NAME OF THE AUTHOR(S): SHAH SHAMIRA SHAKIB
MD ISHTIAQUL ALAM

SUPERVISOR: RAGNAR TVETERÅS

Salmon Consumption Behavior Before and During COVID-19:

An Analysis of Volume and Price Fluctuations of the household market in Belgium, France, Germany, Poland, Portugal, Italy, Spain, Sweden, and the Netherlands.

MSBMAS-1 22H Master Thesis, Year 2023

Master of Science in Business Administration

University of Stavanger Business School

Specialization: Strategic Marketing and Analytics

Candidate Number: 9125, Shah Shamira Shakib
9097, MD Ishtiaqul Alam

Abstract

The thesis investigates the Impact of COVID-19 on Nine European countries in salmon consumption in household volume sales and price of different product categories of salmon products. Through a comprehensive analysis using regression models in Stata, we tried to find out the relation between salmon consumption volume and multiple variables, including price, GDP, lagged volume, and the effect of COVID-19 in specific countries using data from January 2018 to April 2022 obtained from Norwegian Seafood Council. Our findings revealed key insights. We observed that pricing significantly influences sales volume. Salmon sales volume tends to decline as prices rise, demonstrating a normal supply and demand connection. GDP (Gross Domestic Product) has a positive impact on sales volume. The lagged volume of sales strongly influenced the logged volume of sales and COVID-19 had a major impact on sales volume in certain countries. In most cases, household consumption increased during COVID-19 compared to the pre-pandemic period indicating a change in consumption behavior. The results of this study provide essential information for future research by providing an understanding of the sustainability of increasing salmon consumption as well as the potential long-term consequences of the pandemic on consumer behavior. Additionally, it offers a precedent for investigating how national and international crises might change consumer trends in the food sector, particularly for healthy products like salmon.

Keywords: Salmon consumption, COVID-19, Household market, European seafood industry.

Table of Contents

Acknowledgment

First and foremost, we would like to show our profound gratitude to Professor Ragnar Tveterås, who oversaw our thesis. Throughout the entire research process, his mentorship was paramount in providing a well-rounded and analytical approach to our research. This thesis has been profoundly shaped and improved by his knowledge, important advice, motivation, and astute feedback.

We are also deeply grateful to the Norwegian Seafood Council for providing us with the essential data for this study. The data provided by the Norwegian Seafood Council through our supervisor has been pivotal in conducting the empirical analysis and facilitating the exploration of salmon consumption behavior before and during the COVID-19 pandemic.

This thesis is the final part to complete our degree of Master of Science in Business Administration, within the specialization of Strategic Marketing and Analytics at the University of Stavanger. We would also like to thank the University of Stavanger Business School for their support and collaboration during this study project.

This work is a testament to the collective effort of all who we have had the pleasure to learn from and share this journey with. We are thankful to everyone who contributed by sharing their knowledge, in ways big or small, to the completion of this Master's thesis: thank you.

Chapter 1: Introduction

1.1 Background

Fish is one of the top sources of protein in the world, and research has shown that it can help maintain human health by warding off serious inflammatory and chronic diseases. Eating fish and seafood is not only limited to better human health but it has a positive impact on our environment. Salmon is known to be a super versatile and nutritious fish and at the same time widely cherished fish in the world. It is a reliable source of vitamin D, B12, Potassium, Iron, Omega-3 fatty acids, etc. Salmon is extremely popular in the culinary art and food industry and similarly popular in the household market.

World Health Organization (WHO) announced COVID-19 as a pandemic on 11 March 2020 (Organization, 2020). Globally, the COVID-19 pandemic has significantly changed consumer behavior, particularly in the seafood sector. The demand for different food products has been significantly impacted by consumer behavior changes and disruptions to the food supply chains. Among these, salmon consumption patterns have significantly changed. Salmon is a large source of protein and an important part of the diet in many European nations." With the help of this study, we hope to determine whether consumption volume or price hikes have occurred during COVID-19 than before.

Despite the significance of salmon in the diet and economy of Europe, there is a lack of comprehensive understanding of how household consumption patterns of salmon have been affected during the pandemic, the underlying factors contributing to these changes, and the implications for future trends and policy, is being highlighted in this report. Through this research, we are trying to contribute to how during the pandemic and in the future, if there are similar emergencies to occur, the consumption trend can be predicted. Our research will clarify and predict these kinds of market trends beforehand.

At the beginning of the year 2020, as the COVID-19 crisis started spreading around the globe, many companies in the seafood supply chain witnessed a weaker economic performance in quarters 1 and 2 of 2020 consequently. The seafood business, like other economic activities, was especially hit by the temporary closure of HoReCa and food service companies. These market segments represent a major outlet for fresh and prepared products for out-of-home consumption of seafood, on the other hand, seafood sales through the retail channel grew, as consumers increased their purchases for home consumption. (European Commission. Directorate General for Maritime Affairs and Fisheries., 2020)

Salmon is a very nutritious fish and extremely popular in the food industry and in the European fish industry financially. So, we were intrigued to evaluate if COVID-19 pandemic had an impact on the consumption of Salmon. We started our research based on some questions and data. Through this research, we can help other researchers determine the price elasticity of salmon sales in the household market across the selected countries during the COVID-19 pandemic. It will also help other research to identify potential areas for future research and exploration, such as the long-term effects of the pandemic on consumer behavior and the sustainability of increased salmon consumption.

1.2 Research Questions

The objective of the study is to address the following research questions:

1. How did the COVID-19 pandemic influence salmon consumption patterns in the household market across Belgium, France, Germany, Poland, Portugal, Italy, Spain, Sweden, and the Netherlands compared to the pre-COVID Period?
2. What was the impact on different product labels of household salmon consumption volume during the pandemic?
3. What were the key determinants influencing the change in salmon consumption during the COVID-19 pandemic in the household market across the selected countries?
4. Did the COVID-19 pandemic affect the price elasticity of salmon in the household market across the selected countries?

1.3 Contributions of the Study

This study highlights an insightful perspective on the impacts on food consumption patterns during a global disruption, with a specific focus on salmon. The results of the research will be useful for fisheries, distributors, policymakers, consumers, and researchers who would like to comprehend how the pandemic affected food industries and prepare for future resilience and will find the findings to be helpful. Moreover, this study will contribute to the literature on food consumption behavior during crisis or emergency situations and how to monitor the market during pandemics or natural disasters so that food waste can be avoided and price fluctuations in the salmon industry can be anticipated.

Chapter 2: Literature Review

2.1 Global Trends in Salmon Consumption

Seafood is a multi-billion industry and has a major impact on trade and economy worldwide. According to FORTUNE BUSINESS INSIGHTS, the seafood market estimation $333.25 billion in 2022 and is expected to grow almost two times by 2029. Despite COVID-19, the market is growing at an excellent rate and has a greater demand rate compared to pre-pandemic time. This growth in seafood consumption is owed to higher consumption, increasing disposable earnings, and an increased interest in fish-based foods all over the world (Seafood Market Size, Share, Growth | Research Report [2029], n.d.). According to FAO, fish and aquaculture production has increased almost ninefold, from around 19 million tons in 1950 to 178 million in 2020. More than 70 percent of the total production in 2020 was from marine waters, which emphasizes the importance of seafood in global fish production (FAO, 2022). The major species in marine aquaculture include Atlantic salmon, Milkfish, Rainbow trout, Japanese amberjack etc. According to the report of FAO, Atlantic Salmon leads the production of sea fish with 32.6% of the total sea fish capture and cultivation, and production of Atlantic Salmon was around 2719.6 thousand tons (FAO, 2022).

Although fish products saw a large decline in 2018, they were among the food items most impacted by changes in households' purchasing power. However, there were certain outliers that show how customers preferred goods that are convenient and readily available to them throughout the year. The demand for the few fresh species, mostly farmed, that fit these requirements increased in 2018; the biggest examples are seabream and salmon. In fact, consumption of salmon increased in each of the Member States mentioned. (European Commission. Directorate General for Maritime Affairs and Fisheries., 2019)

According to the report of EUMOFA 2022, the top European countries in Salmon consumption are France, Spain, Italy, Germany, Poland, Netherlands, Portugal, Hungary Ireland, Sweden, and Denmark. These countries consumed the highest quantities in the year 2021 and in the last five years, this ranking remained steady. These top 11 countries rank among the most significant in the EU in fish consumption and in 2021, they represented 87% of all household spending aquaculture and on fisheries goods in the EU. In 2021, household consumption in these top 11 countries summed up to 1,43 million tons, which had a 1.6% decrease from the previous year. It is possible to attribute the relative decline in 2021 and the much larger rise in 2020 because more people ate at home during the initial waves of the COVID-19 epidemic. Also in 2020, when food service regulations were tighter. Regarding the sales of numerous important species, EUMOFA reported that imports of salmon showed a strong increase in value between the years 2020 and 2021, albeit the equivalent rise in volumes was tempered by the growing establishment of restaurants. (European Commission. Directorate General for Maritime Affairs and Fisheries. & EUMOFA., 2022)

2.2 Drivers of Seafood Consumption in Europe

According to Almeida et al. (2015), Europe is considered one of the world's largest seafood markets, with a significant amount of the population eating seafood regularly and it is a preferred cuisine throughout Europe because of its taste, nutritional richness, and cultural significance, seafood is a preferred cuisine throughout Europe. Fish and seafood have great nutritional value and are full of vital amino acids, high-quality proteins, contains vitamin A, E, and D, vital minerals such as iron, calcium, selenium, and zinc, and notably omega-3 polyunsaturated fatty acids (Marinac Pupavac et al., 2022). According to Béné et al. (2015), it is scientifically proven that regular fish consumption improves human health including protection against dementia, improves the development of cognition, mental health, and mitigates the risk of cardiovascular diseases. Seafood is rich in high omega-3 content, which is linked to reduced depression symptoms and a lower risk of lifestyle illnesses (Thong & Solgaard, 2017). Although consumption of enormous amounts of seafood can cause health-related problems indicated by (Almeida et al., 2015) as consuming excessive amounts of tuna can contribute to heavy metal poisoning. Moreover, it is advised by the European Food Safety Authority to check mercury levels if someone is eating too much big predatory fish. Seafood is an excellent source of animal protein and in 2010 the protein provided by fish represented twice the number of poultry and more than three times that of cattle-based protein sources (Almeida et al., 2015). Seafood is considered a crucial source of protein as an average person in Europe consumes 24 kilograms of seafood per year (Consumption, n.d.).

The preferences of consumers for farmed vs wild-caught fish in Croatia were examined by Tomić et al. (2017) in a study that investigated how perceptions and knowledge of consumers affect purchasing choices. The study's findings revealed that customers who live in the coastal areas and with high incomes are significantly influenced by the origin of the seafood, whether it was caught in the wild or on a farm. According to their findings Tomić et al. (2017), consumers mostly prefer fresh fish and put emphasis on the taste. Consumers characterize taste, dietary value, and hygiene as one of the major attributes while buying seafood, and some people, mostly children, dislike fish for their smell and taste. It is also evident that dislike from other members of the family prevents a household from consuming fish (Carlucci et al., 2015). Although findings from Verbeke et al. (2007) suggest that some consumers avoid wild fish to support sustainability, others refuse to eat farmed fish because of quality and taste.

2.3 Salmon Consumption

Atlantic salmon is a Coldwater fish species found in sea and coastal areas and is a major and popular seafood source for human consumption. It falls under the finfish category. Salmon are categorized into 2 subsets defined by region: Atlantic and Pacific Salmon, the former being regarded as the most popular among consumers. According to the reports published by FAO (2022), Norway and Chile were the two countries with the largest exporter of salmon exporting worldwide USD 27.6 billion in 2020. Salmon and trout exports accounted for almost one-fifth of the total value of all aquatic product exports in 2020, whereas it was only 5.1 percent in 1976. While Chile distributes its farmed coho salmon to Japan and its Atlantic salmon mostly to the United States and Brazil, Norway sells its salmon primarily to the European Union. Additionally, numerous types of wild Pacific salmon are traded internationally. These fish are captured in the North Pacific by American and Russian fleets, respectively (FAO, 2022).

According to the reports of the Norwegian Seafood Council Norway exported 333,420 tons of salmon in 2020 and the production increased to 344,476 tons in 2023 with a 3.31% increase in production while the price increased by 57.19% during these periods (Yearly exports from Norway, n.d.)

2.4 Salmon categories and types

Earlier studies in the salmon industry conducted by Asche et al. (1998) described the evolution of the salmon industry in the 90's. The article stated that In Europe, fresh Atlantic salmon was treated as a luxury good with a finite supply. During this era, the European smoking business used imported frozen Pacific salmon since it was thought to be of poorer quality and cheaper. But as the Atlantic salmon industry grew making it more accessible and competitive with Pacific salmon, it first took over the high-end segment and it started replacing Pacific salmon in the industry of smoking and began entering the grocery market for household consumption. It also argued that during that period farmed salmon entered the market and lowered the price of Pacific salmon (Asche et al., 1998).

Salmon is categorized based on its place of origin, species, and ways of processing. Salmon is one of the most accomplished species when it comes to product variety and expansion (Asche & Smith, 2018). Based on their origin, salmon are divided into two main groups: Pacific Salmon and Atlantic Salmon. Varied species of Pacific salmon, including the Coho (Silver), Pink (Humpy), Chinook (King), Sockeye (Red), and Chum (Dog) are indigenous to both the Eastern and Western Pacific Oceans (Quinn, 2018). On the contrary, Atlantic salmon are mostly found in the North Atlantic. Overfishing has resulted in a significant decrease in the wild population of Atlantic salmon, which has led to market dominance of farmed Atlantic salmon (Quinn, 2018)

Based on the cultivation process salmon has two subcategories: wild and farmed salmon. Wild salmons: salmons that are caught from natural habitats.

Most farmed salmon are of the Atlantic species and are raised in net pens or cages in the water. Farmed salmons take in processed fish feed, which may comprise fish oil and meal from wild fish, plant-based proteins, and synthetic colors to give their flesh a unique pink hue and they have a high-calorie count (Jacobs et al., 2002)

2.5 Change in Food Consumption During COVID-19

Due to the pandemic, most of the borders were closed and quarantine was in effect in most parts of the world due to shipping constraints, the supply of fresh vegetables, fish, and fruits were limited (Eftimov et al., 2020). On both the supply and demand sides of the food chain, COVID-19 has had a substantial influence on food consumption and created a massive disruption in the food supply chain. Supply chain disruptions, border restrictions, and lockdown procedures have all had an impact on food distribution, and stress-related eating patterns and risk perceptions have altered people’s food consumption behavior. Individual and global health are equally affected by these changes (Janssen et al., 2021). The AI based study conducted by Eftimov et al. (2020) found out that consumption increased by 300%, 280%, and 100%, respectively, for foods like "Pulses or plants that produce pulses," "Pancakes, Tortillas, or Flat cakes," and "Soups or Stews." The consumption of "Perciformes (a type of fish)," "Grains or Cereals, including Corn," and "Wine," significantly decreased, with reductions of 50%, 40%, and 30%, correspondingly (Eftimov et al., 2020). Another comparable research study from Janssen et al. (2021) regarding the change in consumption during COVID-19 analyzed that consumer of Germany and Denmark purchased less fresh food and preferred food with a long shelf life. Still, it was not evident in Slovenia as people lost more income compared to the other two countries. Families with children, however, enjoyed eating fruit and vegetables. Notably, women eat far more fruits and vegetables than males. Their study also detected similar patterns during lockdown Italy and Spain has revealed changes in food consumption habits, with a rise in the consumption of processed comfort foods and a decrease in fresh food purchases. The COVID-19 diet Study in Spain, on the other hand, found that confinement led to improved eating practices, as evaluated by adherence to the Mediterranean diet (Janssen et al., 2021). Studies suggest that household expenditure on seafood and fish-related products increased by 7% in the EU-27 in 2021, continuing the upward trend compared to 2020 as people were forced to stay home (The EU Fish Market 2022, n.d.).

2.6 Previous Studies on Salmon Consumption in Europe

Some similar studies were conducted to determine the effect of COVID-19 on the salmon industry based on different attributes. The Study conducted by Nguyen & Schmitz (2023) has analyzed the supply and demand state of the USA market in 2020 and 2021. The study stated that although there was a reduction of demand in the first year of COVID-19, the demand increased in the following year (2021) and there was a positive market gain of 210 million USD. The study concluded that demand increased mainly because of the desire for meals prepared at home and salmon's relative pricing advantage over meat and pig contributed to the rise in salmon intake during the pandemic. International importers such as Norway, Chile, and Canada reaped the benefits as they are the major suppliers of salmon in the USA market and the market relies heavily on imports. Although there are concerns because of increased international shipping costs which increased the overall transportation cost, domestic labor shortage, and how these problems can be mitigated in future crises (Nguyen & Schmitz, 2023). Another study conducted by Heutte et al. (2023) in France in regards of fish related products during COVID-19 also had equivalent results. Salmon, a popular seafood in France, is heavily dependent on imports. Fresh/chilled salmon imports have been increased throughout 2020, and this pattern looks to be continuing in early 2021. Fresh salmon consumption has increased significantly in both volume (34.2%) and value (27.7%) between 2017 and 2019. This increasing trend is continuing through 2021. Fresh salmon accounted for 31% of all fresh fish consumed across all distribution channels in 2020. In the year 2020, the quantity purchased, and the amount paid for each item remained consistent. Salmon maintained considerable market shares in specialist distribution channels such as fish shops, markets/fairs, and supermarkets in 2020 (Heutte et al., 2023)

Chapter 3: Theoretical Framework and Hypotheses

3.1 Consumer Demand Theory: Microeconomic Perspective

In our research, we have taken the consumer demand for salmon into consideration during COVID-19 and pre-Covid-19 periods. Consumer demand theory is a fundamental concept in microeconomics that describes all aspects of how customers make decisions and their choices. According to the theory, given consumers' earnings and current pricing, consumers want to maximize their utility or satisfaction from the consumption of products or services they purchase.

Salmon is in high demand in Europe, and the demand is also constantly growing over the years. The American Heart Association suggests fish is a reliable source of protein that is low in saturated fat, and eating fish and seafood regularly has been linked to a lower risk of cardiovascular disease (Fish and Omega-3 Fatty Acids, n.d.). During the COVID-19 pandemic worldwide people focused on eating more healthy food. As Salmon is one of the healthiest fish we are trying to identify if the pandemic has influenced the demand for it or not. In our analysis, we have identified that past demand has influenced the mentioned COVID-19 period, positively.

Demand theory, from the consumers' perspective, if the Price of goods increases demand for that product decreases and consumers want less of that product and vice versa. The concept of the fundamental utility measurement is exceedingly dubious, and the satisfaction obtained from various goods cannot be objectively assessed in monetary terms (S M Ikhtiar Alam, 2022).

Though demand can be influenced by several factors, like prices of the Product, income, willingness to spend disposable earnings, Prices of related Products, consumer preferences, and market demand.

Theory of Supply: Demand is represented by consumer theory, whereas supply is represented by producer theory.

Gezahegne (n.d.) explains the primary concept in producer theory, where sellers are driven by profit, and profit can be easily measured. Contrary to this, consumer theory explains what consumers prefer, therefore it identifies something that we must conclude but cannot be readily measured. Consumer theory is predicated on the belief we can determine what people like, from their choices.

Consumer Demand Theory is a key economic concept that seeks to understand the consumer's decision-making process considering their income and the price of items. The idea is founded on the principle of utility-maximizing within the restrictions of a budget. It contains two key impacts on consumer behavior: pricing and income effects. Price effect refers to variations in demand in reaction to price changes. The income effect is the change in demand caused by changes in consumer income.

To summarize, consumer demand theory is critical for understanding consumer behavior, the dynamics of markets, and adopting effective economic measures.

The Budget Constraint delineates the reasonable combinations of products depending on income and pricing in this case. The optimal consumption point is defined as the point at which the maximum possible indifference curve is tangential to the budget restrictions (Budget Constraint - Intelligent Economist, 2019).

Another critical component of the theory is the idea of demand elasticity, which assesses demand's sensitivity to price (Price Elasticity) and income (Income Elasticity) variations. High price elasticity suggests high consumer reactivity to price changes, and vice versa. Positive income elasticity suggests normal goods (demand rises as income rises), whereas negative denotes inferior products.

Some limitations of the theory are that it assumes logical, consistently utility-maximizing consumers with stable choices and perfect knowledge. However, these assumptions often fail due to incomplete knowledge, irrational conduct, and shifting desires. Furthermore, elements such as branding and cultural norms, which can influence customer behavior, are not considered in this approach. Despite these flaws, Consumer Demand Theory remains a valuable tool in economic decision-making and analysis.

3.2 Hypothesis

Based on our research objectives we have formulated our hypothesis.

H0: COVID-19 had a negative impact on the price and demand of Salmon consumption in Major European markets.

H1: COVID-19 had no impact on the price and demand of Salmon consumption in Major European markets.

Chapter 4: Methodology

4.1 Research Design

A quantitative methodology and a longitudinal research design were used in this study. We have tried comparing salmon consumption patterns for the period before and during the COVID-19 pandemic in the top nine European countries. For the report and to do analysis, we preferred quantitative research over the qualitative research method because it is more scientific, focused, fast, objective-oriented, and relatable in our research scenario.

For the quantitative research, we took the data from the household market in nine European countries. The dataset contains records of some volunteer households who purchased seafood to be eaten at home. The data contains household purchase records from the retail market and household purchase records from special fish shops for in-home eating. This panel data does not hold records of seafood purchased by private entities such as small restaurants, hospitals, tourists, etc. This dataset is collected by the Norwegian seafood council of 10 European Countries. But to achieve an error-free result we had to discard the data of Great Britain as we did not have GDP data of Great Britain for the whole-time frame. Since we got our data from a reliable and highly acceptable source, and the data is already precise, consistent, and numerical, so, the analytical work could be done fast and will be helpful considering the market size, demographics, and consumer preferences in distinct categories. In our case, since the panel data does not cover the100% of the purchase reports of the markets, to maintain accuracy, we had to use the quantitative method as the data is more control sensitive. As we are analyzing differences in the purchase behavior of consumers during COVID-19 and pre-Covid years, we were able to estimate, state facts, and test pre-existing hypotheses by using quantitative research methods.

Our reason to choose the quantitative method is also that we are working with a large sample size and represent a larger population. which is more statistically useful to get valid insights into the proposed hypothesis. This method is repeatable and analyzable with the same dataset which gives the results more reliability. Our data is quite large and covers a lot of aspects to help us analyze our hypothesis more accurately, so this method was more organized and analytical for us.

4.2 Data Collection

We have collected our data from the Norwegian Seafood Council, which serves as a vital promotional entity with the overarching objective of facilitating the marketing and advancement of Norwegian seafood products on a global scale. The Council is operating in close collaboration with the Norwegian fishing and aquaculture industry, the undertakes responsibilities like market research, formulation of effective marketing strategies, and provision of comprehensive information and assistance to exporters, importers, and consumers alike.

A primary aim of the Norwegian Seafood Council is to highlight the exceptional quality, sustainable practices, and versatile nature of Norwegian seafood and at the same time consumption, and trade of these commodities worldwide. Through rigorous market research, the council consistently identifies evolving consumer trends, preferences, and demands.

Furthermore, the Norwegian Seafood Council plays a crucial role in conveying accurate and up-to-date information regarding Norwegian seafood, encompassing its nutritional benefits, sustainability credentials, responsible sourcing, and adherence to rigorous quality standards. By effectively communicating these attributes, the council aims to build trust and credibility among international stakeholders, fostering long-term relationships and facilitating trade partnerships between Norwegian seafood exporters and importers.

The research determines if there is any price or volume fluctuation in salmon consumption during COVID-19 and pre-Covid years. We have used household panel data from 9 European countries: Belgium, Sweden, France, Germany, Italy, Spain, The Netherlands, Poland, and Portugal. There are various countries and regions where the Norwegian Seafood Council operates, such as Spain, Netherlands, Sweden, Norway, Germany, Great Britain, Russia, Italy, Slovakia, France, Portugal, Belgium, Poland, and the Czech Republic and the company's products are categorized into three categories: fresh, packaged, and processed (sjømatråd, 2023).

The data covers the sales of seafood in modern grocery stores, where the purchase of goods is registered in the checkout stations and collected in the database at the chains of the store but does not include specialty stores and have the purchase record of volunteer customers (Tveterås, 2021). The supplier of the data is Nelson IQ. The Norwegian Seafood Council buys data from Norway, USA, and Portugal (sjømatråd, 2023).

4.3 Measurement Variables

The dataset we used for this analysis was collected from the Norwegian seafood council. The dataset contained household salmon consumption data of 10 countries Spain, France, Belgium, Poland, Germany, Poland, Portugal, Sweden, Italy, Netherland, and Great Britain from January 2018 to December 2022. The primary data set contained data on Salmon which is categorized into variables: Species, Processing, Condition, Product, Packing, Product Label.

- Species: The species was salmon only.
- Processing: This is a categorical variable that describes the type of processing the salmon underwent before it was sold. The processing variable has five categories: Natural, Prepared, Salted, Salted and/or Dried Smoked, Smoked and Total.
- Condition: This variable represented the condition in which the salmon was sold. The Condition variable is divided into four categories: Canned, Fresh, Frozen and Total.
- Product: In the data we have, the 'product' variable is a categorical variable which describes the type of salmon product. This variable is divided into 23 unique categories, each corresponding to a distinctive product form. These categories include 'Breaded', 'Burger', 'Canned', 'Caviar Substitute', 'Cold Cuts', 'Cured (Gravet)', 'Delicatessen', 'Fillets', 'Fish Meat', 'Marinated', 'Not Spread', 'Other', 'Ready Main Meal', 'Salads', 'Sliced/Filet', 'Slices', 'Spread', 'Steak', 'Steak/Fish Meat', 'Sushi', 'Total', 'Whole', and 'Whole/Steak'. Each observation in the dataset has been assigned with one of these categories, reflecting the form in which the salmon product is offered in the market.
- Packing: The categorical variable “packing” specifies the packaging method used for the salmon product. It includes four categories: 'Canned', 'Not Prepacked', 'Prepacked', and 'Total'.
- Product Label: "In our dataset, the 'Product_Label' variable is a compound variable created from an array of five other variables: 'Species,' 'Processing,' 'Condition,' 'Product,' and 'Packing. Salmon Natural Fresh Steak Not Prepacked' is an example of a 'Product_Label'. 'Salmon' here refers to the species, 'Natural' here refers to the process of preparation, 'Fresh' here refers to the condition of the salmon, 'Steak’ designates product type, and 'Not Prepacked' herein represents the way of packaging.

- Salmon Volume: This variable stands for the quantity of salmon sold in a specific month of the year in a specific country.
- Salmon Value: The 'salmon_value' variable in our dataset represents the total monetary value of salmon products sold in a specific period (month of a year) in a specific country. The quantity of salmon consumed (salmon_volume) and the price per unit (salmon_price) are multiplied together to get this value.
- Salmon Price: This variable contains the unit price of a salmon product in a specific month of a year.
- Currency: The variable contains the countries specific currency where the product was consumed
- Conversion Rate: It includes the conversion rate from the country's currency to Euro. The rate is constant over the whole data set.
- Value Euro: the value of salmon in Euro after conversion.
- Price Euro: the price of salmon in Euro after conversion.
- Currency type: for this data set all different currencies are converted into Euro and Euro is being used as the singular currency type.
- GDP (Gross Domestic Product) Unit: GDP is taken in million Euros for the specific country in current prices.
- GDP Seasonally Adjusted: the variable in the dataset denotes that the GDP part of the dataset has been adjusted seasonally and calendar wise.
- GDP non adjusted items: the variable denotes that there are other products in the market, but we have not adjusted all of them as in Gross domestic products at a market price.
- GDP quarter: is three times the value of monthly GDP.
- Household expenditure seasonally unadjusted data: this is not adjusted in the dataset as seasonally or Calendar wise.
- Household Quarter: the variable denotes three times the value of monthly expenditure as it a quarterly value.

4.4 Data Analysis Techniques

Regression Model: We have used Multiple Linear Regression (MLR). fixed effects (FE) regression model and Ordinary Least Squares (OLS) regression. For the fixed effects (FE) regression, the mathematical equation is described below:

$$y\_it = \alpha\_i + \beta 1 X1\_it + \beta 2 X2\_it + \ldots + \beta n * Xn\_it + \varepsilon\_it$$

Here, y_it is the dependent variable for individual i when time is t.

α_i is the individual-specific impact.

X1_it to Xn_it is explanatory variables for individual i at time t.

β1 to βn are coefficients to be estimated, corresponding to the explanatory variables.

ε_it is the error term.

To calculate the Multiple Linear Regression (MLR) regression we have used the following equation:

$$Y = \beta 0 + \beta 1X1 + \beta 2X2 + \beta 3X3 + \beta 4X4 + \beta 5 * X5 + \ldots. + \beta\_n + X\_n + \varepsilon$$

Where Y is the dependent variable.

β0 is the y-intercept (the value of Y when all X variables are 0)

β1 to β_n are the coefficients of the independent variables (these indicate the amount of change one could expect in Y per unit change in the respective X variable, holding other variables constant)

X1 to X5 are the independent variables.

ε is the error term which captures the variation in Y that is not explained by the X variables (Mehmetoglu & Jakobsen, 2022)

Chapter 5: Data Analysis and Results

5.1 Data Analysis

For the Analysis, we used Stata as the primary analytical tool based on its extensive range of statistical functionalities and its adaptable data management capabilities. Stata is efficient in managing extensive datasets and provides an extensive range of statistical methods, providing it highly appropriate for complex analyses. We also decided to use Stata for its ease of use for beginners, user-friendly interface for running regression models, simplified data manipulation, data cleansing, restructuring, and combining built-in features. As our data was Household panel data Statas linear regression, time series analysis, and panel data analysis is a perfect fit for our analysis. Another major reason to use Stata was reproducibility as Stata's command-based system is highly repeatable. Collecting and replicating data cleaning in analysis phases was a significant factor for using this Specific software.

5.2 Analysis process

For the analysis we used the excel file as our primary data set. Then modified the excel file to create a variable “month_no” to denote the month to a numerical value ranging from 1-12. After that we merged the household and GDP data, merged them under one sheet and imported to Stata. At first, we summarized the data set and set up mat size of 1000 as our dataset is huge. Then we created a new variable “monthly_gdp_nc” by dividing the variable “monthly_gdp” of each country by the variable “convers_rate” to national currency of respective country in the dataset. After that formed “lvolume” which is the natural logarithm (ln) of the “salmon_volume” variable. Utilizing the natural logarithm of the variable salmon_volume can aid in stabilizing variance and arranging the data more closely with the fundamental hypotheses for statistical analyses. The next step was creating “lprice” and “lgdp.” These variables represent the natural logarithm (ln) of the “salmon_price” and “monthly_gdp_nc” Then we created a time variable “yearmonth” for single time identifier for every period. Then, time trend variable ‘t” was generated to account for unobserved factors that change over time. The numerical variable "t" represents time-based progression commencing from the start of January 2018 to April 2022, with a monthly increment from 1 to 52. To capture the shock of COVID-19 the binary variable “covid” was created where we set range of the pre Covid to March 2020 and the Covid era ends in April 2022. Pre Covid period is equal to 0 and Covid period is classified as 1. This was generated to run a time series analysis. Another variable “product_no” which is a numeric encoding of the “product_label” variable was generated to assign an exclusive numeric code to each individual product label. Similarly, “country_no” variable was generated to assign unique numeric identifier to each distinct value of the country variable. For example, Netherlands is assigned as 5, Portugal as 7. The variable “country_product_no” was generated by multiplying “country_no” with 100 and summing up the “product_no”. This variable uniquely identifies each combination of country and product. For example, the “country_product_no” 501 represents the country Netherlands and the product Salmon (Total).

Afterwards, we generated the two variables “lvoume1” and which is the lagged version of “lvolume” the natural log of salmon volume starting from February 2108 and “lprice1” by using the lagged version “lprice”, that is a one-period lag of lprice (the natural log of salmon price) avoiding the first observation for each panel. Next “dlprice” was made which represents the first difference of lprice.

The next step was creating dummy variable for each country. Here, each variable identifies the country from which an observation is made. These variables contain a value of 1 if the observation is from the country and a value of 0 otherwise. These country dummy variables are created to use in a regression analysis to account for effects that are unique to each nation.

The next step was creating interaction between variables and country dummy. We created variables for every country corresponding with “lvolume”, “lvolume1”, “lprice” and “lgdp”. To elaborate we produce new variables “lvolume_sweden” by multiplying lvolume to Sweden. Then “lvolume1_sweden” by multiplying “lvolume1" with “sweden”. The same process repeated for “lprice” and “lgdp” for every country in the dataset.

Next, another new variable named “covid_sweden” was generated. same goes for all the other countries This variable is created by multiplying the values of two existing variables, “covid” and “sweden”. These variables will have a value of 1 if both covid and sweden are equal to 1, indicating that the observation relates to Sweden during the COVID-19 period. Otherwise, it will have a value of 0. To determine the specific effect of COVID-19 in each specific country, this variable can be utilized as an indicator or an interaction term in regression analysis. Finally, nine half-yearly dummy variables starting from “y18_1” to “y22_1” ranging from year 2018 to 2022 have been generated, allowing us to examine and consider any seasonality or time-specific impacts in the data set.

The study aimed to investigate the correlation between multiple factors and the sales volume of salmon, along with the price variation before and during the COVID-19 pandemic on household consumption. The dataset included panel data observations of salmon price, volume, and distinct categories of salmon products in different countries, with domestic GDP data included.

The findings suggest that there is a statistically significant positive effect of the lagged volume of sales (lvolume1) on the present volume of sales. Furthermore, our analysis concluded that there exists an inverse relationship between salmon price and salmon volume which is not surprising as it follows the law of demand and supply. The variable representing Gross Domestic Product (GDP) exhibited a positive impact on sales. The findings indicate a rise in economic growth is linked to an increase in demand for salmon.

Diving into the analysis, initially we tried to analyze the fixed effect (within) regression with lvolume as dependent variable and the rest (lvolume1, lprice, lgdp, covid) as independent variables.

5.3 Results:

Diving into the analysis and results of our analysis, Figure 1 is the illustration of all the variables in the analysis, all the variables, the number of observations, standard deviation, mean, the minimum and the maximum value in the dataset.

. sum

Variable	Obs	Mean	Std. dev.	Min	Max
year	13,200	2019.691	1.263128	2018	2022
month_no	13,200	6.194545	3.497365	1	12
month	13,200	21959.9	456.7565	21185	22736
country	0				
species	0				
processing	0				
condition	0				
product	0				
packing	0				
product_la~l	0				
salmon_vol~e	12,278	574.9534	1103.177	0	11187.6
salmon_value	12,278	14613.42	27273.52	0	348684.5
salmon_price	12,203	42.20929	59.25269	.2292308	671.6736
Currency	0				
convers_rate	13,200	.8155217	.3559385	.091636	1
value_eur	13,200	9352.741	19276.14	0	244267.3
price_eur	12,203	18.3546	8.264363	.2292308	74.69942
curr_type	0				
gdp_unit	0				
gdp_s_adj	0				
gdp_na_item	0				
gdp_time	13,200	21931.71	459.8618	21185	22736
gdp_quarter	13,198	363849.8	276285.6	45294.8	956203
monthly_gdp	13,198	121273.1	92059.05	15098.27	317396.4
hh_exp_s_adj	0				
hh_exp_na_~m	0				
hh_exp_time	13,200	21931.71	459.8618	21185	22736
hh_exp_cur~y	0				
hhexp_quar~r	13,199	192466	144911.4	28466.8	489576
monthly_hh~p	13,199	64158.51	48277.7	9488.933	160183
country_pr~t	0				
monthly_gd~c	13,198	189875	131716.8	15098.27	491395.2
lvolume	12,203	4.823955	2.15946	-4.514138	9.322561
lprice	12,203	3.23965	.8601966	-1.473026	6.509773
lgdp	13,198	11.834	.8912653	9.622335	13.105
yearmonth	13,200	201975.3	125.8018	201801	202204
t	13,200	26.48545	15.00178	1	52
covid	13,200	.4804545	.4996368	0	1
product_no	13,200	32.92455	24.25665	1	79
country_no	13,200	4.907273	2.849118	1	9
country_pr~o	13,200	523.6518	285.3724	101	979
lvolume1	11,967	4.823468	2.157924	-4.514138	9.322561
lprice1	11,967	3.237873	.8597592	-1.473026	6.509773
dlprice	11,807	.0023872	.1749891	-2.034666	4.974572
sweden	13,200	.1536364	.3606135	0	1
poland	13,200	.0590909	.2358037	0	1
italy	13,200	.0512121	.2204385	0	1
germany	13,200	.1536364	.3606135	0	1
belgium	13,200	.1181818	.3228355	0	1
france	13,200	.1648485	.3710578	0	1
netherlands	13,200	.0945455	.2925972	0	1
portugal	13,200	.0551515	.2282844	0	1
spain	13,200	.149697	.3567877	0	1
lvolume_sw~n	12,203	.5529412	1.573449	-2.341476	7.791783
lvolume_po~d	12,203	.3079222	1.256687	-1.671812	7.562023
lvolume_it~y	12,203	.3172045	1.399348	0	8.864671
lvolume_ge~y	12,203	.8955257	2.205194	-.7789498	9.322561
lvolume_be~m	12,203	.509658	1.535692	-2.540792	7.366456
lvolume_fr~e	12,203	.889161	2.159515	-3.426515	9.20702
lvolume_ne~s	12,203	.4169015	1.423555	-4.514138	7.418346
lvolume_po~l	12,203	.2251419	.9985202	-2.935923	6.72752
lvolume_sp~n	12,203	.7094989	1.98308	-3.418852	9.138876
lvolume1_~en	11,967	.5527586	1.572153	-2.341476	7.791783
lvolume1_p~d	11,967	.3077618	1.256388	-1.671812	7.562023
lvolume1_i~y	11,967	.3172517	1.399525	0	8.864671
lvolume1_g~y	11,967	.8949025	2.20367	-.6032885	9.322561
lvolume1_b~m	11,967	.5096576	1.535424	-2.540792	7.366456
lvolume1_f~e	11,967	.8887807	2.158745	-3.426515	9.20702
lvolume1_n~s	11,967	.4169944	1.422605	-4.514138	7.418346
lvolume1_p~l	11,967	.2252445	.9995348	-2.935923	6.72752
lvolume1_~in	11,967	.7101161	1.984503	-3.418852	9.138876
lprice_swe~n	12,203	.7114712	1.768356	0	6.509773
lprice_pol~d	12,203	.2302212	.8922398	0	4.323182
lprice_italy	12,203	.1483787	.6417968	0	3.402769
lprice_ger~y	12,203	.4499124	1.050273	0	4.170534
lprice_bel~m	12,203	.3677743	1.001331	0	4.313472
lprice_fra~e	12,203	.5007759	1.123935	0	4.265904
lprice_net~s	12,203	.2892834	.8844144	-1.473026	3.760578
lprice_por~l	12,203	.1491244	.6084824	0	3.523769
lprice_spain	12,203	.3927086	.9745362	0	3.911271
lgdp_sweden	13,198	1.991514	4.674088	0	13.105
lgdp_poland	13,198	.7223553	2.882663	0	12.79898
lgdp_italy	13,198	.6091904	2.622019	0	11.95825
lgdp_germany	13,198	1.932096	4.534613	0	12.66791
lgdp_belgium	13,198	1.252426	3.421001	0	10.72368
lgdp_france	13,198	2.013067	4.530837	0	12.289
lgdp_nethe~s	13,198	1.05249	3.256993	0	11.25236
lgdp_portu~l	13,198	.5372422	2.226853	0	9.882838
lgdp_spain	13,198	1.723624	4.107772	0	11.5964
covid_sweden	13,200	.0738636	.2615588	0	1
covid_poland	13,200	.0284091	.1661448	0	1
covid_italy	13,200	.0246212	.1549736	0	1
covid_germ~y	13,200	.0738636	.2615588	0	1
covid_belg~m	13,200	.0568182	.2315036	0	1
covid_france	13,200	.0789394	.2696544	0	1
covid_neth~s	13,200	.0454545	.2083068	0	1
covid_port~l	13,200	.0265152	.1606675	0	1
covid_spain	13,200	.0719697	.2584475	0	1
y18_1	13,200	.1154545	.3195818	0	1
y18_2	13,200	.1154545	.3195818	0	1
y19_1	13,200	.1154545	.3195818	0	1
y19_2	13,200	.1154545	.3195818	0	1
y20_1	13,200	.1154545	.3195818	0	1
y20_2	13,200	.1154545	.3195818	0	1
y21_1	13,200	.1154545	.3195818	0	1
y21_2	13,200	.1154545	.3195818	0	1
y22_1	13,200	.0763636	.2655891	0	1

Figure 1: Descriptive statistics of all the variables

```
Fixed-effects (within) regression               Number of obs     =     11,805
Group variable: country_pr~o                    Number of groups  =        245

R-squared:                                      Obs per group:
     Within  = 0.2169                                         min =          2
     Between = 0.6292                                         avg =       48.2
     Overall = 0.5815                                         max =         51

                                                F(4,11556)        =     800.34
corr(u_i, Xb) = 0.3892                          Prob > F          =     0.0000

------------------------------------------------------------------------------
     lvolume | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
    lvolume1 |   .3203949   .0084191    38.06   0.000     .3038919    .3368979
      lprice |  -.8191846   .0287487   -28.49   0.000    -.8755369   -.7628323
        lgdp |   .0653882   .0676906     0.97   0.334    -.0672968    .1980733
       covid |   .1275657   .0090615    14.08   0.000     .1098035    .1453278
       _cons |   5.141856   .7993946     6.43   0.000     3.574907    6.708804
-------------+----------------------------------------------------------------
     sigma_u |  1.5378091
     sigma_e |  .46300561
         rho |  .91688446   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0: F(244, 11556) = 26.53                 Prob > F = 0.0000
```

Figure 2: Fixed Effect Regression on the overall model

In Figure 2, the F-statistic tests the overall significance of the regression model, and its associated p-value is extremely small ($p < 0.0001$), indicating that the model is statistically significant. The outputs suggest that except for lgdp, all the other variables are statistically significant. The overall R Square value indicates 58.15% of the variation in lvolume is explained by the independent variables overall. Lagged logged salmon volume (lvolume1) is associated with a 0.3204 unit increase in the current logged salmon volume (volume), which suggests a strong positive relationship between the volume in the current and previous periods. lprice has a negative coefficient of -0.8192 suggesting that a one-unit increase in the logged salmon price (lprice) is associated with a decrease of 0.8192 units in the current logged salmon volume (lvolume). Logged GDP (lgdp) has a positive effect on lvolume, but it is not significant. The covid variable has a coefficient of 0.127 which implies that during the COVID-19 pandemic (covid = 1), lvolume increased by approximately 12.76% as compared to the pre-COVID-19 period.

```
Fixed-effects (within) regression               Number of obs     =     11,805
Group variable: country_pr~o                    Number of groups  =        245

R-squared:                                      Obs per group:
     Within  = 0.2153                                         min =          2
     Between = 0.7156                                         avg =       48.2
     Overall = 0.6650                                         max =         51

                                                F(10,11550)       =     316.82
corr(u_i, Xb) = 0.5088                          Prob > F          =     0.0000

------------------------------------------------------------------------------
     lvolume | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
    lvolume1 |   .3234888   .0084728    38.18   0.000     .3068807     .340097
      lprice |  -.8114074   .0290097   -27.97   0.000    -.8682713   -.7545436
        lgdp |   .4498049   .0769019     5.85   0.000     .2990642    .6005456
       y18_2 |  -.0263065    .016724    -1.57   0.116    -.0590884    .0064755
       y19_1 |  -.0138234   .0162817    -0.85   0.396    -.0457382    .0180914
       y19_2 |   .0341729   .0162132     2.11   0.035     .0023923    .0659536
       y20_1 |   .1193426   .0176079     6.78   0.000     .0848281    .1538571
       y20_2 |   .1305955     .01666     7.84   0.000     .0979391    .1632519
       y21_1 |   .1088905   .0162874     6.69   0.000     .0769645    .1408165
       y21_2 |   .0642021   .0162722     3.95   0.000     .0323058    .0960985
       _cons |   .5716756   .9093888     0.63   0.530    -1.210881    2.354232
-------------+----------------------------------------------------------------
     sigma_u |  1.4566062
     sigma_e |  .46362122
         rho |  .90801148   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0: F(244, 11550) = 25.92                 Prob > F = 0.0000
```

Figure 3: Fixed Effect Regression on half yearly dummy variables

In Figure 3, After running the fixed-effects panel data regression using OLS (Ordinary Least Square) estimation for the half yearly dummy variables we found out that during y20_1, y20_2, y21_1, y21_2 show a significant positive effect on sales volume. This suggests that during COVID-19 the consumption of sales volume increased. lprice has a significant negative effect on the sales volume ($\beta = -0.811$, $p < 0.001$) and the lgdp demonstrates a notable positive impact on sales volume ($\beta = 0.450$, $p < 0.001$). Overall, the model is statistically significant.

```
. *by product_no: xtreg lvolume lvolume1 lprice covid, fe;

.  xtreg lvolume lvolume1 lprice covid if( product_label=="Salmon Fresh (Total)"), fe

Fixed-effects (within) regression               Number of obs     =        459
Group variable: country_no                      Number of groups  =          9

R-squared:                                      Obs per group:
     Within  = 0.3146                                         min =         51
     Between = 0.1436                                         avg =       51.0
     Overall = 0.1558                                         max =         51

                                                F(3,447)          =      68.39
corr(u_i, Xb) = -0.1053                         Prob > F          =     0.0000

------------------------------------------------------------------------------
     lvolume | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
    lvolume1 |   .0712378   .0470024     1.52   0.130    -.0211353     .163611
      lprice |  -.5727782   .1599339    -3.58   0.000    -.8870938   -.2584625
       covid |   .2502106   .0256636     9.75   0.000     .1997743    .3006468
       _cons |   8.543049   .6487401    13.17   0.000     7.268089    9.818008
-------------+----------------------------------------------------------------
     sigma_u |  .92383607
     sigma_e |  .22766506
         rho |  .94274702   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0: F(8, 447) = 46.51                     Prob > F = 0.0000
```

Figure 4: Fixed Effect Regression for the Product label "Salmon Fresh (Total)"

In Figure 4 we almost run a similar regression but this time we find that for the product label "Salmon Fresh (Total)", both the logged price (lprice) and the presence of COVID-19 (covid) have significant effects on the logged volume (lvolume). The coefficient of lprice is -0.5727782, meaning that a 1% increase in the logged price is associated with a reduction of approximately 0.5727782% in the logged volume, holding other variables constant. The coefficient of covid is 0.2502106, indicating that the presence of COVID-19 is associated with a 0.2502106% increase in the logged volume, all else being equal. And as we can see the model is statistically significant.

Next, we tried to run regressions of lvolume1, lprice of every country and the COVID-19 impact on every country as independent variable keeping lvolume as the dependent variable for the product label Salmon (Total).

```
. reg lvolume lvolume1 lprice_sweden-lprice_spain lgdp covid_sweden-covid_spain  if( product_
> label=="Salmon (Total)")

      Source |       SS           df       MS      Number of obs   =       459
-------------+----------------------------------   F(20, 438)      =    502.88
       Model |  368.488569        20  18.4244285   Prob > F        =    0.0000
    Residual |  16.0473271       438  .036637733   R-squared       =    0.9583
-------------+----------------------------------   Adj R-squared   =    0.9564
       Total |  384.535896       458  .839598027   Root MSE        =    .19141

------------------------------------------------------------------------------------
           lvolume | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------------+----------------------------------------------------------------
          lvolume1 |   .1364132   .0475984     2.87   0.004     .0428636    .2299629
     lprice_sweden |  -.1896258   .1205664    -1.57   0.116    -.4265863    .0473347
     lprice_poland |  -.3510009   .1486506    -2.36   0.019    -.6431581   -.0588437
      lprice_italy |  -.1298419   .1806838    -0.72   0.473    -.4849569    .2252732
    lprice_germany |   .0901745   .1935204     0.47   0.641    -.2901695    .4705185
    lprice_belgium |  -.4403618   .1622451    -2.71   0.007    -.7592375   -.1214861
     lprice_france |    .047141   .1773401     0.27   0.791    -.3014023    .3956843
lprice_netherlands |  -.4790068   .1691516    -2.83   0.005    -.8114565    -.146557
   lprice_portugal |  -.9347573   .2095684    -4.46   0.000    -1.346642   -.5228727
      lprice_spain |   .0548847   .2031329     0.27   0.787    -.3443516     .454121
              lgdp |  -.0986934   .1356491    -0.73   0.467    -.3652975    .1679107
      covid_sweden |   .2311951   .0577684     4.00   0.000     .1176574    .3447327
      covid_poland |   .2526907   .0605739     4.17   0.000     .1336392    .3717423
       covid_italy |   .2114731   .0554437     3.81   0.000     .1025043    .3204419
     covid_germany |   .2276966   .0566023     4.02   0.000     .1164507    .3389425
     covid_belgium |   .1362162   .0545062     2.50   0.013     .0290901    .2433423
      covid_france |     .17263   .0545021     3.17   0.002     .0655118    .2797482
 covid_netherlands |   .2206582   .0555492     3.97   0.000     .1114821    .3298343
    covid_portugal |   .3522469   .0573829     6.14   0.000     .2394668     .465027
       covid_spain |   .2245344   .0552131     4.07   0.000     .1160189      .33305
             _cons |   8.391775   1.523324     5.51   0.000     5.397842    11.38571
------------------------------------------------------------------------------------
```

Figure 5: Multiple Linear Regression on log volume as dependent variable for Product label "Salmon (Total)"

As we can depict from Figure 5, the variable lvolume1 positive and statistically significant relationship with volume of salmon consumed during the previous period and the present time. 1% increase in the previous period's volume is associated with a 0.136% increase in the current period's volume, ceteris paribus. The lprice of Salmon (Total) in Poland, Belgium, Netherlands, and Portugal have a significant negative impact on the volume and statistically significant. For instance, an increase in the logarithm of price in Poland is associated with a decrease in lvolume by about 0.35. The rest of the countries were not statistically significant. Regarding COVID-19 variables all countries have a statistically significant positive effect on the volume of "Salmon (Total)". This suggests that the COVID-19 situation has led to an increase in the volume of salmon across these countries. The lgdp variable was not significant. The high R-squared value of the model (0.9583) indicates a strong model fit, which suggests that the variables included in this analysis explain a substantial portion of the variability in the volume of "Salmon (Total)"

There were a lot of varieties of salmon under the “product_label”. That is why we summarized the consumptions and took the top six salmon product labels in Figure 6. They were respectively Salmon (Total), Salmon Fresh (Total), Salmon Natural Fresh (Total), Salmon Natural Fresh Not Prepacked, Salmon Smoked (Total), and Salmon Smoked Fresh

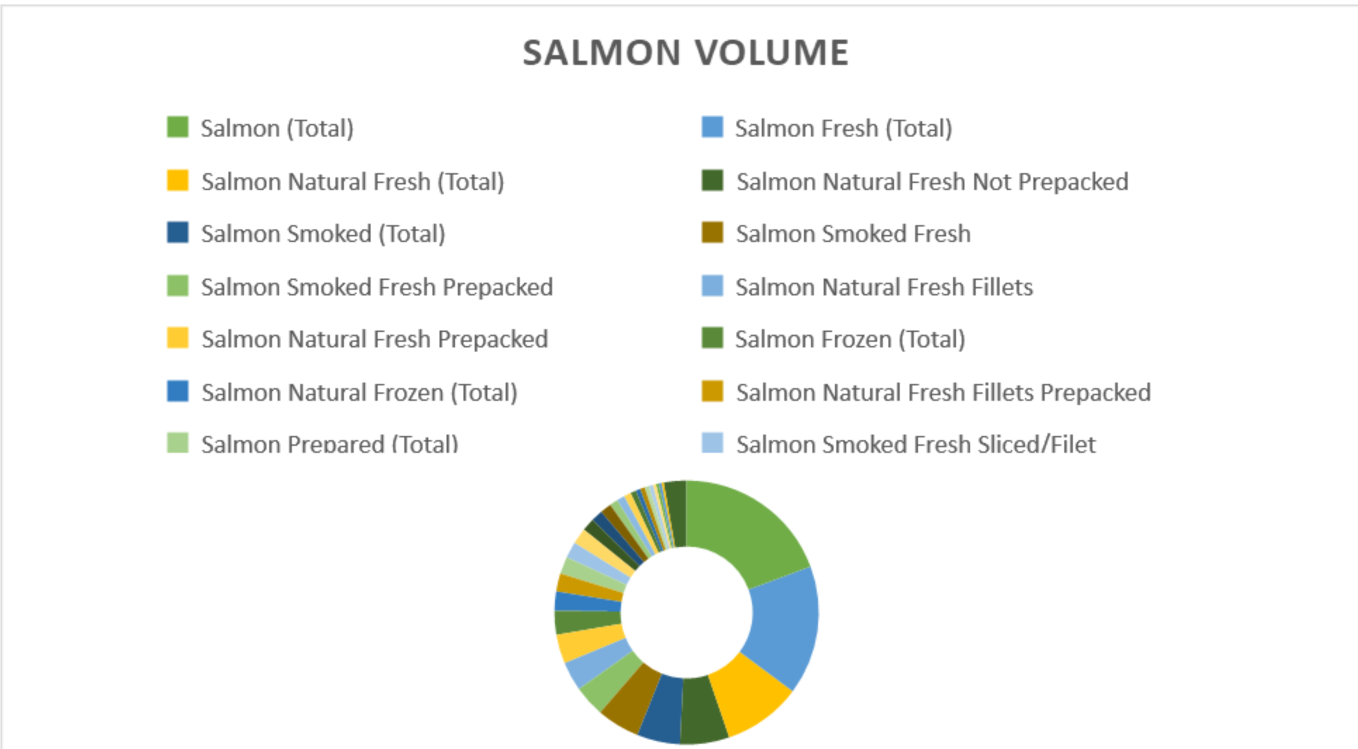

Figure 6: Summary of Salmon volume of all Product Labels

We ran regression against these specific product categories to find more specific outcomes.

```
. reg lvolume lvolume1 lprice_sweden-lprice_spain lgdp covid_sweden-covid_spain  if( product_label=="Salmon Natural Fresh Not Prepacked")
```

Source	SS	df	MS			
				Number of obs	=	459
				F(20, 438)	=	676.26
Model	1010.95889	20	50.5479447	Prob > F	=	0.0000
Residual	32.7386497	438	.074745775	R-squared	=	0.9686
				Adj R-squared	=	0.9672
Total	1043.69754	458	2.2788156	Root MSE	=	.2734

lvolume	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
lvolume1	.319854	.0411456	7.77	0.000	.2389867	.4007213
lprice_sweden	-.9058181	.1073929	-8.43	0.000	-1.116887	-.6947487
lprice_poland	-1.322266	.1239833	-10.66	0.000	-1.565942	-1.07859
lprice_italy	-1.118218	.1579749	-7.08	0.000	-1.428701	-.8077348
lprice_germany	-1.149734	.1546096	-7.43	0.000	-1.45378	-.8456887
lprice_belgium	-1.650452	.1419247	-11.63	0.000	-1.92939	-1.371513
lprice_france	-1.082841	.1569249	-6.90	0.000	-1.391261	-.7744218
lprice_netherlands	-1.769925	.1433061	-12.35	0.000	-2.051578	-1.488273
lprice_portugal	-1.860513	.2087967	-8.91	0.000	-2.27088	-1.450145
lprice_spain	-1.026102	.1768148	-5.80	0.000	-1.373613	-.6785913
lgdp	-.0150283	.1772837	-0.08	0.932	-.3634608	.3334043
covid_sweden	-.2779339	.079393	-3.50	0.001	-.4339725	-.1218952
covid_poland	.0900656	.0837969	1.07	0.283	-.0746284	.2547595
covid_italy	.1193912	.0769553	1.55	0.122	-.0318563	.2706387
covid_germany	-.0163384	.076663	-0.21	0.831	-.1670115	.1343347
covid_belgium	.1331682	.0773475	1.72	0.086	-.0188502	.2851865
covid_france	.0164411	.0765961	0.21	0.830	-.1341004	.1669827
covid_netherlands	.0811116	.0779497	1.04	0.299	-.0720904	.2343136
covid_portugal	.2036629	.0779611	2.61	0.009	.0504386	.3568872
covid_spain	.1218185	.077524	1.57	0.117	-.0305468	.2741838
_cons	8.067563	2.019757	3.99	0.000	4.097944	12.03718

Figure 7: Multiple Linear Regression for Product Label "Salmon Natural Fresh Not Prepacked"

The regression shown in Figure 7 tells us that the variables lvolume1 and lprice are statistically significant. The lgdp variable is not statistically significant in this model. We see a 1-unit increase in salmon volume from the earlier period will result in a subsequent approximate increase of 0.32 unit in the current period's salmon volume. The log prices of all the countries have a negative impact salmon consumption volume. The consumption of salmon volume is significantly impacted solely by the COVID-19 cases in Sweden and Portugal. There is a correlation between the rise in COVID-19 cases and a decline in volume in Sweden, although in Portugal, an increase in COVID-19 cases is associated to an increase in volume which seems to be unexpected compared to the previous regressions. The model has a high R-squared value of (0.9686) and Adjusted R-squared (0.9672), indicating that it explains approximately 96.86% of the variation in the volume of "Salmon Natural Fresh Not Prepacked".

. reg lvolume lvolume1 lprice_sweden-lprice_spain lgdp covid_sweden-covid_spain if(product_label== "Salmon Smoked (Total)")

Source	SS	df	MS			
				Number of obs	=	457
				F(20, 436)	=	448.20
Model	867.475161	20	43.373758	Prob > F	=	0.0000
Residual	42.1934649	436	.096774002	R-squared	=	0.9536
				Adj R-squared	=	0.9515
Total	909.668626	456	1.99488734	Root MSE	=	.31109

lvolume	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
lvolume1	.0397884	.044645	0.89	0.373	-.0479577	.1275345
lprice_sweden	-1.776017	.2205427	-8.05	0.000	-2.209476	-1.342558
lprice_poland	-1.970304	.284344	-6.93	0.000	-2.529159	-1.411448
lprice_italy	-2.096832	.3373069	-6.22	0.000	-2.759781	-1.433882
lprice_germany	-2.141706	.3725569	-5.75	0.000	-2.873936	-1.409475
lprice_belgium	-2.038468	.3370567	-6.05	0.000	-2.700926	-1.37601
lprice_france	-1.94135	.3182128	-6.10	0.000	-2.566772	-1.315928
lprice_netherlands	-2.223649	.3290178	-6.76	0.000	-2.870307	-1.576991
lprice_portugal	-2.737315	.3298344	-8.30	0.000	-3.385578	-2.089052
lprice_spain	-2.177663	.3378587	-6.45	0.000	-2.841698	-1.513629
lgdp	.8604582	.2276506	3.78	0.000	.4130291	1.307887
covid_sweden	.1265317	.0885578	1.43	0.154	-.0475215	.300585
covid_poland	.2114971	.0988739	2.14	0.033	.0171684	.4058258
covid_italy	.3634444	.088824	4.09	0.000	.188868	.5380208
covid_germany	.0137167	.0943205	0.15	0.884	-.1716627	.1990961
covid_belgium	.0016545	.0902465	0.02	0.985	-.1757177	.1790267
covid_france	.0848773	.0872322	0.97	0.331	-.0865707	.2563252
covid_netherlands	.1694911	.0894781	1.89	0.059	-.006371	.3453532
covid_portugal	.3600965	.0994844	3.62	0.000	.1645678	.5556252
covid_spain	.2905	.0904025	3.21	0.001	.1128211	.4681789
_cons	3.186905	2.661871	1.20	0.232	-2.04479	8.418599

Figure 8: Multiple Linear Regression for Product Label "Salmon Smoked (Total)"

We can depict from Figure 8 that lagged volume of salmon is not significant and the lprice and lgdp is statistically significant. The log price of salmon in all the countries has a negative relation with logged salmon volume. The COVID-19 coefficients suggest varied impacts across different countries. Specifically, increases in COVID-19 cases are associated with increased product volume in Italy, Poland, Portugal, and Spain (p-values < 0.05), but not in Sweden, Germany, Belgium, France, and the Netherlands (p-values > 0.05). The dependent variable's variability is predicted by the model to be explained by R-squared and Adjusted R-squared values of 0.9536 and 0.9515, respectively which explains a good model fit.

In Figure 9 we ran a similar analysis for the product label Salmon Natural Fresh (Total). This analysis follows a similar trend. The independent variable lgdp is not statistically significant, while lvolume1 is close to being significant. All the other variables in the model are statistically significant. Overall, the model indicates that prices and COVID-19 cases significantly impact the volume of "Salmon Natural Fresh (Total)". Specifically, increasing prices tend to reduce the

```
. reg lvolume lvolume1 lprice_sweden-lprice_spain lgdp covid_sweden-covid_spain  if( product_label== "Salmon Natural Fresh (Total)")
```

Source	SS	df	MS			
				Number of obs	=	459
				F(20, 438)	=	525.40
Model	445.219329	20	22.2609665	Prob > F	=	0.0000
Residual	18.5579678	438	.04236979	R-squared	=	0.9600
				Adj R-squared	=	0.9582
Total	463.777297	458	1.01261419	Root MSE	=	.20584

lvolume	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
lvolume1	.0827834	.0435362	1.90	0.058	-.0027825	.1683493
lprice_sweden	-1.120826	.1149128	-9.75	0.000	-1.346675	-.8949772
lprice_poland	-1.562736	.1329419	-11.76	0.000	-1.82402	-1.301453
lprice_italy	-1.610743	.1763614	-9.13	0.000	-1.957363	-1.264124
lprice_germany	-1.499556	.1793796	-8.36	0.000	-1.852108	-1.147004
lprice_belgium	-1.754047	.1453501	-12.07	0.000	-2.039717	-1.468376
lprice_france	-1.380842	.1676068	-8.24	0.000	-1.710256	-1.051429
lprice_netherlands	-1.854728	.1527996	-12.14	0.000	-2.155039	-1.554416
lprice_portugal	-2.413525	.2080861	-11.60	0.000	-2.822496	-2.004553
lprice_spain	-1.383861	.1919539	-7.21	0.000	-1.761127	-1.006596
lgdp	.1721511	.144006	1.20	0.233	-.1108775	.4551796
covid_sweden	.217308	.0622671	3.49	0.001	.0949286	.3396873
covid_poland	.4117858	.0657409	6.26	0.000	.2825789	.5409927
covid_italy	.1815438	.0584199	3.11	0.002	.0667256	.2963619
covid_germany	.2013584	.0615513	3.27	0.001	.0803858	.322331
covid_belgium	.1726157	.0587071	2.94	0.003	.0572331	.2879983
covid_france	.2106853	.0591196	3.56	0.000	.0944919	.3268786
covid_netherlands	.1283266	.0602528	2.13	0.034	.0099061	.246747
covid_portugal	.2827924	.0598519	4.72	0.000	.1651597	.4004251
covid_spain	.1918091	.0590394	3.25	0.001	.0757733	.3078448
_cons	8.929268	1.605047	5.56	0.000	5.774717	12.08382

Figure 9: Multiple Linear Regression for Salmon Natural Fresh (Total)

volume while increasing COVID-19 cases seem to raise it. GDP and lagged volume have less impact on household salmon consumption. The R-squared and Adjusted R-squared values are 0.9600 and 0.9582, respectively, explaining the variability in the dependent variable, and the F-statistic and its associated p-value show the significance of the whole model.

After that, we tried to see price fluctuation by keeping the logged price 'lprice' as the dependent variable to examine the relationship between price differentials (lprice_sweden-lprice_spain) and COVID-19 impacts (covid_sweden-covid_spain) on the sales of the product label "Salmon Fresh (Total)" in Figure 10. Albeit the coefficients for all variables except covid_sweden are zero, indicating that there is no statistically significant relationship between price differentials and COVID-19 impacts on the sales volume of "Salmon Fresh (Total)", The R-squared value of 0.4693 suggests there are other factors that should be accounted for in the model which is evident in Figure 10.

```
. reg lprice_sweden-lprice_spain covid_sweden-covid_spain if product_label=="Salmon Fresh (Total)", noconstant

      Source |       SS           df       MS      Number of obs   =       468
-------------+----------------------------------   F(17, 451)      =     23.46
       Model |  604.392788        17   35.552517   Prob > F        =    0.0000
    Residual |  683.388227       451  1.51527323   R-squared       =    0.4693
-------------+----------------------------------   Adj R-squared   =    0.4493
       Total |  1287.78102       468  2.75166884   Root MSE        =     1.231

------------------------------------------------------------------------------------
     lprice_sweden | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------------+----------------------------------------------------------------
     lprice_poland |          0   .0608175     0.00   1.000     -.119521     .119521
      lprice_italy |          0   .0797602     0.00   1.000    -.1567477    .1567477
    lprice_germany |          0   .0785829     0.00   1.000    -.1544341    .1544341
    lprice_belgium |          0   .0749507     0.00   1.000     -.147296     .147296
     lprice_france |          0   .0750011     0.00   1.000     -.147395     .147395
lprice_netherlands |          0   .0756126     0.00   1.000    -.1485968    .1485968
   lprice_portugal |          0   .1020606     0.00   1.000    -.2005734    .2005734
      lprice_spain |          0    .094132     0.00   1.000    -.1849919    .1849919
      covid_sweden |    4.91688   .2461929    19.97   0.000     4.433053    5.400708
      covid_poland |          0   .3446267     0.00   1.000    -.6772735    .6772735
       covid_italy |          0   .3426468     0.00   1.000    -.6733825    .6733825
     covid_germany |          0   .3365334     0.00   1.000    -.6613683    .6613683
     covid_belgium |          0   .3388238     0.00   1.000    -.6658693    .6658693
      covid_france |          0     .33903     0.00   1.000    -.6662746    .6662746
 covid_netherlands |          0   .3384946     0.00   1.000    -.6652224    .6652224
    covid_portugal |          0   .3413152     0.00   1.000    -.6707656    .6707656
       covid_spain |          0   .3394499     0.00   1.000    -.6670999    .6670999
------------------------------------------------------------------------------------
```

Figure 10: Multiple Linear Regression on COVID-19 impact on all the countries for Salmon Fresh (Total)

Chapter 6: Findings and Summary

6.1 Findings

The main aim of the research was to analyze whether there was any fluctuation in salmon price and volume before and during COVID-19 in different countries by analyzing their household panel data. After running distinct types of regressions with the data set, we have found some interesting insights from the data. The regressions were mostly focused on the volume, price, GDP, and effect of COVID-19 on the consumption of different product categories of salmon in household panel data from Spain, France, Belgium, Poland, Germany, Portugal, Sweden, Italy, and Netherlands. Below, we have highlighted key findings based on our hypothesis and key variables.

Log volume and Lagged volume: The lagged volume (lvolume1) variable consistently showed a positive and statistically significant relationship with the currently logged volume of salmon products. This indicates that past sales volume strongly influences the present volume, indicating a positive demand trend.

Relationship between salmon volume and price: We found that in majority of the cases throughout the regression where the results were statistically significant, there was a negative correlation between Salmon volume and price, which shows that if the price increases, the volume of consumption decreases which follows the law of demand and supply. For instance, in Figure 6, we can observe that for the product label 'Salmon Natural Fresh Not Prepacked', for the dependent variable 'lvolume', the independent variable 'lprice' has a negative coefficient for all the countries; In Portugal, 1 unit increase in price for 'Salmon Natural Fresh Not Prepacked' will result in a 1.8605 decrease in salmon consumption volume.

GDP: The regression consistently confirms that an increase in GDP has resulted in an increase in household salmon consumption volume.

The effect of COVID-19: The most interesting insight was revealed during the regression: during COVID-19, household consumption of salmon increased for most of the salmon product labels in some countries. For the Product label "Salmon Natural Fresh Not Prepacked", consumption increased in Sweden and Portugal during COVID-19, although the other countries displayed a positive correlation but were not statistically significant. In coefficients, while others do not. Specifically, Poland, Belgium, France, and Spain show significant coefficients Another example was “Salmon (Total)" shown in Figure 4, where coefficients for all the covid country variables were positive and statistically significant, indicating an increase in volume with the COVID-19 impact.

These findings have some contradictions and some similarities with similar studies conducted in the past. A study conducted by Janssen et al. (2021) in Germany, Slovenia, and Denmark about changes in food consumption before and during COVID-19 discussed that during the pandemic, consumption of fresh vegetables and fish decreased overall; however, consumption of frozen foods and bread increased. It is notable that households in Germany with children were more likely to increase their intake of fish and fruit. Another AI-based analysis also contradicted our assumption. The results indicated that during COVID-19, fish purchases were reduced by 50% (Eftimov et al., 2020).

6.2 Summary of findings

Based on the findings from this research, the original hypotheses (H0 and H1) cannot be entirely supported or refuted across the board due to the observed varied effects of COVID-19 on salmon consumption across various countries.

The volume of salmon consumed was found to be positively influenced by the volume consumed in the previous period, demonstrating a continuous demand trend. The negative correlation between salmon volume and price follows the principles of consumer demand theory: when prices rise, demand (or volume) declines.

In terms of GDP, an increase correlated with a rise in household salmon consumption volume, following the income effect in the consumer demand theory: when income (GDP as a proxy) rises, the consumption of normal goods (salmon, in our case) tends to increase.

In contrast to H0, the effect of COVID-19 on the price and demand for salmon consumption in European markets was not consistently negative. While the pandemic did promote a general trend of higher consumption in certain nations (Sweden and Portugal), no statistically significant positive associations were seen in other countries. Nevertheless, for product labels such as "Salmon (Total)" and "Salmon Natural Fresh Not Prepacked", the COVID-19 variable exhibited positive and significant coefficients, indicating an unanticipated increase in volume during the pandemic. This occurrence could be linked to a consumer behavioral change toward home cooking and healthy eating habits, but more research is needed.

Despite all that has been said, it is worth noting that these findings differ from those of prior research such as Janssen et al. (2021) and Eftimov et al. (2020), which reported a decline in fish intake during the pandemic. This could be due to variances in technique, study period, or shifts in customer behavior as time passes.

In summary, while COVID-19 had an impact on salmon pricing and demand, the trajectory and scope of the effect varied among nations and product labels. To properly explain these disparities, it is critical to go deeper into unique market dynamics, consumer behavior, and local COVID-19 metrics.

Chapter 7: Conclusion and Recommendations

7.1 Limitations of the Study

In our research, we took panel data from the household market, and the dataset has a lot of potential for different analyses. We primarily extracted the data from the whole dataset that we needed for our research and later we again had to deduct some parts of it as the data was not consistent and we did not want to get inconclusive results or errors in our results.

Primarily, we started to work with ten European Countries, namely, Belgium, Sweden, Spain, Italy, Poland, Portugal, Germany, Great Britain, and the Netherlands. But in our dataset, we had GDP records of Great Britain but before till the year 2020 but no records of Household Data of Great Britain so we did not include Great Britain in our analysis. This is one of the drawbacks of our research that we could not include the purchase behavior of the consumers of Great Britain.

Secondly, the data was collected through volunteers from households who were shopping in grocery shops. The data does not represent 100 percent of the household market in those 9 countries. And the data was recorded through scanning which can also sometimes include more input of goods or sometimes can miss the exact data on salmon so the full reliability of the data cannot be guaranteed. The data also only displays the household use of salmon and does not include the whole purchase record of the countries so we cannot estimate the total purchase volume nor can estimate the total fluctuation rate in a complete market level.

Thirdly, there are other elements that can also influence salmon consumption in these countries that we could not consider due to data restrictions. If there were more supply of other fish in that region or country than Salmon, it can also affect consumption. Border restrictions and lack of supply can play a vital role in demand. During COVID-19 period there are other noticeable factors too that were affected and resulted in changes to Salmon consumption.

During our analysis, we found that household consumption of salmon has increased during COVID-19 compared to pre-Covid-19 era, but we could not compare the consumption of salmon against substitute products i.e., cod, mackerel and we lacked data if salmon consumption has increased because of the unavailability of other seafood products in the market or not. Another significant limitation of this study is we conducted our research against household panel data, as in people who have consented to use their consumption history. It does not represent the whole household population. Another argument is we did not consider the sales data in restaurants, supermarkets, and groceries, which would have helped us get a clearer picture of salmon consumption behavior before and during the pandemic.

7.2 Recommendations for Future Research

In our dataset, there are various sorts of data reserved. There are various scopes of research if any researchers want to do that. COVID-19 mortality ratio and its impact on consumption directly did not analyze any connection, but there is a difference it made during COVID-19 period; those aspects can be considered for future research. Some other future scopes are mentioned below:

1. Dietary Modifications: Researchers can investigate further to see whether there were any notable dissimilarities in salmon consumption habits within the pre-COVID and COVID eras. This analysis can help determine whether there was any altercation in consumer behavior and how the epidemic affected eating decisions or their purchase behavior or if they kept dietary nutrients in mind while buying salmon as salmon is known for its dietary supplements.

On the other hand, Omega-3 fatty acids are known for salmon's high nutritional value. Researchers can evaluate whether there were any alterations in the public's perception of the health advantages of eating salmon during, particularly the pandemic. Analyzing variations in salmon intake can also aid in assessing how nutrition may affect public health.

2. Financial and supply chain Impact: Salmon is a well-liked and reasonably priced fish. The consumption of salmon before and during the pandemic can be compared to let researchers determine how much COVID-19 affected households' budgets as during COVID-19 the income of household to household can vary and if the income was affected by their purchase power of salmon. Consumption patterns that change could be a sign of shifting financial circumstances or changes in purchasing power during the pandemic.

At the same time, to match the demand in European markets, salmon is frequently imported from different nations. If there were any supply chain hiccups during the COVID period that had an impact on salmon availability or costs, researchers can investigate them. Such knowledge can help us comprehend how food supply chains can be vulnerable in emergency situations.

3. Sustainability and Environmental Impact: Salmon farming has an impact on the ecosystem, notably fish waste and water contamination. There has been a lot of concern regarding this matter, researchers might investigate whether consumer awareness and purchase behavior regarding the ecological and environmentally friendly procurement of salmon were affected by the pandemic because of the lower price of the product. On the other hand, if, during the pandemic, people preferred sustainability caught Salmon over Farmed salmon and if the high price has an impact on the choice or not.

European cuisines and cultural customs heavily rely on salmon. Researchers can investigate whether the pandemic caused changes in celebratory or festive meals, which would change the cultural importance of salmon eating. This investigation can shed light on how the pandemic has affected dietary customs on a sociocultural level.

7.3 Conclusion

This analysis of salmon consumption patterns in Belgium, Sweden, Poland, France, Germany, Portugal, the Netherlands, Spain, and Italy during and pre-Covid period reveals a significant increase in salmon consumption in the COVID-19 pandemic compared to the mentioned years before the pandemic. This finding contradicts the general assumption that the pandemic had a negative impact on overall food consumption. But in the case of Salmon, the scenario is different.

Aquaculture for salmon is an export-focused industry, although it generates a small percentage of the worldwide production of seafood in terms of volume (Tveterås & Tveterås, 2010). Nevertheless, there can be several variables that helped boost salmon consumption throughout the COVID-19 period. Firstly, salmon's advantages in nutrition were recognized by many, such as its high omega-3 fatty acid concentration, which was important in maintaining a strong immune system during the pandemic. Secondly, individuals spend more time cooking and experimenting with recipes during lockdowns, making salmon a popular choice for home cooking due to its flexibility in culinary preparations. Additionally, the pandemic's effects on the supply chain did not significantly affect these countries' ability to purchase salmon. Importantly, the grocery stores played an essential role in ensuring that consumers would continue to have access to salmon.

It is noteworthy that the increased consumption of salmon during the COVID-19 period also had favorable economic effects for the nations involved. Salmon demand supported the regional and global seafood sectors, benefiting the livelihoods of farmers, fishers, and other connected business entities. This thesis focuses on the countries of Belgium, Sweden, Poland, France, Germany, Portugal, the Netherlands, Spain, and Italy, where salmon consumption increased during the COVID-19 pandemic. However, it is important to keep in mind that country-specific variations may exist due to border regulations, cultural preferences, dietary customs, and regional factors.

The aim of this study was to analyze the impact of COVID-19 on salmon prices and consumption volume in several European marketplaces. The investigation, which used regression models, produced several insights. It was discovered that previous sales volume had a considerable influence on current volume, indicating a steady demand tendency. Furthermore, a negative correlation between salmon price and volume was found, validating the law of demand. Additionally, an increase in GDP was correlated with an increase in salmon consumption, which corresponds to the income effect in consumer demand theory.

Future research could concentrate on conducting in-depth surveys, analyzing sales data, and conducting consumer interviews to gain a thorough understanding of the factors causing the increased consumption of salmon during the COVID-19 era in these European nations. This would validate the findings presented in this thesis and explore additional dimensions

References

Almeida, C., Karadzic, V., & Vaz, S. (2015). The seafood market in Portugal: Driving forces and consequences. Marine Policy, 61, 87–94. https://doi.org/10.1016/j.marpol.2015.07.012

Asche, F., Bjørndal, T., & Salvanes, K. G. (1998). The Demand for Salmon in the European Union: The Importance of Product Form and Origin. Canadian Journal of Agricultural Economics/Revue Canadienne d'agroeconomie, 46(1), 69–81. https://doi.org/10.1111/j.1744-7976.1998.tb00082.x

Asche, F., & Smith, M. D. (2018). Viewpoint: Induced Innovation in Fisheries and Aquaculture. Food Policy, 76, 1–7. https://doi.org/10.1016/j.foodpol.2018.02.002

Asche, F., Straume, H.-M., Garlock, T., Johansen, U., Kvamsdal, S. F., Nygaard, R., Pincinato, R. B. M., & Tveteras, R. (2022). Challenges and opportunities: Impacts of COVID-19 on Norwegian seafood exports. Aquatic Living Resources, 35, 15. https://doi.org/10.1051/alr/2022017

Béné, C., Barange, M., Subasinghe, R., Pinstrup-Andersen, P., Merino, G., Hemre, G.-I., & Williams, M. (2015). Feeding 9 billion by 2050 – Putting fish back on the menu. Food Security, 7(2), 261–274. https://doi.org/10.1007/s12571-015-0427-z

Burlingame, B. A., & Dernini, S. (2012). Sustainable Diets: Directions and solutions for policy, research and action. Food and Agriculture Organization of the United Nations. https://mro.massey.ac.nz/handle/10179/10887

Carlucci, D., Nocella, G., De Devitiis, B., Viscecchia, R., Bimbo, F., & Nardone, G. (2015). Consumer purchasing behaviour towards fish and seafood products. Patterns and insights from a sample of international studies. Appetite, 84, 212–227. https://doi.org/10.1016/j.appet.2014.10.008

Consumption. (n.d.). Retrieved May 18, 2023, from https://oceans-and-fisheries.ec.europa.eu/facts-and-figures/facts-and-figures-common-fisheries-policy/consumption_en

Definition of CONSUMPTION. (2023, May 19). https://www.merriam-webster.com/dictionary/consumption

Eftimov, T., Popovski, G., Petković, M., Seljak, B. K., & Kocev, D. (2020). COVID-19 pandemic changes the food consumption patterns. Trends in Food Science & Technology, 104, 268–272. https://doi.org/10.1016/j.tifs.2020.08.017

FAO. (2022). The State of World Fisheries and Aquaculture 2022: Towards Blue Transformation. FAO. https://doi.org/10.4060/cc0461en

Global fisheries and aquaculture at a glance. (n.d.). https://doi.org/10.4060/cc0461en

Govzman, S., Looby, S., Wang, X., Butler, F., Gibney, E. R., & Timon, C. M. (2021). A systematic review of the determinants of seafood consumption. British Journal of Nutrition, 126(1), 66–80. https://doi.org/10.1017/S0007114520003773

Guillen, J., Natale, F., Carvalho, N., Casey, J., Hofherr, J., Druon, J.-N., Fiore, G., Gibin, M., Zanzi, A., & Martinsohn, J. Th. (2019). Global seafood consumption footprint. Ambio, 48(2), 111–122. https://doi.org/10.1007/s13280-018-1060-9

Heutte, K., Daures, F., Lucas, S., Girard, S., Alban, F., & Le Floc'h, P. (2023). Fisheries and aquaculture products consumption in France: When the Covid-19 crisis did not lead to more sustainable purchases. Aquatic Living Resources, 36, 10. https://doi.org/10.1051/alr/2023004

Hites, R. A., Foran, J. A., Carpenter, D. O., Hamilton, M. C., Knuth, B. A., & Schwager, S. J. (2004). Global Assessment of Organic Contaminants in Farmed Salmon. Science, 303(5655), 226–229. https://doi.org/10.1126/science.1091447

Honkanen, P., Olsen, S. O., & Verplanken, B. (2005). Intention to consume seafood—The importance of habit. Appetite, 45(2), 161–168.

Jacobs, M. N., Covaci, A., & Schepens, P. (2002). Investigation of Selected Persistent Organic Pollutants in Farmed Atlantic Salmon (Salmo salar), Salmon Aquaculture Feed, and Fish Oil Components of the Feed. Environmental Science & Technology, 36(13), 2797–2805. https://doi.org/10.1021/es011287i

Janssen, M., Chang, B. P. I., Hristov, H., Pravst, I., Profeta, A., & Millard, J. (2021). Changes in Food Consumption During the COVID-19 Pandemic: Analysis of Consumer Survey Data From the First Lockdown Period in Denmark, Germany, and Slovenia. Frontiers in Nutrition, 8. https://www.frontiersin.org/articles/10.3389/fnut.2021.635859

Marinac Pupavac, S., Kenðel Jovanović, G., Linšak, Ž., Glad, M., Traven, L., & Pavičić Žeželj, S. (2022). The influence on fish and seafood consumption, and the attitudes and reasons for its consumption in the Croatian population. Frontiers in Sustainable Food Systems, 6. https://www.frontiersin.org/articles/10.3389/fsufs.2022.945186

Naylor, R. L., Hardy, R. W., Buschmann, A. H., Bush, S. R., Cao, L., Klinger, D. H., Little, D. C., Lubchenco, J., Shumway, S. E., & Troell, M. (2021). A 20-year retrospective review of global aquaculture. Nature, 591(7851), Article 7851. https://doi.org/10.1038/s41586-021-03308-6

Nguyen, L., & Schmitz, A. (2023). The welfare impacts of Covid-19 on the U.S. salmon sector. Applied Economics, 55(22), 2579–2595. https://doi.org/10.1080/00036846.2022.2103505

Quinn, T. P. (2018). The Behavior and Ecology of Pacific Salmon and Trout. University of Washington Press.

Seafood Market Size, Share, Growth | Research Report [2029]. (n.d.). Retrieved May 27, 2023, from https://www.fortunebusinessinsights.com/industry-reports/seafood-market-101469

The EU Fish Market 2022: Discover the highlights. (n.d.). Retrieved May 18, 2023, from https://oceans-and-fisheries.ec.europa.eu/news/eu-fish-market-2022-discover-highlights-2022-12-06_en

The State of World Fisheries and Aquaculture 2022. (2022). FAO. https://doi.org/10.4060/cc0461en

Thong, N. T., & Solgaard, H. S. (2017). Consumer's food motives and seafood consumption. Food Quality and Preference, 56, 181–188. https://doi.org/10.1016/j.foodqual.2016.10.008

Tomić, M., Lucević, Z., Tomljanović, T., & Matulić, D. (2017). Wild-Caught Versus Farmed Fish – Consumer Perception. Croatian Journal of Fisheries, 75(2), 41–50. https://doi.org/10.1515/cjf-2017-0007

Verbeke, W., Vanhonacker, F., Sioen, I., Van Camp, J., & De Henauw, S. (2007). Perceived Importance of Sustainability and Ethics Related to Fish: A Consumer Behavior Perspective. Ambio, 36(7), 580–585.

Year. (n.d.). Retrieved May 29, 2023, from https://en.seafood.no/market-insight/norwegian-trade/year/

European Commission. Directorate General for Maritime Affairs and Fisheries. & EUMOFA. (2022). The EU fish market: 2022 edition. Publications Office. https://data.europa.eu/doi/10.2771/71673

European Commission. Directorate General for Maritime Affairs and Fisheries. (2020). The EU fish market: 2020 edition. Publications Office. https://data.europa.eu/doi/10.2771/664425

European Commission. Directorate General for Maritime Affairs and Fisheries. (2019). The EU fish market: 2019 edition. Publications Office. https://data.europa.eu/doi/10.2771/168390

Tveterås, S., & Tveterås, R. (2010). The Global Competition for Wild Fish Resources between Livestock and Aquaculture: The Global Competition for Wild Fish Resources. Journal of Agricultural Economics, 61(2), 381–397. https://doi.org/10.1111/j.1477-9552.2010.00245.x

World Health Organization. (2020). WHO Director-General’s opening remarks at the media briefing on COVID-19. (No Title).

sjømatråd, N. (2023, July 5). Seafood.no. https://en.seafood.no/

Mehmetoglu, M., & Jakobsen, T. G. (2022). Applied statistics using Stata: a guide for the social sciences. Sage.

Tveterås, Ragnar (2021) Introduksjon Sjømatrådet Innsikt

*F*ish and Omega-3 Fatty Acids. (n.d.). Www.Heart.Org. Retrieved July 30, 2023, from https://www.heart.org/en/healthy-living/healthy-eating/eat-smart/fats/fish-and-omega-3-fatty-acids

Gezahegne, A. (n.d.). Chapter One: Theory of Consumer Demand. Retrieved July 29, 2023, from https://www.academia.edu/42547040/Chapter_One_Theory_of_Consumer_Demand

S M Ikhtiar Alam. (2022). Theory of Demand: Consumer Behavior in Microeconomics. https://doi.org/10.13140/RG.2.2.36460.23688

Appendix

Appendix

Saturday July 29 13:37:12 2023   Page 1

```
  ___  ____  ____  ____  ____(R)
 /__    /   ____/   /   ____/
___/   /   /___/   /   /___/
  Statistics/Data analysis

    User: Summary
```

```
  ___  ____  ____  ____  ____ ©
 /__    /   ____/   /   ____/      17.0
___/   /   /___/   /   /___/       MP—Parallel Edition

 Statistics and Data Science       Copyright 1985-2021 StataCorp LLC
                                   StataCorp
                                   4905 Lakeway Drive
                                   College Station, Texas 77845 USA
                                   800-STATA-PC        https://www.stata.com
                                   979-696-4600        stata@stata.com

Stata license: Unlimited-user 64-core network perpetual
Serial number: 18461036
  Licensed to: TEAM BTCR
               TEAM BTCR

Notes:
      1. Unicode is supported; see help unicode advice.
      2. More than 2 billion observations are allowed; see help obs advice.
      3. Maximum number of variables is set to 5,000; see help set maxvar.

1 . use "D:\UIS\Thesis\ongoing analysis\Final Run.dta"

2 . sum
```

Variable	Obs	Mean	Std. dev.	Min	Max
year	13,200	2019.691	1.263128	2018	2022
month_no	13,200	6.194545	3.497365	1	12
month	13,200	21959.9	456.7565	21185	22736
country	0				
species	0				
processing	0				
condition	0				
product	0				
packing	0				
product_la~l	0				
salmon_vol~e	12,278	574.9534	1103.177	0	11187.6
salmon_value	12,278	14613.42	27273.52	0	348684.5
salmon_price	12,203	42.20929	59.25269	.2292308	671.6736
Currency	0				
convers_rate	13,200	.8155217	.3559385	.091636	1
value_eur	13,200	9352.741	19276.14	0	244267.3
price_eur	12,203	18.3546	8.264363	.2292308	74.69942
curr_type	0				
gdp_unit	0				
gdp_s_adj	0				
gdp_na_item	0				
gdp_time	13,200	21931.71	459.8618	21185	22736
gdp_quarter	13,198	363849.8	276285.6	45294.8	956203
monthly_gdp	13,198	121273.1	92059.05	15098.27	317396.4
hh_exp_s_adj	0				
hh_exp_na_~m	0				
hh_exp_time	13,200	21931.71	459.8618	21185	22736
hh_exp_cur~y	0				
hhexp_quar~r	13,199	192466	144911.4	28466.8	489576
monthly_hh~p	13,199	64158.51	48277.7	9488.933	160183
country_pr~t	0				
monthly_gd~c	13,198	189875	131716.8	15098.27	491395.2
lvolume	12,203	4.823955	2.15946	-4.514138	9.322561

lprice	12,203	3.23965	.8601966	-1.473026	6.509773
lgdp	13,198	11.834	.8912653	9.622335	13.105
yearmonth	13,200	201975.3	125.8018	201801	202204
t	13,200	26.48545	15.00178	1	52
covid	13,200	.4804545	.4996368	0	1
product_no	13,200	32.92455	24.25665	1	79
country_no	13,200	4.907273	2.849118	1	9
country_pr~o	13,200	523.6518	285.3724	101	979
lvolume1	11,967	4.823468	2.157924	-4.514138	9.322561
lprice1	11,967	3.237873	.8597592	-1.473026	6.509773
dlprice	11,807	.0023872	.1749891	-2.034666	4.974572
sweden	13,200	.1536364	.3606135	0	1
poland	13,200	.0590909	.2358037	0	1
italy	13,200	.0512121	.2204385	0	1
germany	13,200	.1536364	.3606135	0	1
belgium	13,200	.1181818	.3228355	0	1
france	13,200	.1648485	.3710578	0	1
netherlands	13,200	.0945455	.2925972	0	1
portugal	13,200	.0551515	.2282844	0	1
spain	13,200	.149697	.3567877	0	1
lvolume_sw~n	12,203	.5529412	1.573449	-2.341476	7.791783
lvolume_po~d	12,203	.3079222	1.256687	-1.671812	7.562023
lvolume_it~y	12,203	.3172045	1.399348	0	8.864671
lvolume_ge~y	12,203	.8955257	2.205194	-.7789498	9.322561
lvolume_be~m	12,203	.509658	1.535692	-2.540792	7.366456
lvolume_fr~e	12,203	.889161	2.159515	-3.426515	9.20702
lvolume_ne~s	12,203	.4169015	1.423555	-4.514138	7.418346
lvolume_po~l	12,203	.2251419	.9985202	-2.935923	6.72752
lvolume_sp~n	12,203	.7094989	1.98308	-3.418852	9.138876
lvolume1_~en	11,967	.5527586	1.572153	-2.341476	7.791783
lvolume1_p~d	11,967	.3077618	1.256388	-1.671812	7.562023
lvolume1_i~y	11,967	.3172517	1.399525	0	8.864671
lvolume1_g~y	11,967	.8949025	2.20367	-.6032885	9.322561
lvolume1_b~m	11,967	.5096576	1.535424	-2.540792	7.366456
lvolume1_f~e	11,967	.8887807	2.158745	-3.426515	9.20702
lvolume1_n~s	11,967	.4169944	1.422605	-4.514138	7.418346
lvolume1_p~l	11,967	.2252445	.9995348	-2.935923	6.72752
lvolume1_~in	11,967	.7101161	1.984503	-3.418852	9.138876
lprice_swe~n	12,203	.7114712	1.768356	0	6.509773
lprice_pol~d	12,203	.2302212	.8922398	0	4.323182
lprice_italy	12,203	.1483787	.6417968	0	3.402769
lprice_ger~y	12,203	.4499124	1.050273	0	4.170534
lprice_bel~m	12,203	.3677743	1.001331	0	4.313472
lprice_fra~e	12,203	.5007759	1.123935	0	4.265904
lprice_net~s	12,203	.2892834	.8844144	-1.473026	3.760578
lprice_por~l	12,203	.1491244	.6084824	0	3.523769
lprice_spain	12,203	.3927086	.9745362	0	3.911271
lgdp_sweden	13,198	1.991514	4.674088	0	13.105
lgdp_poland	13,198	.7223553	2.882663	0	12.79898
lgdp_italy	13,198	.6091904	2.622019	0	11.95825
lgdp_germany	13,198	1.932096	4.534613	0	12.66791
lgdp_belgium	13,198	1.252426	3.421001	0	10.72368
lgdp_france	13,198	2.013067	4.530837	0	12.289
lgdp_nethe~s	13,198	1.05249	3.256993	0	11.25236
lgdp_portu~l	13,198	.5372422	2.226853	0	9.882838
lgdp_spain	13,198	1.723624	4.107772	0	11.5964

covid_sweden	13,200	.0738636	.2615588	0	1
covid_poland	13,200	.0284091	.1661448	0	1
covid_italy	13,200	.0246212	.1549736	0	1
covid_germ~y	13,200	.0738636	.2615588	0	1
covid_belg~m	13,200	.0568182	.2315036	0	1
covid_france	13,200	.0789394	.2696544	0	1
covid_neth~s	13,200	.0454545	.2083068	0	1
covid_port~l	13,200	.0265152	.1606675	0	1
covid_spain	13,200	.0719697	.2584475	0	1
y18_1	13,200	.1154545	.3195818	0	1
y18_2	13,200	.1154545	.3195818	0	1
y19_1	13,200	.1154545	.3195818	0	1
y19_2	13,200	.1154545	.3195818	0	1
y20_1	13,200	.1154545	.3195818	0	1
y20_2	13,200	.1154545	.3195818	0	1
y21_1	13,200	.1154545	.3195818	0	1
y21_2	13,200	.1154545	.3195818	0	1
y22_1	13,200	.0763636	.2655891	0	1

3 .

Figure 1

```
Fixed-effects (within) regression               Number of obs     =     11,805
Group variable: country_pr~o                    Number of groups  =        245

R-squared:                                      Obs per group:
     Within  = 0.2169                                         min =          2
     Between = 0.6292                                         avg =       48.2
     Overall = 0.5815                                         max =         51

                                                F(4,11556)        =     800.34
corr(u_i, Xb) = 0.3892                          Prob > F          =     0.0000

------------------------------------------------------------------------------
     lvolume | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
    lvolume1 |   .3203949   .0084191    38.06   0.000     .3038919    .3368979
      lprice |  -.8191846   .0287487   -28.49   0.000    -.8755369   -.7628323
        lgdp |   .0653882   .0676906     0.97   0.334    -.0672968    .1980733
       covid |   .1275657   .0090615    14.08   0.000     .1098035    .1453278
       _cons |   5.141856   .7993946     6.43   0.000     3.574907    6.708804
-------------+----------------------------------------------------------------
     sigma_u |  1.5378091
     sigma_e |  .46300561
         rho |  .91688446   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0: F(244, 11556) = 26.53                 Prob > F = 0.0000
```

Figure 2

Fixed-effects (within) regression — Number of obs = 11,805

Group variable: country_pr~o — Number of groups = 245

R-squared:

- Within = 0.2153
- Between = 0.7156
- Overall = 0.6650

Obs per group:

- min = 2
- avg = 48.2
- max = 51

F(10,11550) = 316.82

corr(u_i, Xb) = 0.5088 — Prob > F = 0.0000

lvolume	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
lvolume1	.3234888	.0084728	38.18	0.000	.3068807	.340097
lprice	-.8114074	.0290097	-27.97	0.000	-.8682713	-.7545436
lgdp	.4498049	.0769019	5.85	0.000	.2990642	.6005456
y18_2	-.0263065	.016724	-1.57	0.116	-.0590884	.0064755
y19_1	-.0138234	.0162817	-0.85	0.396	-.0457382	.0180914
y19_2	.0341729	.0162132	2.11	0.035	.0023923	.0659536
y20_1	.1193426	.0176079	6.78	0.000	.0848281	.1538571
y20_2	.1305955	.01666	7.84	0.000	.0979391	.1632519
y21_1	.1088905	.0162874	6.69	0.000	.0769645	.1408165
y21_2	.0642021	.0162722	3.95	0.000	.0323058	.0960985
_cons	.5716756	.9093888	0.63	0.530	-1.210881	2.354232
sigma_u	1.4566062					
sigma_e	.46362122					
rho	.90801148	(fraction of variance due to u_i)				

F test that all u_i=0: F(244, 11550) = 25.92 — Prob > F = 0.0000

Figure 3

```
. *by product_no: xtreg lvolume lvolume1 lprice covid, fe;

.  xtreg lvolume lvolume1 lprice covid if( product_label=="Salmon Fresh (Total)"), fe

Fixed-effects (within) regression               Number of obs     =        459
Group variable: country_no                      Number of groups  =          9

R-squared:                                      Obs per group:
     Within  = 0.3146                                         min =         51
     Between = 0.1436                                         avg =       51.0
     Overall = 0.1558                                         max =         51

                                                F(3,447)          =      68.39
corr(u_i, Xb) = -0.1053                         Prob > F          =     0.0000

------------------------------------------------------------------------------
     lvolume | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
    lvolume1 |   .0712378   .0470024     1.52   0.130    -.0211353     .163611
      lprice |  -.5727782   .1599339    -3.58   0.000    -.8870938   -.2584625
       covid |   .2502106   .0256636     9.75   0.000     .1997743    .3006468
       _cons |   8.543049   .6487401    13.17   0.000     7.268089    9.818008
-------------+----------------------------------------------------------------
     sigma_u |  .92383607
     sigma_e |  .22766506
         rho |  .94274702   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0: F(8, 447) = 46.51                     Prob > F = 0.0000
```

Figure 4

```
. reg lvolume lvolume1 lprice_sweden-lprice_spain lgdp covid_sweden-covid_spain  if( product_
> label=="Salmon (Total)")

      Source |       SS           df       MS      Number of obs   =       459
-------------+----------------------------------   F(20, 438)      =    502.88
       Model |  368.488569        20  18.4244285   Prob > F        =    0.0000
    Residual |  16.0473271       438  .036637733   R-squared       =    0.9583
-------------+----------------------------------   Adj R-squared   =    0.9564
       Total |  384.535896       458  .839598027   Root MSE        =    .19141

------------------------------------------------------------------------------------
           lvolume | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------------+----------------------------------------------------------------
          lvolume1 |   .1364132   .0475984     2.87   0.004     .0428636    .2299629
     lprice_sweden |  -.1896258   .1205664    -1.57   0.116    -.4265863    .0473347
     lprice_poland |  -.3510009   .1486506    -2.36   0.019    -.6431581   -.0588437
      lprice_italy |  -.1298419   .1806838    -0.72   0.473    -.4849569    .2252732
    lprice_germany |   .0901745   .1935204     0.47   0.641    -.2901695    .4705185
    lprice_belgium |  -.4403618   .1622451    -2.71   0.007    -.7592375   -.1214861
     lprice_france |    .047141   .1773401     0.27   0.791    -.3014023    .3956843
lprice_netherlands |  -.4790068   .1691516    -2.83   0.005    -.8114565    -.146557
   lprice_portugal |  -.9347573   .2095684    -4.46   0.000    -1.346642   -.5228727
      lprice_spain |   .0548847   .2031329     0.27   0.787    -.3443516     .454121
              lgdp |  -.0986934   .1356491    -0.73   0.467    -.3652975    .1679107
      covid_sweden |   .2311951   .0577684     4.00   0.000     .1176574    .3447327
      covid_poland |   .2526907   .0605739     4.17   0.000     .1336392    .3717423
       covid_italy |   .2114731   .0554437     3.81   0.000     .1025043    .3204419
     covid_germany |   .2276966   .0566023     4.02   0.000     .1164507    .3389425
     covid_belgium |   .1362162   .0545062     2.50   0.013     .0290901    .2433423
      covid_france |     .17263   .0545021     3.17   0.002     .0655118    .2797482
 covid_netherlands |   .2206582   .0555492     3.97   0.000     .1114821    .3298343
    covid_portugal |   .3522469   .0573829     6.14   0.000     .2394668     .465027
       covid_spain |   .2245344   .0552131     4.07   0.000     .1160189      .33305
             _cons |   8.391775   1.523324     5.51   0.000     5.397842    11.38571
------------------------------------------------------------------------------------
```

Figure 5

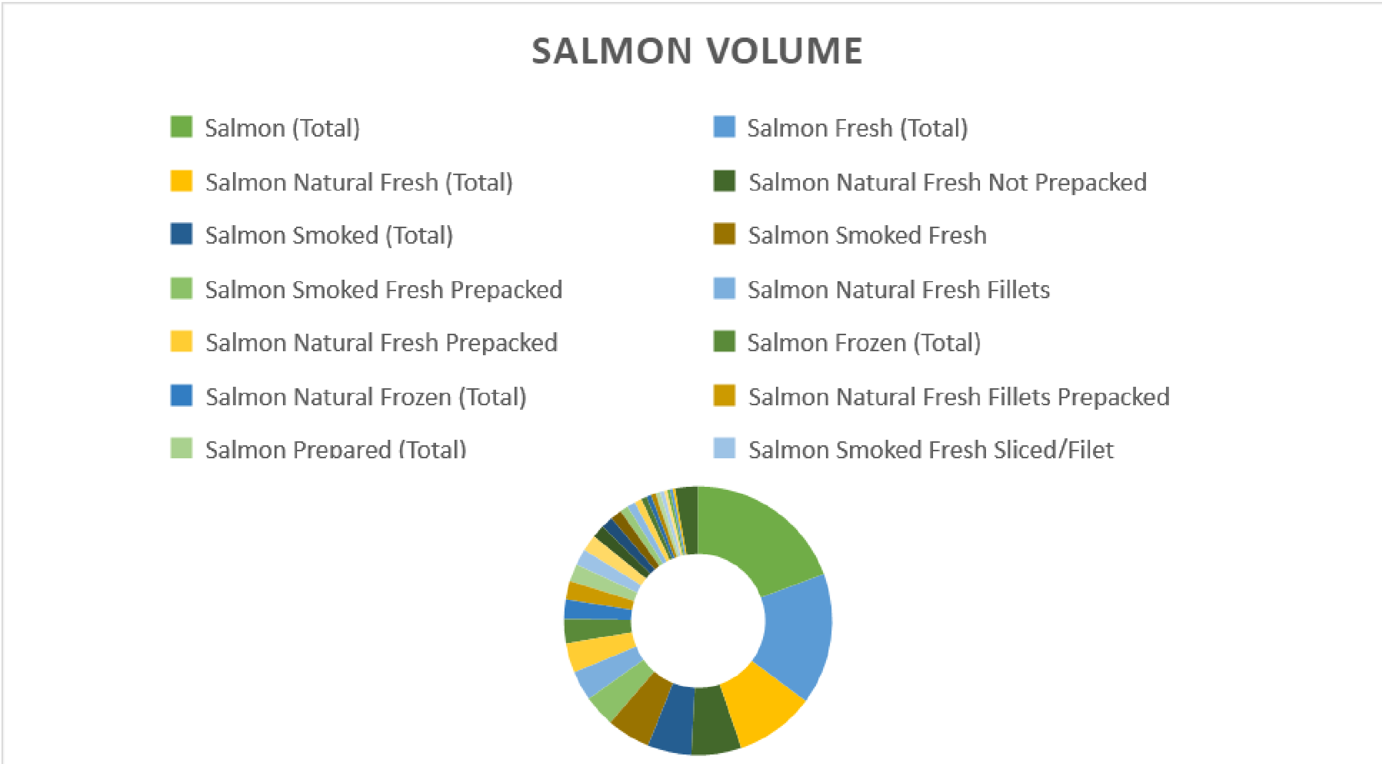
SALMON VOLUME
Salmon (Total)
Salmon Fresh (Total)
Salmon Natural Fresh (Total)
Salmon Natural Fresh Not Prepacked
Salmon Smoked (Total)
Salmon Smoked Fresh
Salmon Smoked Fresh Prepacked
Salmon Natural Fresh Fillets
Salmon Natural Fresh Prepacked
Salmon Frozen (Total)
Salmon Natural Frozen (Total)
Salmon Natural Fresh Fillets Prepacked
Salmon Prepared (Total)
Salmon Smoked Fresh Sliced/Filet

Figure 6

. reg lvolume lvolume1 lprice_sweden-lprice_spain lgdp covid_sweden-covid_spain if(product_label=="Salmon Natural Fresh Not Prepacked")

Source	SS	df	MS			
				Number of obs	=	459
				F(20, 438)	=	676.26
Model	1010.95889	20	50.5479447	Prob > F	=	0.0000
Residual	32.7386497	438	.074745775	R-squared	=	0.9686
				Adj R-squared	=	0.9672
Total	1043.69754	458	2.2788156	Root MSE	=	.2734

lvolume	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
lvolume1	.319854	.0411456	7.77	0.000	.2389867	.4007213
lprice_sweden	-.9058181	.1073929	-8.43	0.000	-1.116887	-.6947487
lprice_poland	-1.322266	.1239833	-10.66	0.000	-1.565942	-1.07859
lprice_italy	-1.118218	.1579749	-7.08	0.000	-1.428701	-.8077348
lprice_germany	-1.149734	.1546996	-7.43	0.000	-1.45378	-.8456887
lprice_belgium	-1.650452	.1419247	-11.63	0.000	-1.92939	-1.371513
lprice_france	-1.082841	.1569249	-6.90	0.000	-1.391261	-.7744218
lprice_netherlands	-1.769925	.1433061	-12.35	0.000	-2.051578	-1.488273
lprice_portugal	-1.860513	.2087967	-8.91	0.000	-2.27088	-1.450145
lprice_spain	-1.026102	.1768148	-5.80	0.000	-1.373613	-.6785913
lgdp	-.0150283	.1772837	-0.08	0.932	-.3634608	.3334043
covid_sweden	-.2779339	.079393	-3.50	0.001	-.4339725	-.1218952
covid_poland	.0900656	.0837969	1.07	0.283	-.0746284	.2547595
covid_italy	.1193912	.0769553	1.55	0.122	-.0318563	.2706387
covid_germany	-.0163384	.076663	-0.21	0.831	-.1670115	.1343347
covid_belgium	.1331682	.0773475	1.72	0.086	-.0188502	.2851865
covid_france	.0164411	.0765961	0.21	0.830	-.1341004	.1669827
covid_netherlands	.0811116	.0779497	1.04	0.299	-.0720904	.2343136
covid_portugal	.2036629	.0779611	2.61	0.009	.0504386	.3568872
covid_spain	.1218185	.077524	1.57	0.117	-.0305468	.2741838
_cons	8.067563	2.019757	3.99	0.000	4.097944	12.03718

Figure 7

```
. reg lvolume lvolume1 lprice_sweden-lprice_spain lgdp covid_sweden-covid_spain  if( product_label== "Salmon Smoked (Total)")
```

Source	SS	df	MS
Model	867.475161	20	43.373758
Residual	42.1934649	436	.096774002
Total	909.668626	456	1.99488734

Number of obs	=	457
F(20, 436)	=	448.20
Prob > F	=	0.0000
R-squared	=	0.9536
Adj R-squared	=	0.9515
Root MSE	=	.31109

lvolume	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
lvolume1	.0397884	.044645	0.89	0.373	-.0479577	.1275345
lprice_sweden	-1.776017	.2205427	-8.05	0.000	-2.209476	-1.342558
lprice_poland	-1.970304	.284344	-6.93	0.000	-2.529159	-1.411448
lprice_italy	-2.096832	.3373069	-6.22	0.000	-2.759781	-1.433882
lprice_germany	-2.141706	.3725569	-5.75	0.000	-2.873936	-1.409475
lprice_belgium	-2.038468	.3370567	-6.05	0.000	-2.700926	-1.37601
lprice_france	-1.94135	.3182128	-6.10	0.000	-2.566772	-1.315928
lprice_netherlands	-2.223649	.3290178	-6.76	0.000	-2.870307	-1.576991
lprice_portugal	-2.737315	.3298344	-8.30	0.000	-3.385578	-2.089052
lprice_spain	-2.177663	.3378587	-6.45	0.000	-2.841698	-1.513629
lgdp	.8604582	.2276506	3.78	0.000	.4130291	1.307887
covid_sweden	.1265317	.0885578	1.43	0.154	-.0475215	.300585
covid_poland	.2114971	.0988739	2.14	0.033	.0171684	.4058258
covid_italy	.3634444	.088824	4.09	0.000	.188868	.5380208
covid_germany	.0137167	.0943205	0.15	0.884	-.1716627	.1990961
covid_belgium	.0016545	.0902465	0.02	0.985	-.1757177	.1790267
covid_france	.0848773	.0872322	0.97	0.331	-.0865707	.2563252
covid_netherlands	.1694911	.0894781	1.89	0.059	-.006371	.3453532
covid_portugal	.3600965	.0994844	3.62	0.000	.1645678	.5556252
covid_spain	.2905	.0904025	3.21	0.001	.1128211	.4681789
_cons	3.186905	2.661871	1.20	0.232	-2.04479	8.418599

Figure 8

```
. reg lvolume lvolume1 lprice_sweden-lprice_spain lgdp covid_sweden-covid_spain  if( product_label== "Salmon Natural Fresh (Total)")
```

Source	SS	df	MS
Model	445.219329	20	22.2609665
Residual	18.5579678	438	.04236979
Total	463.777297	458	1.01261419

Number of obs	=	459
F(20, 438)	=	525.40
Prob > F	=	0.0000
R-squared	=	0.9600
Adj R-squared	=	0.9582
Root MSE	=	.20584

lvolume	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
lvolume1	.0827834	.0435362	1.90	0.058	-.0027825	.1683493
lprice_sweden	-1.120826	.1149128	-9.75	0.000	-1.346675	-.8949772
lprice_poland	-1.562736	.1329419	-11.76	0.000	-1.82402	-1.301453
lprice_italy	-1.610743	.1763614	-9.13	0.000	-1.957363	-1.264124
lprice_germany	-1.499556	.1793796	-8.36	0.000	-1.852108	-1.147004
lprice_belgium	-1.754047	.1453501	-12.07	0.000	-2.039717	-1.468376
lprice_france	-1.380842	.1676068	-8.24	0.000	-1.710256	-1.051429
lprice_netherlands	-1.854728	.1527996	-12.14	0.000	-2.155039	-1.554416
lprice_portugal	-2.413525	.2080861	-11.60	0.000	-2.822496	-2.004553
lprice_spain	-1.383861	.1919539	-7.21	0.000	-1.761127	-1.006596
lgdp	.1721511	.144006	1.20	0.233	-.1108775	.4551796
covid_sweden	.217308	.0622671	3.49	0.001	.0949286	.3396873
covid_poland	.4117858	.0657409	6.26	0.000	.2825789	.5409927
covid_italy	.1815438	.0584199	3.11	0.002	.0667256	.2963619
covid_germany	.2013584	.0615513	3.27	0.001	.0803858	.322331
covid_belgium	.1726157	.0587071	2.94	0.003	.0572331	.2879983
covid_france	.2106853	.0591196	3.56	0.000	.0944919	.3268786
covid_netherlands	.1283266	.0602528	2.13	0.034	.0099061	.246747
covid_portugal	.2827924	.0598519	4.72	0.000	.1651597	.4004251
covid_spain	.1918091	.0590394	3.25	0.001	.0757733	.3078448
_cons	8.929268	1.605047	5.56	0.000	5.774717	12.08382

Figure 9

```
. reg lprice_sweden-lprice_spain covid_sweden-covid_spain if product_label=="Salmon Fresh (Total)", noconstant
```

Source	SS	df	MS			
				Number of obs	=	468
				F(17, 451)	=	23.46
Model	604.392788	17	35.552517	Prob > F	=	0.0000
Residual	683.388227	451	1.51527323	R-squared	=	0.4693
				Adj R-squared	=	0.4493
Total	1287.78102	468	2.75166884	Root MSE	=	1.231

lprice_sweden	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
lprice_poland	0	.0608175	0.00	1.000	-.119521	.119521
lprice_italy	0	.0797602	0.00	1.000	-.1567477	.1567477
lprice_germany	0	.0785829	0.00	1.000	-.1544341	.1544341
lprice_belgium	0	.0749507	0.00	1.000	-.147296	.147296
lprice_france	0	.0750011	0.00	1.000	-.147395	.147395
lprice_netherlands	0	.0756126	0.00	1.000	-.1485968	.1485968
lprice_portugal	0	.1020606	0.00	1.000	-.2005734	.2005734
lprice_spain	0	.094132	0.00	1.000	-.1849919	.1849919
covid_sweden	4.91688	.2461929	19.97	0.000	4.433053	5.400708
covid_poland	0	.3446267	0.00	1.000	-.6772735	.6772735
covid_italy	0	.3426468	0.00	1.000	-.6733825	.6733825
covid_germany	0	.3365334	0.00	1.000	-.6613683	.6613683
covid_belgium	0	.3388238	0.00	1.000	-.6658693	.6658693
covid_france	0	.33903	0.00	1.000	-.6662746	.6662746
covid_netherlands	0	.3384946	0.00	1.000	-.6652224	.6652224
covid_portugal	0	.3413152	0.00	1.000	-.6707656	.6707656
covid_spain	0	.3394499	0.00	1.000	-.6670999	.6670999

Figure 10