during the period of 2000 to 2010, but dropped 66.3 percent in 2011, and continued to drop in 2013, 2015 and 2016. In 2016, only 598 tons of fresh salmon were imported from Norway of the 32,810 tons that China imported.

As 2016 drew to a close, the Norwegian government announced that relations with China was fully normalized. In the press release dated 2016-12-19, Minister of Foreign Affairs, Børge Brende, stated: "Ever since the Government took office in autumn 2013, normalizing our relations with China has been a key priority"(MoFA 2018).

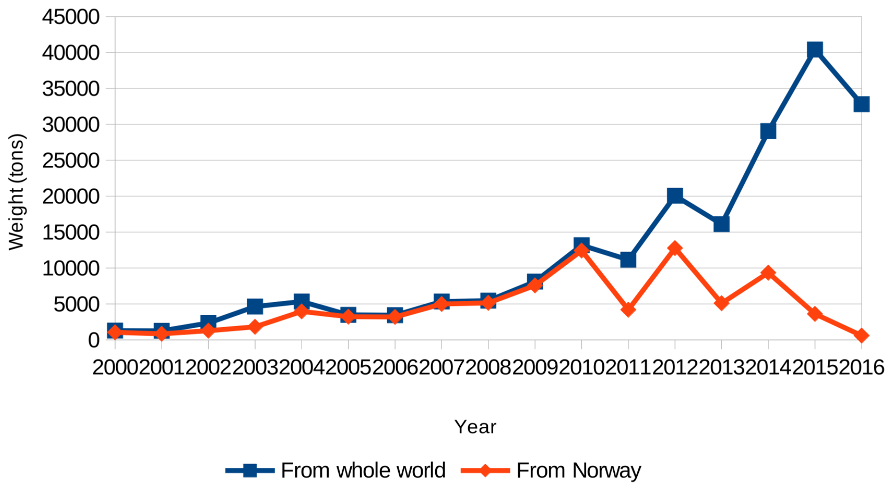


Figure 2.6: China's import of fresh salmon from the World and Norway in volume (UN Comtrade 2018)

In April 2017, the prime minister of Norway, Erna Solberg, was invited to pay an official visit to China. A consensus was reached on rekindling free trade agreement negotiations that was stalled in 2010. In the negotiations, there are full consultation in the area of goods and services trades, as well as trade barriers. The results of the normalized relationship is clear enough: Norway's salmon export to China increased 39 percent from 2016-17.

The same day as the salmon trade agreement was signed by Norwegian and Chinese authorities, the 24th May 2017, the Norwegian Seafood Council (NSC) released the aptly named, “Target 2025”, a plan to greatly increase salmon exports to China. The goal is to reach, in export sales of seafood to China, 10 billion RMB ($1.51 billion) by 2025, and increase the export volume of salmon to 156,000 tons by the same year.

2.3.3 Norway's main competitors in the Chinese salmon market

Chile, Faeroe Islands, Canada, United Kingdom, Norway and Australia are China's top six suppliers of fresh whole salmon (HS030214). During 2010-2017, their relative shares of the Chinese salmon market, have shifted.

As shown in Figure 2.7 and Table 2.3, since 2010, the Faeroe Islands and Chile have rapidly expanded in the Chinese market. In 2015 and 2016, the two newcomers rose to become the biggest exporters of fresh salmon to China. Conversely in those same two years, Norway's share sunk to the smallest of all exporting countries. The fall from 2010 to 2016 is one from near total dominance (94,36%) to a fairly insignificant share (1,82%).

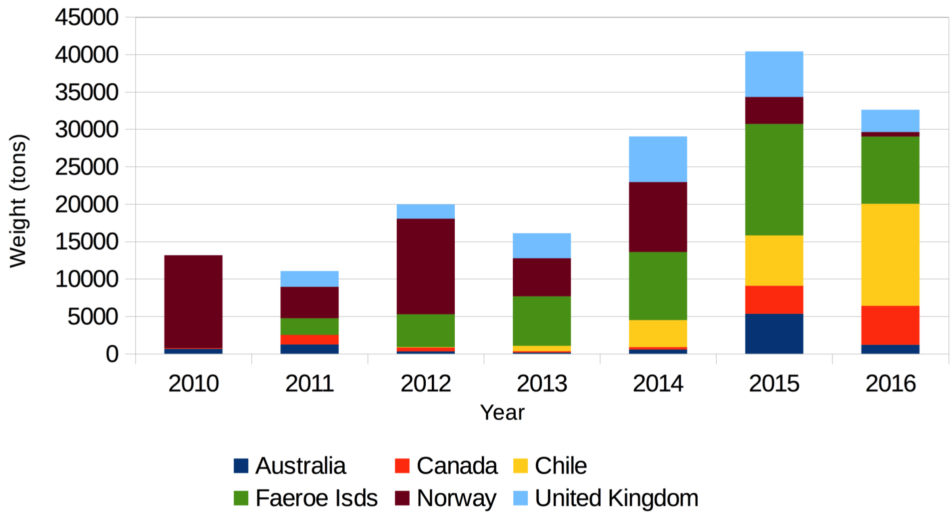


Figure 2.7: China's import of fresh salmon in volume (tonnes). (UN Comtrade 2018)

The United Kingdom has, since 2011 - with the exception of two peak years in 2014 and 2015, nearly doubling their share from the previous year - been relatively stable. Canada remained a small player until expanding in 2015 and 2016. Lastly, Australia had a strong year in 2015, with a 13% share, but have otherwise taken a very small share.

Table 2.3: China's import volume of fresh salmon (1000 kg) (UN Comtrade 2018)

Year	Chile	Canada	Australia	Faeroe Isds	Norway	UK
2010	-	100	636	3	12434	1
2011	-	1285	1228	2230	4192	2120
2012	57	519	307	4392	12772	1922
2013	709	194	146	6625	5095	3343
2014	3613	320.5	554	9116	9343	6102
2015	6733	3757	5323	14902	3609	6084
2016	13648	5218	1178	8991	598	2978

The traditional market mechanisms, demand and supply, determine the salmon price (Guttormsen 2013), but they are not the only forces at work. Climatic conditions, seasonality, diseases outbreak and globalization are factors that influence the salmon price level (Rakvåg and Sandøy 2017).

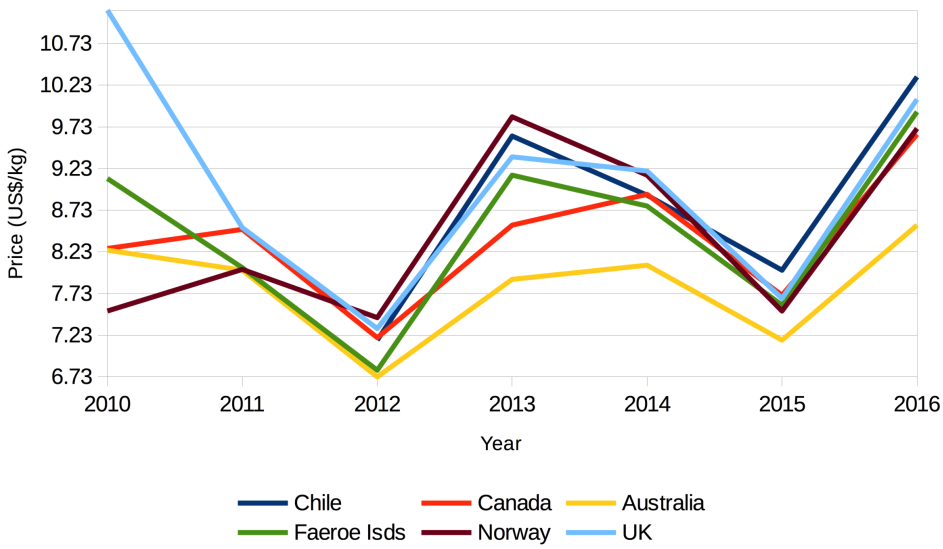


Figure 2.8: China's import price of fresh salmon (US$/kg) (UN Comtrade 2018)

In Figure 2.8 and Table 2.4, the historical development in Chinese fresh salmon import prices from Chile, Faeroe Islands, Canada, United Kingdom, Norway and Australia during the period 2010 to 2016, is presented. Figure 2.8 shows that the differences in salmon prices of the six countries were not very big. Australia had the price advantage, offering the lowest prices from 2011 to 2016. The United Kingdom had the highest average price in this period. Norwegian salmon prices have been relatively unstable compared to the other five countries: Norway offered the lowest price in 2010, but then had the highest prices in 2012 and 2013. Then the price dropped again to the second lowest in 2015.

Table 2.4: China's import price of fresh salmon (US$/kg) (UN Comtrade 2018)

Year	Chile	Canada	Australia	Faeroe Isds	Norway	UK
2010	-	8.27	8.25	9.11	7.52	11.13
2011	-	8.5	8.01	8.04	8.02	8.52
2012	7.17	7.2	6.73	6.81	7.44	7.31
2013	9.62	8.55	7.9	9.15	9.85	9.37
2014	8.91	8.92	8.07	8.78	9.15	9.2
2015	8.01	7.71	7.17	7.59	7.52	7.67
2016	10.33	9.64	8.55	9.91	9.71	10.06

The 2016 market leader, Chile, remains fairly stable in the upper price range, from its entry into the Chinese market in 2012 and has the highest prices in 2015 and 2016. The Faeroe Islands, currently the second biggest exporter to the Chinese fresh salmon market, exhibits a price level from the lower to the upper middle ranges.

2.3.4 Norway's marketing expenditure in China for Salmon from 2000-2017

Data concerning marketing activities by Norwegian actors in the Chinese market is, for the most part, hard to come by. The information is considered sensitive and not shared with the public. However, this might very well be more a consequence of company policy, rather than there being any actual data to keep safe from the prying eyes of the competition. NSC's director in China, Sigmund Bjørgo says that, due to limited market access: "There aren't many actors from the industry in Norway that have invested in the marketing of Norwegian salmon during the last few years"(Bjørgo 2017).

The NSC is, on the other hand, a public institution and budgets are made public. Most of the marketing activities of the NSC is limited to higher level marketing, building business-to-business relations between Norway and China. NSC plays the role of the facilitator. However, as noted by Bjørgo: "Since market access has been limited in the last few years, the NSC has only invested small sums in marketing"(Bjørgo 2017). The spending in 2016 was 1.5 million NOKs, the lowest in the whole study period. In 2017, it increased to 4.5 million, and the budget for 2018 is 5 million. (Bjørgo 2017).

We can see from Figure 2.9 that the NSC's market expenditures, for salmon in China, generally follows the success of Norwegian exports to the Chinese market. From 2005 to 2010, with the volume of Norwegian fresh salmon imports increasing, the NSC was also increasing their marketing expenditure in China. In the years that followed, consistent with the impression of how the two are related, that expenditure follow volume, after Liu Xiaobo was awarded the Nobel Peace Prize in 2010, expenditure trend downwards with volume exported. Indeed, as marketing expenditure seems to mostly be trailing volume, one could easily get the impression that NSC's marketing expenditures are not simply investments for future success - they are perhaps more correctly considered allowances determined by budgets drawn from forecasts and expectations: If we follow the blue line in Figure 2.9, as it relates to the red line for volume, we may be able to see it as an expression of confidence: High upon entering the market in the first years, steady and mostly increasing during the years of diplomatic stability that followed until 2010, where both volume and expenditure drops abruptly. Then, in the following period, with an overall drastic reduction until 2016, both volume and expenditure is a bit of a roller coaster,- perhaps as a result of varying degrees of hope in resolving the diplomatic crisis at hand. Of course, one should not fail to mention that such an interpretation of the data would be highly speculative.

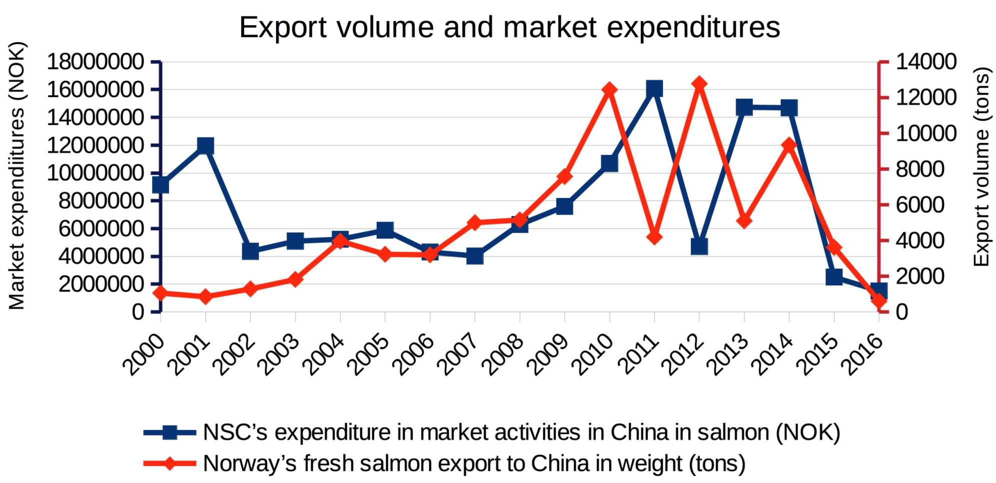


Figure 2.9: Norway's marketing expenditures for salmon in China vs. export volume (UN Comtrade 2018), (NSC 2018[c]) and (Bjørgo 2017)

2.3.5 Emerging Chinese salmon aquaculture and green trends

With the emergence of the environmentally concerned consumer in China, there is now the appearance of a "buy green" trend. The 2012 and 2014 Greendex surveys, measuring consumer behaviour in select countries around the world, rapports that 65 percent of the subjects in China answered that it is very important to know how the food is produced and 64 percent answered they were willing to pay more for organically produced food. That is up from 57 percent in 2012 (National Geographic, Globescan 2014). The drivers behind this green movement, as China Business Review, sees it: "spring from the actions of the PRC government, nongovernmental organizations (NGOs), and the country's growing middle class. [...] Though China recognized the importance of protecting the environment as early as 1973, when it held its first national environmental protection conference in Beijing, the government did not implement strong environmental policies until recently. At the 2007 Chinese Communist Party Congress, PRC President Hu Jintao called on all actors in Chinese society to change their behavior to benefit the environment — the first time a major policy speech in China emphasized the quality over the quantity of growth. To give its environmental protection agency more power, China elevated it to full ministry status in 2008. In recent years, China has issued a slew of environmental measures, including laws on renewable energy and water pollution, regulations on chemical substances and electronic waste, and new emissions and pollution standards"(China Business Review 2018).

Currently, there is little competition from land based indoor recirculating tank salmon farms. The cost is much higher and energy consumption much greater than for sea farms. According to Marine Harvest CEO, Alf-Helge Aarskog, salmon farming on land makes about as much sense as raising pigs at sea (Bergens Tidene 2018). However, the advantages of land-based salmon farming plays well with the concerns of the environmentally concerned consumer. The method is given highest marks by Seafood Watch: "Atlantic salmon farmed worldwide in indoor recirculating tanks is a 'Best Choice'. Indoor recirculating tanks often have less effluent, disease, escapes and habitat impacts than other aquaculture systems. Currently [in 2017], only 0.1 percent of farmed Atlantic salmon is produced by this method"(Seafood Watch 2018).

At 0.1 percent, salmon production in indoor recirculating tanks is no match to marine salmon aquaculture, but technology is evolving, and as analyst Georg Liasjø in ABG Sundal Collier points out: The cost of transporting fresh salmon, farmed in Norway, to market in China is considerable. Even though it is more expensive with land-based farming in China, there indeed is a bit to go on. Intrafish predicts that "within 20 years, there will be a production of $100,000$ tonnes of salmon in land based farms in China"(Intrafish 2018). It takes a strong brand to have concerned consumers convinced that a product that is produced in a less environmentally friendly way, with more disease and parasites, airlifted from Norway and brought to market in six days instead of two, is the superior product. Of course, in the time it takes for land based salmon farming to evolve, we can perhaps also expect advances at sea.

2.4 Background summary

While the GoN's vision of "Green Competitiveness" is not a declaration of a set of cohesive policy actions in a well defined strategy, there have been steps taken to increase output from the salmon industry. A series of budget increases in the areas of research and infrastructure has been made, as well as an opening up for growth in the industry by the selling of new concessions and increasing existing concessions. After normalization of diplomatic relations with China, Norwegian fresh salmon exports to China are again on the rise and, after an all time low in 2016, so is NSC's marketing budget for promoting "Seafood from Norway" in China.

The popularity of seafood in China is increasing the most next to pork. The growth in the Chinese economy and increasing popularity of imported foods are factors that make China's fresh salmon market attractive for growing the industry.

An interesting point is that Norwegian fishery companies operate across borders and regions. Strengthening the industry in Norway is, in a sense, also strengthening the competition abroad. We can therefore speculate that, beyond providing a level of competitive conditions for industry operations in Norway, the main focus should be to strengthen incentives to buy Norwegian salmon in overseas markets and less on direct industry support, as far as *competitiveness* in "Green Competitiveness" is weighted. Strengthening the industry in Norway, without also strengthening the the national brand of "Seafood from Norway", may be inefficient, insofar as the origin of imported salmon exerts significant influence on consumer behavior. A focus on "Seafood from Norway" would also have the added benefit in China of increasing competitiveness with domestic competitors, now still in experimental stages of development. Land based salmon farming has a stronger environmental profile than marine aquaculture, better fish health and thereby, possibly, perceived quality. In the face of emerging Chinese land based salmon farming, with a future potential for supplying the Chinese market with an alternative to imported salmon, a strengthening of "Seafood from Norway", could maintain market incentive to buy Norwegian.

3 Theory and related literature

What are the factors that influence demand in foreign trade? To lay the foundation for a method of approach to the research question posed in section 1.1, relevant theory and related case studies will be explored.

3.1 Influencing factors in import demand

Let us first, on a very general note, discuss supply and demand in the Chinese salmon market, with the help of Figure 3.1. Assume that there are two countries, China and Norway. China's import demand (excess demand, ED) is defined as demand (D) minus supply (S). As mentioned in section 2.3.5, since China only recently (late 2010) started salmon production, and its domestic supply is still very limited, we simplify the situation to not account for domestic supply (S = 0). Therefore, as far as this study is concerned, China's import demand is equal to total salmon demand (ED = D). What then are key influencing factors on consumer demand for Norwegian salmon, with regards to economic theory? Commonly included variables in the study of excess demand are income, price, substitute price, exchange rate, as well as various categorical variables, depending on the study case, such as policy:

$$\text{ED} = f(\text{GDP}, \quad \text{P}, \quad \text{E}, \quad \text{PSub}, \quad \text{Pol}), \tag{1}$$

Where ED is import demand, GDP is used as a measure of income, P is price, E is exchange rate, $PSub$ is substitute price and Pol is a categorical variable for policy.

3.1.1 Income

Changes in income in China effect demand for Norwegian salmon and thereby import volumes, as shown in Figure 3.1. With P as the price of Norwegian salmon, China's import demand is Q_0. An increase in China's income leads to an increase in salmon demand and China's salmon demand curve will shift up, illustrated by the green D_2. With the new demand curve, excess demand quantity increases to Q_2 from Q_0.

Marginal propensity to import (MPM) is a measure of the fractional change in import expenditure that occurs with a change in disposable income (defined as

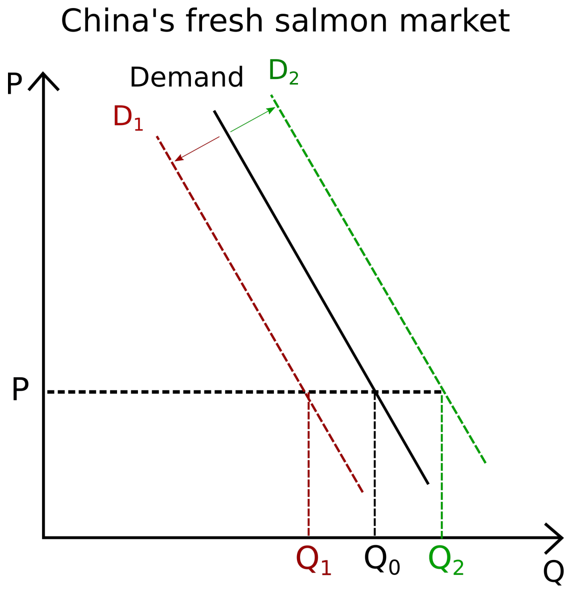


Figure 3.1: Import demand in China's fresh salmon market.

total income minus taxes). Since Norwegian fresh salmon is an expensive import good in the Chinese market, its MPM is expected to be a positive number, which means that there is a positive relationship between disposable income and demand for salmon, i.e. consumers' spending increases when income increases.

3.1.2 Price

As shown in Figure 3.1, China's demand curve for fresh salmon slopes downwards from left to right. It shows that there is a negative association between demand and price, which means that Chinese consumers will buy more salmon as the price falls.

Fluctuations in the price of imported Norwegian salmon effects consumption demand and thereby import. If the export price of Norwegian salmon increases, China's excess demand will decrease, as shown in Figure 3.1, with a downwards shift of the demand curve, illustrated by the red D_1. With the new demand curve, the excess demand quantity decreases to Q_1 from Q_0.

It takes time for consumers to change their consuming patterns, so there is usually a time lag before demand is effected by a change in price. The magnitude of the lag is influenced by many factors that are product specific. Crude oil (Ziramba 2010), and raw materials (Noland 1989) for instance, might be difficult to replace and, as industries need time to come up with new technologies that use less -or other fuels and materials, it could be several years before demand significantly responds to a price increase. Contrariwise, if the price of chicken increases, the response may be almost immediate, as substitutability is high. A product may also be effected both in the short- and long-run, e.g. first due to changes in consumer behavior and later by technological advances or shifts.

3.1.3 Price of substitute

In economic theory, price of substitutes/complements are expected to effect demand for a good (Nicholson 1998). Formally, a product **A** is a substitute of product **B** if, when the price of **A** rises, the demand for **B** increases. Thus, China's import demand for Norwegian salmon is influenced by changes in substitute prices. An increase in price of a substitute for salmon leads to an increase in demand, as shown in Figure 3.1, as the demand curve shifts up to the green D_2 and demand quantity increases to Q_2 from Q_0. A decrease in price of substitute for salmon leads a decrease in demand as the demand curve shifts down to the red D_1 and demand quantity decreases to Q_1 from Q_0.

3.1.4 Exchange rate

In trade theory, exchange rate influences price and thereby, demand (Houck 1992). Houck defines the exchange rate between national currencies as the price of the local currency in terms of foreign currencies. Exchange rate influences trade by transmitting changes in domestic prices of goods and services across international borders, and vice versa. A rising exchange rate (revaluation, which means increase in local currency to foreign currency) leads to a rise in foreign prices, and therefore a fall in export volume. On the other hand, a falling exchange rate (devaluation) leads to a decrease in foreign prices, and consequently a rise in export volume (Houck 1992).

Theory thereby predicts that changes in the exchange rate, between Norwegian kroner (NOK) and Chinese yuan (CNY), affects China's excess demand (ED) of Norwegian salmon. In Figure 3.2, ED is China's excess demand for fresh salmon. In the upper panels of Figure 3.2, the ED curve is priced in NOK, and in the lower panels, the ED curve is priced in CNY. When NOK and CNY are equal in value, the ED curve is the same for both currencies. A devaluation of NOK will increase the Chinese excess demand, priced in NOK, leading to a decrease of price of salmon in CNY to P_1 from P_0. Subsequently, China's import quantity increases to Q_1 from Q_0. In contrast, a revaluation of NOK will shift China's excess demand, priced in NOK, down. As a result, the price of salmon in CNY increases to P_2 from P_0, and import quantity decreases to Q_2 from Q_0.

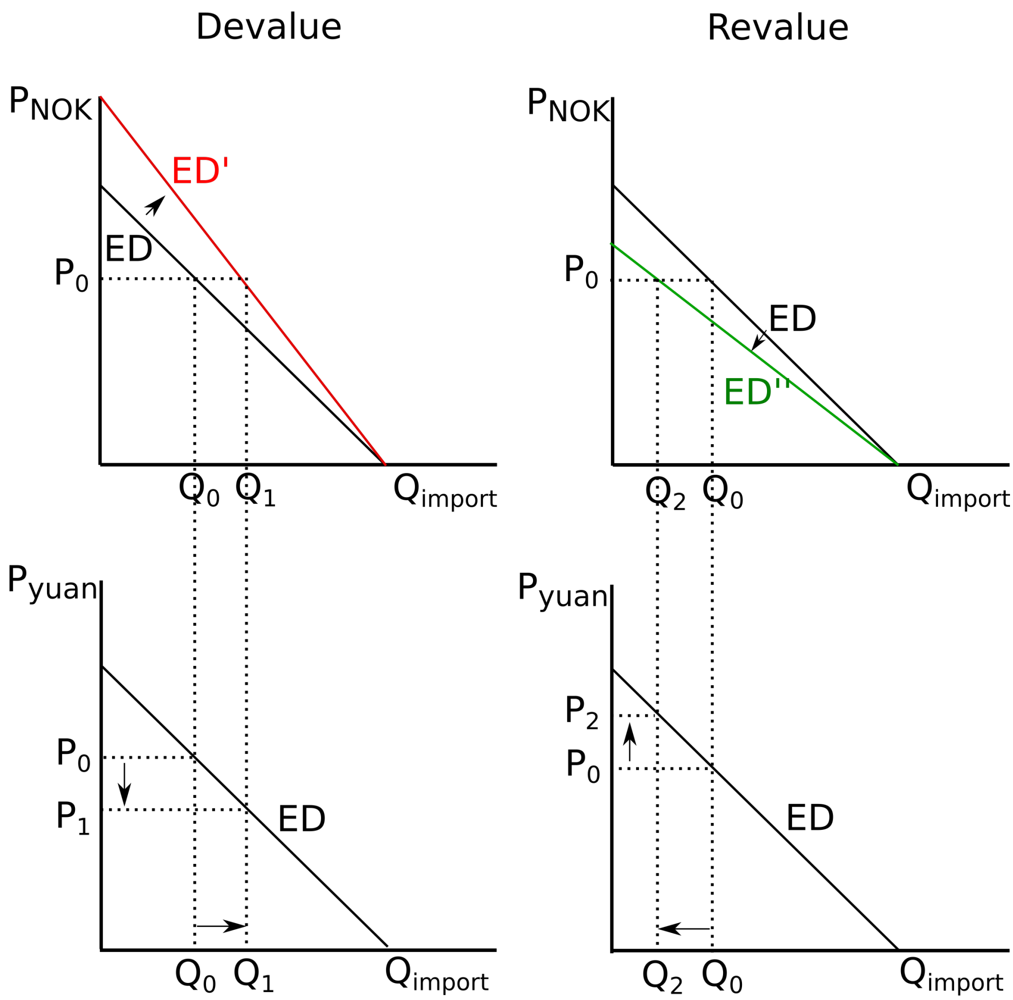


Figure 3.2: Effects of devaluation and revaluation

Exchange rate influence on trade is not immediate. Bahmanii-Oskooee and Ratha (2004) point out that, when there is an exchange rate devaluation, usually there is no immediate, significant increase in export volume. It takes time to change consuming patterns and fulfill contracts. The implication is a time-lag effect on exchange rate influence on demand (Bahmani-Oskooee and Ratha 2004). Consequently, while goods trade tends to be exchange rate inelastic in the short-run, Bahmanii-Oskooee and Kara found that currency depreciation could increase the export and improve the trade balance in the long-run (Bahmani-Oskooee and Kara 2005) in a study of how exchange rate influenced import and export demand for 28 countries.

3.1.5 Exchange rate volatility

Depending on risk preference, it is a reasonable assumption that trade flows are effected by the volatility of the exchange rate. Greater volatility means profits are more difficult to predict. Conversely, a relatively stable exchange rate, makes it easier to predict the outcome of future transactions.

Hooper & Kohlhagen (1978) pointed out that, exchange rate volatility increases the uncertainty and risk of international trade and “a most economic man” have the tendency of avoiding risk. Therefore the volatility of the exchange rate has a strong inhibition on export (Hooper and Kohlhagen 1978).

Opinions do, however, differ. Thursby et al. (1985) found that Hooper & Kohlhagen’s (1978) conclusion was based on the assumption of risk aversion. If this assumption is omitted, a totally different conclusion may be reached. Their belief was that, the effect exchange rate volatility has on export, depends on the risk preferences of exporters (J. G. Thursby and M. C. Thursby 1987). Indeed, exchange rate volatility is not merely a stumbling block for prosperous and predictable trade, it is also an opportunity for additional profits (Giovannini 1988). Higher risk exports have potentially higher earnings, so greater exchange rate volatility may improve export performance (McKenzie 1999).

The production cycle of salmon is approximately three years and, since the finished product is marketed fresh, all salmon produced in one period must be consumed in the same period. Supply therefore, is inelastic in the short-term. Investments for increased production volume to meet a predicted rise in demand happens well ahead of transactions to offload product. Assuming risk aversion to be the norm, given the nature of the industry, with high volatility in the exchange rate, one would expect only cautious optimism when demand is on the rise and, similarly, hardened pessimism when demand is expected to slow down. Conversely, we would expect to see greater optimism and more restrained pessimism in longer periods of more stable exchange rates. Influence from exchange rate volatility may vary from company to company. As we shall take the aggregate view here, and study the Norwegian salmon industry as a whole, we will know little of the variation in the group, but hopefully more about the general trend of how the exchange rate volatility influences the salmon trade.

It is worth noting, in the discussion of NOK/CNY exchange rate, that after decades of pegging CNY to USD at a fixed rate, China changed its policy and started a managed floating exchange rate regime. Instead of the dollar alone, the CNY was allowed to float within a daily band of 0.3% of a basket of select currencies, until 2007, when the band was widened to 0.5%. The reform was halted in the global recession of 2008-2009, but resumed in 2010 (Quin et al. 2015). The question therefore, of NOK/CNY fluctuations, strictly until 2005 and softly since, may really be a question of NOK against other major currencies.

The Chinese central government has never revealed exactly which currencies are in the CNY basket, or what weights they are given, but Frankel 2009 provides an estimate of the new CNY exchange rate regime: "Our results, with the benefit of more recent data and a technique that allows for changes in currency weights as well as changes in the rigidity of the peg, suggest that the regime probably is not best described as a dollar peg with a trend appreciation. Rather, the regime that was in effect in 2007 is better described as a basket peg with some weight on a non-dollar currency, the euro in particular. By mid-2007, the weight on the dollar had fallen to 0.6 and the weight on the euro had risen correspondingly to 0.4. The euro apparently played almost as important a role as the dollar. It follows that the appreciation of the CNY against the dollar in 2007 was attributable to the appreciation of the euro against the dollar, not to a trend effective appreciation of the CNY. The distinction in characterizations of the regime could make a big difference for the future. Our results suggest that if the euro in the future reverses its 2005-07 appreciation against the dollar, the Chinese currency would automatically do the same thing. [...] unless the regime were to evolve again (necessitating further estimation), as is likely"(Frankel 2009, pp. 357–358).

In light of the above, it would seem that the key to explaining the volatility of the NOK/CNY exchange rate, lies in understanding the appreciation of NOK against the USD and the EURO. Europe and the United States are the biggest trading partners to China, so it is perhaps as expected. What happens during crisis, however, is less certain: "China is one of the very few countries that did not experience a severe recession during 2008–2009, due to its limited openness to foreign investors. Because of China's 'immunological strength' to global financial contagion and also because of the ever-growing economy under a strictly managed exchange regime, The CNY exchange rate regime and its timely reforms have attracted a great deal of attention from researchers, investors, and a wider public"(Quin et al. 2015, p. 444).

3.1.6 Sanctions

If policy is against trade, China's demand curve will shift down, and the Chinese import demand will decrease. The much talked about diplomatic crisis, as a result of the Nobel Peace Prize Committee awarding Liu Xiaobo the peace price in 2010, reeked havoc on the export of Norwegian salmon to China, as demonstrated in Figure 2.7. The decision was strongly protested by representatives of the Chinese Government. Spokesperson for the Chinese Foreign Ministry, Jiang Yu, said conferring the award to Liu Xiaobo, was "a shameless provocation, openly supporting criminal activities in China and meddling in Chinese judicial sovereignty"(NRK 2018[a]).

However, this is not the first time the two nations have been at odds over the Nobel Peace Prize. In 1989 the prize was awarded Dalai Lama. This was also not well received in Beijing. Of course, the Nobel Peace Prize, is not the only problem that could arise in diplomacy, but what is interesting about it is that, while it is seen as an independent organization in Norway - without ties to the Norwegian government, this is not necessarily how it is perceived abroad. The committee consists of five members, all of which are appointed by the Norwegian parliament. In addition, the government is, to a very large degree, by media and opposition, expected to support the work of the committee members. Failure to do so will not be well received at home. Those are perhaps among the reasons the prize is oftentimes interpreted as an expression of official policy. It all speaks to the intricacies of diplomacy as it interweaves with domestic politics and cultural institutions. An example of which is a visit by Dalai lama in 2014 to celebrate the 25th anniversary of winning the Nobel Peace Prize. It certainly did not go unnoticed by the opposition and media in Norway, that the government decided not to meet with him. Critics claimed that, despite presenting themselves as champions of democracy and human rights, the Norwegian government sacrificed these ideals for the sake of improving relations with China and regaining access to the Chinese market (Hotvedt 2018).

3.2 Elasticities of import demand

3.2.1 Income elasticity

As income increases, different products are effected in different ways. In the case of low cost foods, such as canned foods, consumption might decrease as income increases and consumers can afford higher valued foods, like fresh meats and fish.

On the other hand, assuming imported Norwegian salmon falls in the category of higher valued foods, we might expect to see increases in demand as income increases.

If we model import demand as a function of income:

$$\text{Import demand} = \text{ED} = f(\text{GDP}), \tag{2}$$

ED is import demand and GDP is a measure of domestic income. Income elasticity is the change in demand with respect to incremental changes in income:

$$\text{Income elasticity} = \frac{d(\text{ED})}{d(\text{GDP})} = \frac{df}{d(\text{GDP})} \tag{3}$$

An income elasticity equal to one means the percentage increase in income is exactly the same as percentage increase in demand. For an income elasticity less than one, meaning inelasticity is implied, the increase in demand is less than the increase in income. When income elasticity is greater than one, meaning elasticity is implied, the demand increase is greater than the increase in income.

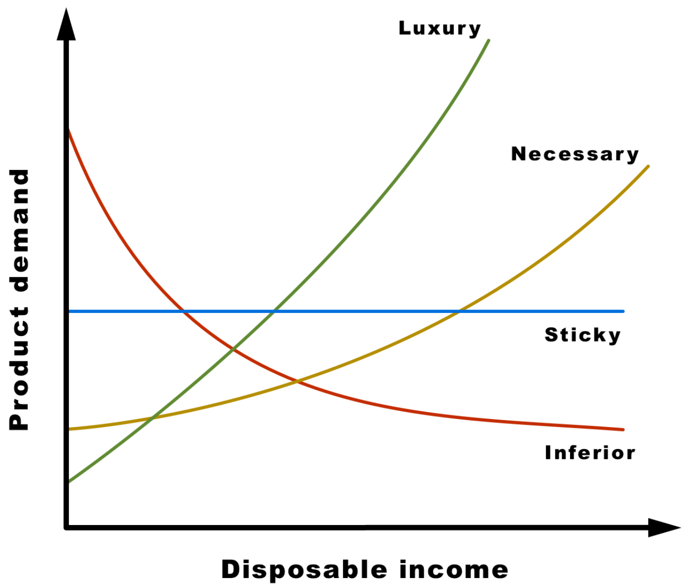


Figure 3.3: Typical categories of income elasticity characteristics for consumer products

Each consumer product will have it's own curve. Typically, we would separate products into the following three categories: normal good (Income elasticity > 0) which includes necessary goods ($0 <$ Income elasticity ≤ 1) and luxury goods

(Income elasticity > 1), sticky goods (Income elasticity $= 0$), and inferior goods (Income elasticity < 0).

As illustrated in Figure 3.3, demand for normal goods increase as as income increases. Normal, necessary goods increase less than the corresponding increase in income. Typical examples of necessary goods would be potatoes, water and electricity. Normal, luxury goods, on the other hand, are particularly sensitive to increases in income as a unit increase causes more than a unit increase in demand. Luxury goods could be travel and wine. Of course, what is considered a luxury, may vary wildly, depending on context. Sticky goods are not influenced much by income increases. Examples are toilet paper and soap. Lastly, inferior goods have negative elasticity. The greater the income, the less the demand. Examples are canned foods, as mentioned above, and public transport.

3.2.2 Price elasticity

The concept of elasticity of demand, as we have seen above, is related to income, but also price, this occurs not only through the dynamics of income-induced price changes, but generally, as price and demand are locked in their own interdependent dynamic. From the perspective of spending power, one could argue that price and income are two sides of the same coin, as price and income changes both determine the value of disposable income, albeit in diametrically opposite fashions. As income increases, so does the value of disposable income and as price decreases, the value of disposable income also increases.

Similarly as for income, if we model import demand as a function of price:

$$\text{Import demand} = \text{ED} = f(\text{P}), \tag{4}$$

then ED is import demand and P is price, and price elasticity is the change in demand with respect to incremental changes in price:

$$\text{Price elasticity} = \frac{d(\text{ED})}{d\text{P}} = \frac{df}{d\text{P}} \tag{5}$$

If price elasticity is less than one, the demand for a good is price elastic, meaning a small change in price can lead to a big change in quantities demand from consumers. Typically, we can see this dynamic in relation to, for example, cars and consumer electronics, i.e. luxury goods as described in section 3.2.1. A price elasticity less than one, on the other hand, requires a meaningful change

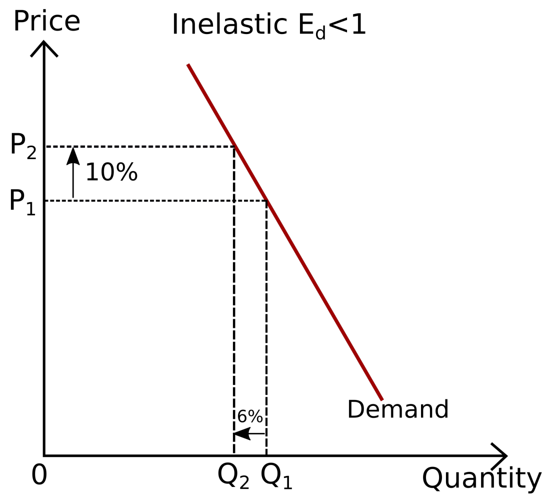


Figure 3.4: Price inelasticity

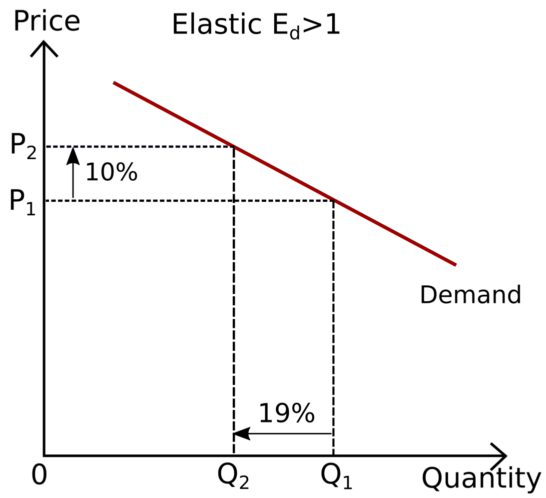


Figure 3.5: Price elasticity

in price to influence demand. Typical examples that exhibit such insensitivity to changes price, are milk and fuels. In a stagnant economy, elasticity is greater as demand is more sensitive to price changes. In an economy with strong growth, like China's, sensitivity, and thereby elasticity, is much less.

The demand curve for an inelastic product is steep, as shown in Figure 3.4. When price goes up 10 percent from P_1 to P_2, the demand for this product only decreases 6 percent from Q_1 to Q_2. By comparison, in Figure 3.5, the demand curve for an elastic product is more flat. When the price goes up 10 percent from P_1 to P_2, the demand goes down 19 percent from Q_1 to Q_2.

3.2.3 Substitutes and price elasticity

Whether or not a product has many substitutes, also influences demand elasticity of price. When a good has many possible substitutes, demand is more price elastic. Say the price of chocolate increases, you might easily find other products that satisfy your sweet tooth. With fuel and milk, for instance, substitutes are perhaps fewer and further between and elasticity is therefore less.

In the case of salmon as a source of protein, there are many possible substitutes in the category of common sources of protein: pork, poultry, eggs, milk, soy, other seafood, etc. However, the significance of eating salmon is perhaps something other than purely satisfying the need for protein. Exactly to which degree salmon is regarded a higher-valued food in China, is not known to us, but if it is perceived to be of high value then the substitutes may be found among other higher valued foods, like lobster or crabs, caviar, imported, higher quality beef etc. Of course, in the case of *Norwegian* salmon, in particular, we may count salmon from other exporters to the Chinese market as substitutes.

3.2.4 Time-lag in price elasticities

In the short-term, as price increases, price changes may be statistically insignificant in explaining changes in demand, or the effects could be minimal. To break consumer habits, a certain degree of motivation is required and consumers might also be unaware of possible substitutes. New products also need time to reach the market, if substitutes are few. If the price increase is more permanent, consumers might become motivated to increase their efforts in search of substitutes and industry may present new alternatives. As a result, the long-term effect of a price increase may be much greater and exhibit traits of greater elasticity.

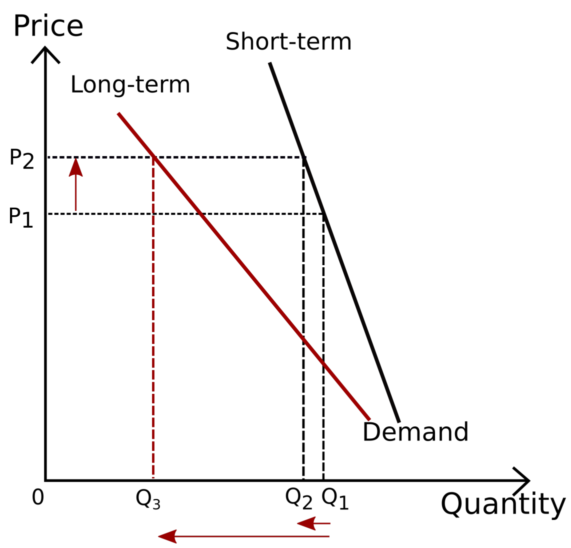


Figure 3.6: Short term and long term price elasticity of demand.

As shown in Figure 3.6, the short-term demand curve is steeper than the long-term curve. Short-term, when price increases from P_1 to P_2, the demand decreases a little from Q_1 to Q_2. But long-term, demand reaction to the same price change is much stronger. A price increase to Q_2 leads to a demand decrease to Q_3.

3.3 Branding and consumer perceptions

Perhaps an important reason for the popularity of imported food in China, is the distrust in domestic food products, a result of negative media coverage in the wake of revealed abuse or neglect in food industries. Bad press can have detrimental effects on popular opinion, and not only in China. In the case of salmon, there is certainly no shortage of bad publicity, with subjects ranging from environmental impact, animal cruelty, carcinogens in the feed, heavy metals, displacement of local catch fisheries and friendly research bought and paid for by the industry.

Judging from the current trend in Norway, the uncertainty surrounding farmed salmon, is growing. Compared to 2016, 2017 saw a reduction in seafood consumption in Norway of 15% (NSC 2018[d]). What exactly is the reason for this, is not entirely clear, but public opinion could certainly be one of the factors involved. As one commentator writes after the yearly risk assessment report for aquaculture, commissioned by the MoTIF, came out: "Norwegian salmon has an aura of health and sustainability - the world over. But it is becoming increasingly hard to maintain the illusion"(Lund 2018), adding another voice to the public discourse for or against farmed salmon.

The NSC seems very aware of a possible effect that food scares can have on brand equity. It is evident, through their online promotion of their "Seafood from Norway" brand, both at home and abroad, with a strong focus on health, quality and sustainability. Their online presence in China is no exception, at the time of writing, assuring Chinese consumers that a certain virus is natural in salmon and safe for human consumption (NSC 2018[e]).

Serra (2011) notes that widespread coverage by mass media and growing public concerns about food safety have resulted in significant food market crisis. Serra studied the effects of mad cow disease (BSE). The objective of the study was to assess impacts of food scares on price volatility in the beef market chain in Spain: "[...] results suggest that the BSE crisis has substantially affected both beef price levels and volatility at the different levels of the marketing chain. While price levels have declined, volatility has increased"(Serra 2011, p. 179).

In the case of salmon, there is a good deal of confusion amongst consumers whether or not it is healthy to eat it. A search on Google with the text (in Norwegian): "Is it healthy to eat salmon?", yields more than 300 000 hits, not all of them to the point, no doubt, but nonetheless a telling number. As a response to public concern, NSC and Norwegian Seafood Federation, have created a website aptly named: salmon facts (laksefakta.no). At the time of writing, at the head of the homepage there is a carousel of images and text addressing common concerns: “Are there environmental toxins in farmed salmon?”, “How healthy is farmed salmon?”, “Pollution from salmon farms”, “Does salmon eat genetically modified feed?” (NSC, NSF 2018). There is a translated “international” version of the website in English and one in French. In 2017, Poland was the largest trading partner for Norwegian salmon, but that is largely due to processing and redistribution. Poland is more of a transit market. In second place is France (UN Comtrade 2018). Besides the prominent position, an incident in 2010 might give us a clue to the reasons for specifically having a French translation: The documentary “Assiette Tous risques” (“A plate full of risk”) aired on the second largest public television channel in France, France 3. As reported by the Norwegian National Broadcasting Company (NRK 2018[b]), the documentary claims Norwegian salmon is full of carcinogens from medicine used to treat salmon for lice. The documentary got wide news coverage and resulted in top level diplomatic contact when the minister of fisheries in France, Bruno Le Maire, contacted his Norwegian colleague for assurances.

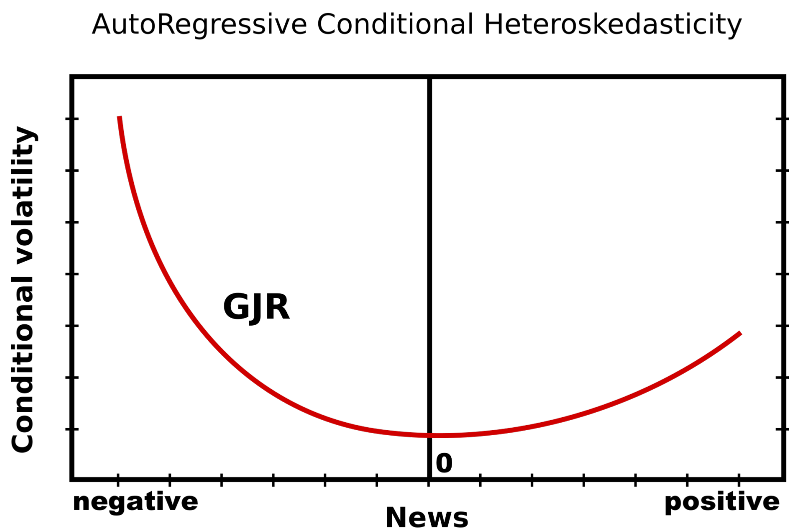


Figure 3.7: Positive and negative product news and future price volatility

According to theory, there is a relationship between positive and negative news, relating to a product, and future price volatility. Engle (1982) introduced the concept of AutoRegressive Conditional Heteroskedasticity (ARCH), describing volatility conditioned by a various degrees of prior good and bad news, at a specific point in time, as illustrated in Figure 3.7 (Engle 1982). Different models have been developed, with varying degrees of asymmetry, in relation to good vs. bad news.

Engle and Ng (1993) studied daily Japanese stock return data and concluded that a particular model called GJR after the its creators, Glosten, Jagannathan, and Runkl yields the most accurate results (Engle and Ng 1993). Generally, for all asymmetric models, bad news leads to a greater increase in volatility than good news, as seen in Figure 3.7.

With the basic economic concept of price effects from supply and demand in mind, it follows that price volatility is a result of underlying characteristics of supply and demand in the marketplace, with high volatility signifying extraordinary events on either the supply -or the demand side. Of course, in regards to good or bad news, we have a case of a demand side dynamic, where consumers react to new information about a product or a brand.

3.4 Literature review

3.4.1 Studies on China's import demand function

Import demand functions for China have been studied at both the aggregate -and various disaggregate levels. Gozgor (2014) used the ARDL model and dynamic OLS estimation technique to estimate both the disaggregated- and aggregated import demand functions for China over the period from January 1993 to September 2012 with quarterly data. He used the seasonality-adjusted real GDP index as an income measure, and also included exchange rate, perception of tail risk, global recession period and exchange rate reform as explanatory variables. For disaggregated imports, he studied six groups of products based on the Standard International Trade Classification (SITC): machinery and transport equipment (MTE), crude materials, inedible (CM), mineral fuels, lubricants and related materials (MFLM), manufactured goods chiefly by materials (MG); chemicals and related products (CRP), and miscellaneous manufactured articles (MMA). He found that there were positive effects from income increases on China's imports, while a real revaluation of the CNY reduced import demand, as theory predicts.

Fukumoto (2012) studied elasticity for import demand functions of china, in both the short- and long-run, at the disaggregated level over the period from 1988 to 2005 with annual data. He used the ARDL model and the FMOLS estimation method to estimate different classes of imports. Mostly relevant in our case is the class of consumption goods. GDP, disposable income, aggregate consumption, aggregate investment and aggregate exports were used as variables for China's domestic income. His research show that consumption goods were income elastic and that there was a significant correlation with both China's GDP -and disposable income. He also found that, for all categories studied, that price elasticity was negative and inelastic.

Zhang et al. (2013) estimated the dynamics for China's import of 4893 products over the period from 1996 to 2008, in a panel framework, by using the generalized method of moments (GMM). In their model, the following five variables were used as domestic activity indicators: GDP, private consumption expenditure, government consumption expenditure, fixed assets investment and net export. Besides unit value of products, the following three explanatory variables were used in the study of price dynamics: China's domestic price index, exchange rate CNY/USD and import tariffs. The study found that all the five domestic activity indicators significantly and positively influenced China's disaggregated import demand. Price's influence on demand varied across industries, with the greatest negative influence when quality -and product differences were small.

Tang (2003) investigated the import demand function of China over the period from 1970 to 1999 by applying the ARDL model. In his model, the following four variables were included: China's income, the relative price, exchange rate and a dummy variable for the trade reform. The following four indicators were used as the measure of the Chinese income: GDP, GDP minus exports, national cash flow (GDP minus investment minus government expenditure minus exports), and the decomposition of GDP (investment goods expenditure, exports expenditure, and final consumption expenditure). In his first estimation, with GDP as the variable for the income, the result indicated that the income elasticity was 0.73 and the price elasticity was -0.48 in the long-run, and both were significant. In his second estimation, the GDP minus exports as the variable for income, the results indicated that income did not significantly influence import demand. Price, on the other hand, did with a coefficient of -0.45. In his third estimation, with national cash flow as the variable for income, the results also indicated that the income elasticity was not statistically significant, but that price was with, with elasticity -0.51. In his fourth estimation, the decomposition of GDP as the variable for the income, the results showed that the investment goods expenditure and final consumption expenditure did not significantly influence China's import demand, but exports expenditure did, with a coefficient of 0.51. Price again, was significant with a coefficient of -0.60. He also found that exchange rate did not influence China's import demand significantly, but the dummy variable for trade reform did, positively so.

Yin and Hamori (2011) estimated China's aggregated import function over the period from 1978 to 2009 with the ARDL model and the dynamic OSL method. They used GDP as the measure of China's income, and also included relative price and exchange rate in the explanatory variables. They found that the income elasticity was 2.66, and the price elasticity was -0.91 in the long-run. They also found that the exchange rate had no significant influence on China's import demand which supported the findings of Tang (2003).

Wang and Lee (2012) estimated China's import demand elasticity by using the ARDL model with monthly data from July 1992 to July 2011. In their model, the dependent variable was China's import volume, and the independent variables were the industrial production index (IP), as a measure of domestic income, real effective exchange rate (REER), as a measure of exchange rate and implied volatility of the US stock market (VIX), as a measure of global risk. Their empirical results showed that income in China had a significant and positive effect on its imports. Exchange rate affected the import demand significantly and negatively as a revaluation in the Chinese currency could decrease its imports. The perception of global risk also had a significantly negative influence on China's aggregated imports.

In summary, GDP has been found to have a positive impact on import demand. However, the magnitude of the influence varies. Results have indicated income elasticity of import demand to be both elastic and inelastic. Price is negatively inelastic and varies across industries. Effect is greater in industries where quality and product differences are small. There is considerable controversy regarding exchange rate, with some studies showing the expected effects and others showing no significant influence on demand. This study has a much more focused subject matter, a single trade and- trade relationship between Norway and China, as opposed to China and the world. However, the studies of Gozgor (2014), Fukumoto (2012), Zhang et al. (2013), Tang (2003),Yin and Hamori (2011) and Wang and Lee (2012), will serve as a frame of reference, both with respect to general Chinese import dynamics and methodology.

3.4.2 Studies on income elasticities of salmon demand

Kinnucan and Myrland (2005), found a value of aggregated income elasticity in world trade for salmon at about one. As such, we would therefore expect the increase in demand to grow at about the same rate as income. However, as the study points out: "[...] owing in part to policies that restrict [export] supply response, not all exporters will share evenly in this growth, with UK producers benefiting the most and Norwegian producers the least"(Kinnucan and Myrland 2005, p. 1967).

This finding, might be attributable to Norway's restrictive concessioning policy and general focus on decentralized structures (section 2.1.1). However, the Kinnucan and Myrland study was conducted in 2005 and, with the recent changes in policy, allowing for greater growth in salmon production, Norwegian producers might benefit more (MoTIF 2018[d]). Furthermore, perhaps as a testament to the rather intuitive scenario that salmon demand is not a function of income alone, the study also found that: "The worldwide total income elasticity for salmon conceals significant regional variation. In particular, our analysis suggests the mean total income elasticity for the EU is inelastic at 0.89 and for Japan is elastic at 1.72. This suggests that countries that export salmon to the EU and Japan will find their volumes expanding slower and faster, respectively, than the average rate of growth in world income"(Kinnucan and Myrland 2005, p. 1977).

Kinnucan and Myrland also found that, failing to take into account income induced price effects, introduces considerable inaccuracies: "In the case of salmon we find that the total income elasticity in world trade is 1.02 (mean value from stochastic simulations), which means imports worldwide will grow at about the same pace as world income. If induced price effects are not taken into account, the income elasticity in world trade increases to 1.22. Hence, for salmon the failure to take into account price rises associated with an increase in world income would cause predicted trade volume growth to be overstated by some 20 percent"(Kinnucan and Myrland 2005, p. 1976). I take inspiration from these findings and will take induced price effects into account by using real GDP as a measure of income.

3.4.3 Studies on exchange rate effects on Norwegian salmon price

Choi and Prasad (1995) studied how import demand was influenced by exchange rate volatility across 409 U.S. multinational firms during the years 1978-1989, and found that "[...] 60% of the firms with significant exchange risk exposure benefited, and 40% lost, with a depreciation of the dollar"(Choi and Prasad 1995, p. 87). The study grouped the firms into 20 portfolios based on two-digit SIC classification. However, they "found limited support for the importance of the exchange rate factor. This may be explained by the fact that allthough firms in a given industry are in the same primary line of business, they are still heterogeneous in terms of their operational and financial characteristics"(Choi and Prasad 1995, p. 87).

In the case of this thesis, where fresh salmon is the focal point, we can perhaps expect a much greater degree of homgoneity in operational and financial characteristics than Choi and Prassad's (1995) rather more "pixelated" two-digit SIC business classification. However, no company is the same and each deserve to be judged according to its own particular characteristics. In any case, it seems to be an interesting prospect to consider the inclusion of, not only exchange rate, but also exchange rate volatility as an influencing factor in the Norway-China fresh salmon trade.

A study of greater, particular interest to our case is Xie et al.'s study on exchange rate effects on export prices of farmed salmon in the world market. They studied exchange rate effects on export prices of farmed salmon by extending the inverse Central Bureau of Statistics, or CBS, model to include exchange rates. The model was estimated using monthly data from 1998-2005 on fresh salmon exports and prices from Chile, the UK, Norway and the rest of the world. The study found that exchange rate pass-through, i.e. absorption into export prices, differed depending on currency. For the British pound and the Chilean peso, the pass-trough was complete, indicating that producers in Chile and the UK are sensitive to exchange rate variability. In the case of NOKs and USDs, however, the pass-through was incomplete, suggesting "sticky" export prices, which in the case of Norway and NOKs, is plausible, "[...] as Norway dominates the world salmon market and has instituted a variety of controls to adapt supply to market conditions." (Xie, Kinnucan, and Myrland 2008). Since the focus of my study is the China-Norway fresh salmon trade, it will be interesting to see if my results on exchange rate influence can corroborate the results for the Norway-world fresh salmon trade.

3.4.4 Studies on sanction effects on China's salmon demand from Norway

Stable diplomatic relations is the bedrock of the export industry, and it doesn't always come easy. Chen and Garcia (2016) studied how China's prominent position in global markets enables the use of economic sanctions to achieve foreign policy goals. Access to its lucrative and rapidly growing market is the means by which foreign policy objectives are pushed. The study found evidence to support the claim that China imposed sanctions on Norwegian salmon imports in response to the 2010 Nobel Peace Prize being awarded Liu Xiaobo: "The findings support the claim that China applied a partial boycott on fresh/chilled whole Norwegian salmon which was underpinned by non-tariff barriers (e.g. more restrictive import-licencing approval practices and more stringent inspection methods delaying customs clearance). Furthermore, the timing of the changes in customs practices and border measures, discriminatorily applied to Norwegian salmon, coincided with the awarding of the Nobel Prize. Under WTO rules, stricter sanitation testing and veterinary inspection procedures are allowable sanitary and phytosanitary measures, but the WTO Secretariat has to be notified of the justification for such measures. Moreover, no food safety concerns over Norwegian salmon were brought up by other importing countries. The measures imposed by China were decrees or changes in practices that were not based on legislation, which suggests China's tendency to resort to subtle sanctions"(Chen and Garcia 2016, p. 48). The Chen and Garcia (2016) study is of particular significance as their findings offer an explanation to a most prominent characteristic of the import demand dataset, the dramatic decline in the Norwegian share of the Chinese fresh salmon market, from 2011 onwards.

3.4.5 Studies on brand significance

Krishnamurthi and Raj (1991) studied price elasticity, substitute goods and brand preference. They used an integrated choice-quantity model, where a variable derived from a logit model, representing a selectivity bias correction term, was included as a an additional regressor in the quantity regression model. They found, in accordance with presumptions, that consumers with a higher degree of brand preference, i.e stronger sense of loyalty, were less sensitive to price changes, as far as switching brands go, i.e. demand is more inelastic in respect to price. At the same time, demand is more elastic in respect to quantity: "Our central hypothesis is that loyals are less price sensitive than nonloyals in the choice decision but more price sensitive in the quantity decision. The choice hypothesis is intuitive, but the quantity hypothesis is subtle"(Krishnamurthi and Raj 1991, p. 181). It would seem that loyals are willing to reduce the quantity, to stick with the preferred brand in the face of price increases. As such, in line with common sense and intuition, the strength of a brand influences the likelihood of substitution.

The findings of Krishnamurti and Raj relate to private brands. I make the assumption here that the same psychology applies to national brands. Krishnamurti and Raj's study may serve as a reference for my own, when trying to decipher the numerics of the Norway-China salmon trade dynamics, in terms of signs of loyalty to the national brand of Norwegian salmon in the Chinese marketplace.

Intuitively, one would expect that national brands and private brands can be understood within the same psychological framework of stereotyping, the process of simplifying the world around us to a series of generalized images. The intrinsic value of an object is of little importance, as people act on what they *believe* to be true, rather than what *is* true. (Papadopoulos and Heslop 1993). From a philosophical point of view, this is not a matter of choice. We can only know the world as it appears to us. The nature of the world itself, is beyond our reach (Kant 1781). Relating to the world is a matter of “best guess”.

Philosophy aside, the complexities of the world alone, necessitates a “best guess” approach. Stereotypical images help us navigate those complexities at greater speed and at lesser costs, albeit with a varying degree of accuracy. Stereotypical imagery can be influenced or manipulated to benefit one player at the cost of another, an example of which is are “Seafood from Norway” campaigns by the NSC. As with any marketing and brand building campaign, the goal is to create positive stereotypical images in the minds of consumers.

Though, I assume national brands and private brands adhere to the same general psychology of branding, there may be important differences between them. The effect of a price decrease could be a decrease in brand equity, as a result of the association between higher prices and quality. The phenomenon is apparent in the findings of Garretson, Fisher and Burton (2002). For consumers of private brands, a decrease in price can make a product less attractive. Contrarily, a reduction in price of a national brand can be viewed very favorably, as a way to save money without sacrificing quality (Garretson, Fisher, and Burton 2002). The basic implication is that, in respect to brand equity, national brands are more resilient than private brands, making marketing strategies and “Seafood from Norway”, specifically, all the more interesting to our question of ways to achieve “Green Competitiveness”.

The method of the study was interview based, with recording of supermarket customers attitudes and corresponding consumer behavior. As the methods used in my thesis belongs to the field of econometrics and not to behavioral economics, our findings can at best be tangential as we are confined by our method to a discussion of elasticities of Norwegian salmon demand. The study may, however, serve as broader reference in the interpretation of our results.

Related to national brand, is the concept of country of origin image (COI). I understand a national brand to be, at some level of aggregation, a product specific instance of COI, i.e. “German beer”, “Chinese silk”. Another study from the field of behavioral economics investigates various countries' attitudes to country of origin. Interestingly, Chinese consumers attach particular importance to price and country of origin. Brand (private), design and guarantee are of less importance (Godey et al. 2012). The implication of these findings for my study, is that we should only expect to find demand to be inelastic, in relation to price changes, if some perceived qualities of the product in question are strong enough to trump general Chinese frugality, and that COI is likely important among those qualities. The method used in the study was customer interviews and it includes a sample of around 150 people for each of the seven countries included in the study.

There are many potential influencing factors for brand equity and perceptions of quality and safety are certainly among them, not least in the case of food products. Combating negative news coverage is essential to maintaing brand equity. Messer et al. (2011) found highly significant effects of generic advertising in alleviating consumer concerns over food safety, as discussed in section 3.3. It was a short-term study and do not speak much to the effects of repetitive or resilient scares, but nonetheless it gives both credence to the existence of web pages like those of the NSC, with their focus on health and safety.

The study theorized that positive messages from generic advertising could invoke psychological coping mechanisms to mitigate concerns: "The results indicate that, contrary to the standard interpretation of attribution theory, generic advertising can be a useful tool in offsetting negative messages by the media. The average willingness to pay (WTP) for a hamburger decreased by more than 58.9% from the control group after consumers were shown information about mad cow disease (BSE). When exposed to both the negative BSE information and generic beef advertising, the average WTP fell only 3.3% relative to the control group"(Messer et al. 2011, pp. 1545–1546).

Failing to comply with consumers' expectations for health and environmental profiles, may have consumers fleeing one source of protein and embracing another. The recent story that two Norwegian companies have been accused of exporting salmon with pancreas decease (PD) to China (Nettavisen 2018) and the NSC website's (NSC 2018[e]), the refuting of various online articles and rumors reporting on Norwegian salmon and PD, as well as the infectious salmon anemia virus (ISA) and even some rumors that Norwegian salmon may be infected with the ebola virus (Saving Seafood 2018), can serve as a reminder that trust is hard earned but easily lost.

Negative news coverage for salmon, typically have elements of either health -or environmental concerns (or both). I make the assumption that negative news coverage and word of mouth, over time, has the potential to alter consumer perceptions of quality and thus brand equity. In light of the findings of Messer et al., I also make the assumption that effects of negative news coverage can be offset by counter advertising and positive stereotypical product narratives (Papadopoulos and Heslop 1993). It is beyond the scope of this study to analyze specific interactions, but we can however find general indication of brand image condition in the analysis of import demand elasticities, as discussed in Section 3.2.

4 Modeling and data

This thesis will use an autoregressive distributed lag model (ARDL) to estimate influencing factors in China's import of Norwegian fresh salmon during January 2000 to August 2017. The ordinary least squares (OLS) method will be used for estimating the unknown parameters in the ARDL model. The ARDL model is useful for estimating dynamic effects by including both lagged independent and lagged dependent variables, and it was used by Gozgor (2014), Fukumoto (2012), Yin and Hamori (2011), Tang (2003), and Wang and Lee (2012) to estimate China's import demand functions.

Table 4.1: Influencing factors, their explanatory variables -and data sources

Factor	**Quantitive variable**		**Exp. sign**	**Source**
	Original variable	**First difference of log-scaled variable**		
Import demand (Vol)	Import volume	Import volume rate of change (dVol)	−	Norwegian Seafood Council
Income (RGDP)	China's real GDP (GDP/CPI)	Rel GDP rate of change (dRGDP)	+	National Bureau of Statistics of China
Price (PR)	Price ratio	Price ratio rate of change (dPR)	−	UN Comtrade & Norwegian Seafood Council
Price of substitute (PSub)	Consumer price index (CPI) of substitute	CPI rate of change (dPSub)	+	National Bureau of Statistics of China
Exchange rate (E)	NOK/CNY	NOK/CNY rate of change (dE)	−	The United Nations Statistics Division
Factor	**Dummy variable**		**Exp. sign**	**Source**
Sanctions (San)	Nobel Peace Prize		-	Dates: Start and end of conflict

According to theory described in section 3, the following influencing factors will be checked, with respect to their influence on Chinese import demand of Norwegian fresh salmon: income in China, exchange rate, relative price of Norwegian salmon, price of substitute for salmon and the salmon sanctions as a result of the Nobel Peace Prize in 2010.

4.1 Variable selection and data source

As shown in Table 4.1, China's import volume of Norwegian fresh salmon will be used as the depended variable for import demand. China's real gross domestic product (RGDP) will be used as a measure of income in China. Real GDP is a measure of the economic output value, adjusted for price changes due to deflation and inflation, and is used to measure national income. In previous research on China's import demand functions, Gozgor (2014), Zhang et al. (2013), Fukumoto (2012), Yin and Hamori (2011), all used real GDP as an indicator of China's income.

To better reflect the price dynamic of salmon in the marketplace, price ratio is used, instead of price, to measure the Norwegian prices relative to the price of other competing exporters. Volume and value for all salmon exporters was used to calculate data for the Norwegian fresh salmon price and average competitor price. The ratio is calculated by dividing the price of Norwegian salmon by that of a weighted average price of other exporters to the Chinese market.

A substitute for Norwegian fresh salmon will be determined by a regression test in section 4.1.2. Availability of data and salmon viewed as a source of protein gives three Chinese product categories as potential substitutes: meat, poultry and aquatic products. The meat category includes pork, beef and lamb. Poultry includes chicken, duck, goose, other birds and their eggs. Aquatic products include fresh -and salt water produce and seafood. For all categories, monthly consumer price index (CPI) will be used as variables for substitute price in the regression model.

Monthly exchange rates of USD/CNY and USD/NOK are collected from the UN statistics division, and NOK/CNY is calculated based on the data of USD/CNY and NOK/USD. In addition, daily data on the NOK/CNY exchange rate, was gathered from the Bank of Norway to construct a time series for monthly standard deviation as an expression of exchange rate volatility. Missing daily data from January 2000 to December 2004 was constructed from CNY/USD and NOK/USD.

In the case of the dummy variable for the salmon sanction , I have chosen to represent a non-sanction month by the label 1, and an sanction month by label 0. The main difficulty is when to mark the beginning of the sanction period, as a result of the 2010 Nobel Peace Prize, and when to mark its end. There were protests from China, already at the time of the announcement of Liu Xiaobo as a candidate for the prize, some seven months prior the announcement he had been chosen as the winner. However, given causality, the effect is visible in the data only from January 2011 after a period of strong growth. While it is indeed conceivable that sanctions were put in place before that, the side effect of choosing a later date, is a shortening of the lag. Therefore the presumption was a stable diplomatic relationship until (and including) the month Liu Xiaobo was awarded the Nobel Peace Prize in December 2010. The end of the sanction, I have set to the month, in which a "Full normalisation of relations with China" was announced by the GoN (MoFA 2018).

To make the sample larger, monthly data are used. The start of the time series is 2000, at which China had already archived economic growth since 1978 and had the chance to develop a bit of an economic foundation the consumption of imported foods. China started importing fresh salmon in 1992, but it was only around 2000 that had established itself as a product with steadily increasing import demand (UN Comtrade 2018). Therefore the time series start in January of 2000 and ends in August of 2017.

4.1.1 Test variables for stationarity

To get a consistent estimator, all independent and dependent variables in a regression need to be stationary. Regression of a non-stationary variable on other non-stationary variables will likely yield very high significance, despite the fact there is no correlation between them. Their relationship is spurious and regression results from them are invalid.

Stationarity test for the original variables: The augmented Dickey-Fuller test is used for the purpose of checking whether variables are stationary or not. The data are monthly, so a dickey-fuller with 12 months lagged differences is used to cover the whole year and conceivably create a dynamically complete model.

As shown in Table 4.2, the augmented dickey-fuller test yields p-vaules, for all original variables, are greater than 0.01. This means that, with a significance level of 1%, the null-hypothesis of non-stationarity, cannot be rejected.

Stationarity test for first difference of variables: Since all the original variables are non-stationary, the first difference of logarithmically scaled variables is generated and checked for stationarity. The first difference of the dependent variable (Vol) and explanatory variables (RGDP, PR, E, PSub and San) are generated in the way shown in Equation (6) and (7).

$$\Delta \log y_t = \log y_t - \log y_{t-1} = \log \left(\frac{y_t}{y_{t-1}} \right) \tag{6}$$

$$\Delta \log x_{i,t} = \log x_{i,t} - \log x_{i,t-1} = \log \left(\frac{x_{i,t}}{x_{i,t-1}} \right) \tag{7}$$

From the results of the augmented dickey-fuller test in Table 4.2, we can see that all p-vaules, for first difference (d), are less than 0.01. This means that with a significance level of 1%, we have sufficient reason to reject the null-hypothesis and reach the conclusion that the first differences of the variables are stationary.

4.1.2 Selection of a protein substitute for Norwegian fresh salmon

From section 4.1.1, we know that the first differences of all variables are stationary, so they are suitable for building regression Model (8):

$$\text{dVol} = \alpha_0 + \alpha_1 \text{dRGDP} + \alpha_2 \text{dPR} + \alpha_3 \text{dE} + \alpha_4 \text{dPSub} + \alpha_5 \text{San} + \epsilon, \tag{8}$$

Where Vol is China's import demand of Norwegian fresh salmon in volume, RGDP is real GDP of China, PR is the price ratio of salmon, E is the exchange rate between NOK to CNY, PSub is the consumer price index of substitute for salmon and San is the salmon sanction due to Nobel Peace Prize in 2010.

Testing the three potential substitute categories separately using Model (8), as shown in Table 4.3, the p-value for meat is 0.125, aquatic foods is 0.044 and poultry is 0.025. Setting 5% as the significance level, both aquatic -and poultry products are significant influencing factors for the Chinese import demand of fresh

Table 4.2: Dickey-Fuller test results

Variable	Test-statistic	p-value**	Stationarity*
RGDP	2,244	0,9989	No
PR	-1,766	0,3973	No
E	-1,020	0,7461	No
PPoultry	-3,203	0,0198	No
PMeat	-3,396	0,0111	No
PAquatic	-2,796	0,0588	No
Vol	-2,203	0,2053	No
dRGDP	-24,301	0,0002	Yes
dPR	-5,772	0,0000	Yes
dE	-4,691	0,0001	Yes
dPPoultry	-6,709	0,0000	Yes
dPMeat	-5,030	0,0000	Yes
dPAquatic	-5,857	0,0000	Yes
dVol	-4,466	0,0002	Yes

* 1% significance level
** McKinnon approximate p-value
The critical value at the 1%, 5% and 10% are -3.477, -2.883 and -2.573, respectively.

salmon. Due to the relatively smaller p-value of poultry, this category exerts the greatest influence on the demand. Therefore poultry is used as a substitute for Norwegian fresh salmon in Model (8).

Table 4.3: Regression test results for potential substitutes

Variable	Coefficient	Standard error	t-value	p-value
dPMeat	1,174468	0,7628757	1,54	0,125
dPPoultry	1,211696	0,5347545	2,27	0,025
dPAquatic	2,135921	1,053857	2,03	0,044

4.2 ARDL Model building

4.2.1 Test for serial correlation

Serial correlation in the estimation of Equation (8), implies that previous periods influence the current period's import demand of Norwegian fresh salmon. Breusch-Godfrey is used to test for serial correlation.

From the Breusch-Godfrey test results in Table 4.4, with 6 months arbitrarily chosen as number of lags, the p-values are much smaller than 0.05. This means that with a significance level of 5%, the null-hypothesis of no serial correlation can be rejected. We conclude that there is serial correlation in Model (8), and lags should be added in to the model.

Table 4.4: Breusch-Godfrey linear model test results for autocorrelation

lags(p)	**chi2**	**df**	**Prob > chi2**
1	12.938	1	0.0003
2	16.216	2	0.0003
3	16.532	3	0.0009
4	19.594	4	0.0006
5	23.005	5	0.0003
6	23.417	6	0.0007

H0: no serial correlation

4.2.2 Test for the optimal lag length

As we can see in Figure 4.1, autocorrelation testing of residuals with a 40 month lag length shows that a lag of 1, 11 and 15 month are outside the Bartlett's formula for a moving average model of order 40 [MA(40)] at 95% confidence bands. This means that, at these lag points, there is serial correlation.

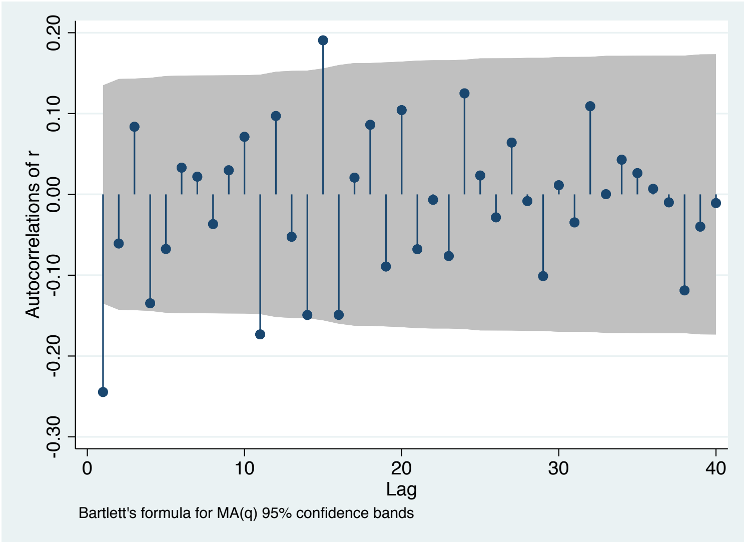


Figure 4.1: Autocorrelation test with 40 months lag

Since the longest lag length from the autocorrelation test, shown in Figure 4.1, is 15 months, an auto-regression final prediction error test of residual is done with 15 months as the maximum lag.

The test result in Table 4.5 shows that, minimizing Araike's information criterion (AIC), the lag length should be 5 months. Minimizing Schwarz's Bayesian information criterion (SBIC), the lag length should be 1 month. Therefore, if a shorter lag length is wanted, 1 month could be chosen. If a longer lag length is wanted, 5 months could be chosen.

There are advantages and disadvantage with both shorter and longer lag lengths. With a lag length of 1 month, the regression result is more precise, with smaller standard errors and greater reliability, but the regression result has larger bias. Large bias means that the estimated value is further from the real value, and therefore the regression result is less valid. With a lag length of 5 months, on the other hand, the regression result is less precise, with bigger standard errors and lower reliability, but the regression result has smaller bias. Smaller bias means the estimated value is nearer to the real value, and therefore the regression result is more valid.

In an attempt to get most valid estimates and make a compromise between precision and bias, a 5-month lag length is chosen. An ARDL model is therefore built with a 5-month lag length, as shown in Equation (9).

Table 4.5: Final prediction error for autoregression

Selection-order criteria
Sample: 2001m5 - 2017m8 Number of obs = 196

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-948.237				942.2	9.68609	9.69287	9.70282
1	-942.239	11.996	1	0.001	895.353	9.63509	9.64864*	9.66854*
2	-940.599	3.2808	1	0.070	889.523	9.62856	9.64887	9.67874
3	-940.394	.40931	1	0.522	896.774	9.63668	9.66376	9.70358
4	-938.872	3.0435	1	0.081	892.017	9.63135	9.66521	9.71498
5	-936.949	3.847	1	0.050	883.658*	9.62193*	9.66255	9.72228
6	-936.711	.47487	1	0.491	890.571	9.62971	9.67711	9.74678
7	-936.675	.07331	1	0.787	899.382	9.63954	9.69371	9.77334
8	-936.562	.22497	1	0.635	907.581	9.6486	9.70954	9.79912
9	-936.519	.08703	1	0.768	916.505	9.65836	9.72607	9.82561
10	-936.076	.88569	1	0.347	921.757	9.66404	9.73852	9.84802
11	-933.96	4.2319	1	0.040	911.353	9.65265	9.73391	9.85335
12	-933.877	.16558	1	0.684	919.961	9.66201	9.75004	9.87944
13	-933.416	.92184	1	0.337	925.08	9.66751	9.76231	9.90166
14	-930.491	5.8501*	1	0.016	907.137	9.64787	9.74944	9.89875
15	-929.689	1.6049	1	0.205	909.026	9.64989	9.75822	9.91749

Endogenous: r
Exogenous: _cons

$$\begin{aligned} \text{dVol}_t = \alpha_0 &+ \sum_{i=1}^{5} \alpha_i \text{dVol}_{t-i} + \sum_{i=0}^{5} \beta_i \text{dRGDP}_{t-i} + \sum_{i=0}^{5} \gamma_i \text{dPR}_{t-i} \\ &+ \sum_{i=0}^{5} \delta_i \text{dE}_{t-i} + \sum_{i=0}^{5} \xi_i \text{dPSub}_{t-i} + \sum_{i=0}^{5} \psi_i \text{San}_{t-i} \end{aligned} \tag{9}$$

4.3 Testing residuals for serial correlation, heteroskedasticity and normality

The OLS method is used to estimate the unknown parameters in ARDL Model (9). To get valid estimates for standard errors and P-values from the OLS method, the error term has to be checked for serial correlation, homoscedasticity and a normal distribution.

4.3.1 Serial correlation

When there is serial correlation in the residuals, the OLS estimator is consistent, but the usual covariance matrix is incorrect. If enough lags have been included, the ARDL model becomes dynamically complete which means that no further lags have any explanatory power. Under this condition, there is no serial correlation in the error terms, but there may be heteroscedasticity.

Table 4.6: Breusch-Godfrey linear model test for autocorrelation

lags(p)	**chi2**	**df**	**Prob > chi2**
1	0.009	1	0.9259
2	1.637	2	0.4411
3	1.646	3	0.6490
4	2.754	4	0.5999
5	3.072	5	0.6889
6	3.797	6	0.7042

H0: no serial correlation

As shown in the Breusch-Godfrey test result in Table 4.6, with 1 - 6 months lag, all p-values exceed 0.05. This means that with a significance level of 5%, there is not enough reason to reject the null-hypothesis, and we can be confident that there is no serial correlation in ARDL Model (9).

4.3.2 Heteroskedasticity

The OLS estimator is optimal in the class of linear, unbiased estimators when there is no serial correlation and heteroskedasticity in the residuals. A minimum-variance, mean-unbiased estimation is provided by the OLS method under this condition. Otherwise, when the residuals are heteroskedastic, the estimator can be trusted, but the standard error is invalid. The hetroskesasticity could be fixed by robust regression.

As shown in Table 4.7, the p-value of White's test for homoskedasticity is 0.4672 greater than 0.05. With a significance level of 5%, there are not grounds for rejecting the null-hypothesis of homoskadasticity, and we can draw the conclusion that there is no heteroskedasticity in the error term. Since the residuals in ARDL Model (9) are homoskedastic and serially uncorrelated, the standard errors from the OSL estimator can be trusted.

Table 4.7: Results of White's test for homoskedasticity

chi2(206) = 206.00
Prob > chi2 = 0.4672
Cameron & Trivedi's decomposition of IM-test

Source	**chi2**	**df**	**p**
Heteroskedasticity	206.00	205	0.4672
Skewness	45.22	35	0.1156
Kurtosis	1.68	1	0.1953
Total	252.89	241	0.2866

White's test for H0: homoskedasticity
against Ha: unrestricted heteroskedasticity

4.3.3 Normality

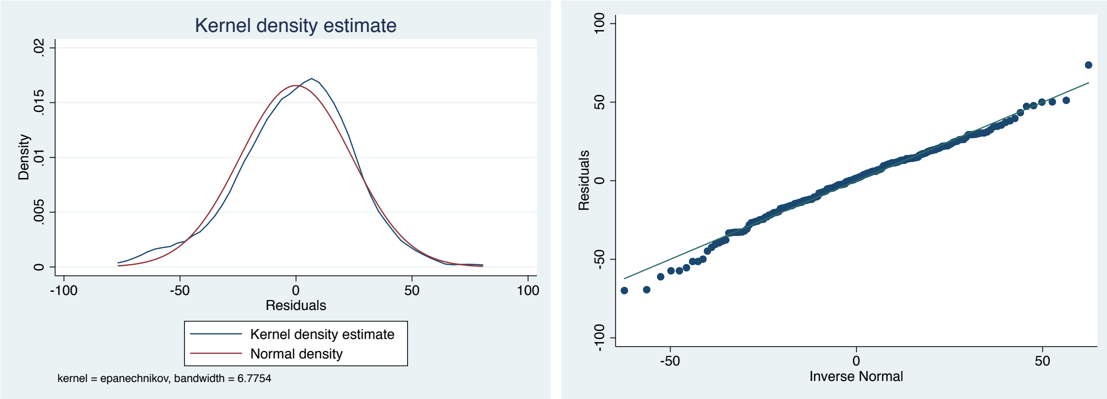
When the residuals are normally distributed, the method of OLS is the maximum likelihood estimator, which means that the p-value in the OLS estimators can be trusted.

The Kernel density estimate in Figure 4.2a shows that the distribution of residuals in ARDL Model (9) is very near to a normal distribution. In the quantile normal distribution test, the residuals in ARDL Model (9) are shown as blue dots. The tendency is that, as shown in Figure 4.2b, except at the ends, the residuals follow the inverse normal line, so there is no problem with normality. In the extremes, however, the residuals diverge from the line, indicating a problem with normal distribution.

The Skewness/Kurtosis test results for normality in Table 4.8 show that the joint p-value is $0.0898 > 0.05$. With a significance level of 5%, we can not reject the null-hypothesis of normality. Therefore we conclude that the residuals are normally distributed. The value of Kurtosis probability shows how fat the tails of the residuals-distribution are. As shown in Table 4.8, Pr(Kurtosis) is 0.2069 > 0.05, so the null-hypothesis of normally distributed tails can not be rejected. In other words, the tails are not too fat or too thin.

Consequently, we postulate that the residuals in ARDL Model (9) are normally distributed, and the p-values of the OLS estimator can be trusted.

Since the residuals are serially uncorrelated, homoscedastic and normally distributed, the OLS estimator is consistent and its p-values can be trusted. In



(a) Kernel density estimate (b) Quantile normal distribution

Figure 4.2: Kernel density estimate vs. normal density (a) and Quantile normal distribution (b)

Table 4.8: Skewness/Kurtosis test for normality

Variable	**Obs**	**Pr(Skewness)**	**Pr(Kurtosis)**	**joint adj-chi2(2)**	**joint Prob>chi2**
residuals	206	0.0747	0.2069	4.82	0.0898

Chapter 5, the OLS regression technique will be used to estimate the unknown parameters in the following ARDL model with a five-month lag length.

$$\begin{aligned} \mathrm{dVol}_t = \alpha_0 &+ \sum_{i=1}^{5} \alpha_i \mathrm{dVol}_{t-i} + \sum_{i=0}^{5} \beta_i \mathrm{dRGDP}_{t-i} + \sum_{i=0}^{5} \gamma_i \mathrm{dPR}_{t-i} \\ &+ \sum_{i=0}^{5} \delta_i \mathrm{dE}_{t-i} + \sum_{i=0}^{5} \xi_i \mathrm{dPSub}_{t-i} + \sum_{i=0}^{5} \psi_i \mathrm{San}_{t-i}, \end{aligned} \tag{10}$$

where d means the first difference of the logarithmically scaled variable, i represents i-months lag. Vol is China's import volume of Norwegian fresh salmon, RGDP is real GDP of China, PR is the price ratio of salmon, E is the exchange rate NOK/CNY, PSub is the consumer price index of substitute for salmon and San is imposed salmon sanctions.

5 Results

Model (10), described in section 4.3, intends to measure the strengths of potential influences on China's import demand of fresh Norwegian salmon, namely those from real GDP, price ratio, substitute price, exchange rate and salmon sanctions over the period from January 2000 to August 2017. The regression yields an R-squared value of 0.383, indicating that 38.3% of China's import demand for the salmon can be explained by the explanatory variables in the model.

A detailed account of the regression results are shown in Tables 5.1. L1 - L5 represent 1 - 5 months lag. The current month is represented by "- -". The prepending, lowercase d, indicates that the variable is a measure of rate of change (first difference of the logarithmically scaled variable). Vol is China's Norwegian salmon import volume, RGDP is real GDP in China, PR is price ratio (Norwegian fresh salmon price/Competition average price), PSub is the consumer price index of poultry in China, E is exchange rate NOK/CNY and San is sanctions against trade.

At a 5% significance level, under the whole period, past import volume shows significant negative influence with lags of one- and four months. Real GDP shows no significant influence. Price ratio shows negative influence with a lag of one month. Neither Price of substitute nor exchange rate show any significant influence. Sanctions show very strong negative influence with a lag of 2 months. Consequently, Equation 11 represents a model of Chinese import demand for Norwegian fresh salmon over the whole period.

However, due to the possibility that sanctions, starting in 2011, may exert an inordinate level of influence on the results, I have also run a regression test on the period before sanctions started, from January 2000 to December 2010. In this period, real GDP does show significant positive influence with lags of one and five months.

$$\begin{aligned} \mathrm{dVol}_t = & - 0.198\ \mathrm{dVol}_{t-1} - 0.209\ \mathrm{dVol}_{t-4} \\ & - 0.273\ \mathrm{dPR}_{t-1} + 80.330\ \mathrm{San}_{t-2} - 3.136 \end{aligned} \tag{11}$$

5.1 Past salmon import volume from Norway

For the lagged dependent variable, dVol, we have a p-value of $0.011 < 0.05$ at L1, which means last month's import volume is likely to influence the current

Table 5.1: Results of regression

Source	SS	df	MS			
Model	73797.311	35	2108.4946	Number of obs	=	206
Residual	118924.054	170	699.55326	F(35, 170)	=	3.01
				Prob > F	=	0.0000
Total	192721.365	205	940.10422	R-squared	=	0.3829
				Adj R-squared	=	0.2559
				Root MSE	=	26.449

dVol	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dVol						
L1.	-.1979565	.0766638	-2.58	0.011	-.3492921	-.046621
L2.	-.0576549	.0753624	-0.77	0.445	-.2064216	.0911117
L3.	.0167942	.0737126	0.23	0.820	-.1287156	.162304
L4.	-.208776	.0756313	-2.76	0.006	-.3580734	-.0594786
L5.	-.1033119	.0695668	-1.49	0.139	-.2406379	.0340141
dRGDP						
--.	-.0741862	.3339411	-0.22	0.824	-.7333915	.5850192
L1.	.1120265	.337481	0.33	0.740	-.5541665	.7782196
L2.	.4026099	.3265167	1.23	0.219	-.2419395	1.047159
L3.	.2509166	.3231942	0.78	0.439	-.3870742	.8889074
L4.	-.4434325	.3235864	-1.37	0.172	-1.082198	.1953325
L5.	.3264249	.3236404	1.01	0.315	-.3124467	.9652964
dPR						
--.	-.0433744	.0834777	-0.52	0.604	-.2081608	.121412
L1.	-.2731266	.0878785	-3.11	0.002	-.4466002	-.099653
L2.	.119653	.0883081	1.35	0.177	-.0546687	.2939746
L3.	.1009088	.0879915	1.15	0.253	-.0727879	.2746055
L4.	.091001	.0898292	1.01	0.312	-.0863233	.2683254
L5.	-.0705586	.0792628	-0.89	0.375	-.2270247	.0859076
dE						
--.	-.5345496	.6098335	-0.88	0.382	-1.738371	.669272
L1.	-.1694244	.6122915	-0.28	0.782	-1.378098	1.039249
L2.	-.2085923	.6230331	-0.33	0.738	-1.43847	1.021286
L3.	.9804383	.6096315	1.61	0.110	-.2229845	2.183861
L4.	-1.106806	.6088124	-1.82	0.071	-2.308612	.0949999
L5.	-.3581784	.6190626	-0.58	0.564	-1.580218	.8638616
dPSub						
--.	.8760562	.5163712	1.70	0.092	-.1432692	1.895382
L1.	-.303898	.5303406	-0.57	0.567	-1.350799	.7430032
L2.	.0832096	.5283712	0.16	0.875	-.959804	1.126223
L3.	-.1061892	.5300096	-0.20	0.841	-1.152437	.9400585
L4.	.0857112	.5323891	0.16	0.872	-.9652338	1.136656
L5.	.1193698	.5246412	0.23	0.820	-.9162807	1.15502
San						
--.	-14.58506	20.26648	-0.72	0.473	-54.59143	25.42132
L1.	-2.365048	28.50606	-0.08	0.934	-58.63649	53.90639
L2.	80.33032	31.39104	2.56	0.011	18.36388	142.2968
L3.	-46.37313	35.08634	-1.32	0.188	-115.6342	22.8879
L4.	-23.16742	35.29781	-0.66	0.512	-92.84588	46.51104
L5.	9.862907	23.77167	0.41	0.679	-37.06277	56.78859
_cons	-3.136054	3.342103	-0.94	0.349	-9.733422	3.461313

month's import volume significantly. The coefficient is negative at −0.20, so if there was an increase last month, a likely decrease is implied this month. From the general data, as shown in Figure 5.1, it is possible to see that there is a patten of pseudo-monthly oscillation across time.

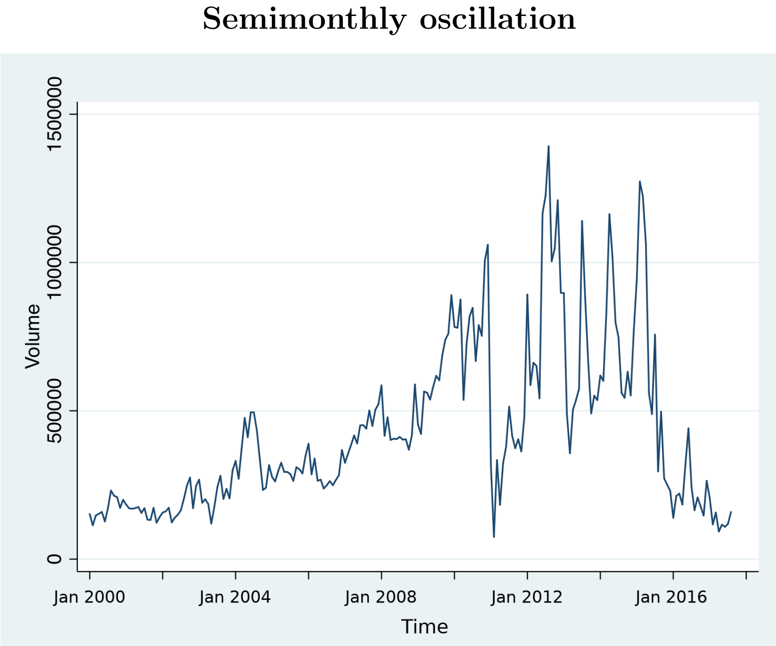


Figure 5.1: Semimonthly oscillation of volume over time

Similarly, a p-value of $0.006 < 0.05$ at L4, also with a negative coefficient of −0.21, implies that the import volume of four months ago negatively impacts current volume. The predicted decrease, as a result of a one percent increase one and four months ago, is 0.20 and 0.21 percent, respectively. While the oscillations seem too random to be completely accounted for by seasonality, still some of the dynamic may be due to seasonal variations, public holidays and other such factors that may inspire changes in consumer behavior. Pseudo-monthly oscillation could be caused by a cyclical dynamic of overly optimistic imports one month, flooding the market and causing prices to reduce. The following month imports are therefore more cautious. Between 2011 and 2016, the magnitude of the oscillations are of an order that cannot be explained by conventional market mechanisms. It seems more likely that diplomatic instability play a role here.

5.2 China's real GDP

We can see that real GDP in China, unexpectedly, does not have significant influence on import volume across the whole study period, with p-values much greater than 0.05. If we limit the period to before sanctions, we do however see from table 5.2 that, while the overall tendencies for other remaining variables (sanctions is in this period a constant 0) are similar to what they were in the whole period, for real GDP the results are very different (the complete result is shown in Appendix A). With a p-value at L2 of 0.048 -and of 0.027 at L5, coefficients are 0.51 and 0.58, respectively.

Exactly why real GDP seems to be offset more than the other variables by sanctions may seem odd but, comparing the results for the two different periods, it is plausible that a relationship between sanctions, real GDP and import volume, obscures real GDP influence that otherwise, in the absence of sanctions, is apparent. A clue to why this happens can perhaps be found in the nature of the real GDP variable. Unlike all the other variables, that oscillate quite strongly across time, real GDP is steadily increasing in the whole period. Import volume, on the other hand, is strongly increasing overall before sanctions and strongly decreasing overall during sanctions. This means that import volume and real GDP is first positively- and then negatively correlated and ultimately, for the whole period, uncorrelated at conventional confidence levels. A graphical comparison between the two variables can be seen in Figure 5.2. I will assume the lack of correlation is "on paper only" and interpret the results before sanctions as indicative of real GDP and import volume correlation.

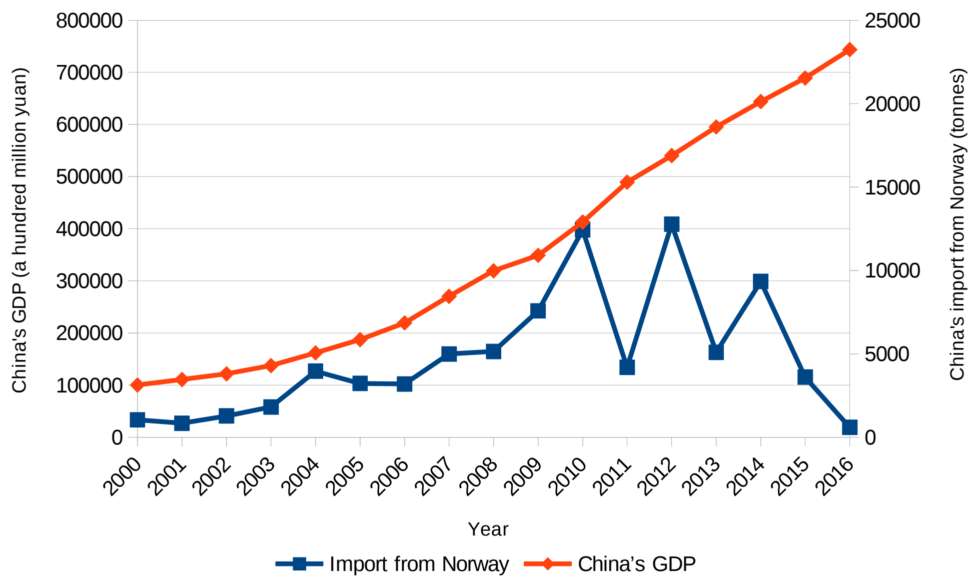


Figure 5.2: Caracteristics of real GDP and Norwegian fresh salmon import volume across time

With coefficients of 0.51 at L2 and 0.58 at L5, it is implied that the cumulative effects, over a 6 months period, of a percentage increase in income is a 1.09 percent increase in Norwegian fresh salmon demand. With an income elasticity of $1.09 > 1$, as described in section 3.2.1, Norwegian fresh salmon can be placed in the category of luxury good, a type of good particularly sensitive to increases in income. This result reflects the discussion of lag in section 3.2.4. Consumer habits do not change instantly with increased spending power. The result is also very similar to Kinnucan and Myrlands's (2005) results for the world. They found a percent increase in world income resulted in a Norwegian fresh salmon demand increase of 1.02 percent.

On a more general note, that GDP growth has a positive effect on China's import demand, is in line with the studies of Gozgor (2014), Fukumoto (2012), Zhang et al. (2013), Tang (2003),Yin and Hamori (2011) and Wang and Lee (2012).

Table 5.2: Regression result for the period before the sanction

dVol	**Coef.**	**Std. Err.**	**t**	**P > |t|**	**[95% Conf.**	**Interval]**
RGDP						
–	-.0114618	.266346	-0.04	0.966	-.5402981	.5173745
L1	-.1820172	.2685204	-0.68	0.500	-.7151707	.3511363
L2	.5128786	.255829	2.00	0.048	.0049242	1.020833
L3	.2921972	.2594022	1.13	0.263	-.222852	.8072464
L4	-.3560613	.2558757	-1.39	0.167	-.8641085	.1519859
L5	.575128	.2564047	2.24	0.027	.0660305	1.084226

Offering explanations to exactly how the national brand of Norwegian salmon has established itself in the collective consciousness of Chinese consumers as a luxury good, is outside the scope of this thesis, whether by mechanisms intrinsic to China and its markets, by the marketing expenditures of the NSC in China, mostly in the form of business to business schemes, as described in section 2.3.4, or the online presence of NSC (NSC 2018[e]). However, my results do demonstrate, in line with theory, the significance of a luxury label in an expanding economy and suggests that expenditures for the sake of maintaining such a label, may be well spent. Consequently, as a possible answer to the research question in section 1.1 of what marketing strategy can help realize the vision of "Green Competitiveness" vis-á-vis the Chinese salmon market, it should be one that strengthens the perception of Norwegian salmon as a luxury good. An example could be targeted advertising, where online adds are shown with certain search words for -or on web pages with references to other established luxury goods, over time forging stronger mental connections between salmon and the world of established luxury goods. Of course, a fully worked out marketing strategy is well beyond the scope of this thesis. The example is only meant to serve as a frame of reference. I have picked this example in particular, because of the increasing space that web services occupy in the lives of people, because of the cost efficiency of being able to reach the right audience and the ease and expedience by which online campaigns can be orchestrated.

Perhaps what exactly a luxury good means, in the context of salmon, deserves consideration. While it is conceivable that a food product, or any product for that matter, can be of high quality, yet not considered a luxury good, e.g. a generic brand bag, the idea of a luxury food of lesser quality is rather more difficult to conceive of. My understanding therefore, is that a core component, in the concept of a luxury food item, is its perceived quality, with all that entails: Taste, texture, food safety etc. It is therefore a reasonable assumption that the efforts of the NSC in countering negative effects from negative news -and rumors, with advertising campaigns, is important for the maintenance of the luxury narrative of Norwegian fresh salmon (Messer et al. 2011).

5.3 Price ratio

The price ratio of Norwegian fresh salmon to average competitor price (dPR), shows a highly significant influence at L1, with a p-value much less than 0.05 of 0.002. The coefficient value, -0.27, implies a negative relationship. The model predicts a decrease of 0.27 percent for every percent increase in price. L0, L2, L3 and L4 all show p-values much greater than 0.05 and is rejected under the restrictions imposed by a 95% confidence interval. The results indicate a reaction time of one month before a price change is reflected in import demand.

In relation to the research questions in section 1.1, the coefficient value of -0.27 is of particular interest. It indicates that Norwegian fresh salmon in the Chinese market is price inelastic at $\mid -0.27 \mid < 1.0$. The result is in line with Fukumoto

(2012), Yin and Hamori (2011) and Tang (2003). Their studies all showed various degrees of negative price inelasticity of import demand, in the general case of China.

The implication of inelasticity, as outlined in section 3.2.2, is a level of perceived brand or product uniqueness that makes it difficult to replace in the short run. It means substitutes are scarce and the Chinese consumer is less sensitive to price changes. The finding of Godey et al. (2012) are interesting in this context. They found that, for Chinese consumers, price and country of origin are both of particular importance. It is therefore, plausible that if price is not important, as implied by the price inelasticity, perhaps, country of origin is. With this understanding in mind, my results demonstrate the value of the perceived strength and uniqueness of the national brand of Seafood from Norway and the importance of maintaining this perception.

I would argue that any strategy to realize the vision of "Green Competitiveness", vis-á-vis the Chinese salmon market, should include marketing strategies to maintain and strengthen the uniqueness aspect of Norway as a salmon producer. As in the example above with targeted advertising, in section 5.2 on real GDP, the uniqueness aspect could be emphasized in online adds directed to the right audience. Though the perception of uniqueness -and luxury are not the same and one can exist fine without the other, uniqueness is certainly often an integral part of the marketing narrative of a luxury good. Therefore, emphasizing the uniqueness aspect of Norwegian salmon ingrates well with a luxury narrative and one campaign or strategy may very well achieve both objectives concurrently, maintaining and strengthening Norwegian fresh salmon as a unique, luxury good.

Of course, in the context, unique means positive uniqueness and ultimately as a quality indicator. As in the discussion of real GDP in section 5.2, it is a reasonable assumption that, in the strengthening of the uniqueness narrative the national brand image of Norwegian salmon, countering the effects of food scares (Serra 2011) through advertising is also important to ensure positive uniqueness (Messer et al. 2011).

An advantage of national brand advertising is that the problem of cross region industry operation, as discussed in section 3.4.5, where the strengthening of the industry in Norway, might also strengthen the competition from other regions, is not encountered. With the exception of "trickle down" effects from national brand strengthening to a general strengthening of a product type, advertising campaigns emphasizing uniqueness and luxury narratives of fresh Norwegian salmon, presumably, mostly improves the competitiveness of salmon from Norway.

5.4 Substitute price

The results for the substitute (PSub), a lowest p-value of 0.09 with no lag, implies no significance under a 95% confidence interval. The results are in line with the results for the price variable, indicating low substitutability and that Norwegian salmon is perceived as a unique good. If, however, we relax the confidence requirement to a 90% interval, a coefficient of 0.88 describes a near one-to-one relationship of substitution. The immediate effect is perhaps indicative of the position of domesticated fowl in Chinese cuisine. Within this category, there are many highly priced, special occasion foods from duck, dove, quail and goose, including eggs, which could explain a substitution effect in relation to other luxury food categories. Of course, the poultry category also include common and cheap sources of protein, i.e. chicken and their eggs. Consequently, with the assumption that luxury products constitute the smaller portion of the category, we need to consider that most of the substitution effect is due to cheaper products.

Perhaps then, rather than the perspective of one luxury food substituting another, a price-gap perspective may hold more explanatory power. As the cheaper product experiences price increase, assuming the more expensive product is relatively stationary, the price-gap decreases. As a result, the threshold for buying the the more expensive, imported good is lowered. The immediacy of the effect may indicate that it relates to consumers who are already "on the fence" about buying salmon. This mechanism may explain the results that a percentage increase in substitute price predicts a near percentage immediate increase in Norwegian fresh salmon demand. On the other hand, if the price of the cheaper alternative decreases, the benefits for the consumer, in the form of savings, might persuade her the cost of buying salmon is too high.

There is a particular significance of substituting a luxury good with a non-luxury good or a strong brand with a generic brand. The perceived utility of the consumer experience decreases, so that the consumer is more likely to "bounce back", given favorable circumstances. The stronger the brand, the greater the reduction in perceived utility, when abandoning the brand, and the stronger the tendency to "bounce back". In line with the discussion in section 3.4.5, the strength of a brand influences the likelihood of substitution (Krishnamurthi and Raj 1991).

An interpretation of domestic poultry products as, overall, the cheaper, less valued product - and Norwegian salmon as the higher valued and more expensive import, gives further weight to my interpretations of the results for real GDP and price, suggesting benefit from consumers placing Norwegian salmon in the category of unique and luxury goods, all the while uniqueness is integral to the luxury narrative. Of course, the condition being that the price-gap perspective indeed explains my results, in the first place. Otherwise, insignificance under a 95% confidence interval is also corroborating low substitutability.

Norwegian salmon in the Chinese marketplace, as a vehicle to realizing the vision of "Green Competitiveness", may rely on strategies that strengthen and maintain the national brand of Norwegian salmon, with regards to uniqueness and quality, the assumption being that perceptions of uniqueness and quality, causing low substitutability, are key components in the building of a strong brand. Godey et al. (2012) found that Chinese consumers placed particular importance on country of origin, and Garretson et al. (2002) found that national brand equity is more resilient to the negative psychological effects of a price decrease (i.e. low price implies low quality) than private brand equity, implying that national brands, once established, are more robust or "low maintenance". With reference to these findings, strengthening and maintaining the national brand of Seafood from Norway may be an effective strategy to increase import demand for fresh Norwegian salmon in China.

5.5 Exchange rate

If we take a look at the results for the exchange rate variable (dE), we can see that L0, L1, L2 and L5 all have p-values much greater than 0.10 and that exchange rate influence on demand must be rejected. However, at L3, with a p-value of 0.011, a fairly light handed trimming of the conventional 90% confidence interval, allows us to accept exchange rate influence with a lag of 3 months. At L4, the p-value is 0.071, which is within conventional confidence levels. Generally speaking, a possible explanation for the lagged influence is that it takes time to fulfill contracts and, as we have seen indicated for the price variable (dPR), consumer habits do not change instantly when prices increase. Another factor may be loyalty in buyer/seller relationships.

The case of L3 and L4 is interesting in that the coefficients are very near to each other but with opposite signs, showing that, at L3, demand likely increases by a factor of 0.98 for every unit revaluation of the exchange rate, but at L4 - almost the exact opposite seems to be the case. For every unit revaluation of the exchange rate, demand is predicted to decrease 1.11 units. At first glance, these may seem to be contradictory results, but there might be a reasonable explanation for them, consistent with the theory and what is found in the literature.

If we include the results from the price variable (dPR), that there is a one month lag from price increase to market reaction, under the assumption that exchange rate influences demand via price (section 3.1.4), it seems we must discretize lag length into three different periods after a revaluation has taken place. There is the unresponsive period encompassing L0, L1 and L2. Then there is the positively responsive period, only encompassing L3. Lastly, encompassing L4, we have the negatively responsive period. If the revaluation at L0 is symptomatic of a trend in the period, we might see a promotion marketing strategy from suppliers to counter the effects of exchange rate revaluation (Xie, Kinnucan, and Myrland 2008). This might explain the increase in demand at L3. If payments are cash in advance, there is also the possibility that buyers gamble on a price increase, due to the perceived revaluation trend, effectively making a long position investment and also increasing demand (Giovannini 1988). Exchange rate volatility as an opportunity to increase profits is discussed in section 3.1.5.

At this point, it might be useful to point out that importers act with a certain degree of independence from the consumer. So far, through L0 - L3 we have mostly discussed the dynamic between exporter and importer, but if L4 is included in the discussion, we must switch to an importer - consumer dynamic. Whether a price is high or low is, in and of itself, of little concern to the importer. What matters is consumer demand. The final judge of price therefore is the consumer. Since the price variable (dPR) is inelastic with a lag of one month and the market responds negatively to exchange rate revaluation of NOK against CNY at L4, it is implied that a meaningful price increase has already occurred at L3, giving consumers time to significantly alter their behavior.

In relation to the research questions, since the exchange rate is assumed to effect demand through price, the answers will be much the same as for the price variable (dPR). If, however, the discussion is limited to the exchange rate alone, we may note that though demand may react to changes in the exchange rate, the total impact is not very big, as the negative effects are preceded by a positive effect of a similar magnitude. Perhaps one can think of it as a ripple or flow, then ebb. Of course, one cannot induce from the results that exchange rate is unimportant, but the results for the exchange rate variable might be interpreted in a way that supports the findings of Xie et al. (2008), that the overall limited effect of a revaluation may be due to incomplete pass-through, from changes in exchange rate to price, as a result of controls, instituted by Norwegian companies, to adapt supply to market conditions.

From a general point of view, there is no consensus on exchange rate effects on import demand in China. Gozgor (2014), Zhang et al. (2013) and Wang and Lee (2012) report significant negative effect from exchange rate devaluation of CNY, while Tang (2003) and Yin and Hamori (2011) found no significant correlation.

Table 5.3: Regression result with the exchange rate NOK/USD as the variable

dVol	**Coef.**	**Std. Err.**	**t**	**P > |t|**	**[95% Conf.**	**Interval]**
dNOK/USD						
–	-.2898742	.602762	-0.48	0.631	-1.479737	.8999881
L1	-.3993579	.6026171	-0.66	0.508	-1.588936	.7902164
L2	-.1158427	.6183703	-0.19	0.852	-1.336516	1.104831
L3	1.134177	.6058729	1.87	0.063	-.061826	2.33018
L4	-.9756772	.6046806	-1.61	0.108	-2.169327	.2179725
L5	-.304975	.6139808	-0.50	0.620	-1.516983	.9070333

In section 3.1.5, I discuss whether NOK/CNY is really a case of NOK against other major currencies, as a result of China pegging the CNY to the dollar until 2005 and using a managed floating exchange rate regime from then on. I included results from using NOK/USD instead of NOK/CNY in Table 5.3 (the complete result is shown in Appendix B). The results are almost identical to those for NOK/CNY. At L3 the p-value is 0.06, with a coeficcient of 1.13 and at L4 the p-value is 0.11 and the coefficient is -0.98. The only significant difference is that, while for NOK/CNY, L3 is slightly outside of conventional confidence levels and L4 is inside, for NOK/USD the situation is opposite. This indicates that CNY, to a large degree, also follows USD after July 2005, when the managed floating exchange rate regime was started. In contradiction to the mid-2007 estimate of a 0.6 weight on the dollar and a 0.4 weight on the euro (Frankel 2009), as discussed in section 3.1.5, when using NOK/EUR for the exchange rate variable, exchange rate show no significant influence on the demand, with p-values well above 0.10. Frankel (2009) used a different method to estimate influence, where currency weights were allowed to change across time. The period is also different from this study, from 2005-2008. The two studies are therefore not directly compatible. The NOK/EUR result is shown in Table 5.4, and the complete result is shown in Appendix C.

Table 5.4: Regression result with the exchange rate NOK/EUR as the variable

dVol	Coef.	Std. Err.	t	P > |t|	[95% Conf.	Interval]
dNOK/EUR						
–	-.8699126	1.053666	-0.83	0.410	-2.949868	1.210042
L1	1.213515	1.055471	1.15	0.252	-.8700029	3.297033
L2	-.5679299	1.015643	-0.56	0.577	-2.572826	1.436967
L3	.5628643	1.024667	0.55	0.584	-1.459845	2.585573
L4	-.7878363	1.019132	-0.77	0.441	-2.799619	1.223947
L5	.9427311	1.038921	0.91	0.365	-1.108116	2.993579

The significance of these considerations, in relation to the research questions, is that whatever strategies the GoN employs to control NOK exchange rates and create favorable conditions for Norwegian exporters, there is still a fairly fixed relationship between the USD and the CNY and whatever is done, in respect to the dollar, also applies to the yuan. However, as implied by the "ripple" effect from L3 to L4 in the NOK/CNY results, exchange rate might not be of pivotal importance to Norwegian fresh salmon demand.

Also tried was a regression with exchange rate volatility in place of exchange rate. To calculate an expression of volatility, daily NOK/CNY data from the Bank of Norway (Norges Bank 2018) was used to calculate standard deviation, with a period of one month, to get monthly values. From January 2000 until January 2005, data were not available. The period did, however, fall under the USD peg regime and could therefore be calculated by triangulating from the NOK/USD rate. The volatility results are shown in Table 5.5 and show no significant influence under a 90% confidence interval (the complete results are shown in Appendix D). The results support the "ripple" effect of the exchange rate, first positive, then negative and therefore, overall, a very small influence on import demand, possibly as result of controls, instituted by Norwegian companies, to adapt supply to market conditions (Xie, Kinnucan, and Myrland 2008).

Table 5.5: Regression result with the exchange rate volatility as the variable

dVol	Coef.	Std. Err.	t	P > |t|	[95% Conf.	Interval]
dVolatility						
–	-.0248526	.0453212	-0.55	0.584	-.1143174	.0646122
L1	.0126494	.058009	0.22	0.828	-.1018613	.1271601
L2	.0370284	.0597844	0.62	0.537	-.080987	.1550439
L3	-.0000429	.0582761	-0.00	0.999	-.1150808	.1149951
L4	.0598775	.0550545	1.09	0.278	-.0488009	.168556
L5	.004045	.044304	0.09	0.927	-.0834118	.0915018

5.6 Nobel Peace Prize sanctions

The results for the dummy variable for sanctions against trade, in the wake of awarding the Nobel Peace Prize to a Chinese dissident, show a p-value of 0.01 at L2. Otherwise the p-value is well outside of conventional confidence levels, which leads us to reject significant influence, except at L2. The coefficient is very strong at 80.33, signifying a very strong positive influence (positive, in relation to the absence of sanctions), with a reaction time of 2 months. The reason for the lag might be that it takes time to implement sanctions. Now, while officially no sanctions were ever put in place by the Chinese government, it is hard to imagine other factors that adequately explain the dramatic decrease in the Norwegian market share since 2010. These results are also supported by Chen and Garcia (2016), who found there is strong evidence that links changes in trade patterns of fresh/chilled whole Norwegian salmon to border measures applied in response to the peace prize, as discussed in section 3.4.4.

Since we are dealing with a dummy variable, we end up with different models for when we have a period of stable diplomatic relations, San = 1 and when we have a period of instability, San = 0. Consequently, absence of diplomatic relations cancels the diplomatic relations term (13), while existance of diplomatic relations shifts the output of the model up by 80.33 units (12).

Political stability, San $= 1$**:**

$$\begin{aligned} \text{dVol}_t = &- 0.198\ \text{dVol}_{t-1} - 0.209\ \text{dVol}_{t-4} \\ &- 0.273\ \text{dPR}_{t-1} + 77.194 \end{aligned} \tag{12}$$

Political instability, San $= 0$**:**

$$\begin{aligned} \text{dVol}_t = &- 0.198\ \text{dVol}_{t-1} - 0.209\ \text{dVol}_{t-4} \\ &- 0.273\ \text{dPR}_{t-1} - 3.136 \end{aligned} \tag{13}$$

The coefficient for PSub variable far outweighs all other coefficients. However, it is important to note that the results do not give any real indication to whether or not the Nobel Peace Prize of 2010 caused the fall of Norway's fresh salmon share in the Chinese market. As a dummy variable, the data are, in effect, created by me. Consequently, it is susceptible to bias and prejudice. The validity of the data rather relies on the research, into the effects of the 2010 Nobel Peace Prize on the Norway-China salmon trade, by Chen and Carcia (2016). They concluded that the Chinese government resorted to subtle sanctions, like more stringent inspection methods, that, despite their subtlety, effectively conveyed a message to the GoN. Given these findings, the dummy variable is likely to be valid and the coefficient of 80.33 gives some indication of the degree of influence exerted on demand by the implementation of non-trade barriers. I am, however cautious to accept the number as an accurate reflection of the influence from the 2010 Nobel Peace Prize. My data cannot account for sanction busting efforts, such as port-shifting, source-shifting, mislabelling, trans-shipment and smuggling. Though the Chinese government seems to have been aware of such practices, no countermeasures were put in place (Chen and Garcia 2016). Nevertheless, there is little evidence to support that the Chinese subtle sanctions were ineffective. The GoN's decision not to meet with Dalai Lama in 2014, contrary to tradition, and subsequent efforts by the GoN to improve diplomatic relations, are clear indications of their effectiveness.

Therefore, in relation to the research questions of political strategies to increase salmon exports to China, as a part of the vision of "Green Competitiveness", it is clear that any such strategy must be one that cushions the effects of political differences in sensitive areas, such as issues relating to the "One China" policy, with the sensitive topics of Taiwan, Tibet Autonomous Region and Xinjiang Uygur Autonomous Region, and issues relating to oppositional forces like the democracy movement. Of course, whether or not to implement such a strategy, is a decision better left to the political establishment. The discussion here is limited to the context of access to the Chinese fresh salmon market, for the sake answering the research questions.

6 Conclusions

To develop insights to assist policy makers in the construction of marketing or political strategies that can help increase Norway's salmon export to China and thereby contribute to the realization of Norway's "Green Competitiveness", this study builds an autoregressive distributed lag model (ARDL) to estimate how China's import of Norwegian fresh salmon is influenced by income, exchange rate, salmon price, price of substitute and policy, by using ordinary least squares (OLS) method with monthly data from January 2000 to August 2017. Import demand volume is used as the dependent variable. Real GDP is used as a measure of income. Price ratio, the price of Norwegian salmon relative to average competitor price, is used as a measure of price. Domestic poultry products are used as substitute for salmon. Monthly exchange rate and exchange rate volatility are used as measures of exchange rate variability. A dummy variable for sanctions is also included.

The study found indication in the results for real GDP, within a 95% confidence interval, that income elasticity of import demand for Norwegian fresh salmon is positively elastic with a cumulative effect on import demand of 1.1 percent increase for every percent increase in real GDP and may therefore be placed in the category of luxury good. The results are in line with the more general findings of Kinnucan and Myrland (2005), who found a similar positive effect on world demand for Norwegian fresh salmon with increases in world GDP. These findings only apply to the period before sanctions. In the sanctions period the influence of real GDP is likely obscured by the sanctions variable.

In the case of price ratio, negative inelasticity of -0.27 was implied, also within a 95% confidence interval, indicating a high score on the uniqueness scale, i.e. consumers are not sensitive to price changes and find it hard to source alternatives to Norwegian fresh salmon.

The substitute variable is significant with no lag within a 90% confidence interval, with a coefficient of 0.88. Insofar as Norwegian fresh salmon is the higher priced, more desired good, the results indicate sensitivity to a price gap decrease with cheaper, domestic poultry products. The effect is immediate, indicating, to a certain degree, that Norwegian fresh salmon is an established and desirable alternative for "on the fence" consumers.

The analysis of the results for real GDP, price ratio and price of substitute all point in a similar direction. Norwegian salmon in the Chinese marketplace, exhibits the characteristics of a highly valued good, with income elasticity of a luxury good, the price elasticity a unique good, and is established as desirable substitute for a domestic source of protein. This position that Norwegian salmon holds in Chinese markets, is indicative of a high national brand value and it follows that it should be maintained and strengthened with emphasis on the luxury and uniqueness narrative of Seafood from Norway. This interpretation of the results is corroborated by Godey et al. (2012) who found that Chinese consumers place particular importance on country of origin.

The exchange rate results offer more complex interactions. Insofar as the variable influences import demand through price, the implications are also similar to those of the price variable. Within a 90% confidence interval, a ripple effect is apparent, first positive influence on demand (0,89)- then negative influence of nearly the same magnitude (-1,11). The result may be interpreted as an exporter - importer dynamic where Norwegian exporters counter the effects of revaluation with promotion marketing strategies (Xie, Kinnucan, and Myrland 2008).

Exchange rate volatility was also tested. The result showed no significant influence on the demand, indicating that, in an exporter - importer dynamic, exchange rate volatility is either of limited importance or the effects are successfully kept in check. If the end consumer is included in our perspective, insensitivity to exchange rate volatility, insofar as the effects are propagated through to retail, is another indication of brand loyalty.

The overall limited effect of the exchange rate on import demand, could be interpreted as an indication that the industry is well equipped to mitigate exchange rate effects on price and that, in relation to strategies for increasing salmon demand in China, exchange rate is of no particular importance.

As expected, sanctions against trade, show dramatic influence on demand. Though the analysis did not account for transshipment and other sanction-busting efforts, the numbers for official trade supports the findings of Chen and Garcia (2016) and the claim they studied, that the Chinese government indeed used subtle measures to limit or restrict imports of Norwegian fresh salmon, and indicate very strong detrimental effects to demand in the six years of the alleged sanctions regime. Consequently, access to Chinese market does depend on strategies for navigating areas of political controversy.

6.1 Limitations of the study

In the study period, the effects of non-trade barriers are shown to exert an inordinate level of influence on demand, effectively, masking presumed effects of GDP. Though the period was discretized to the period before sanctions and the period as a whole, the study may have benefited from including a separate study of the period during sanctions. The proposition does, however, present some challenges, precisely because of the strong, and potentially obscuring, effect of the sanctions. Furthermore, the strong effects indicated for the sanction variable are based on official trade data. The study does not account for sanction busting effects, such as mislabeling, port shifting, smuggling etc. Though there is little reason to doubt strong effects, the accuracy of the sanctions coefficient is questionable.

The study has also been limited by the availability of monthly data on marketing expenditures. The analysis, in this area and its implications, are theoretical. Though the analysis is supported by previous research and economic theory, it is not directly data driven.

As we are just starting to see policy actions under the GoN's "Green Competitiveness" banner, such as opening up for growth in the aquaculture industry and plans for a new seafood terminal at Oslo Airport, a direct study of the effectiveness of the GoN's strategies has not been possible.

6.2 Suggestions for further research

An extension of the model to include a variable for Norway's export volume to Vietnam, could perhaps assist in achieving higher accuracy for the influence on Chinese import demand as it is likely that there was a considerable amount of transshipment to China through Vietnam (Chen and Garcia 2016) in the sanctions period.

Since data on advertising expenditure -and type is limited, a more direct approach could be adopted in the study of the effects of advertising on brand image -and equity. Insights into how perceptions of Norway and its salmon are formed in China, could provide important information for the NSC's work to promote Norwegian salmon in the Chinese marketplace. Recent improvements in the field of machine learning and data mining may offer valuable tools to researchers to analyze consumer behavior and motivation, and study how to effectively maintain and strengthen the luxury and uniqueness narrative of Norwegian salmon.

The study focuses on the Chinese market dynamics for Norwegian fresh salmon. A more complete understanding could be achieved by studying the same influencing factors for competing regions.

In relation to the vision of “Green Competitiveness”, should we see an outline of appurtenant strategies and cohesive policy actions in the years to come, a study of their effectiveness in Chinese -and other markets, is called for.

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Appendix A: Results for period before sanctions

Source	SS	df	MS			
				Number of obs	=	124
				F(29, 94)	=	2.29
Model	17015.3568	29	586.73644	Prob > F	=	0.0015
Residual	24116.8098	94	256.561807	R-squared	=	0.4137
				Adj R-squared	=	0.2328
Total	41132.1666	123	334.407858	Root MSE	=	16.018

dVol	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dVol						
L1.	-.2547694	.0999365	-2.55	0.012	-.4531958	-.0563431
L2.	-.224345	.102654	-2.19	0.031	-.4281669	-.0205232
L3.	.0948986	.1041959	0.91	0.365	-.1119847	.301782
L4.	.0912247	.1084215	0.84	0.402	-.1240487	.3064981
L5.	-.0226283	.1012023	-0.22	0.824	-.2235678	.1783113
dRGDP						
--.	-.0114618	.266346	-0.04	0.966	-.5402981	.5173745
L1.	-.1820172	.2685204	-0.68	0.500	-.7151707	.3511363
L2.	.5128786	.255829	2.00	0.048	.0049242	1.020833
L3.	.2921972	.2594022	1.13	0.263	-.222852	.8072464
L4.	-.3560613	.2558757	-1.39	0.167	-.8641085	.1519859
L5.	.575128	.2564047	2.24	0.027	.0660305	1.084226
dPR						
--.	.0709246	.0773531	0.92	0.362	-.0826618	.2245111
L1.	.0169018	.0772517	0.22	0.827	-.1364834	.1702869
L2.	-.1712658	.0772021	-2.22	0.029	-.3245523	-.0179792
L3.	.1593529	.080195	1.99	0.050	.0001238	.3185819
L4.	.0538465	.0810043	0.66	0.508	-.1069895	.2146826
L5.	.0562836	.0794778	0.71	0.481	-.1015214	.2140886
dE						
--.	-1.191992	.5062406	-2.35	0.021	-2.197144	-.1868391
L1.	.1908572	.5061962	0.38	0.707	-.8142073	1.195922
L2.	-.1478478	.4937953	-0.30	0.765	-1.12829	.8325943
L3.	1.115345	.4838412	2.31	0.023	.1546671	2.076023
L4.	.1333652	.5079375	0.26	0.793	-.8751567	1.141887
L5.	-.8425929	.5043558	-1.67	0.098	-1.844003	.1588174
dPSub						
--.	1.188866	.4509566	2.64	0.010	.2934806	2.084251
L1.	-.5235407	.473367	-1.11	0.272	-1.463422	.4163405
L2.	.1966673	.4737117	0.42	0.679	-.7438984	1.137233
L3.	-.2978064	.4735835	-0.63	0.531	-1.238118	.6425047
L4.	.4565425	.4769639	0.96	0.341	-.4904804	1.403565
L5.	-.3519492	.4616222	-0.76	0.448	-1.268511	.5646124
San						
--.	0	(omitted)				
L1.	0	(omitted)				
L2.	0	(omitted)				
L3.	0	(omitted)				
L4.	0	(omitted)				
L5.	0	(omitted)				
_cons	.6472666	1.812928	0.36	0.722	-2.952345	4.246879

Appendix B: Results using NOK/USD

Source	SS	df	MS
Model	73503.564	35	2100.10183
Residual	119217.801	170	701.281183
Total	192721.365	205	940.10422

Number of obs	=	206
F(35, 170)	=	2.99
Prob > F	=	0.0000
R-squared	=	0.3814
Adj R-squared	=	0.2540
Root MSE	=	26.482

dVol	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dVol						
L1.	-.1999785	.076622	-2.61	0.010	-.3512317	-.0487254
L2.	-.048663	.0755084	-0.64	0.520	-.1977179	.1003918
L3.	.013048	.0736707	0.18	0.860	-.1323791	.158475
L4.	-.2055336	.0755799	-2.72	0.007	-.3547296	-.0563376
L5.	-.0993395	.0694869	-1.43	0.155	-.2365078	.0378289
dRGDP						
--.	-.0866297	.3345345	-0.26	0.796	-.7470064	.5737471
L1.	.1306169	.3385806	0.39	0.700	-.5377469	.7989807
L2.	.3736984	.3278517	1.14	0.256	-.2734864	1.020883
L3.	.2559469	.324327	0.79	0.431	-.38428	.8961738
L4.	-.4454233	.3245272	-1.37	0.172	-1.086045	.1951988
L5.	.3087821	.324946	0.95	0.343	-.3326668	.9502309
dPR						
--.	-.0396244	.0836288	-0.47	0.636	-.204709	.1254602
L1.	-.2760201	.0878651	-3.14	0.002	-.4494673	-.1025728
L2.	.1168762	.0883455	1.32	0.188	-.0575194	.2912718
L3.	.0989706	.0879435	1.13	0.262	-.0746314	.2725726
L4.	.0893283	.0898722	0.99	0.322	-.0880809	.2667376
L5.	-.068402	.0793241	-0.86	0.390	-.2249892	.0881851
dNOKUSD						
--.	-.2898742	.602762	-0.48	0.631	-1.479737	.8999881
L1.	-.3993597	.6026171	-0.66	0.508	-1.588936	.7902164
L2.	-.1158427	.6183703	-0.19	0.852	-1.336516	1.104831
L3.	1.134177	.6058729	1.87	0.063	-.061826	2.33018
L4.	-.9756772	.6046806	-1.61	0.108	-2.169327	.2179725
L5.	-.304975	.6139808	-0.50	0.620	-1.516983	.9070333
dPSub						
--.	.8061	.5179474	1.56	0.121	-.2163368	1.828537
L1.	-.3035956	.5300522	-0.57	0.568	-1.349928	.7427364
L2.	.0696089	.5287968	0.13	0.895	-.9742447	1.113463
L3.	-.0410777	.5304297	-0.08	0.938	-1.088155	1.005999
L4.	.0355944	.5319378	0.07	0.947	-1.01446	1.085648
L5.	.1178377	.523568	0.23	0.822	-.9156943	1.15137
San						
--.	-15.32004	20.39186	-0.75	0.454	-55.5739	24.93382
L1.	1.212405	28.69324	0.04	0.966	-55.42852	57.85333
L2.	76.78346	31.6369	2.43	0.016	14.3317	139.2352
L3.	-47.66724	35.27218	-1.35	0.178	-117.2951	21.96063
L4.	-21.44909	35.53279	-0.60	0.547	-91.59142	48.69324
L5.	10.16644	23.91199	0.43	0.671	-37.03622	57.36911
_cons	-2.966583	3.357192	-0.88	0.378	-9.593737	3.660571

Appendix C: Results using NOK/EUR

Source	SS	df	MS			
Model	71181.3037	35	2033.75153	Number of obs	=	206
Residual	121540.061	170	714.941538	F(35, 170)	=	2.84
				Prob > F	=	0.0000
Total	192721.365	205	940.10422	R-squared	=	0.3693
				Adj R-squared	=	0.2395
				Root MSE	=	26.738

dVol	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dVol						
L1.	-.1856504	.0783127	-2.37	0.019	-.3402409	-.0310599
L2.	-.0762148	.0780887	-0.98	0.330	-.2303633	.0779337
L3.	.0051723	.0759104	0.07	0.946	-.1446761	.1550207
L4.	-.1956597	.0769518	-2.54	0.012	-.3475639	-.0437556
L5.	-.1200733	.0705664	-1.70	0.091	-.2593726	.019226
dRGDP						
--.	-.0859713	.3433856	-0.25	0.803	-.7638201	.5918775
L1.	.1716792	.3455979	0.50	0.620	-.5105369	.8538953
L2.	.3529954	.3407636	1.04	0.302	-.3196777	1.025668
L3.	.3447328	.3303322	1.04	0.298	-.3073485	.9968141
L4.	-.491773	.3296716	-1.49	0.138	-1.14255	.1590042
L5.	.3484593	.3280035	1.06	0.290	-.2990252	.9959437
dPR						
--.	-.0424165	.0835839	-0.51	0.612	-.2074125	.1225796
L1.	-.2649376	.0884612	-2.99	0.003	-.4395614	-.0903138
L2.	.1444416	.0892939	1.62	0.108	-.031826	.3207092
L3.	.0783786	.0897214	0.87	0.384	-.0987329	.2554901
L4.	.0708174	.0905672	0.78	0.435	-.1079638	.2495986
L5.	-.0820275	.0799437	-1.03	0.306	-.2398377	.0757827
dNOKEUR						
--.	-.8699126	1.053666	-0.83	0.410	-2.949868	1.210042
L1.	1.213515	1.055471	1.15	0.252	-.8700029	3.297033
L2.	-.5679299	1.015643	-0.56	0.577	-2.572826	1.436967
L3.	.5628643	1.024667	0.55	0.584	-1.459845	2.585573
L4.	-.7878363	1.019132	-0.77	0.441	-2.799619	1.223947
L5.	.9427311	1.038921	0.91	0.365	-1.108116	2.993579
dPSub						
--.	.9565807	.5263066	1.82	0.071	-.0823573	1.995519
L1.	-.3962357	.5419507	-0.73	0.466	-1.466055	.673584
L2.	.0590006	.5403435	0.11	0.913	-1.007646	1.125648
L3.	-.0558372	.5342975	-0.10	0.917	-1.110549	.9988751
L4.	.105201	.5368344	0.20	0.845	-.9545191	1.164921
L5.	.1065891	.5300693	0.20	0.841	-.9397767	1.152955
San						
--.	-17.93185	20.18623	-0.89	0.376	-57.7798	21.91611
L1.	-4.719191	28.11424	-0.17	0.867	-60.21717	50.77879
L2.	91.4294	31.3935	2.91	0.004	29.45811	153.4007
L3.	-48.90193	35.65633	-1.37	0.172	-119.2881	21.48426
L4.	-25.07832	36.27433	-0.69	0.490	-96.68446	46.52782
L5.	7.885262	24.49918	0.32	0.748	-40.47653	56.24706
_cons	-2.432071	3.363862	-0.72	0.471	-9.07239	4.208248

Appendix D: Results using exchange rate volatility

Source	SS	df	MS			
				Number of obs	=	206
				F(35, 170)	=	2.90
Model	72119.7143	35	2060.56327	Prob > F	=	0.0000
Residual	120601.651	170	709.421476	R-squared	=	0.3742
				Adj R-squared	=	0.2454
Total	192721.365	205	940.10422	Root MSE	=	26.635

dVol	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dVol						
L1.	-.204125	.0761925	-2.68	0.008	-.3545304	-.0537197
L2.	-.0505583	.0756213	-0.67	0.505	-.1998361	.0987194
L3.	-.008369	.0737888	-0.11	0.910	-.1540293	.1372912
L4.	-.202312	.0764623	-2.65	0.009	-.3532498	-.0513742
L5.	-.1133596	.0703397	-1.61	0.109	-.2522113	.0254922
dRGDP						
--.	-.0704795	.3422404	-0.21	0.837	-.7460677	.6051087
L1.	.1386768	.3458252	0.40	0.689	-.5439879	.8213416
L2.	.3793695	.33503	1.13	0.259	-.2819853	1.040724
L3.	.2908032	.3259137	0.89	0.374	-.3525558	.9341623
L4.	-.4591992	.3280174	-1.40	0.163	-1.106711	.1883127
L5.	.3088788	.3254563	0.95	0.344	-.3335775	.951335
dPR						
--.	-.0527368	.0842638	-0.63	0.532	-.219075	.1136014
L1.	-.2498202	.0886168	-2.82	0.005	-.4247512	-.0748891
L2.	.131665	.0888106	1.48	0.140	-.0436486	.3069785
L3.	.0915542	.0883458	1.04	0.302	-.0828418	.2659502
L4.	.0727098	.0904188	0.80	0.422	-.1057784	.251198
L5.	-.0949998	.0811609	-1.17	0.243	-.2552128	.0652131
dVolatility						
--.	-.0248526	.0453212	-0.55	0.584	-.1143174	.0646122
L1.	.0126494	.058009	0.22	0.828	-.1018613	.1271601
L2.	.0370284	.0597844	0.62	0.537	-.080987	.1550439
L3.	-.0000429	.0582761	-0.00	0.999	-.1150808	.1149951
L4.	.0598775	.0550545	1.09	0.278	-.0488009	.168556
L5.	.004045	.044304	0.09	0.927	-.0834118	.0915018
dPSub						
--.	.8385463	.5242291	1.60	0.112	-.1962907	1.873383
L1.	-.214528	.5303504	-0.40	0.686	-1.261449	.8323925
L2.	.039219	.5342437	0.07	0.942	-1.015387	1.093825
L3.	-.0767071	.5323943	-0.14	0.886	-1.127662	.974248
L4.	.0491887	.5396019	0.09	0.927	-1.015994	1.114372
L5.	.2191841	.5333394	0.41	0.682	-.8336367	1.272005
San						
--.	-16.39586	20.29785	-0.81	0.420	-56.46415	23.67244
L1.	-3.698967	28.31618	-0.13	0.896	-59.59558	52.19764
L2.	86.56806	31.37759	2.76	0.006	24.62818	148.5079
L3.	-43.18886	35.44195	-1.22	0.225	-113.1519	26.77414
L4.	-31.76065	35.5647	-0.89	0.373	-101.966	38.44466
L5.	11.38634	24.12935	0.47	0.638	-36.2454	59.01809
_cons	-2.502344	3.330488	-0.75	0.453	-9.076783	4.072095

Norges miljø- og biovitenskapelige universitet
Noregs miljø- og biovitskapelege universitet
Norwegian University of Life Sciences

Postboks 5003
NO-1432 Ås
Norway